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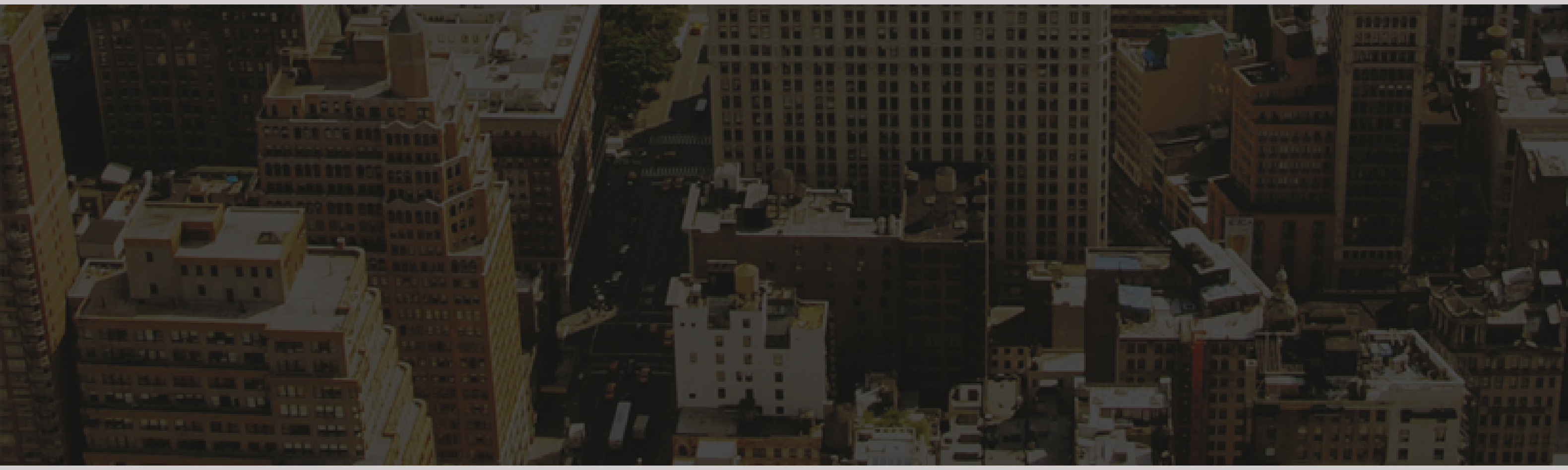

Living and Sustainability:
An Environmental Critique of Design & Building Practices, Locally and Globally

AMPS PROCEEDINGS SERIES 9

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AMPS, Architecture_MPS; London South Bank University
09—10 February, 2017

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INTRODUCTION

This publication is the product of the conference *Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally* held at London South Bank University in 2017. The event was set in the context of estimates of the building industry's contribution to world carbon emissions reaching as high as 30% worldwide – with figures on energy consumption in the region of 40%. Given the scale of the industry's contribution to these figures it is obvious that we cannot ensure a sustainable planet without addressing the practices, materials and legacy of our building industries, our cites and our buildings. However, key to a sustainable future are also related social questions. The sustainability of communities is one of the most basic components of the quality of life and opportunity. Badly planned developments can not only lead to the destruction of habitats, they bring unaffordable housing, displaced communities and negative effects on physical health. Hosted in London, this conference was concerned with the broad range of issues that affect the cities of advanced economies, the metropoles of new economic powerhouses, and the conurbations of the developing world from both these related perspectives.

Keynotes at the event included Professor Andy Ford, Director of the Centre for Efficient and Renewable Energy in Buildings (CEREB) and Paul Allen, Project Coordinator, Zero Carbon Britain, Centre for Alternative Technology.

This publication, and the conference which it documents, were organised by the research organisation AMPS, its academic journal Architecture_MPS, and the School of The Built Environment and Architecture at London South Bank University. It formed part of the AMPS program of events, *Housing – Critical Futures*.

Special thanks to Dr. Aaron Gillich of the School of The Built Environment and Architecture for his coordination of the event.

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VERNACULAR ARCHITECTURE AS AN APPROACH TO LOW ENERGY DESIGN: LEARNING FROM ANCIENT AND LOCAL KNOWLEDGE

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INTRODUCTION

Vernacular architecture exemplifies historical vision for the low energy design to the local environment which incorporates the essence of environment architecture. Vernacular architecture is rich with effective procedures and techniques to protect inhabitants from various and changing weather conditions to which they we subjected (Attia et al. 2011). Historically limited resources were available and with little opportunity to travel, local resources were used in the most effective way possible(Naciri 2007).

The current building stock and the planned building sector growth present major environmental challenges and social difficulties. Buildings account for 40% of total energy use and close to 35% of worldwide CO2 emissions(SBCI 2007). The statistics of energy use change starting with one nation then onto the next, however energy consumption for the running and maintenance of buildings together with urban transportation takes up more than a half of the total energy consumption in the city(Rode and Burdett 2011). Vernacular building techniques are usually functional and can be "rediscovered" to fit with contemporary sustainable forms and types of architecture design. Promoting sustainable good practices in building design involves a variety of activities, including developing energy-efficient, non-polluting transportation systems, design frameworks, energy-efficient building practices, water-conserving open green areas and renewable energy resources(Al-asad and Emtairah 2011).

This paper will present an overview of the potential contribution of vernacular architecture techniques to low energy building design through a series of good practice case study get-together with the results of a study on the effects of the potential of the passive low energy design in vernacular architecture and increasing the public awareness about the importance of moving towards low energy buildings.

THE CONTRIBUTION OF VERNACULAR TECHNIQUES TO LOW ENERGY DESIGN

Vernacular architecture involves a natural invention of interaction between environmental factors (site, topography, and climate) and cultural values (religion, traditions, and background). It reflects people's vision to the environment as a living entity. Due to the lack of technology in the past, passive strategies were used for heating and cooling. These were based on available resources and a variety of criteria such as orientation; form and local materials. A view that appears at different levels whether in urban planning or architectural design shaped by the beliefs and actions of inhabitants who adhered to societies as a way of life with social ideals(Coch 1998, Engin et al. 2007, Fathy 1986). Communities knew from experience that their welfare depended intrinsically on maintaining harmony with the surrounding environment (Fathy 1986) and that knowledge derived from vernacular architecture can provide the basis for low energy design development(Singh, Mahapatra, and Atreya 2011) .

There have been a series of studies from different countries and climates zones aimed at proving scientifically that the features of vernacular architecture are relevant and feasible today. For example, those of Singh, Mahapatra, and Atreya (2011), Singh et al. (2010), Zhai and Previtali (2010), Kimura (1994), Engin et al. (2007), Shanthi Priya et al. (2012),and Martin (2004) who discuss the advantages and effectiveness of the use of vernacular techniques for improving energy efficiency.

Recent decades have brought significant changes to the architectural profession. In the wake of a high increase in energy prices, blackouts, and hostilities, along with heightened concerns over pollution, environmental conditions, and climate change, awareness of the environmental influence and impact of design has dramatically increased(Smailes and Hugo 2003). Architects and designers through vision have come to realize that it is no longer the goal of good design to form a building which is visibly satisfactory, buildings of the future must be naturally and environmentally responsive as well (Smailes and Hugo 2003).

Most contemporary buildings across the world are not considered environment-responsive. Excessive use of concrete and glass and heavy reliance on mechanical space air conditioning is a common feature. It is imperative that architects in the world start designing climate adaptive, energy efficient buildings(Bell 2008). Designing sustainable buildings has become a great challenge that faces architects at the present time. Ever since the building industry started to move toward the promotion of sustainable building in the late half of the 1980s various techniques, procedures and approaches took place by architects worldwide (Bell 2008).

Principles of sustainable development have three main dimensions, as shown in table 1,(Edgar and Lahham 2008).

Table 1: Principles of Sustainable Development have three main dimensions. Source: Researcher according to(Edgar and Lahham 2008).

Dimension		**Description**
1st	**Economic**	Increasing the welfare of society through the optimum utilization of natural and human resources.
2nd	**Social**	relationship among human beings and between them and nature.
3rd	**Environmental and the preservation of resources**	physical, biological, and ecological systems and their reproduction and advancement

Principles of sustainable design while serving to attain the comfort and requirements of the building users, work to significantly decrease the building's impact on the environment. These principles focus on the following factors: energy efficiency, daylight strategy, in- door air quality, water systems, materials and building techniques(Edgar 2007).These principles are classified through two themes: active and passive design, as shown in Table 2,(Abdelsalam and Rihan 2013).

Table 2: Passive Design. Source: Researcher according to (Abdelsalam and Rihan 2013).

Theme	**Features**
Active design	Reflect the reliance on photovoltaic systems, wind turbines, micro power generation, waste recycling, gray water systems, and glass technology(Figure 1, 2).
Passive design	Reflect the reliance on compact layout to reduce heat gain and loss, passive ventilation (wind catcher and courtyard), and passive thermal performance (domes and vaults, double thick walls, and mashrabiya or shanashel).

Figure 1: Features of the modern technology trend in a residential building

Source ScienceDirect.com

Figure 2: Features of modern technology trend in a single family unit.

Source ScienceDirect.com

Early design stages offer the greatest opportunities to influence the environmental performance of buildings at low costs and rates(UNEP 2011, WBCSD 2009). Form is an important input in architectural design. Form in architecture is not merely related to space and the activity occurring within this space. Form is also a vehicle for meaning or a sign(Bacon 1974).Architecture form is the point of contact between mass and space. Architecture forms, textures, materials, lighting and shading, color, all combine to inject a quality or spirit that architectures space. The quality of the architecture will be determined by the skill of the designer in using and relating these elements, both in the interior spaces and in the spaces around building(Bacon 1974).The importance of such architectural forms for sustainable design is well exemplified in S Behling's diagram (Figure 3), in which it is showed that in future buildings should give priority to architectonic form and passive systems, in order to reduce the importance of active systems(Abalos 2009). It seems valid to add a new triangle, representing the past, which is made up of only two elements: architectonic form and passive systems(Abalos 2009). This historical triangle is highly relevant and important for future planning as understanding the two systems is the first step towards improving the techniques used in specific vernacular design in order to adapt them for contemporary design purposes. The good designs of such systems reduce the need for active systems and consequently reduce energy consumption.

A number of studies on the thermal performance of vernacular buildings conducted in different parts of the world supported this idea that show that these buildings achieved acceptable thermal comfort standards throughout much of the year just using passive strategies, in some cases indoor temperatures remaining almost constant(Cardinale, Rospi, and Stefanizzi 2013, Priya et al. 2012, Singh, Mahapatra, and Atreya 2010), which supports the idea that passive strategies used in vernacular buildings are feasible for use in contemporary buildings (Molodin 2016, Priya et al. 2012).

In this sense, the definition of the future of architecture and design should seek a blend of tradition with modernity, thus aiming at a hybrid system that involves the use of traditional design techniques and allow for the exploration of new aesthetic and functional concepts (Kimura 1994; Abalos 2009). To ignore the knowledge and technological potential that exists today would be a mistake when aiming to achieve high-performance buildings (Leatherbarrow and Wesley, 2009).

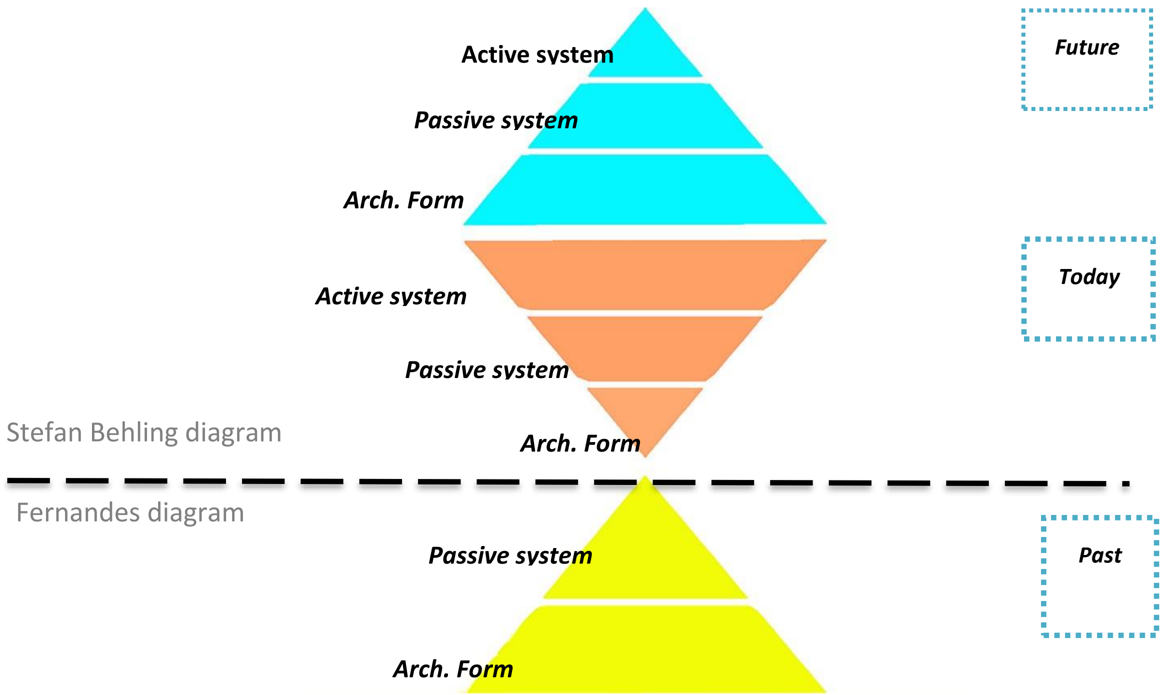

Figure 3. Behling's diagram (present and future triangles)(Abalos 2009)

VERNACULAR LOW ENERGY DESIGN STRATEGIES FOR HOT CLIMATES

Vernacular design approaches in Arab cities are much more responsive to environmental elements. Some Arab cities have common vernacular features in their architecture as they locate in similar geographical region and have the same climate effects. This section analyzes common architectural features across Arab countries despite their different locations.

The special characteristics of any climate mainly effect formation of the architecture in the given zone and create verity of architectures proportional to the climate of any region.

The principle of building introversion is considered as one of important parameters in local architecture in hot and arid regions. In these regions, houses generally include a central yard and the shape of yard is designed in the form of orchard hole to create cooling spaces in the lower rooms. Likewise, the application of elements such as a wind hole in building has succeeded to remove the need for cooling equipment in addition to producing favorable airflow in the building. In local architecture for hot and dry regions, it has been considering intensive form plans and to position the direction of buildings from southern to southeastern side so that rather than fewer levels of exposure to sunlight in summer, they could maximize energy in winter. The application of local materials like clay with properties such as high thermal capacity to resist against heat and also using pale color materials in constructions has been emphasized to provide comfortable conditions for human in addition to cost-effectiveness. In contrast, modern architecture has removed the comfortable conditions for the inhabitants as well as the application of modern materials like concrete, iron, and brick as well as using dark colored materials such as black tar in roofing coverage and construction of thin walls and ceilings ,synthetic cooling and heating..

With respect to aforementioned subjects, traditional architecture has inflicted the least damage to natural environment. In traditional architecture, materials have been selected in

construction of building and these factors indicate this fact that traditional architecture is deep-rooted in traditional cultural beliefs and it is line with low energy design. In contrast, with uncoordinated methods of design with the climate, modern architecture can cause discomfort for human and the use of materials and rising of fossil energy consumption. Vernacular architecture cannot meet various requirements of inhabitants at present, but an increase in the resistance and strength of building by employing architecture principles and its constituent factors and using local materials properly reducing costs for building construction and the architecture may advance toward low energy design.

Vernacular passive design techniques

• **Urban layout —** Choice of construction site and the development of town can reflect different climatic, economic and social influences, which inhabitants attempt to make best use of. For example, traditional Arab cities have an urban layout characterized by a myriad a narrow winding streets whose configuration forms urban patios. This pattern reduces the effect of strong winds. In the morning, due to their high thermal inertia, the walls and road surfaces of these narrow streets remain cooler than the temperature of the air. The cool air is denser and therefore heavier, remaining at street level during the morning as long as there is no wind. This compact urban layout reduces the number of surfaces which are exposed to the sun's rays and enables buildings to provide shade for one another, thereby reducing solar gain by the building envelope (Hinrichs 1987).

• **Natural ventilation —** The aim is to promote the circulation of air inside the building to increase well-being and thermal comfort, which is particularly useful for overnight cooling in hot climates.

Vernacular architecture in hot climates is based on using different treatments and elements to avoid the high temperatures and to adapt with the climatic environments. For example, using the interior courtyards and the wind towers to achieve cross ventilation, using "Al Malqaf" (Badger)[1] this tower serves to catch the outside air that flows through it towards the building's rooms and uses the fountains in the courtyards and gardens. Interior courtyards and Mashrabyaa (Shanasheel)[2] provide shade within the housing without complete closure of the window and allows the movement of air, which helps to reduce the temperature in the summer. Heat transfer between the external environment and internal spaces of the building by the type of building materials, can be used such as light colours in external façades and the use of building materials with high density like brick, mud and stone.

• **Lighting and visual impact—**having small and limited openings to the outside may lead to suppose that these buildings are mostly dark inside .This is not the case in vernacular buildings due to the existence of the courtyard as a major space for the distribution and organization of the other spaces. Openings toward the outdoors are not limited to the Mashrabyaa (Shanasheel) only .Large vents are usually used at the top of the walls of living rooms to obtain fresh air. However, these are not limited to enhance air movement only as light can also enter repeating the same decorative pattern of the openings. Light enters the room in limited amounts and the occupants can enjoy its reflection from the wall facing that opening. The design of these light filters also controls the amount of light entering the building.

[1]-Al Malqaf (Badger): Wind Tower.

[2]- Mashrabyaa (Shanasheel): Wooden Grill or Screen.

Due to absence of glass, the traditional building used wooden screens to control the light coming from the outside. The small openings designed through the Mashrabyaa (Shanasheel) are deliberately designed to allow the view from the outside. Sunrays enter through limited spaces in order to reduce the uncomfortable effect on the occupants which can also damage furniture and raising the heat indoors (Hinrichs 1987).
The courtyard is used to solve the problem of limited light provision indoors. The special design of the proportional size of the court compared to the size of the building in addition to its position at the heart of the building make it possible to provide the light to all indoor and outdoor spaces in the building.
Shading the ground floor by walkways surrounding the court in the first floor create a comfortable microclimate in the area surrounding the court.

• **Building Materials—**In hot climate, indigenous and local building materials were appropriate for the ambient environment. Vernacular building materials, such as brick, stone, palm trunks and wood are usually natural thus they are generally and mostly low in embodied energy and toxicity(Kim and Rigdon 1998). Traditional building materials are local and better suited to climatic conditions; thus, they create a comfortable internal environment naturally, passively and sustainably. They are also often reusable, recyclable, and energy efficient. Vernacular building materials, such as brick and stone, were used extensively as they are good thermal insulators when used as thick walls with minimum external openings, and the almost solid elevations provided privacy for the family, especially in ground floor spaces. External treatments were simple, reflecting the humility and social equity of the people.

SUCCESSFULL GOOD PRACTISE

Some Arab cities have succeeded to develop low energy buildings that take into consideration vernacular features and passive design techniques that have been discussed earlier in this paper combining them with modern eco-friendly technologies and applying low energy design principles.
– Masdar City Institute Housing, UAE:
Considered as the first sustainable city in the region that is inspired by architectural design techniques from traditional cities and their techniques , but also introduce design and construction with high levels of technology and environmental technique, whilst include local identity. The city is considered a global model that can give lessons to others cities in the future. Masdar city introduces perfect examples for utilizing advanced modern technology in sustainable housing design. The institute campus has 102 residential apartments spread between 4 residential blocks. High density, low-rise living is a major component of this low impact development and is vital in achieving a balanced, socially and economically sustainable campus. The residential concept focuses on the creation of a lively animated neighborhoods(Reiche 2010),(Fig. 4). The project includes also dedicated potable and recycled water supplies, with separate grey and black water drainage, and latest low-energy lighting specifications (Figs.5 and 6). Six criteria were chosen to be applied at the Masdar city to achieve the objectives of this project: 1. **Water Conservation**: Use of mixer taps, double flush toilets, intelligent irrigation for the gardens (drop by drop system and irrigation at the end of the day), use of biodegradable cleaning and bathroom products (nonphosphate, non-toxic, non-corrosive, non-chlorinated). 2. **Energy Conservation**: Use of renewable energy technologies (80% of the electricity and all of the water heating come from photovoltaic panels), low consumption light bulbs, passive solar

heating and maximization of natural lighting and ventilation. 3. **Waste Management**: Implementation of the 3RV rules (Reduce, Reuse, Recycle and Valorization), reduction of disposable objects, no individual packing and hence less packages, left over vegetables are used as animal feed, the hotel in non-smoking establishment. 4. **Purchasing Practices**: Local organic garden with organic fertilizers, respect of the seasonality of products, appreciation of local and non-pollutant products (Pottery, Reed…). 5. **Integration with landscape**: Use local traditional architecture, interior and exterior walls made of entirely of natural products (mud bricks walls, tadelakt, ..)- these not only create a striking building, but this clever use of materials also aids in keeping the interior cool in summer and warm in winter-, over 90% of the Kasbah terrain is open green spaces, integration of representative elements of the region's culture and tradition. 6. **Environmental aspects**: change the city design to zero city. The city itself is designed to maximize convenience and reduce environmental impacts.

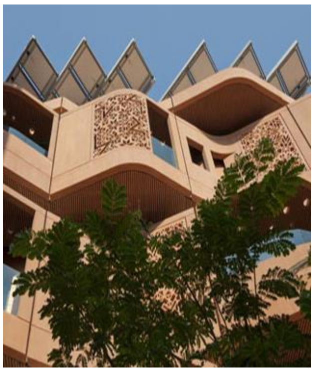

Fig. 4 Elevation of the residential units. www.masdar.ae/

Fig. 5, 6 Wind tower in the housing courtyard and the main housing courtyard. www.masdar.ae/

The university plan is considered as one of the world's sustainable communities, combining renewable energy sources and efficient resource usage with traditional Arabian design and mighty architectural elements(Salama 2008). All buildings at Qatar University have been designed to maximize the use of natural light, and must adhere to strict regulations concerning the use of insulation, low-energy lighting, and energy-efficient appliances(Moini et al. 2009). To control the harsh climatic conditions an Egyptian architect, Kamal Kafrawi, integrated modern technology with traditional elements of Arabic Islamic architecture(Salama 2008). as follows: Wind tower structures: these are one of the most outstanding features of the university and are used to provide cool air and reduce humidity; also to provide cover for the university buildings (Figure 7). Protected courtyards: with their gardens and fountains, the courtyards provide pleasant areas of coolness and shade, both open and partially covered. They provide connection and circulation spaces within the university complex. Towers of light are also introduced and are intended to control the harsh sunlight, and abundant use of mashrabiya and some stained glass also serve to mediate the environment (Figure 8). Geometric forms: the octagonal shape of the modular unit was derived from traditional principles which enhances ventilation through wind towers and provides lighting through indirect sunlight.

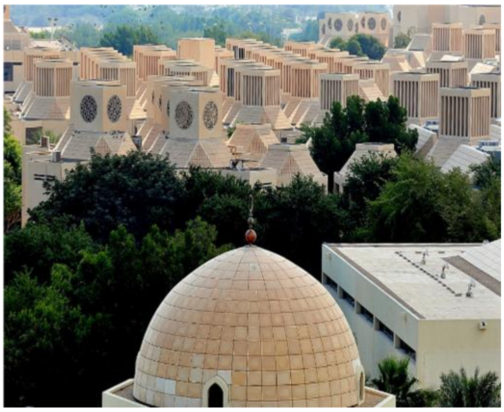

Figure 7: Emphasizing natural ventilation by using wind towers in the education technology centre.
Source:(*Moini et al. 2009*)

Figure 8: Using Mashrabiya in the university buildings and using fountains to provide humidity.
Source: (Moini et al. 2009)

–Residential Community in Muscat, Oman:

The concept of this project is inspired by traditional courtyard planning, and the facades are designed as a response to the environmental conditions. The facades of the various components are inspired by traditional mashrabiya and inner courtyard designs. The facades are designed to handle the transformation of patterns, protection from the sun's rays, and privacy. The concept of mashrabiyaa is re-interpreted in a contemporary manner through this residential tower to reflect environmental, social, and cultural influences in the heart of Oman city (Fig. 9).

The residence is built around a central courtyard and includes a full array of modern facilities that fulfill the occupants' expectations of modern comfort. The bedrooms, living and library rooms are stretched along the north façade and are cooled by prevailing winds. The spaces location and their articulation around the courtyard allows cross ventilation thus enhancing the quality of the internal microclimate naturally(Singhal 2012) (Fig. 10).

Fig. 9 the residential units. www.klingmann.com

Fig. 10 Courtyard of the residential units. www.klingmann.com

The three low energy building examples illustrate that each project has applied earlier principles of low energy building to achieve sustainability and to minimize its effect on the environment. Each one of the three projects has taken in consideration the location and the orientation of the building according to its climatic conditions.
Each project has chosen the suitable and sustainable material from the local available material. Each project has used the most energy efficient heating, cooling, lighting and watering system. Knowledge of the local inhabitants to increase the success of each project has been obtained.

Vernacular architectural feature of each case study make it clear in the design and structure of the buildings; such as the courtyards, the mashrabiaa, wind tower and other features used in each project. The use of local finishing materials and the landscaping of each project according to the traditions and beliefs of each city.

CONCLUSIONS

This paper discusses vernacular principles that could influence low energy trends in building design through examples of low energy buildings in hot climates. Through the analysis of the selected succeeded architectural examples of low energy buildings, it is found that the combination of vernacular architecture features and modern eco-friendly technologies could produce a successful building that has a low impact on its surrounding environment, comfortable and accessible to its inhabitance, serving all their needs and giving a clean environment to leave in. This combination is one of the solutions that could help cities to be sustainable and to achieve low energy building but further studies are recommended to find other solutions for this problem. The principles and the approaches of low energy buildings should be firmly applied to buildings and there should be laws and strategies which regulates there application on buildings to make sure of the building efficiency.

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WHAT ARE SMART GRID OPTIMISED BUILDINGS?

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INTRODUCTION

Buildings have always been responsible for a significant amount of energy consumption and the consequent carbon emissions, creating major energy and environmental concerns. As the building sector is often not recognised as a separate entity from several energy agencies, exact figures and energy-related data are difficult to find[1]. In 2010, buildings accounted for 32% of the global final energy demand, 24% of which originated from residential and 8% from commercial buildings. Furthermore, buildings were responsible for 23% of the global primary energy and 30% of the global electricity consumption[2], while 32% of the total greenhouse gas emissions (GHG) in the UK originated from the building sector, in 2012[3].

If no further actions are taken, building energy demand is expected to increase by 50% by 2050[4]. Given the importance of building energy performance, there is an increasing number of literature referring to building types and their characteristics, towards improving energy efficiency and achieving sustainability. Different definitions and objectives can be found but they all include common concepts, particularly intelligence and efficient utilisation of resources, while aiming to achieve a satisfying combination of comfort level and minimisation of energy consumption[5].

Smart and Zero-Energy Buildings

Although there is no consensus on a proper definition, smart buildings are expected to include the usage of advanced integrated systems, responsible for several functions such as automation, communications and management. As the world is technologically dynamic, smart buildings must reflect the latest technological achievements and follow the most cost-effective approach, regarding their design and incorporated systems. Their characteristics are critical for the consequent energy demand, affecting directly the future energy network, commonly known as smart grid, a convergence of electricity network infrastructure with telecommunications and very large scale data processing[6 7 8]. Automation systems for HVAC, lighting, power management and metering are extremely important for their energy efficiency. The smart grid will be highly dependent on buildings and their capabilities, which are consequently expected to play a critical role as an effective sub-system[9].

Zero Energy buildings (ZEBs) and Near-Zero Energy Buildings (NZEBs) are additional building definitions, often mentioned in the literature. Their objectives and operation can vary significantly as

well and the most common interpretations include net zero site energy use, net zero source energy use, net zero energy emissions, net zero cost, off-grid and energy-plus[10].

Active Buildings

To make the transition to smarter power systems, the role of buildings must shift from passive users to active participants, with the ability to change their energy demand and act as an energy supplier, when the grid is in need. In order to achieve this, the introduction of new technologies is of fundamental importance, including self-generation of electricity with renewable energy sources (RES), local energy storage (ES), demand flexibility and complete systems automation. In this direction, an active building incorporates several smart grid features, local RES and has a two-way active interaction with the energy network through responses to dynamic electricity prices and carbon emissions. While there is no universally accepted definition of their characteristics, their strong and dynamic relationship with the smart grid is recognised[11].

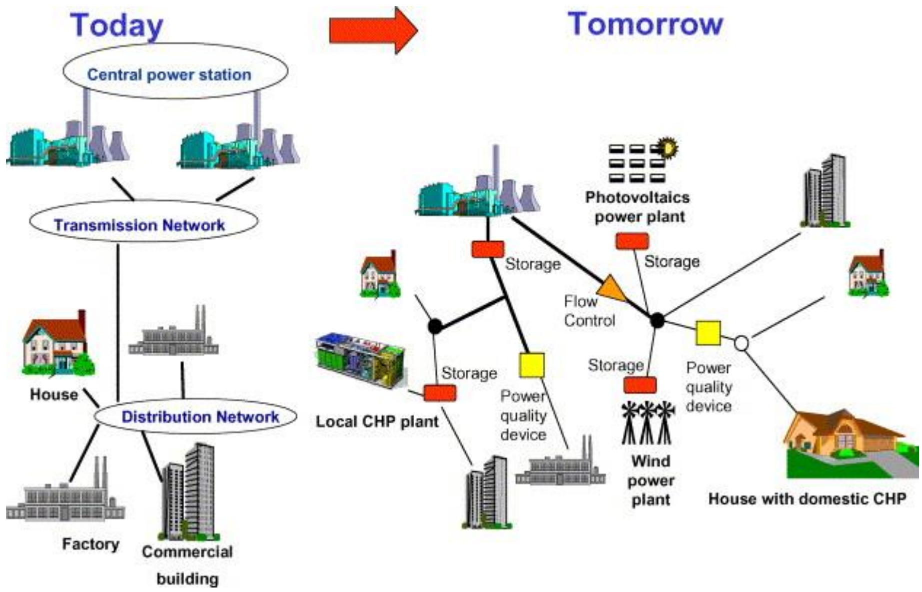

Figure 1. Present and future energy networks[12]

Buildings as part of the Smart Grid

Smart Grid opens the door for new technologies and applications, with important inter-disciplinary impacts. Given its capabilities, a revolution can potentially take place in the building sector, as buildings are expected to generate locally a percentage of the energy they need to consume, becoming in this way NZEBs or even ZEBs in the longer term. Additionally, by applying the basic attributes of Active Buildings, they have the possibility to reform dramatically their role and act as “prosumers”, a combined identity through producing and consuming energy. As this can lead to decentralisation of supply, the benefits can be several, including improvement of power quality and energy security[13].
This operational environment can also enable the building to control and adjust its consumption, a function known as demand-side response (DSR). For a domestic customer, this may mean interacting with their electricity provider by way of a more flexible tariff that allows for time-of-use (TOU)

pricing and the capability for control of appliances such as washing machines, fridge/freezers and electric vehicle (EV) charging stations[14 15].

This decentralisation of supply through distributed generation is illustrated in Figure 1, where the omnipresence of buildings, RES and ES can be seen for the future energy network[12]. Therefore, it is clear that the role of buildings have to be reconsidered in order to constitute an effective and highly active sub-system of the wider smart grid environment. Their integration as a component of a systems-based approach to energy utilisation and efficiency might provide an alternative solution, recognising that the most efficient building design and operation is not necessarily the best option for participation in grid support.

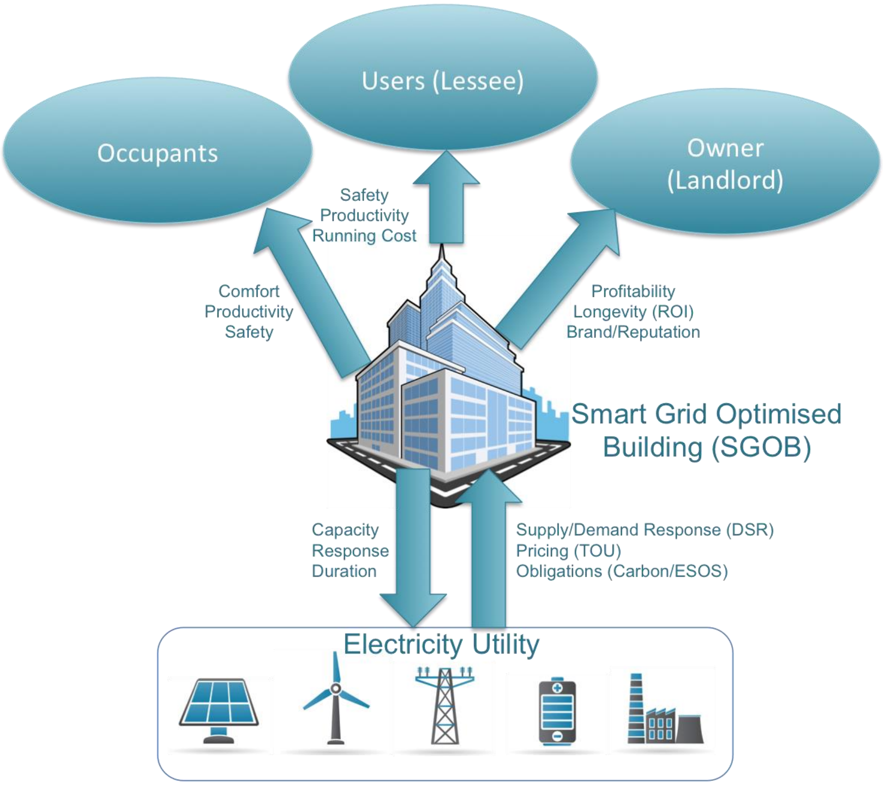

Figure 2. Service relationships between building occupants, SGOB and electricity provider

SMART GRID OPTIMISED BUILDINGS

A building that is capable of providing a functional work environment for its occupants, a return for its owner and offer flexibility to service providers, in this case specifically the electricity utility, can be thought of as offering a variety of services to its stakeholders (Figure 2). This builds on the description of smart and active buildings[5 11] by adding a set of external drivers that come in the form of direct requests from beyond its own limits. In this sense, it is being invited to become involved in a community that contributes to the broader goals of energy efficiency through financial incentives.

A Smart Grid Optimised Building (SGOB) can be thought of as meeting its service obligations to its occupants and minimising its operational cost and footprint to its owner, while actively engaging with the electricity provider and enabling best use of the resources available. Receiving information and

prompts from the grid network, the SGOB can determine the appropriate level of participation based on the intelligence of the embedded systems and the service obligations it has to its stakeholders.
The advent of the Smart Grid creates an opportunity in which both current and future buildings can be incentivised to operate within national grid-aligned drivers. This research proposes that a building can be designed to maximise the benefits from these incentives and that this design is beyond control of individual building systems alone. Particular focus is given on non-domestic buildings as their energy consumption constitutes 30% of the total demand across all sectors in Great Britain, on a typical winter weekday[16]. Therefore, they have great potential to be utilised by the Smart Grid in managing energy demand, given the scale of their energy consumption. As SGOBs constitute an entirely novel concept presented in this paper for the first time, it is vital to describe their suggested characteristics and operation.

Suggested Operation

The operation of a SGOB will depend on the notifications and requests, sent by the grid operator. When received, based on the available resources, the building will adjust its loads and use its ES systems if necessary, in order to meet the objectives set. These requests can be broken down temporally as follows:

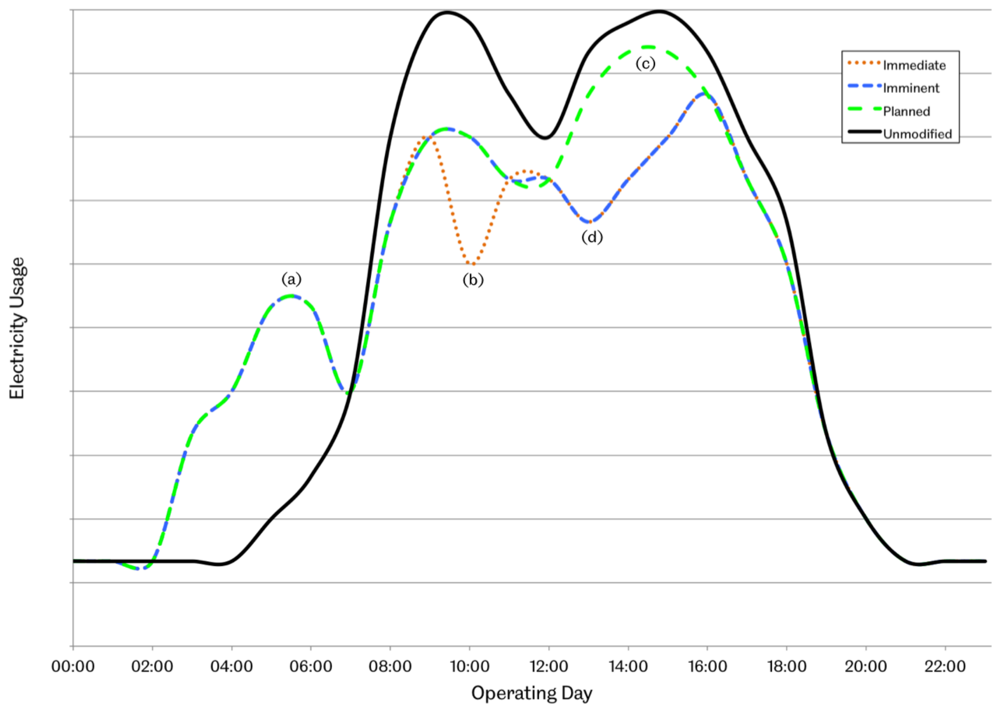

Figure 3. Electricity usage pattern and effect of Smart Grid requests for modification (a)-(d).

- Planned: largely informational this data allows the grid to request that suitably equipped buildings prepare themselves a day ahead; for instance to maximise the use of its passive systems to store or release energy.

- Imminent: communication intended to enable the management of demand when unexpected

changes in consumption occur during the daily usage cycle.
- Immediate: urgent request to modify consumption in response to unplanned and unexpected incidents such as generating equipment or transmission system failure.

An expected pattern of usage and effect of the above is shown in Figure 3. In the very early morning, the grid sends a planned request for the building to maximise its use of available ES (a) in order to reduce demand later in the day. This leads to a reduction in demand during the morning of the business day. However, an incident occurs in the electricity network that leads to a request to immediately reduce consumption to which the building responds (b). Once passed, and based on the previously received planned information, the building's consumption would return to the level shown (c). However, the event that led to the immediate request results in a subsequent imminent request and again the building systems adapt to modify consumption (d) at the most critical time. Consumption then rises in order that the service levels to the building occupants are maintained during the remainder of the afternoon. It should be noted that Figure 3 reflects the SGOB operation principles and philosophy; therefore, it does not involve modelling or simulation results.
In this way, the building systems are able to contribute to the reduction of the peak and shifting of demand, both common concepts when considering Smart Grid deployment[17]. The building can respond to event requests and participate in maintaining grid stability, because of the design decisions and adaptions made during its construction. While the pattern of usage in Figure 3 is hypothetical, there is evidence from early building adaptations to suggest that this kind of adjustment is broadly achievable[18].

Characteristics

The functional characteristics of a building designed to work as an edge system within a wider smart grid and operate as a SGOB are presented in Table 1. For each ideal SGOB characteristic, there are important perceived barriers, directly linked with the conventional character of the current building stock.
An ideal SGOB is expected to have an energy storage system (ESS) installed to take advantage of the associated benefits and the flexibility. Basic applications include integration of RES, time-shifting of energy, providing balancing services, peak shaving and voltage control[19]. In terms of electrical ESS, the system imports electricity and, when needed, the stored energy is converted back to electricity and the ESS is discharged. By configuring their design and ESS, buildings can be techno-economically optimised for the needs of the Smart Grid. It is anticipated that a SGOB will have a particular design and ES characteristics, different from low carbon or low energy buildings.

Financial Incentives

In case of an imbalance between supply and demand, the element of instability will be introduced into the system and the network's frequency will move away from the 50 Hz target. National Grid, as the National Electricity System Operator, can instruct generators to modify their output and receive offers from large users to reduce their energy consumption. It is worth mentioning that the balancing services constitute a huge market, worth £1 billion in 2014[20]. Therefore, there are expected to be significant financial opportunities for buildings to respond to Smart Grid events over different time periods, by actively participating at the balancing services market. The current regime of balancing services in Great Britain is presented in Table 2.

Buildings could benefit from the ability to modify their energy use, provided that a new enhanced regulatory framework is established in the future, expanding the current policy to include buildings as energy-related entities and prosumers. This will allow them to enter the energy market as a storage vector. Furthermore, the approach to quantifying SGOB in light of dynamic pricing should increase the clarity surrounding the role of ES technologies through development of the understanding of their economic value in relation to the temporal aspect of ES to the function and goals of Smart Grids.

Table 1. Characteristics and Barriers for SGOBs

Element of hypothesis	Ideal SGOB characteristic	Perceived barriers
Capability to reduce grid-connected load on demand.	Diverse and resilient methods to achieve load reduction across all timescales.	Conventional buildings may already include demand reduction characteristics but diversity, resilience, and timescales are not known to be objectively considered at all.
Capacity to increase grid-connected load on demand.	Diverse and resilient methods to achieve load increase across all timescales.	Conventional buildings may not include any deliberate means to increase load in response to external instructions.
Acceptability of impact arising from reduction or increase in grid-connected load.	No impacts upon normal operation, productivity, or energy being to put to a useful purpose without wastage, when participating in load modification.	Conventional buildings may exhibit a direct link between connected load and internal control measures, which would mean that reduction in load could be achieved but with compromised level of service, and increased energy use could result in energy wastage.
Notice required to make a change to grid-connected load.	Capability to predict with certainty the ability to participate in events across all timescales.	Conventional buildings are not known to predict the quantity of energy that will be taken from the grid at any point in time, and in-use data has shown significant variation from design predictions.
Response time between request for change (event) and change being evident.	Capability to reliably deploy methods to achieve the predicted change (event) within an acceptable tolerance of the required timescale.	Conventional buildings are not known to have demonstrated reliable deployment of load modification activities across all potential vectors.

The financial incentives, associated with the operation of SGOBs may be offered in one of three ways:

1. Through greater energy efficiency leading to lower direct costs.
2. Taking advantage of one-off incentives or attractive electricity tariffs for those participating in DSR.
3. Avoiding levies intended to discourage inefficient energy use or penalties that may be introduced for those failing to contribute to emissions reduction.

Table 2. Balancing Services in Great Britain[21] [22] [23] [24] [25]

Service	Mandatory/Firm Frequency Response			Frequency Control by Demand Management	Short Term Operating Reserve
	Primary Response	Secondary Response	High Frequency Response		
Response Time	≤ 10 seconds	≤ 30 seconds	≤ 10 seconds	≤ 2 seconds	20 minutes min. 240 mins max.
Duration	≤ 20 seconds	≤ 30 minutes	Indefinite	30 minutes minimum	120 minutes minimum
Power provided	10-100 MW or more. Depends on the size of the power plant and the Transmission Operator.		Reduction in active power	3 MW minimum	3 MW minimum
Rewards	Availability (£/h) Nomination (£/h) Window Initiation (£/window) Tendered Window Revision (£/h) Response Energy Fee (£/MWh) Holding Payment (£/h) (FFR Only)			Availability (£/MWh)	• Availability (£/MW/h) • Utilisation (£/MWh)
Comments	FFR is open to all consuming or generating plants that meet the requirements. MFR is open to generators only.			Negotiated on an individual basis with National Grid	N/A

METHODOLOGY & RESULTS

The methodology of the ongoing SGOB research is reflected in Figure 4, along with the most critical characteristics of building design, ES and the grid. In terms of modelling software, DesignBuilder is used to simulate buildings through the EnergyPlus integrated engine, taking into account their design and the incorporated energy systems[26]. The generated hourly energy loads are then exported to the

external ES model, where different electricity tariffs are applied under different grid scenarios. In this way, by comparing the results from different buildings, it can be determined what's the optimal building design (energy wise) and how its battery storage system should be used to meet the needs of both the building and the smart grid.

Initial results include a simplified SGOB approach where battery storage is deployed in a reference commercial building to take advantage of the price difference among peak, off-peak and mid-peak tariffs, as well as to reduce pressure from the grid with the load-levelling service. For the purposes of the current research, fully electric buildings with ground source heat pumps were considered. As all loads are electrical and no fossil fuels are used, the building can participate in a bi-directional exchange of power and energy. Electricity storage can render the buildings fully active elements of the smart grid, as electricity can be fed back to the grid when requested.

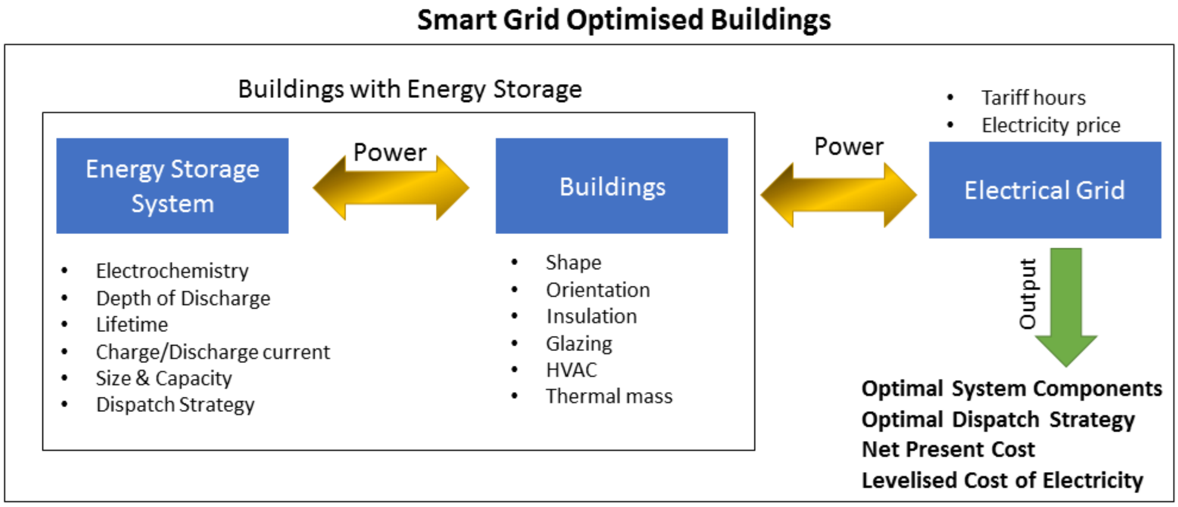

Figure 4. Modelling Methodology for SGOBs

Building Energy Simulation

A typical heavyweight south-oriented office building was constructed for the needs of the energy simulation, located in central England. CIBSE and ASHRAE standards were taken into account in order to meet thermal comfort requirements. Using the operative temperature for temperature control in order to avoid underheating, the EnergyPlus simulation gave a number of 29 discomfort hours for the first year of its operation. The visualisation and the geometry of the building can be seen in Figure 5, while its characteristics and specifications are presented in Table 3.

Each floor consists of two occupied zones, the main office area where all the activity and the office equipment is based and a smaller zone that includes stairways and lifts. Room electricity refers to the office equipment, while auxiliary energy refers to the so called 'parasitic' energy, including the loads required for the operation of fans, pumps and controls. In this particular case, an assumption of a constant auxiliary load throughout the year was considered. The building energy loads per sector are shown in Figure 6.

Energy consumption for heating and cooling purposes appear to be lower than in a conventional building with natural gas boilers due to the relatively higher coefficient of performance (CoP) of the heat pump system. Cooling loads are present only during the summer months and are minimal, as

economisers are used to provide free cooling, when the outdoor temperature is lower than the indoor temperature. Using the generated data, the average daily energy profile was calculated in order to be used and ‘manipulated’ by the ES model.

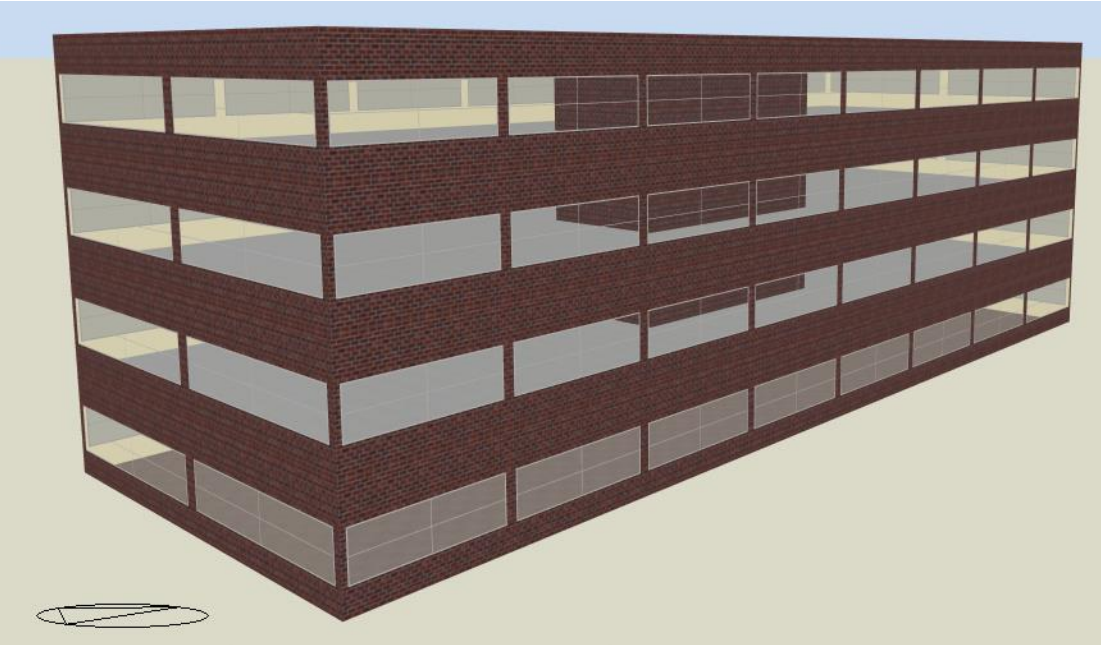

Figure 5. Simulated Building in DesignBuilder/EnergyPlus

Table 3. Properties of the simulated Reference Building

Parameter	**Values & Specifications**
Building type	Commercial: Office and Workshop Business.
Location	Birmingham Airport, United Kingdom
Orientation	South-North
Dimensions	3 storeys. 41.66m x 15m internally (625 m^2 of area per floor)
Construction	Type: Heavyweight External wall: 100 mm brickwork, 79.5 mmm extruded polystyrene, 100 mm concrete block, 12 mm gypsum plastering (U-value = 0.35 W/m^2K) Flat roof U-value = 0.25 W/m^2K Air infiltration rate = 6 m^3/m^2hr at 50 Pa
Glazing	Window to Wall ratio = 40% Type: Clr 6mm/13mm Air (e2 = 0.1) U-value = 1.761 W/m^2K
Shading	Type: Internal blinds with high reflectivity slats. Operation: Solar Control (120 W/m^2)
Activity	Generic Office Area. Working hours: 8am – 6pm Occupancy = 12 m^2/person Office equipment gain = 8 W/m^2
Lighting	LED with linear control (10 W/m^2)
HVAC	Ground-source heat pumps Heating system seasonal CoP = 3.8

	Cooling system season CoP = 5 Mechanical ventilation with free cooling Auxiliary energy = 8kWh/m^2 (annually)

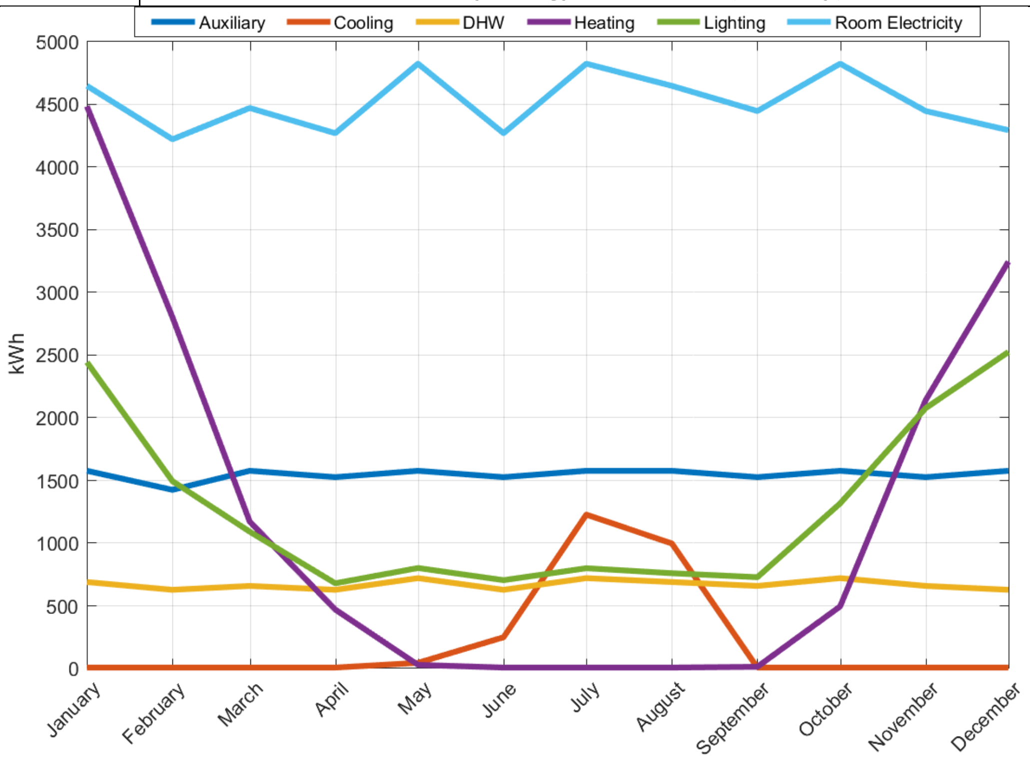

Figure 6. Energy consumption per building sector

Battery Storage Modelling

A simplified but concrete methodology was selected to model the battery storage system (BSS) operation, including the bi-directional converter for the necessary DC/AC and AC/DC conversions[27]. The modelling parameters are listed in Table 4, along with the tariffs and the economic factors considered. The maximum state of charge (SOC) that the battery can reach is 100% while the minimum value is 20% to avoid battery degradation issues and maximise its lifetime. The first objective for the SGOB includes time-shifting of the energy loads and more specifically, 40% of the peak demand is moved to the off-peak period of the day. Power is purchased from the grid during off-peak hours (1am-6am) to charge the battery until its SOC reaches 100%. Later in the day, the stored energy is released to meet part of the building loads, between 1pm and 11 pm. For the needs of the simulated building, 13 LG Chem RESU-64 batteries were used in series to meet the arbitrage objective, having a combined capacity of approximately 83 kWh. The dispatch strategy is shown in Figure 7.

The operation of the BSS during arbitrage is illustrated in detail in Figure 8, where it is clear that the purchased energy during peak hours is significantly reduced. When discharging the battery, the original peak power demand is replaced by the 'Remaining Load' curve, achieving an important drop from the range of 24-27 kW to 12-16 kW. As the building's activity ceases at 6pm, there is no need for arbitrage and the battery stops operating. Furthermore, due to the criteria used to pick the BSS size,

there is no energy left to be exported back to the grid. This is evident from the SOC value at the end of the day, which is equal to the minimum value permitted.

Table 4. Battery Storage modelling parameters and assumptions

Parameter	Value
Peak load to be met by Battery (Arbitrage)	40% of total
Number of off-peak hours for full charge	6 hours
Load-levelling limit	15 kW
Battery brand	LG Chem RESU-64 6.4 kWh Lithium-Ion
Battery Roundtrip Efficiency	95%
Inverter Efficiency AC/DC	97%
Max. Depth of Discharge	80%
Self-discharge coefficient	δ = 1
Battery Lifetime at 80% DOD	7,000 cycles > 10 years[28]
Nominal Voltage	51.8 V
Maximum Charge/Discharge Current	42/110 A
Inflation Rate	3%
Interest Rate	2%
Cost of Battery Unit	£4,000[29]
Feed-in Tariff (based on Ofgem 2016)	0.0981 £/kWh[30]
Lifetime of the Project	10 years
Lifetime of the Converter	15 years
Tariffs (based on the Spanish Electrical Grid)	● Peak: 0.16 £/kWh (1pm-11pm) ● Mid-peak: 0.08 £/kWh (11pm-1am and 7am-1pm) ●Off-peak: 0.05 £/kWh (1am-7am)

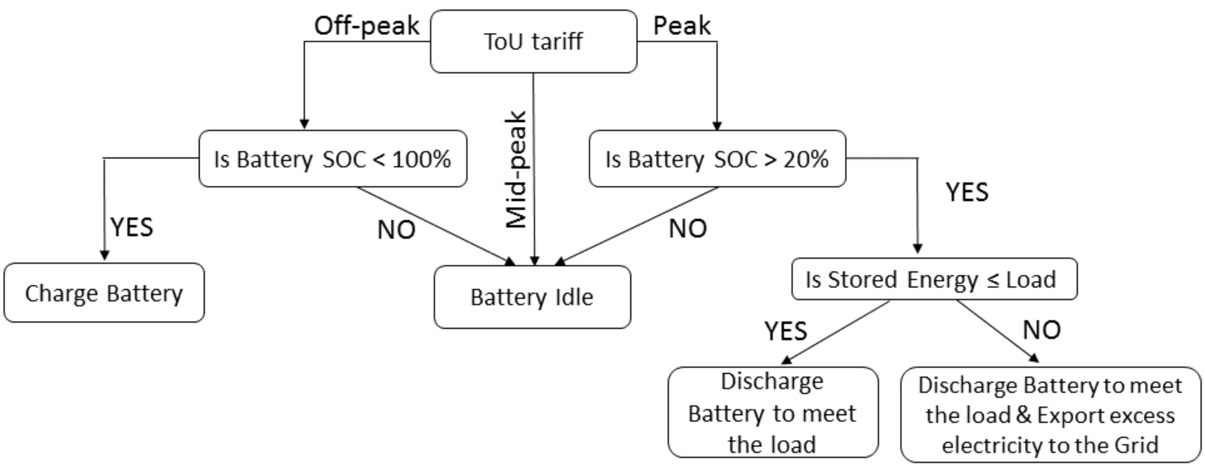

Figure 7. Operational Strategy of the Arbitrage model

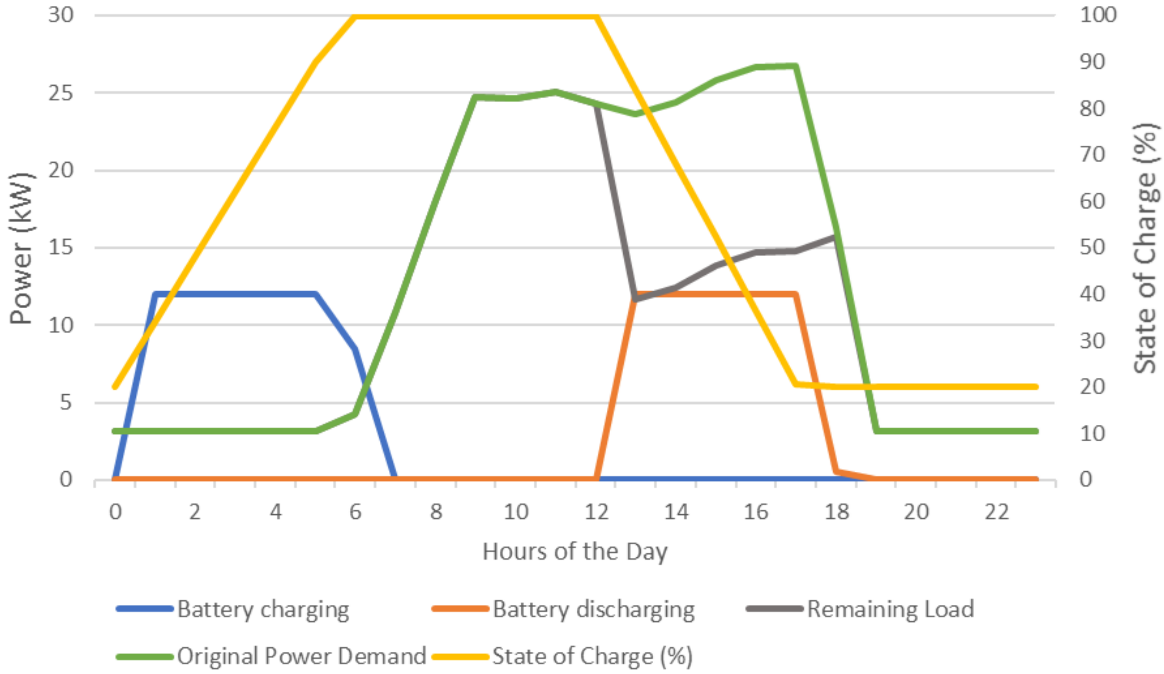

Figure 8. Time-shifting of Building Loads using Li-on Battery Storage (Arbitrage)

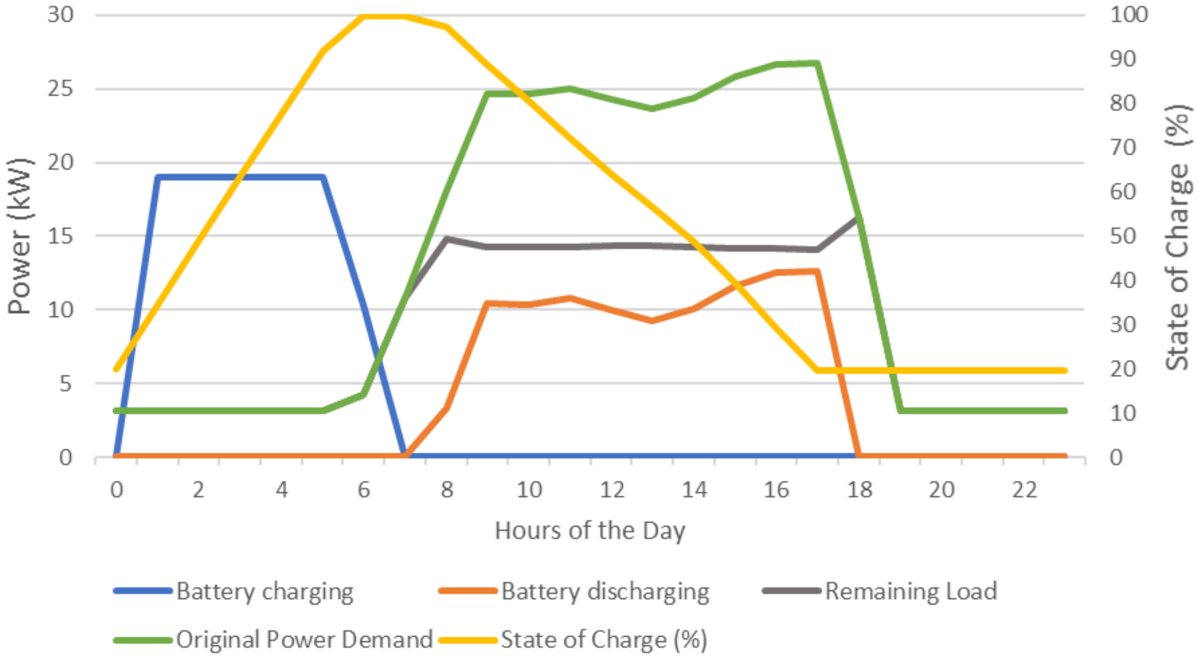

Figure 9. Providing load-levelling by maintaining grid purchases below 15 kW

It should be noted that the battery bank capacity is always higher than the time-shifted load, as only 80% of its capacity can be used due to the SOC constraints and the energy losses. Regarding the economic viability of the scheme, because of the high capital costs associated with batteries, it is

currently cheaper to buy directly energy from the grid than to take advantage of the price difference between peak and off-peak periods. This is clear when comparing the net present cost and the levelised cost of electricity for the two cases: with and without battery storage (Table 5).
The second objective is load-levelling, maintaining the power demand below a specific limit, during peak hours. The battery is charged during the night and then ready to be used for the rest of the day, ignoring mid-peak and off-peak tariffs this time. As this balancing service is more energy intensive than arbitrage, for a power purchase limit of 15 kW, a total of 20 LG Chem RESU-64 batteries were used in series, with a combined capacity of 128 kWh. The difference between the original power demand and the remaining load, resulting in the so called 'peak shaving' are presented in Figure 9. As currently there are no financial incentives or mechanism for buildings to provide balancing services, a proper regulatory framework has to be established, similarly to industrial users and generating plants, as previously mentioned in Table 1.

Table 5. Arbitrage Results & Economics

Parameter	**Value**
Objective	Arbitrage (time-shift)
Load to be met by Battery Storage	62.46 kWh (40% of peak load)
Number of batteries needed	13 x LG Chem RESU-64 (Lithim-ion)
Capacity of the batteries	83.2 kWh
Bi-directional Converter rating	12 kW
SOC at the end of the day	19.96 %
Exported Electricity	0 kWh
Levelised Cost of Electricity with Storage	0.159 £/kWh
Levelised Cost of Electricity without Storage	0.127 £/kWh
Net Present Cost with Storage	£179,633 for 10 years
Net Present Cost without Storage	£143,820 for 10 years

CONCLUSIONS

In conclusion, the concept and the theoretical background of SGOBs was presented, along with initial modelling results. While it is not currently cost effective to use battery storage at the building scale, lithium-ion battery costs are expected to decrease in the future from \$550/kWh in 2014, to \$300/kWh in 2017 and \$200/kWh in 2020[31]. The introduction of financial mechanisms by the grid operator to reward buildings for their services are critical towards the success of the SGOB concept. Despite that only one specific building design was considered during the initial results, it is expected that specific building characteristics will affect the ESS requirements. Therefore, by optimising both the design and the ESS, the building can be more responsive to notifications from the grid and participate effectively to DSR events, unlocking their full potential.
SGOBs can constitute a reliable and concrete platform to address the present challenges, reflecting potential strategies and indicating the future of the building sector and its role in the wider smart grid. The impact of changing the definition of building performance from a low energy or low carbon objective to a smart grid optimised objective would have a significant impact upon the ability to decarbonise the UK energy system. Therefore, introduction of the SGOB concept could support the long term planned changes, not only in the UK dynamics and constituency but also around the globe if adapted to the unique environment and requirements of each country.

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AN ALTERNATIVE DESIGN APPROACH FOR CURRENT ENERGY-EFFICIENT HOUSING CONCEPTS: CONCEPTUAL FRAMEWORK ENABLING A DYNAMIC WAY OF LIVING THROUGHOUT THE SEASONS

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INTRODUCTION

The search for sustainable and quality housing renovation leads to a strong focus on energy-efficiency where the implementation of housing concepts, such as passive houses, has become common practice. The imposed measures focus mostly on optimizing the building envelope and introducing extra systems to lower operational energy consumption. It is therefore an object-centred design approach. However, not all effects are beneficial, since the material consumption and renovation costs of energy-efficient buildings are rapidly increasing. Besides, highly insulated, energy-efficient environments, where the resident is considered passive, can still have higher energy consumptions due to the influence of user practices[11].

These problems, arising from an object-centred design approach, indicate a need for an alternative solution that considers the environmental impact from buildings (supply) *and* residents (demand) [2, 24]. Finding consistency between supply and demand is seen as a fundamental component to promote more efficient use of all resources (materials, energy and costs) in the built environment, also referred to as *resource*-efficiency [23]. European policy on resource efficiency for buildings aims to provide designers with usable information on decision-making and promote improved design to bring resource efficiency gains [5]. Therefore, the overall research shifts away from an object-centred energy-efficient supply to a user-centred design approach which promotes more sufficient energy demand by dealing with an active resident.

This paper provides theoretical insights on challenges of the current object-centred approach in energy-efficient buildings by investigating user interaction between the resident and environment. In addition, the paper explores alternative design criteria for an innovative user-centred design approach. This results in a conceptual framework which considers the interactive relationship between resident and environment (building and climate) and proposes a more dynamic way of living throughout the seasons for residents to lower the actual energy demand.

METHOD

First, by means of a literature study, the interactive relationship between resident, building and climate is explored through literature on “dynamic architecture” which clarifies the complex interaction between the residents and environment. Secondly, the paper investigates the current lack of user interaction in energy-efficient housing concepts by means of studies on occupant behaviour and comfort, resulting in three design challenges within an object-centred design approach. Thirdly, as a

response to these design challenges, alternative design criteria that promote more effective user interaction are derived from literature on user-centred design methodology.

RESULTS & DISCUSSION

User interaction: A static built environment responding to a dynamic resident and seasonal changes

Due to the influence of user practices on the energy demand, exploring interaction between resident and environment is needed. Within the field of "dynamic architecture", the interactive relationship between resident, building and climate serves as the foundation for designing efficient buildings. This interaction is described as the environment acting on, responding to and interacting with the resident and vice versa [17]. The building can be seen as an intrinsically static, solid element with a potential ability to adapt, move and rotate, otherwise referred to as adaptable, transformable and flexible architecture. Although there are many interpretations for "dynamic architecture", the overall aim of the building is responding to change, more specifically, seasonal changes and residents [8].

The latter is seen as, active, moving and energetic, also defined by the Oxford dictionary as *dynamic*, due to diversified comfort and spatial preferences[3]. The dynamic resident interacts with his environment by occupying, utilizing (heating, cooling, ventilation) and experiencing the indoor living environment in different ways. These user interactions vary daily but recur every season and can be considered as a pattern, the living pattern of the resident. The living pattern, characterized by carrying out activities (e.g. cooking, sleeping, bathing) and actions (e.g. opening windows, changing thermostat), influences the energy demand. Similarly, the outdoor climate is a non-static element as it is characterized by varying climatic conditions throughout the seasonal changes [9]. The underlying dynamic parameters of the outdoor climate (position of sun, sun radiation, temperature, wind and humidity) are directly and indirectly (comfort of resident) influencing the energy demand. Consequently, dynamic residents and seasonal changes can highly affect the steady-state of the built environment. The intrinsically static building needs to respond to these changing elements with a more user-centred design approach in order to promote an efficient living pattern and sufficient energy demand.

To further develop such an alternative approach, a conceptual framework is derived from literature which serves as a red dread throughout the overall research. The framework builds upon the three key parameters which influence the actual energy demand: resident, building and climate. It presents the current design challenges of object-centred energy-efficient building which cause a lack of efficient user interaction. As a response to these challenges, the framework also suggest three design criteria based on a user-centred design methodology which deal with dynamic residents and seasonal changes. To clarify the application of the suggested design criteria, design support is added to the framework and presented as examples throughout the paper.

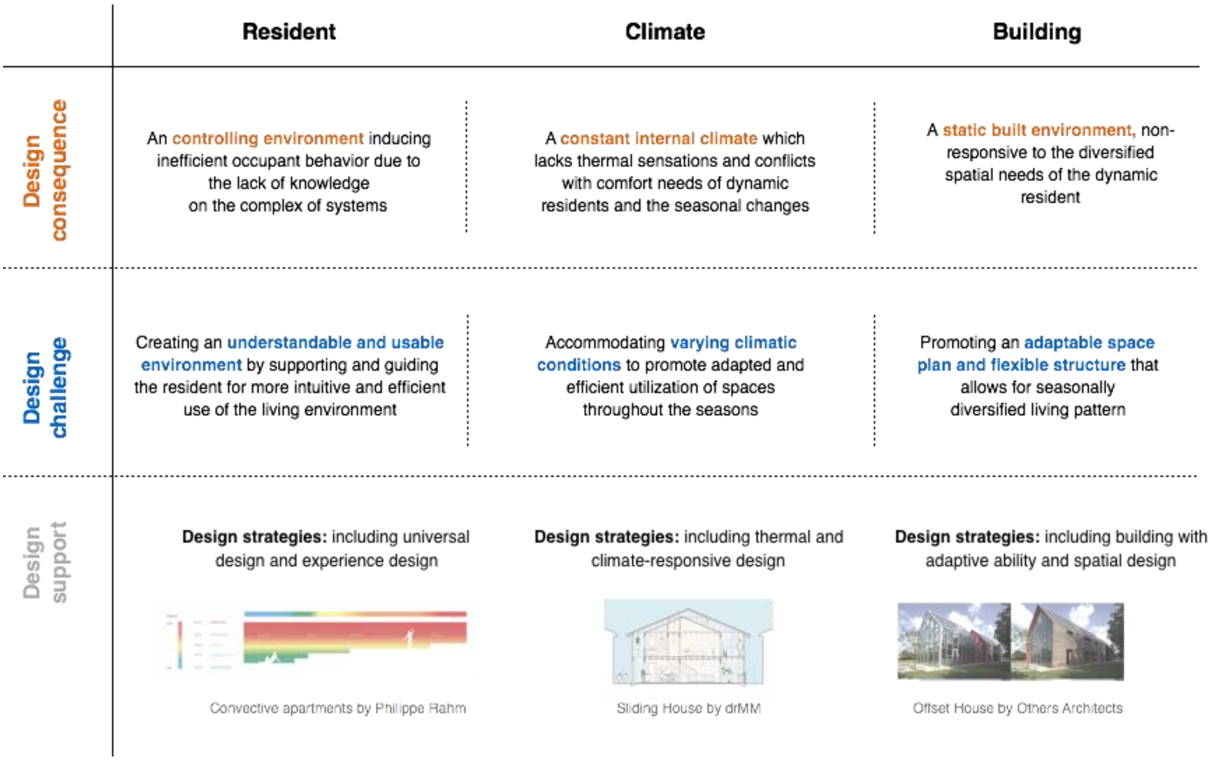

Figure 1 Conceptual framework enabling a dynamic way of living throughout the seasonal changes

The conceptual framework aims for enabling varying indoor climatic conditions for more adapted use of spaces, adaptation to diversified occupation of spaces throughout the seasons and support and guidance of the dynamic resident for more experience and user satisfaction. Therefore, the intrinsic concept of the framework within the context of the research is defined as enabling a dynamic way of living throughout the seasonal changes. In the next three paragraphs, the paper elaborates on these design challenges, criteria and support.

1. From an actively controlled environment to an intuitive, user-friendly environment

The first, often recurring energy-efficient measure is implementation of active systems for heating, ventilation and cooling (HVAC). Currently, critical questions about actively controlled environments are raised by researchers as well as architects, for instance “What is more important: efficient technologies or efficient user practices?” [10]. Through the standardization of comfort norms in combination with the excessive use of fully automated HVAC systems, the need of the resident for personalized conditions and the possibility to feel in control of the environment is neglected.[3]. The mechanization of the built environment is generating a controlled, complex environment for the non-passive resident and unfolds as a first indication of lack of user interaction.
Currently residents are often implicitly seen as passive recipients of their environment. However, residents intend to change and interact with the indoor conditions in a dynamic manner to assure optimal comfort [6]. Field studies on occupant behaviour show that residents are more satisfied and tolerant in a living environment when experiencing control and having more options towards changing the internal conditions[18]. However, the complexity of the operation of active systems often overpasses

the knowledge of the resident, which is only inducing disconnection between the resident and the built environment [13]. Consequently, when the dynamic resident is not interacting properly or is dissatisfied with the systems, it is inherently linked to actions (e.g. opening windows for ventilation, heating with additional devices) which are conflicting with the operating systems (e.g. automatic thermostat). The lack of proper user interaction and efficient occupant behaviour are two of the underlying causes of the performance gap, leading to higher actual energy demands [20, 25].
Thus, taking control over the indoor environment, or controlling the resident, is not inducing effective user interaction or promoting efficient use (e.g. space heating) of the building. Therefore, a first design challenge is derived: an actively controlled environment, can induce a lack of user interaction and lead to inefficient occupant behaviour and higher actual energy demand due to lack of knowledge about the operation of the complex systems.
Consequently, there is a clear need for a living environment that is more understandable and usable for residents to promote effective user interaction and consequently, more (energy)-efficient use of the indoor living environment [22]. User-centred design improves the quality of user interaction, not by forcing residents' behaviour, but guiding and supporting them [1]. Underlying strategies, such as Universal Design (UD), enable more intuitive, easy-to-use environments that allow for more experience, more sustainability, more interaction through an alternative design process and the implementation of design principles [15, 14]. For instance, by designing an environment in such a way that inefficient occupant behaviour becomes more difficult and sustainable behaviour is made easier [26].
Therefore, as a response to the previous design challenge, a first design criterion for the framework is proposed: creating a living environment that is understandable and usable for a more intuitive and efficient use of the indoor living environment by supporting and guiding the dynamic resident.

2. From an insulated, constant internal climate to varying climatic conditions

A second important measure within the object-centred design approach are the large amounts of insulation, rapidly filling our buildings and isolating the resident, from the outdoor climate [21]. Besides the implementation of active systems, highly insulated buildings can induce higher comfort temperatures (e.g. keeping a constant 22°C within the *whole* building volume throughout the year) [16]. Therefore, the efficiency of optimizing the building envelope turns into an increase of the actual energy demand due to change in occupant behaviour (e.g. higher comfort needs) [11].
Consequently, the benefits of implementing high amounts of insulation are argued by researchers and practicing architects by pointing out that it is leading to the disappearance of the appreciation of thermal variations and sensation for the resident [4, 16]. Furthermore, in comfort studies it is often questioned if it is necessary to keep such a constant indoor climate, as it can lead towards designing our buildings with anticipation of constant and high comfort conditions[3].
Sociological studies on occupant behaviour show variations in heating consumption depending on residents' activities and behaviour and the diversified thermal requirements of these activities [12]. In addition, comfort experiences of residents can vary widely because they have personalized preferences throughout the year regardless of the often anticipated constant indoor climate[12]. Therefore, a conflict arises between insulating buildings and isolated residents who are in need of varying thermal conditions. Thus, leading to a second design challenge: a constant internal climate with lack of thermal sensations is in conflict with seasonal changes and the comfort needs of a dynamic resident which can lead to higher energy demand than needed.
As a response, it is argued that varying indoor climatic conditions answer better to the seasonally diversified comfort needs of residents as it is a source of sensory and pleasure [3]. Although, people are

quite sensitive to subtle changes in the thermal conditions of the environment, it is also shown that people have a wide range of thermal conditions they can adapt to [16]. Within the field of physiology and psychology, some research aims for varying indoor climatic conditions to induce dynamic human experiences and recognition of activities with different thermal requirements [6]. Additionally, in practice, designers argue that a principle of energy-conscious architecture lies not only within taking advantage of the energy of the dynamic climate, but also from the energy produced by residents who acclimatize the indoor environment in different ways throughout the year [4, 7]. Therefore, as a response to the second design challenge, a new design criterion is derived that responds to the isolation of the resident from dynamic (outdoor) climate by aiming for: accommodating varying climatic conditions for the living environment that promote an adapted and efficient utilization of the living environment throughout seasonal changes

For instance, the Swiss architect Philippe Rahm experiments with varying indoor climatic conditions in his "Convective apartments" where he uses the phenomenon of stratification to divide the indoor living environment in different thermal zones.

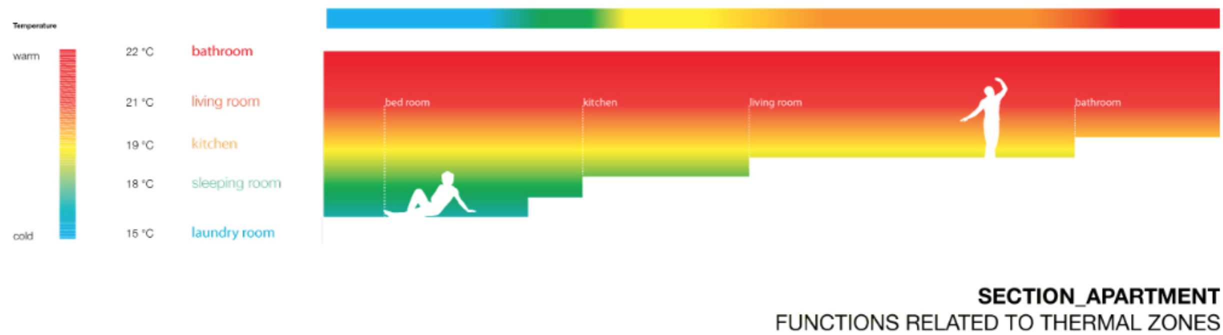

Figure 2 Convective apartments by Philippe Rahm (2010), derived from philipperahm.com on 19/12/15

3. From a static built environment to an adaptable and flexible living environment

The third challenge within an object-centred design approach relates to the static built environment. The resident is often forced to adapt to the buildings' design rather than the building responding to the dynamic living pattern of residents (e.g. different occupation rates of spaces throughout the seasons), only inducing the lack of proper user interaction. Studies on occupancy prediction and occupant behaviour show the high influence of the occupation pattern on energy demand[20]. For instance, the amount of energy wasted during non-occupied hours can be higher than during occupied hours due to buildings' design and static features that are not responding to the daily varying occupancy rates of spaces[7].

Not anticipating and responding to the diversified spatial needs of residents can cause a weak link in energy-efficient building. Although, most occupancy studies focus on non-residential buildings, considering the dynamic resident and its daily *and* seasonally changing spatial preferences in dwellings is needed due to the influence on the actual energy demand. Therefore, the buildings' design must cope with dynamic and constantly moving residents by allowing for adjustments within the buildings' space plan or structure to fit the diversified spatial needs of residents [17]. Consequently, a

third design challenge can be derived: a static built environment cannot efficiently respond to the diversified spatial needs of the resident throughout the day and seasons.
As indicated in the first paragraph on user interaction, literature on dynamic architecture (flexible, adaptable, transformable architecture), expresses the need for buildings that adapt to the dynamic resident rather than the resident, having to adapt to the (static) built environment [19]. A crucial principle of user-centred design, contrary to object-centred design, is starting the design process from the spatial preferences and personal comfort needs of a dynamic user by means of providing adaptive environmental conditions to enhance the user interaction [27]. More specifically, a flexible, adaptable mode of living promotes a living environment that can change when circumstances (e.g. seasonal varying climatic conditions) require it [17]. Therefore, a third design criterion is suggested: providing an adaptable space plan and flexible structure to promote seasonally diversified occupation of spaces, leading to more effective user interaction and dynamic use of the living environment.
For instance, the McCoy House Project (Figure 3) discussed in "Sun, wind and light" by DeKay and Brown (2014), where movable walls ensure different seasonal occupation possibilities for residents (e.g. from a closed building in winter to an open building in summer)

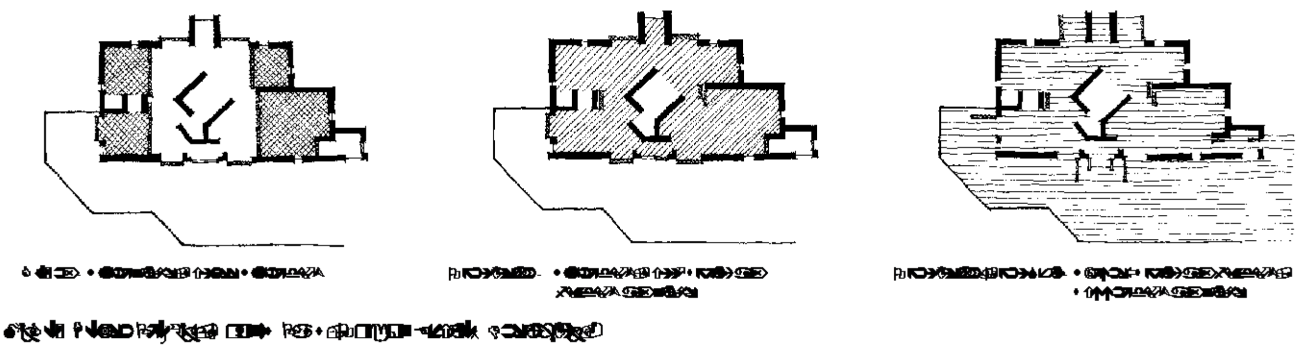

Figure 3 The McCoy House Project, derived from DeKay and Brown (2014)

CONCLUSION

Enabling a more dynamic way of living throughout the seasons for the resident for more (energy)-efficient use of the living environment

The applied object-centred design approach that focusses more on the development of an energy-efficient supply than promoting a sufficient demand for the resident induces new design challenges: a controlling, constant and static living and built environment for a dynamic resident and varying seasons. The lack of user interaction, inducing inefficient occupant behaviour, within energy-efficient housing concepts can lead towards higher actual energy demands when the building is in use. As a response, a user-centred design approach, by means of three design criteria, is suggested for further development of an alternative energy-efficient housing concept. The approach considers the seasonally varying comfort needs and spatial preferences of the dynamic resident to create more effective user interaction which is defined as a dynamic way of living throughout the seasons. The results are presented in a conceptual framework by means of design challenges and suggested criteria and aims for more (energy)-efficient use of the living environment. However, the research will further

investigate if, when implemented, a dynamic way of living throughout the seasons can decrease the actual energy demand. Moreover, if the design approach limits the need for large quantities of additional materials (e.g. insulation) and expensive systems for more resource-efficient renovations.

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RETROFIST FOR CONTINUITY! SUSTAINABILITY AND GENTRIFICATION OF TENEMENT APARTMENT BLOCKS IN DUTCH CITIES FROM INTER AND POST WAR PERIOD

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INTRODUCTION

Increasing energy efficiency of the housing stock is one of the largest challenges in the built environment today. In line with the international Paris-Climate-Change-Conference 2015**,** Dutch cities have great ambitions to reduce CO_2 and to transform their cities into smart and climate neutral cities. In accordance with the transition from the use of fossil energy towards renewable energy, Dutch housing association organization Aedes have promised that their average housing stock is going to have Energy Performance Certificate (EPC) B in 2020. The recently published *Woonagenda 2017-2021* of Aedes speaks about zero carbon housing stock for all housing associations in 2050.[1] Moreover, refurbishment of the existing housing stock is broadening and including more social and feasible themes: providing affordable and attractive housing for young people in the rapid growing Dutch cities; encouraging local and self-governance; improving quality of life; green space, change of behaviour of tenants before and after the transformation and cultural heritage.[2]

However, in current practice the emphasis is on energy efficient renovation approaches for row-housing. Besides that, current design solutions are mainly supply-driven, being developed by contractors for professional clients who have a focus on technological aspects. Parameters like aesthetics, heritage, behaviour and user preferences are not explicitly addressed in current innovative programs.[3] The complex transformation of tenement apartment blocks in city regions are not taken into account. There are some risks with the refurbishment of this housing stock.

First, there is a performance gap in the prediction of energy consumption before and after the deep renovation because of changing use of the dwelling by tenants.[4] Second, the consequence of transformation is an inevitable house expense increase. Since the renewed Housing Act of 2015, houses are only being assigned to tenants with appropriate low incomes. According to the new *Woningwaarderingstelsel*, the rent of refurbished dwellings increase could rise above the so-called ‘Social Housing’ limit (€592,55 and €635,05). Hence, the apartments will become unaffordable for individual tenants since they will no longer be eligible for state income subsidies when residing in more expensive housing. Third, when speaking about refurbishment, there are issues to be considered

like whether a building has heritage or narrative value. In addition, according the Dutch Housing Act 70% of the tenants of a block must agree to the refurbishment. For this reason there is a need for a more integral vision and approach to deal with deep renovation of tenement apartment blocks.

The research group Beyond the Current[5] of Delft University of Technology is aimed to develop a feasible General Transformation Framework (GTF) for affordable tenement apartment blocks of three to five storeys in Dutch city areas from inter war (1916-1925) and post war period (1946-1965). Characteristics of these tenement blocks are. Each stair well has no lift and between 4 to 8 apartments. The apartments are between 50 and 70 square meter. The different units are always a part of housing block, the housing blocks are always a part of a coherent urban ensemble.

All together there is estimated that 480,000 of these apartments are in the city regions of Amsterdam, Rotterdam, Den Haag and Utrecht.[6] A more thorough conceptualization of transformation of these blocks and clearer correlation between and within the parameters energy efficiency, user preferences and cultural heritage is yet to be developed for the coming period. For each time period new goals are established, which means that the transformation of buildings will be adapted to the requirements of that time. Our foremost aim and assumption is that an apartment building stays affordable and can be retrofitted to sustainable housing, instead of being demolished for new building. The present paper describes the first phase and explains the method of the research project.

Figure 1: Tenement apartment blocks are sometimes designed by well-known modern architects as Michel de Klerk, Gerrit Rietveld, Michiel Brinkman

RESEARCH THROUGH DESIGN METHOD

Research framework

The aim of the project is to develop a more generic General Transformational Framework (GTF) in refurbishing the tenement housing stock with respect to the parameters heritage, user preferences and reduction of CO_2 emission. The method to achieve that is Research Through Design (RtD). This is an approach to scientific inquiry that takes advantage of the unique insights gained through design practice to provide a better understanding of complex and future-oriented issues in the design field. RtD is not a new approach.[7] This method with the use of case studies is necessary to develop attractive and feasible GTF and design models for architects for this more complicated part of the housing stock. With our method we make it possible to repeat our research.

Case study is defined as an empirical inquiry that investigates a phenomenon within its real-life context.[8] The cases should be studied in their real-life context, provide multiple sources of evidence and provide the opportunity to generalize a theory.[9] To this end, the project will focus on the tenement apartment blocks, which represent a relatively large proportion of the non-row housing stock in the cities in the Netherlands.

This is a multi-disciplinary research with different tools (Heritage Assessment, Energy Assessment, Life Cycle Costing, Discrete Choice Modelling). Each field of research has its own method. Design alternatives will be developed for renovation of a selection of housing types, and will be tested for user preferences by employing a discrete choice modelling method with 3D virtual design models, resulting in design solutions that are likely to be accepted by the users. Validation of our RtD-method and GTF will be done with test cases.

Object of research, a survey

The research object is the tenement apartment blocks from the interbellum and post war period in the city regions. A survey is important on the one hand in order to identify the relevant building types and subtypes, resulting in the selection of design cases. On the other hand, understanding an existing building is essential for the proposed feasible design interventions. We have sought to include types that share both similarities and differences. The similarities can be useful to render the solutions comparable and therefore applicable to larger parts of this housing stock. The differences, on the other hand, help to identify specific architectural, technological and social challenges. The present research proposes a systematic way to categorize the buildings and assess the development of the typology in their context. Heritage assessment is a more or less objective tool developed for building historians to assess cultural, architectural and urban historic aspects of a building. The transformational framework is a subjective tool for architects developed at the Delft University of Technology, Heritage & Architecture by professor Wessel de Jonge to deal in a broader sense with the transformation process of old building and urban ensembles.[10] With this assessment, the different options are designed by an experienced architect and a GTF will be developed. Once the design is produced, an energy assessment and life-cycle-costing are calculated.

Energy Assessment and Life Cycle Costing

The energy demand of existing buildings is usually calculated with standard formula's dealing with energy labels. This is a limited and imprecise way to calculate energy use. For the purpose of the present study, the output is related to the information needed for the users to choose their preference. To this end, a dynamic energy calculation is used as a means to determine the energy demand, translated into energy costs/month. Accurate data of the building's size and construction, location climate and occupancy based on the building's function were used as input to calculate the rental price. In this study we use life-cycle-costing (LCA) as a tool to estimate the cost of the transformation and to calculate the rent as a so-called cost-price-rent. In addition we check whether this cost-price-rent is in accordance with the *Woningwaarderingsstelsel*.[11] LCC provides a systematic approach to estimating costs during the whole life cycle of a product, such as a building. In case of buildings, we use the model conform NEN-standard 2699.[12] In this standard, several costs are taken into account, such as: cost of the site or an old building and a site, construction or transformation costs, taxes, financing the transformation, maintenance of the building in use etc. This data is used to calculate the cost of the transformation and the new rent. Together with the Energy Assessment, which calculates the cost of energy each tenant is paying each month, the information is presented via questionnaires in the next step: Discrete Choice Modelling.

User Preferences Assessment (Discrete Choice Modelling)

The design alternatives will be tested by Housing Associations for household preferences by employing a discrete choice modelling method with 3D models.[13] Respondents will be asked to choose between several pairs of images of design proposal. Sets of images will be created from the design alternatives; while systematically varying combinations of design attributes of renovation measures, materialization, duration of renovation, costs, and energy savings. Subsequently, household preferences are determined by employing a multinomial logit model resulting in a selection of design solutions that are most likely to be accepted by households for the various types of dwellings.[14] This is a quantitative and visual method for collecting data about user preferences tested design models.

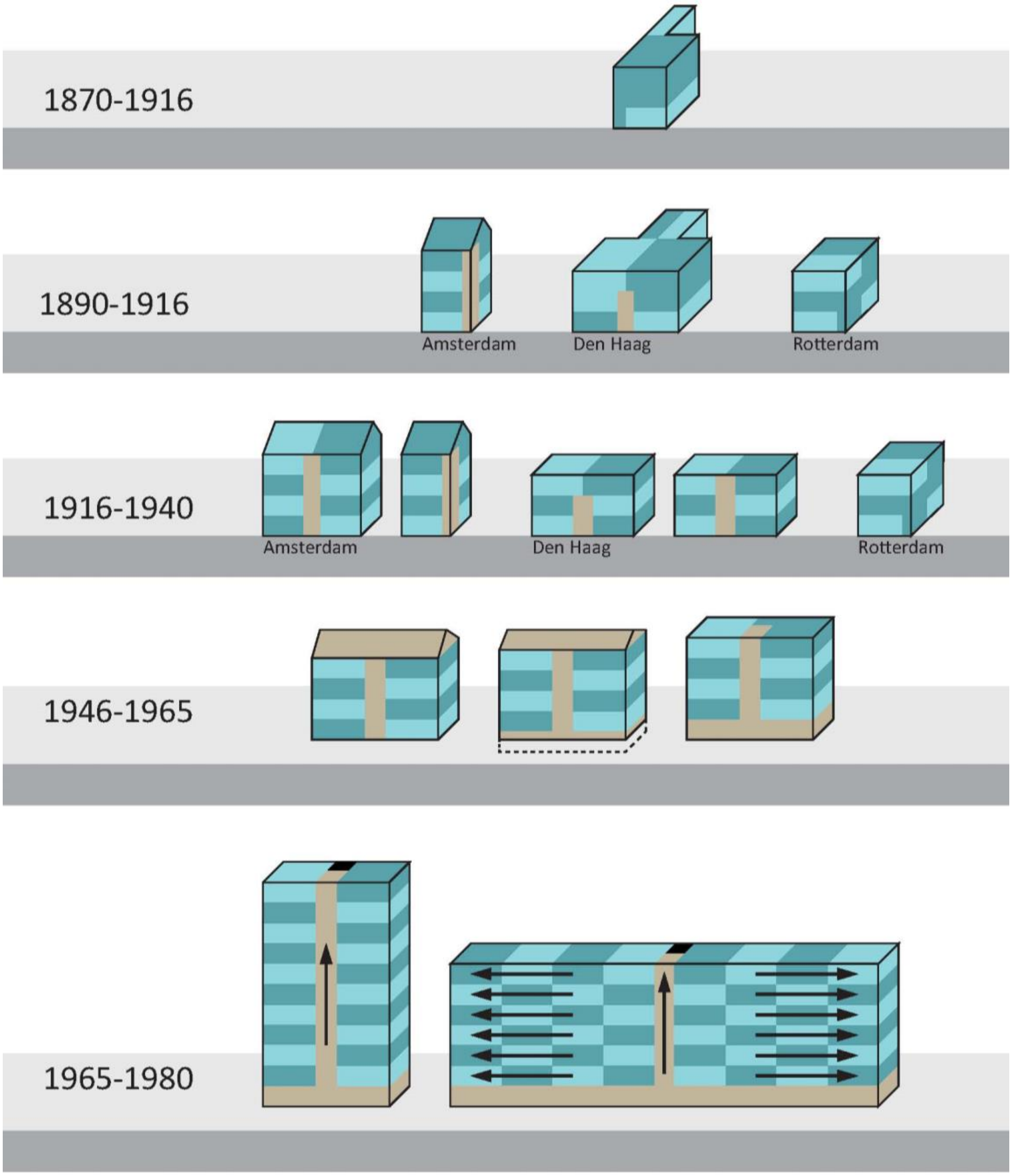

Figure 2: Subtypes tenement apartment blocks of the Netherlands, only subtypes from inter war (1916-1940) and post war period (1946-1965) are assessed in this research.

Figure 3: Four subtypes tenement apartment blocks;
left above subtype 1 inter war Amsterdam, left right subtype 2 inter war Den Haag,
left below, subtype 3 post war mix traditional and construction system,
right below subtype 4 post war dry prefabricated construction system

HERITAGE ASSESSMENT AND TRANSFORMATION FRAMEWORK

First step is to provide data with a building-inventory, including the categorization and interpretation of tenement building types in Amsterdam, Rotterdam, Den Haag, and Utrecht. Several criteria were developed and buildings were selected. For the survey we used primary literature sources from the inter war and post war period, and special books or articles exhibiting 'good examples' of tenement apartment blocks. Additional literature was examined to get a historical impression. The inventory does not claim completeness but it is an overview with insight into the development of the building type, used materials and service systems. Implicitly, we assume that protocols from the period in question, among other factors, have had a big significance on the architecture and certainly on the readability of the buildings. As a result, four subtypes of tenement apartment blocks, each with their own characteristics, are derived from the period we are assessing. Others subtypes are excluded from this research. Two from the interbellum: subtype 1 'Inter war Amsterdam' and subtype 2 'Inter war The Hague' and two from the post war period, subtype 3 'Post war mix traditional and construction system' and subtype 4 'Post war dry prefabricated construction system'. Result of this first step is the selection of the cases.

Second step is to develop a General Transformational Framework (GTF) with the parameters heritage, user aspects and energy efficiency. Architects can use this framework for deep renovation of one of the subtypes. The framework categorizing objectives and makes it possible to give several aspects of parts of a building a value. Some subtypes and some buildings have great transformational potential and others less. The framework determines the band width of the potential changes. When the GTF is established, the program of the building owners and maybe that of tenants can be developed by the architect, and building and exploitation costs can be determined for a case.

Third step is the assessment of the selected design cases. To recognize qualities, a quick-scan-tool for tenement apartment blocks was developed, based on the approach of the Cultural Heritage Agency[15] and the municipality of Amsterdam.[16] There will be an assessment of external cultural historic values, internal architectural historic values and internal urban historical values. All of these will have a value.

Fourth step is documentation of the information about the building historical assessment. Three situations are compared and documented; the original state of the building, the current state and possible interventions in the future. In the current situation there is given a value to certain building elements.

Fifth step are the four design cases. Subsequently, the designing process can start. Energy assessment and life cycle costing are done and the consequence for increase or decrease of the rent is clear for tenants if they choice for a certain intervention.

At last, each design cases will be evaluated, and with the results of the users preference assessment the GTF will be perfected with each design case to a feasible refurbishment tool.

Table 1: General Transformation Framework GTF these interventions are used in the questionnaires of the user's preference assessment.

Heritage	Façade change and details with respect of the original character of the building. Interior change and details with respect of the original character of the dwelling.
Energy efficiency *zero carbon / all electric in the exploitation of the renovated dwellings*	Improve the skin of the building and reduce energy demand. Aim is applying low temperature heating LTH and mechanical ventilation, if possible with demand control ventilation DCV. Use renewable energy sources, in relation to apartment. • Central block heating • Air Source (to water) Heat Pump ASHP with indoor water tank for central heating and domestic hot water. The source could be air from the ventilation system or from outside. A small electric heater is still necessary in winter time. • Demand Controlled Ventilation DCV • Mechanical ventilation with Exhaust Air Heat Pump EAHP • Mechanical Ventilation Heat Recovery MVHR • Photovoltaic panels (with battery).
User preferences	Change kitchen-bathroom (make a connection) Change living-bedrooms (change the place of the living and bedrooms) Change living-kitchen (make connection) Extension dwellings (serre on the garden side) Extension balcony (garden side) Improve accessibility dwellings (lift en gallery garden side)
Improve quality and safety	Acoustic insulation between dwellings Fire safety between dwellings (wooden floors)
Change or add new functions	New apartment on the roof Change ground floor from storage space to apartments

CONCLUSIONS

It is too early to draw conclusions. At the moment the user preference assessment are executed by Housing Associations, and the GTF is improving to a feasible design tool. The result will be statistically analysed to result in generalised user preferences. At the moment we are dealing with the problems such as the user's preferences and the performance gap in the prediction of energy consumption before and after the transformation because of changing use of the dwelling by tenants. And we are dealing with the problems related to the refurbishment in relation to the expenses and the rent since the renewed Housing Act of 2015. The practice of deep renovation changed. Our research will conclude in June 2018.

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ENDNOTES

1 http://www.aedes.nl/
2 Guzman, Pereira Roders and Colenbrander 2017; Majcen 2016
3 http://www.energiesprong.nl/
4 Majcen 2016
5 Beyond the Current is a multi-disciplinary research group of Delft University of Technology: A+BE Architecture and the Built Environment organised by professor Vincent Gruis of the chair Housing Management, professor Thijs Asselbergs of the chair Architectural Engineering and professor Wessel de Jonge of the chair Heritage and Design. This research is financed by NWO/STW/SIA.
6 http://statline.cbs.nl/
7 Godin and Zahedi, 2014
8 Yin 1994
9 Groat & Wang 2013
10 De Jonge, Quist and Zijlstra 2017
11 https://www.rijksoverheid.nl/onderwerpen/huurprijs-en-puntentelling
12 De Jonge 2005; Van den Dobbelsteen 2006; https://www.nen.nl/NEN-Shop/Norm/NEN-26992016-Ontw.-nl.htm
13 Kwak, Yoo, & Kwak, 2010; Orsborn, Cagan, & Boatwright, 2009; Riccardo, et al., 2012; Van Oel & Van den Berkhof, 2013
14 Kuhfeld, 2009
15 Cultural Heritage Agency 2009
16 Amsterdam 2013

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FLEXIBLE NEIGHBORHOOD FOR SUSTAINABLE LIVING

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INTRODUCTION

“You can’t have a totally structured place and then expect people to fit in”[1]

Social sustainability is the attempt to introduce the human dimension in the sustainability calculations. The Three Pillars Model of sustainability suggests that Social, Environmental and Economic dimensions are the main pillars of sustainability, but the question is: “Are the three dimensions given the same attention?”

Sustainability practices and approaches prioritize environmental and economic sustainability, while the Social pillar is often referred to as the weakest pillar.[2] The Social pillar is as important as the environmental and economic pillars but not as well defined and measured as they are. The means to operationalize social sustainability aspects in a project are an obstacle that faces many practitioners.[3]

“If a new community is to be successful and sustainable, the place – the physical space, the housing stock and amenities, the social infrastructure – needs to be able to adapt over time to new needs and new possibilities.” [4]

How can the relatively static housing plans cope with the fast-changing people’s needs?

Could housing flexibility concepts be a mean to reinforce social sustainability aspects in housing projects?

Flexible Housing emerged to help designers cope with this ongoing change. Flexibility emerged as a concept in 1920; however, it didn’t have a definition at that time, and its application differed from one project to another. “It was a flexible division of the interior for Corbusier, flowing space for Ludwig Mies van der Rohe, multiple-use rooms for Mart Stam and the various combination of standard components for Walter Gropius in the 1920s.”[5]

What is Flexible Housing?

Flexible housing has been defined as the housing that can adapt to the changing needs of users.[6] Flexibility is generally perceived as an adaptive response to environmental uncertainty[7]. More specifically, it is a reflection of the system’s ability to change or react with little penalty in time, effort, cost, or performance.[8]

In housing, flexibility can contribute to raising users’ satisfaction with market offerings by responding to their developing needs.

“Flexibility is not the exhaustive anticipation of all possible changes. Most changes are unpredictable. ... It is the creation of a capacity with a wide margin that enables different and even opposing interpretations and uses”[9]

What is Flexible Neighborhood?

"People need an identifiable spatial unit to belong to."[10] This Spatial unit is what we call a neighborhood, and it is where the community lives or resides. Rick Jarvis, founder of One South Realty Group defined Flexible Neighborhoods as neighborhoods that offer an entire life cycle for its residents.[11] In other words, people wouldn't have to leave friends behind, change schools, or part with the community they belong to.

The city of Wyndham in Australia developed a vision that ensures flexible neighborhoods for all residents. "To ensure a housing stock that is diverse in its types, designs, sizes and tenure and that are flexible and adaptable to be able to accommodate changing needs within the community."[12]

Flexibility on the neighborhood scale isn't widely spread, yet there is a need for a defined framework on an urban scale to guide the planning of more flexible neighborhood.

WHICH SCALE:

Flexibility is a notion that is more supported than criticized. It spreads widely between designers and architects nonetheless; it doesn't enjoy such popularity between housing market developers or users. The question here is why? And which scale should it address?

The research is addressing the significance of flexibility on various scales. It argues that designing flexible neighborhoods requires flexibility on planning and urban design scopes, as well as architecture, and cannot be achieved without a holistic view from all perspectives.

Flexibility in Architecture

Flexibility in architecture can be interpreted in multiple ways; in terms of materials, finishes, facades, structure, interior, furnishing, etc.

It can be classified in several ways[13]; one of which is the 'Till & Schneider' classification which works on three-level principles:

- Interior: The layout of the unit should allow adjustable space use and be designed in a way that doesn't predetermine its use.
- Unit: The units should allow size expansion or reduction by being linkable/detachable both horizontally and vertically.
- Building: The building should be flexible enough to allow complete change of its use.[14]

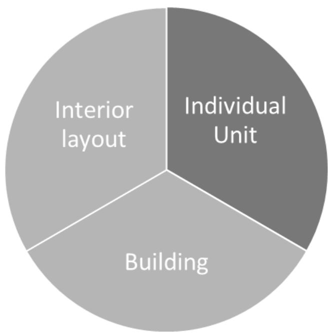


Figure 1 Degrees of flexibility in architecture scale

Flexibility in planning

Urban planning profession sprang from both architecture and landscape; both professions are mainly concerned with the physical design. In the earlier years of planning, planners emphasized the physical aspect over the social aspect up until the1960s and 1970s due to social movements which introduced the social aspect as a key aspect to planning. [15]

Housing is the field in which physical planning influence most obviously, where planning decisions affect facilities, housing types, rent, prices, and thus members of the community (through zoning ordinances and social categorization). Consequently where someone lives has a major impact on their social life.[16]

Social identity theory states that people define themselves in answer to the question “Who am I?” according to their social categories, focusing on several attributes which include their homes, to communicate their social identity[17] [18].

As much as planning contributes to users’ self-perception and identity; users contribute greatly to the success or failure of planning.

The case of Pruitt-Igoe (1954-1976) public housing project in St. Louis is one of the cases which indicate that successful physical design does not always ensure social success. After the project has been designed and constructed, it failed to fulfill social needs. The city failed to deal with the multiple social problems caused by the project which led to its demolition, and the site was cleared.[19] The failure of Pruit-Igoe project has been a result of several social, political and economic aspects. It indicates that such aspects when not taken into consideration, or predesigned with a possibility for more flexibility may lead to failure on large scale of planning.

Figure 2 Photo courtesy of Missouri History Museum of Pruitt-Igoe public housing project in St. Louis

Inflexibility in planning led to some extreme contradicting views. Heijne and Vink in their book ‘Time-based Architecture’ stated: “The city of adaptable buildings is not a city of zoning… Zoning is inflexible and thus unsustainable.”[20] This completely resists and refuses the concept of zoning.

The Change in neighborhood population and social factors across generations calls for adapting to change on a wide scale of planning. Some characteristics that may enhance the capacity to change can be introduced to planning application, such as those adopted by the Australian and Canadian governments to reach a more flexible planning through mixed land use, adaptable land parcels, compact patterns, variable size, types and ownership of retail businesses and anticipation of urban land needs.[21] [22]

Nabil Hamdi, author of the book *Housing without Houses,* developed considerations based upon several practices with various intervention options on the planning scale which include circulation networks, different options for lot sizes, configuration according to land value, facilities, etc. These

considerations can be identified as an approach to designing flexible neighborhoods on planning scale.[23]

Flexibility in urban design:

Housing is considered an integral part of urban design.[24]

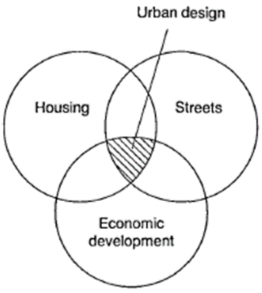


Figure 3 urban design as an integration of streets, housing and economic development

Urban Design has been defined by many as the bridge and mediator between architecture and urban planning. In Chicago conference 1958, Jose Serte defined urban design as "The part of planning concerned with the physical form of the city" [25]

Tibbalds describes urban design as a vital bridge giving reality to abstract planning briefs and master plans before detailed architecture begins.[26]

"Urban design involves the design of buildings, groups of buildings, spaces and landscapes, and the establishment of frameworks and processes that facilitate successful development".[27] Such definitions claim urban design as the mediator of the physical aspect on the neighborhood scale, concluding the need for flexibility in urban design

Flexibility aspects are addressed in urban design objectives such as; Adaptability, Quality of public realm and livability, Diversity, Urban self-resilience. [28]

FLEXIBILITY CONCERNS:

The following Table *1* shows concerns for flexible designs on different scales.

Table 1 Flexible housing approaches in terms of methods and concerns to be applied to architecture, urban design, and planning scales
Source: Author

Flexible housing suggestions		Architecture	Urban Design	Planning and legislation
Completely change the use of the building	Method	- Flexible design with linkable/detachable units	- Designing adaptable urban space	- Adaptable land lots with proper size
	Concerns		- Parking, public space requirements, privacy concerns	- Adequate Road design and drop off
Solving the changing social situation	Method	- Flexible interior to cope with changing family size	- Designed with urban objectives to cater all sections of the community	- Design with compact patterns and create options for change
	Concerns	- Lack of users know how to alter the design		- Demographic variations might be challenging for planning to provide adequate services
User Empowerment	Method	- The users' sense of ownership and identity through controlling the space design	- Designed with urban objectives of identity and character - Urban design acting as a mediator	- Applying participatory planning approach
	Concerns	- Lack of users who know how to alter the design	- Subjectivity of analysis process to the design team's views and ideologies instead of the users' needs	- Lack of coordination between planning and architecture, not involving urban design as a mediator

Concerns in architecture: If the design is flexible, it is important to convey this information to the client or the user in "Flexibility Protocol"[29]
It is expected that the flexibility aspect will become a standard consideration when designing buildings. Exactly what that flexibility will entail is a matter for the designers and the client to decide. Time will tell whether there is a market for physically changing buildings; that means buildings whose structures allow for a variable volume. Projects that are flexible enough become anything something neutral that one does not know how to relate.[30]
Concerns in planning: one of the flexibility approaches is movable dwellings, but would that affect the planning and lead to informal patterns? Maybe, this can be used in specific deserted places or for the temporary housing approach, but strict legislations are needed for such approach.
Concerns in Urban design: Practitioners need theoretical grounding otherwise practice is blind
Concerns in Urban design: Practitioners need theoretical grounding, otherwise practice is blind.
The urban design analysis process is somewhat subjective to the design team's views, ideologies and problem definition. The process lacks public involvement in plans development.[31]

FLEXIBILITY TRIALS:

Figure 4 provide a brief analysis of selected examples of different flexibility approaches and the possible application of these concepts in flexible neighborhoods.

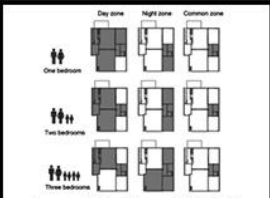
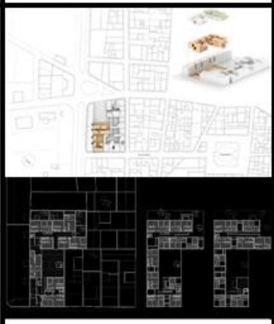
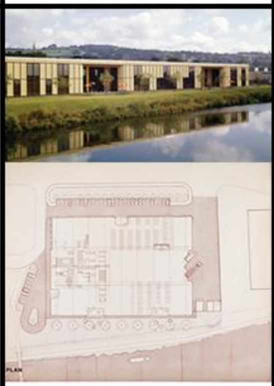
Selected Examples		Flexibility Approach
Traditional Japanese house (Kazuhiko & Kaoru Obayashi, 1850)	 Source: (Schneider and Till 2007)	Designed to cope with variations in family structure ⬇ This will facilitate targeting more than one social group
Ripolltizon (Pep Ripoll & Juan Miguel Tizón, 2012)	 Source: (Ripllitizon 2008)	Adaptive to design to programme and context diversity ⬇ Working with this approach will help maintain neighborhood identity
Incremental (Alejandro Aravena, 2003)	 Source: (Greene 2010)	Designed to empower and include the user in design choices ⬇ Increasing user's sense of belonging to the neighborhood
Herman Miller factory in Bath (Nicolas Grimshaw, 1976)	 Source: (Farrell and Grimshaw 1975)	Context aware design with capactity to change building use ⬇ The ability to change building use when needed especially service buildings, is economically efficient and increase the building life time

Figure 4 flexibility trials
Source: Author

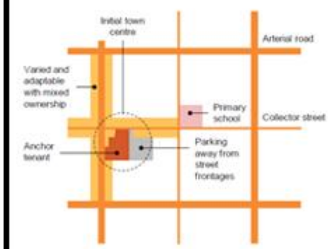
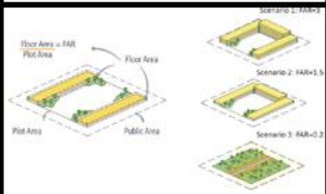
Selected Examples		Flexibility Approach
Sipoo high school & IT college (K2S, 2007)	 Source: (Schneider and Till 2007)	Same as previous example
Adaptable local town centre layout (Hybrid model) (Grattan Institute, 2012)	 Source: (Grattan Institute 2012)	Designing adabtable land lots with various in type, size, and ownership ⬇ Adaptable land lots facilitates the rezoning of the neighborhood and coping with population growth & shrinkage
Estimating urban land needs in a model city (UN-Habitat, 2002)	 Source: (UN-Habitat 2002)	Same as previous example
Mobile Homes & Services	  Source: (Colony factory crafted homes)  Dental services, Chile. Source: (Housing without houses 1991)	Movable structures ⬇ Movable structures can help in the neighborhood intitation, to speed the neighborhood growth and habitation

Figure 5 flexibility trials cont.
Source: Author

After going through the flexible housing literature, it was found that flexibility was applied on the three levels: Architecture, Urban Design, and Planning. However, it wasn't applied holistically on all levels (with few notable exceptions). Flexibility attempts in most cases were treated as trials; therefore pilot projects were carried on one of the three levels.

The previous case studies show how flexibility trials can address all scales, but the most popular case studies were on the architectural scale because of the lower risk. Social challenges on the architectural scale can be easier to anticipate and design variables are generally less than those of the planning and urban design scales. Hence, many programs have been designed to conduct a simulation to architecture units with flexible design, but none have been developed so far to predict such change on neighborhood and planning scales due to interconnected economic, social, environmental, and political factors.[32]

DEVELOPING FLEXIBILITY CONSIDERATIONS

The above literature and analysis indicate the need to integrate flexibility within various scales of planning, urban design, and architecture. Henceforth, some considerations can be extrapolated on all scales which -with further studying and research- can contribute to the success of the flexibility concept when implemented on various scopes and integrated into different phases.

Figure 6) shows the developed considerations throughout the research. It categorizes the considerations into planning, urban design, and architecture scales. All the following considerations can be adapted and tailored according to different contexts.

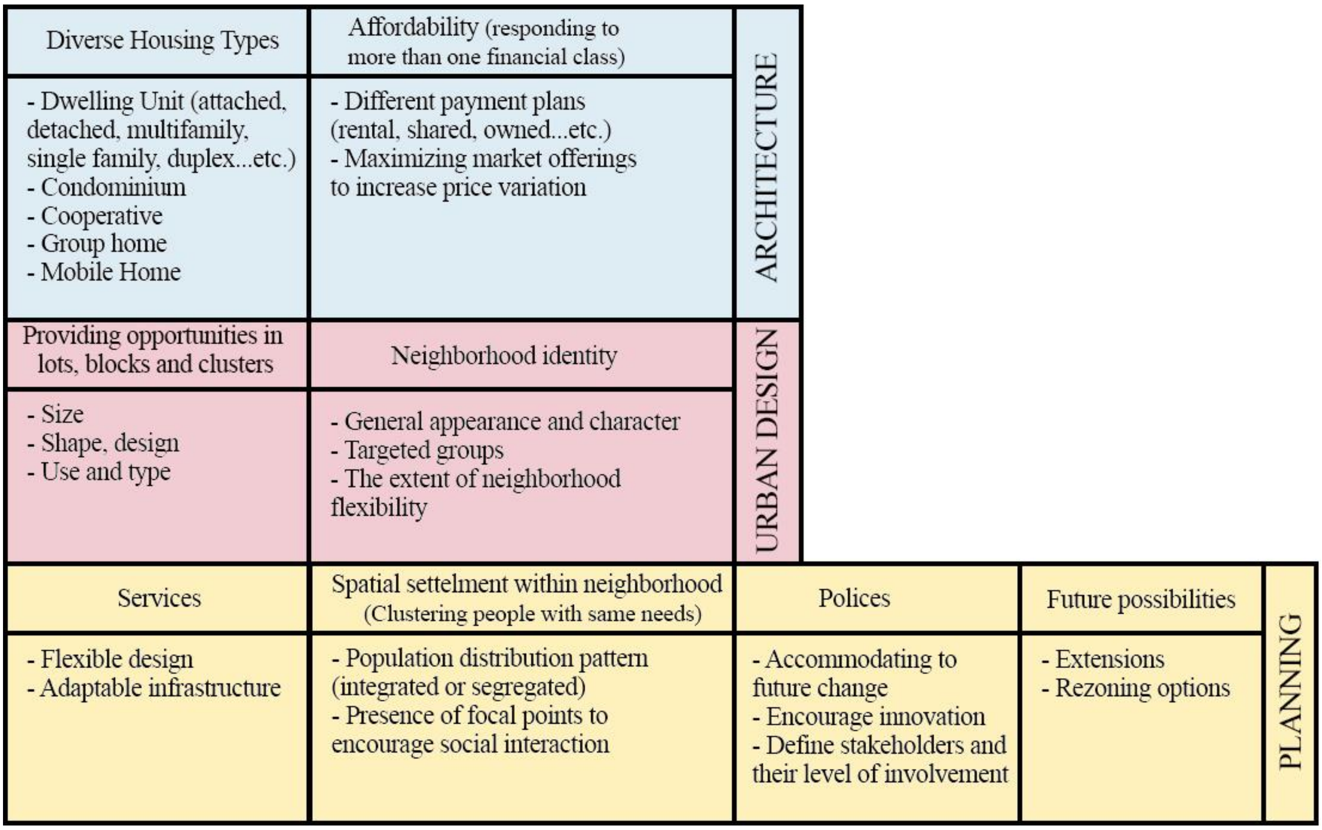


Figure 6 Neighborhood flexibility considerations
Source: Author

IS FLEXIBILITY FOR EVERYONE?

Flexible Housing is a multidisciplinary concept which encompasses all scales of design, starting from planning all the way to interior design, yet "the promise of the concept had outgrown its ability to deliver"[33]

The user is reluctant to follow flexibility instructions, and since flexibility is partially user-dependent, this affects and limits the design outcome on the long term.

There is no guarantee of success when it comes to the market, since economic factors are missing in flexibility studies.

The following table analyses the relationship between market and different flexibility approaches from different aspects, including economy, market mobility, services, and new technologies.

Table 2 Housing market views towards flexibility approaches
Source: Author; Zeitun, M. (2014, June 5). Can housing be affordable? (A. weekly, Interviewer); Till, J., & Schneider, T. (2005). Flexible housing: the means to the end. Architectural Research Quarterly, 287-296; MERIS. (2004). EGYPT: OVERVIEW OF THE HOUSING SECTOR. OPIC; Moulton, J. (1999). Evaluating Housing. The Brookings Institution.

Aspect	Flexibility Approach	Housing market developers	
		Public	Private
Economic	Long-term: requires high initial cost but lower running cost	Seek short-term solutions and Affordable initial cost	Seek short-term economic profit
Market Mobility	Promotes staying in one place for many generations	No conflict	Encourage market mobility to sell more (deals with housing as a disposable commodity)
New Technology	Requires new technologies with high cost	Lack of resources	Lack of interest due to existing over-demand
Services	Accommodate different social groups with different standards	Provide basic services according to social standard	Promote segregation of social groups to profit from higher service qualities.

CONCLUDING REMARKS

This research is assuming that flexibility is not new. It has been there for a long time, and has been used on all scales to solve problems faced in different countries, towns, neighborhoods, buildings, even apartments, yet it didn't break the cycle of pilot projects, nor been applied holistically. Flexibility success to solve problems on different scales makes us wonder if applying it on a more holistic and organized manner could be a new approach for sustainable housing.

It is not merely an architectural approach, but one that is promoted in both planning and urban design; yet flexibility concepts aren't broadly connected on different disciplines.

The need for Multidisciplinary communication might be a way to widely apply flexible housing on neighborhood scale not just architectural units.

Developing a set of considerations on various scales is required to apply flexibility in an integrated and multidisciplinary manner.

Such considerations should be further developed and tailored according to the context they belong to.

The market's concerns are that flexibility is not very well defined. The market needs trials on wider scales and with a more holistic approach; however, trying this concept on a wider scale could be very risky from an economic perspective.

The process involves many people who don't want to learn. Users are dependent on the designer as they don't want to exert effort in thinking and trying, designers limit the user's input in design, thinking that, as professionals, they know better, and finally the market developers aren't willing to fund untested projects.

Factors affecting neighborhood flexibility such as the diversity of housing market, social sustainability of the neighborhood, could determine whether flexibility can be applied in a specific context, or it is not just right for them. Yet ensuring a successful application to flexibility requires applying its considerations on all scales of planning, urban design and architecture.

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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally
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THE RELATIONS BETWEEN BUILDING PERFORMANCE AND EMBEDDED ENERGY – A NEW FOCUS ON BUILDING MATERIALS

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INTRODUCTION

This paper is based on a parallel study of European Directives and Danish Building Regulations in relation to energy performance. The study takes point of departure in historical sources, international directives and national legislations and regulations in order to investigate how energy performance has become a central aspect of the architectural discipline. It aims to map the established understanding of energy performance and how it relates to other contemporary environmental issues especially material embedded energy, material use and waste connected to the building industry. Furthermore, it is discussed if the established understanding of energy performance corresponds with the future challenges regarding the environmental impact of the building industry and how this will challenge the role of the architect.

The energy issues are highly complicated and influenced by different agendas. As an example, sustainable energy sources carry a lot of inherent problems e.g. rare earth resources used in windmill turbines, which ultimately question the term ‘sustainability’ as, defined within the Brundtland report.[1] Furthermore, the national economic aspects, (energy) politics, incitement of the building industry, and private economy in general are also crucial factors when the energy issue presents itself in the contemporary debate. However, the article will not be addressing these aspects, as it focuses on theoretical and practical building technology.

The international energy crises of the 1970’s positioned Denmark in a unique and fragile position, which ignited a national common consciousness on buildings performance energy. This has resulted in an ambitious Danish regulation regarding performance energy and governmental financial support when making energy renovations. In comparison with other European countries, Denmark is close to fulfilling international directives on this subject. For this reason, the article focuses on Denmark as a case; what has been learned and what sort of problems has the one-sided focus on performance energy started to generate?

In the following, we will differentiate between 'directive', 'legislation' and 'regulation'. 'Directive' is used when addressing EU initiatives, whereas 'regulation' is used to depict the legal requirements regarding buildings within a Danish context. 'Legislation' is used as a unifying term both within different Danish legal acts as well as Danish and EU acts as a whole.

THE PROGRESS OF THE DANISH BUILDING REGULATION

When energy performance became crucial

Up until the 1960's the Danish Building Regulations have their roots in an architectural tradition based on classical craftsmanship. The regulation had its main emphasis on cityscapes, building construction and handling of materials - whereas the energy performance of the buildings was not addressed.

Figure 1: Thermal bridge. Beam going from inside to outside in a building pre-1970's regulation. Photo: Pelle Munch-Petersen, 2017

In the fall of 1973 the October War between Israel and Egypt broke out. This lead to an energy crisis prompted by the Arab oil states raising the oil prices and boycotting export to western Israeli supportive countries.[2] At this time nine tenth of Denmark's total energy supply were oil based.[3] Fearing an oil shortage, the Danish Government established the Energy Committee. Through campaigns the public was encouraged to save oil and energy by sealing off windows and doors, and using less electric light, heating and hot water. Prohibitions were upheld until July 1974. The crisis revealed how vulnerable Denmark's energy sources were, when geopolitical issues interfered with foreign raw material export. As a result, new interests in alternative energy sources, such as windmills emerged as well as the search for national oil sources intensified[4] saved by lowering the general consumption in housing.[5] At this time, heating was the majority of the buildings energy consumption.[6] Thus, a minimum demand of insulation was introduced in the Danish Building Regulations of 1977 and 1979.

Between the regulations of 1966 and 1977 a significant change of focus occurs. Whereas, the regulation of 1966 describes a transmission coefficient based on well-known construction methods using wood, brick, block brick and concrete, the regulation of 1977 describes a general approach to transmission coefficient, materials and constructions. Since then, specific examples of construction and materials

have steadily become less important within the regulations and have been replaced by general performance based numerical criteria.

Energy performance in the perspective of EU

In a European perspective, the attention regarding energy performance in buildings has led to directives with direct influence on national legislations. "EU Directive 2010/31/EU of 19 May 2010 on The Energy Performance of Buildings" [7] states that the independency of the EU Union and its emissions of greenhouse gasses depend on the reduction of foreign energy sources ((3)). This includes fulfilling the goal set by the Kyoto Protocol of 1992. Firstly, this reveals a European ambition to be independent from potential geopolitical crisis of the future. Secondly, the necessity to guide the building industry towards a common sustainable future is being articulated. Furthermore, the directive states, that the goal is to reduce the energy performance of all new buildings to nearly zero-emission by the end of 2020 (Article 9, 1a). 'Nearly zero-emission' is not defined, but the directive states the individual countries must define the term depending on the specific climate (Article 9, 1b).

The Directive mainly enforces energy performance optimization of buildings through common calculation methodologies, requirements of legal certifications, technical installations and minimum demands regarding the building envelope (article 1). Indoor climate and related technical installations (heating, hot water, air conditioning, ventilation) are central to a number of the paragraphs. One aspect of this is the optimization of the technical installations and implementation of intelligent measurement systems (article 8). In loose terms, the Directive refers to features traditionally associated with the architectural discipline such as daylight, sun, shadows (article 9) and passive thermal performance of the building envelope, but this is mentioned exclusively as a means to decrease the usage of air-conditioning (article 25).

The Directive focuses on the technical developments as an aid to optimize the energy performance of the building thereby promoting the importance of operational performance energy without consideration of the embedded energy or impact of the materials needed to meet the demands. Another aspect of the Directive is the general neglect of how the architecture can contribute to adjust energy performance by site-specific design and deliberately chosen materials - thereby reducing the need for technical installations.

In a Danish context, the Directive has had a direct influence on the Building Regulations (BR), as well as it has led to mandatory standards such as; energy labelling. In the coming Building Regulations of 2020 (BR 2020) the energy performance of new buildings is defined as 20 kWh/m2/year, which must be considered as the Danish definition of 'nearly zero-emission'. Although, the performance demands have steadily increased since the 1970's the EU Directive of 2010 made a significant impact in Denmark challenging more than 10 years of unchanged energy demands.

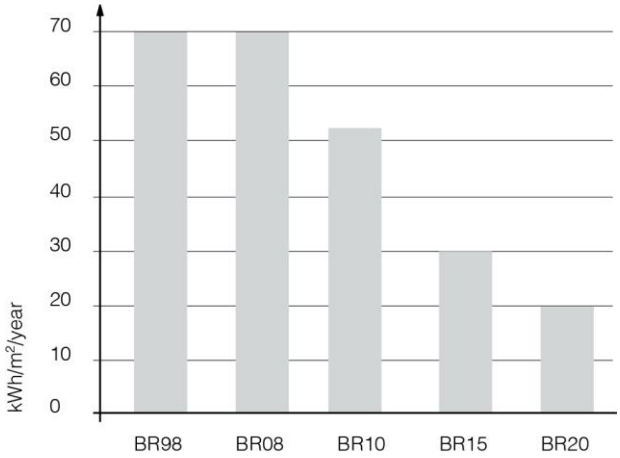

Figure 2: The rising performance demands of housing in the last 20 years as defined by the Danish building regulation (Pelle Munch-Petersen and Henriette Ejstrup 2017).

While the Building Regulations do not explicitly dictate specific constructions - the result of increasing performance demands has a direct influence on the amount of material, especially insulation. As an example, BR66 required approximately 70 mm mineral wool to reach the insulation demands of the building envelope, whereas it takes about 350 mm to reach the demands in BR2020.

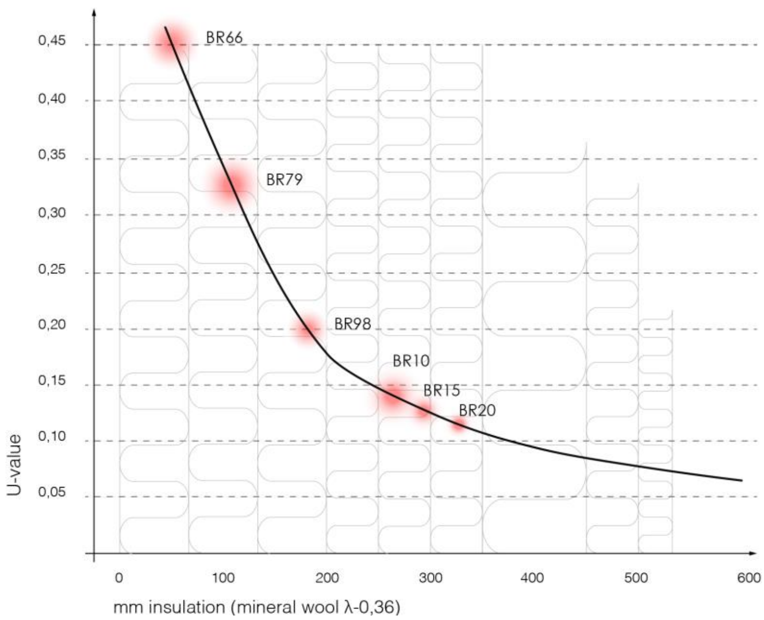

Figure 3: The transmission coefficient for all envelopes (housing) in building regulations (pre- and post- energy crisis) is shown in relation to the declining U-value of an insulation λ-0,36. Defined kWh supplements within the different regulations are not included. The amount of insulation is shown as an estimate based on general calculations of the BR performance demands, governmental building instructions and recommendations by different mineral wool manufacturers (Pelle Munch-Petersen and Henriette Ejstrup 2017).

The EU Directive supports a perception of buildings energy performance being the fundamental reason for CO_2 impact, which is mirrored in the Danish Building Regulations. The legislation promotes better numerical performance values based on construction criteria, technical installations and accounts only for energy performance. Arguably it will be difficult to reach the Danish nearly-zero definition. But, by making ‘energy compensations’ e.g. by adding photovoltaic cells the building will be considered as fulfilling the demands on a theoretical level. Potentially, this will create an increase of material ‘appendixes’ in buildings. Furthermore, a focus on how the overall architecture (form, materials and function) of the building benefits its CO_2 impact is absent in the legislation.

ENERGY SOURCES, EMBEDDED ENERGY AND MATERIAL SCARCITY

Energy mix and material energy profile

From 1990 and onwards there has been a steady increase of the renewable energy in Danish public energy supply. The energy-mix of renewable energies and fossil fuels has risen from approximately 6% renewables of the total production in 1990 to more than 23% in 2012. The political ambition was to reach an energy-mix with 30% renewable energy by 2020, which has already been accomplished.[8] The future aim is to phase out fossil fuels by 2050, where the energy production is to be based completely on renewable resources.[9] As the renewable energy becomes a larger part of the energy-mix the performance energy of buildings is becoming more sustainable ensuring geopolitical energy independence and posing as a lesser environmental threat.
Renewable energy is also becoming a part of production of building materials and components. To a varying extent the public energy supply also influences the material production. In addition to the development in public energy supply, the political ambition and the increasing attention to sustainability will arguably give manufacturers of building materials the incitement to restructure production toward renewable energy. But for now renewable energy generally occupies a minor percentage of the total energy use in the production industry. As an example, the energy used in the production of mineral wool and gypsum boards includes less renewable energy in production than what is represented in the local public energy-mix.[10] Many existing materials were produced with a lesser amount of renewable energy. Hereby, materials represent a constant energy-profile linked to the time and place they were produced. This profile is unaffected by contemporary development in energy-mix i.e. energy-profile of existing materials represent a greater environmental impact than future versions of the same materials. This leads to the question: Is it reasonable to continue focusing on performance energy of buildings without addressing the necessity of limiting the impacts tied to building materials?

Materials embedded energy and building lifetime environmental impact

As indicated in the previous paragraph an increasing amount of materials are being used in achieving a more energy efficient building stock. A study of 7 Danish office buildings showed that the embedded emission counts for 21%-75% of the total impact in a lifespan period of 50 years. The highest performing office building had a material-to-operation impact ratio of 9.1 kg to 3.0 kg CO-equivalent/ (m2 x year) resulting in 75% embedded emissions, whereas the lowest performing building had a material-to-operation impact ratio of 5.5 kg to 21.1 kg CO-equivalent/ (m2 x year) resulting in 21% embedded emissions.[11] Furthermore, a Norwegian study of national office buildings shows that the embedded emission is becoming a substantial part of the environmental impact with a total impact of 66% over a

60 years' life span tied to its materials.[12] Despite the fact that Denmark has less renewables in its energy-mix than Norway, both cases show that the bulk of energy increasingly is tied to the materials of the building instead of its performance. Especially, in high performance buildings it demonstrates that the impact is shifting from lifetime performance energy use and emissions to energy embedded in the materials.
In a Danish perspective, a primary means to achieve high performance buildings, such as nearly-zero energy buildings, is highly insulated building envelopes. The relations between embedded energy of mineral wool and its impact on operational energy over time was analysed in the fall of 2016. The analysis shows that the optimal point, where the total environmental impact of insulation is at its lowest (operational plus material impact within the building's lifetime), does not correlate with an increasing amount of insulation.

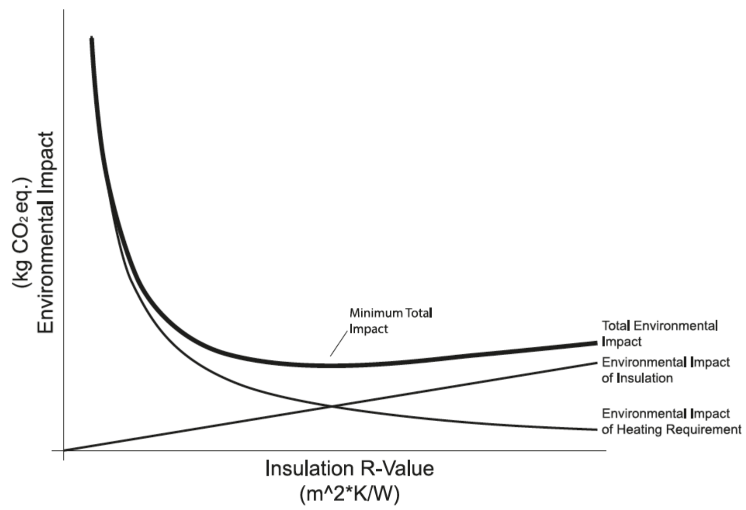

Figure 4: The optimal level of insulation showed by relating total lifetime impact tied to the insulation material to the attained benefits on heating requirements.[13]

The performance effect of the insulation material decreases as quantity increases. This indicates that performance energy cannot stand alone when assessing the environmental impact of a building. To get a realistic picture of the total lifetime impact of a building the material impact and a dynamic view on energy-mix must be part of the assessment. The latest LCA-assessment software[14] is addressing the need for looking upon energy-mix in a dynamic way. It is possible to weigh material choices for buildings against a static and dynamic setting. In the included example of an average office building in Denmark the static view on energy-mix (2015 levels) suggests approximately 38% of total lifetime impacts are tied to materials and in a dynamic setting the impacts tied to materials go up to approximately 68%. This indicates that as long as material impacts and development in energy-mix are not addressed in the Danish Building Regulations it is impossible to substantiate the CO_2 impact of Danish buildings.

A holistic view on material environmental impacts

As the building industry is beginning to look more closely at building materials and their environmental impact other related challenges are beginning to emerge. The Danish building industry causes approximately 1/3 of the total waste production. Although, 87% of the waste is recycled only a marginal percentage is reused.[15] In the Danish context, the definition of recycling means that most building

materials are grained and used for road fill.[16] As a result, a down cycling of materials at the buildings end-of-life happens and the need for virgin materials remains high.

During the last decade, the demands on virgin materials have influenced the prices of scarce raw materials.[17] The scarcity of raw materials influences the building industry on many levels. Amongst others, the demand for concrete has increased in the last 20 years creating a request for useful sand types. Sand mining has lead to damages in biodiversity and land erosions in river basins, coastal areas and inland areas across the globe - as well as it is creating economical uncertainty in impoverished communities.[18] [19] As a consequence, the need for better, more efficient, and larger quantities of reused materials within the building industry is part of the agenda in Denmark both within the building industry and at political level.[20] [21]

DISUCUSSION

Since the 1970's the Danish Building Regulations and National Legislations have enforced an understanding of high performance buildings being the optimal solution for providing answers to the energy crisis and sustainability. But, the legislation comes across with a one-sided focus that has not adjusted to new knowledge and challenges, and it does not include a broad approach to environmental issues such as, materials environmental impacts, waste production and material scarcity. When considering the sustainable development in the energy-mix, the discussion on buildings energy-performance will become a question of supply capacity and finances whereas the environmental aspects increasingly will be tied to the impact of the building materials. Combined with the waste production of the industry and the risk of material scarcity a focus on material use in architecture is re-emerging.

The focus on energy performance has led to new markets of energy efficient products. The result has been an escalation in the number of building materials and components on the market.[22] High-tech composite materials are common in buildings today and their environmental impact is difficult to assess. Layered construction methods ad to this complexity and can be hard to decipher. Together, these aspects make a complex and expert based building culture that is difficult to maintain and deconstruct. This makes re-use of building materials challenging and expensive, and as a result; destructive demolition is often chosen at end-of-life. Questioning the overall environmental impact of buildings and especially materials used in a performance based building culture could potentially lead to a new understanding of the role of architecture when aiming for a sustainable future.

The role of the architect has changed with the performance based architecture and has resulted in a breach between 'traditional' craftsmanship and material understanding as governed by the pre-1970's Danish Building Regulations. Although, the increasing industrialisation of building constructions, the development of technology and material complexity of the 21th Century have revolutionized construction practices, simultaneously traditional crafts have been wiped away without regards to its empirically developed circumstances.[23] One could argue, that contemporary construction, older industrialised construction and historical construction methods build upon different tectonic visions, which not necessarily work together with the construction methods developed as part of contemporary energy performance based building culture. With a re-discovered focus on materials - a return to an architectural understanding/ethos as perceived in the pre-crisis Building Regulations could occur; resulting in a new tectonic vision based both on contemporary energy performance, as well as material energy-profiles. Ideas based on material circular economy can introduce an architecture where buildings are approached as; 'temporary storages of materials', which opens the door for flexible and reversible architectural designs. Although, the premises of material use are changing and becoming a part of an

energy equation - it may nonetheless address a return to materials being the point of departure of architecture.

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CRITICAL CITIES. LEARNING FROM DELHI EXTREME URBAN CONTEXTS, PATHS FOR A SUSTAINABLE URBAN PLANNING

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INTRODUCTION

New Delhi is the second largest megacity in the world, housing around 26 million inhabitants, it's also a city of extremes.[1] Uneven growth and social segregation, massive urbanization, environmental threats, lack of public services, infrastructural weaknesses are a daily routine, and not some future dystopian scenario[2]. According to Delhi Master Plan (2021), only 24% of the population lives in considered legal areas, with the remaining population inhabiting unauthorized areas, with poor access to basic services such as house, water, electricity, health or education.[3]The majority of urban population seems to have been forgotten across time or doomed to social-spatial exclusion, enunciating an outstanding gap between planning practice and the dynamics and needs of the city. We may question whether the perpetuation of this gap hasn't been always embedded in planning and policy practice, constituting an echo of political, economic, institutional and scientific 'influences' from the West to the East or a mirror of the Indian fragmented society.[4] Three urban planning moments will be revisited in this paper, corresponding also to specific historical contexts, urban models, polices and regulations: Colonial planning driven by the interests of the British empire; modernist planning motivated by post-independence democracy; and, more recently, what one may venture to categorize as neoliberal planning, boosted by economic structural adjustments in the 90's.[56] It's intended to demonstrate the nexus between the exercise of planning and police making and the growing detachment between a 'planned city' and an 'unplanned city', with its extreme consequences and risks. Finally, the paper presents some concluding remarks on the importance to critically analyse the permeability of concepts, models and practices to external influences, and how urban planning field may be undermined and/or undermining the solving of urban challenges around the World. This paper presents preliminary achievements of a research exchange at the Centre for the Study of Science Policy, Jawarlal Nehru University (New Delhi) under the European Marie Currie project "Crossing Borders. Knowledge, Innovation and Technology transfer across borders". Main results are based on literature review, consultation of planning/policy tools and the analysis of a set of interviews

conducted to researchers from several disciplinary fields and to public institutions related to urban planning.

Fig 1. Nizamuddin informal area. Sebastião Santos

DELHI METROPOLITAN AREA - A REVIEW OF PLANNIG PRACTICE

The colonial city or the 'Garden-city' of the powerful

In its origin Delhi corresponds to a set of fortified nuclei or 'cities' founded by the Mughal empire of which Shahjahanabad (Old Delhi) would be the capital. It was possible to observe a social hierarchy 'embedded' in its physical structure: in the citadels, at the top, would live the clerics or administrators and in the outskirts, or outside the walls, in densely built areas, the remaining inhabitants[7]. British occupation did not invert this trend to urban stratification; on the contrary, it deepened even more. A crucial moment in the history of Delhi was the decision to transfer the colonial capital from Calcutta to Delhi (1912), due to the partition of Bengal and the rise of nationalist attitude against the British occupation in Calcutta. It became necessary to design a new city, able to 'perform as a political symbol' and strategically respond to imperial interests of stabilization, a city that would be able to confirm its importance near the old capital of the Mughal empire[8]. 'New Delhi' Lutyens plan was the first planning instrument that addressed the new capital, in what seems to be a transference of Ebenezer Howard's city-garden movement into the Indian urban context.[9] In contrast to the densely-occupied 'Old Delhi', where mixed land use coexisted with a large cultural diversity, New Delhi was planned as its opposite, a low-density city with wide avenues to accommodate car traffic, green areas to combat the extreme climate and a new urban order based on the spatial division of its social structure according to "race, occupational rank, and socio-economic status"[10] [11]. During the 30's, the bipolar nature of the city becomes clear, with the imperial, comfortable and planned New Delhi on one side, and the congested and unplanned Old Delhi on the other side, where informal mixed-use occupations (dwellings, shops and small industrial units) proliferated but also diseases (tuberculosis,

malaria) leading to a high infant mortality rate[12]. Over Population and urban densification, coupled with insufficient sanitation structures, end up compromising public health. In 1937, Arthur Parke Hume was nominated responsible for the first attempt to solve the accelerated city growth through the development of Delhi Improvement Trust (DIT).[13] This tool should improve road infrastructure, sanitation and waste treatment systems, but, above all, the elimination of slums by building new neighbourhoods to meet the needs of a homeless population expected to rise up to 200 000 in a fifteen year projection.[14] British Central Government resisted to the idea of addressing informal areas through the planning system by opting for an alternative scheme, based on developing new neighbourhoods for high-income classes, in order to finance housing for the poor in a later phase.[15] This strategy failed to meet its objectives, not only due to continuous delays but mainly as a consequence of succeeding events, independence and partition between India and Pakistan (1947), that leaded to a huge population influx. Urban development model under the colonial period was mainly based on the interests of the British Empire. Indian people had minimum influence in policy or decision-making across administration scales. The garden-city model based on principles of social progress and environmental concerns that emerged under a scenario of precarious working and leaving conditions in British industrial cities was appropriated and (re)contextualized into an urban model based on social segregation and the representation of colonial generating a bi-polar city, New Delhi (planned for government and administrators) and Old Delhi (not addressed by planning systems).

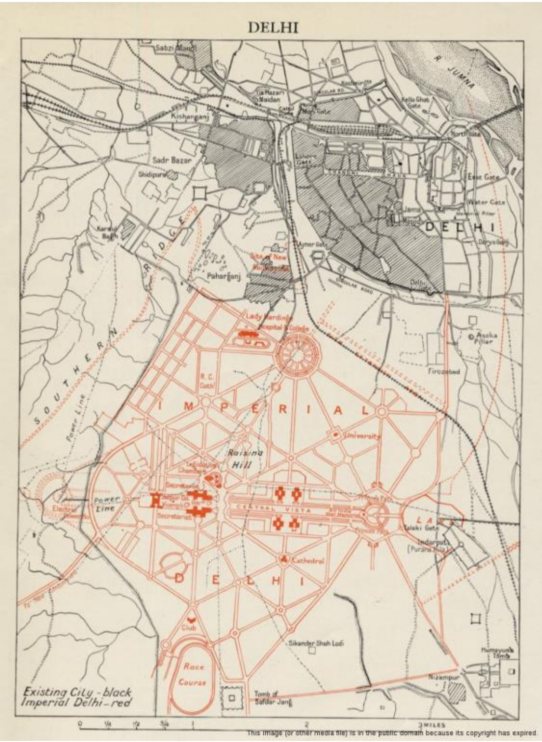

Fig 2. New Delhi, Edwin Lutyens Plan. Encyclopædia Britannica Eleventh Edition

The modern independent metropolis or the subversive city

As the efforts for a unified India failed, extreme violence and an unprecedented migration of Sikh and Hindu refugees from Pakistan to the capital occurred. The jump from a city to a metropolis seems to have started here. Between 1941 and 1951 the population increased from 700 000 inhabitants to 1.4 million inhabitants and the area of the city doubled.[16]The spread of slums and informal areas was paralleled by the lack of multiple infrastructures due to an 'environment' of weak regulation and control over the urban form. In response, the first Delhi Master Plan (MPD 1962) was developed from a partnership between Delhi Development Authority (DDA) and the American Ford Foundation that was already supporting the country in the process of institutional modernization and policy development.[17] [18] MPD 1962 was influenced by the American school of planning in the 1960s in areas such as urban regeneration, functional planning or zooning, and it also followed the trends of Indian development policies in the early decades of the independence (1950s and 1960s).[19] The plan included the development of a green belt and seven satellite towns, in order to simultaneously divert and contain urban growth by decentralizing population, housing, commerce and industries to the periphery.[20] Additionally a new land police drove public acquisition of large areas required for houses and other land uses in an attempt to match supply and demand without any private assistance.[21] Very soon the first Master Plan of Delhi became obsolete. In 1971, the growth of the city had already largely surpassed the numbers forecasted. Industries and commercial spaces had spawned and housing needs increased. Approximately 1.5 million people lived in substandard houses or in expanding slums.[22]The first MPD 1962 was the object of multiple criticisms: on one side, the American planning team blamed the failure of planning with the overload of bureaucracies, jurisdictions and leadership changes, and also to what they have defined as an Indian 'aversion to planning'; on the other side, the Indian authorities refer the 'plan maladjustment' to the cultural and social reality of India, its inability to respond to the speed of economic and social transformations that the metropolis was subjected to, including powerful migratory flows[23].The monopoly of public control over land leaded to constraints regarding the proper development of urban land and plan implementation, causing an inflation of urban land prices and resulting in a constant subversion of MPD.[24] The expansion of informal areas, the eviction of slums during the state of emergence (1975-77), the proliferation of unauthorized private colonies and, more recently, the expulsion of small industries due to court orders determined the absence of a specific living, economic and industrial centre, giving rise to mobility problems and urban pollution proliferation[25]. The second and third planning instruments proposed by the DDA in 1985 (National Capital Region Planning Board Act) and in 2001 (Master Plan 2001) were mainly acts of revision of the first MPD 1962. Modernist planning based on principles of zoning, urban regeneration and public interest over land was endorsed as a mean to materialize the capital of an Independent India. If modernist views were greatly contested in the west for its homogeneous views of society and for the risks resulting from (de)contextualization, in Delhi its translation traduced in the general failure of planning. Constraints in the proper development of urban land, maladjustments between the plan and Indian cultural reality, the displacement of the poorest communities, small industries and commerce gave rise to the subversion of the plan and to the proliferation of an unplanned city parallel to the planned city, in response to population needs.

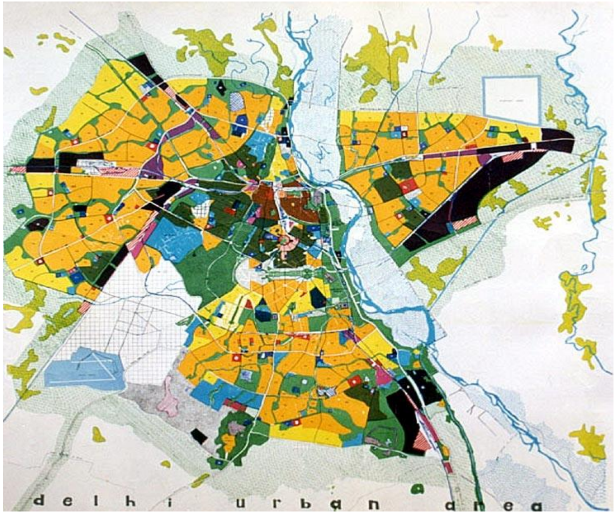

Fig 3. Delhi Master Plan 1962. Delhi Development Authority

The global megacity or the city for just a few

The shock in oil prices due to the Golf war forced the country to request for immediate help in 1990 to the International Monetary Fund (IMF). In exchange for its loan, the Indian government was obliged to make structural and macroeconomic adjustments, easing the inflow of foreign capital through a new legislation and police framework. The investment in rural areas fell from 14.5% (before the reforms) to only 6% of GDP in 1998, which together with the liberalization and mechanization of agricultural market, resulted directly in a decrease in agricultural employment and rural nutrition problems, triggering a massive migration of population from rural areas to cities in search for employment[26] . Almost simultaneously de-industrialization occurred in cities like Delhi due to the growing importance of other Asian countries. Millions of immigrants who arrive everyday in Delhi mainly integrate the low-paid informal economy (that represents around 66% of the city working force) or see their efforts to obtain a job forged, since demand is mainly increasing for graduated workers.[27] The result is the uncontrollable expanding of slums and the worsening of the already existent social inequality gap.[28] As Mike Davis points out in 'Planet of Slums' "the Third World now contains many examples of capital-intensive countryside and labour-intensive deindustrialized cities" where urbanization "is driven by the reproduction of poverty, not by the supply of jobs". [29] The most recent National Capital Region Plan (NCRP 2021) and Delhi Master Plan (MPD 2021) follow the context of economic liberalization and the aim of including the metropolis in the global economic circuit. Since 1985 to 1990 police and legislation changes in India influenced by global institutions as the World Bank and IMF promoted decentralization of urban governance, stimulated multi-sectorial private public partnerships (PPP) in urban management and provided a friendly framework for business (low taxes and deregulation) in order to attract foreign direct investment (FDI).[30] The spatial translation of these changes in Delhi (National Capital Region) was the proliferation of Special Economic Zones (SEZ), business parks, massive luxurious urbanizations, shopping malls, public space revitalizations and large infrastructures (e.g. tube or highways) financed by private and public budget.[31] The Asian Games of

1982 and more recently the Commonwealth Games of 2010 are also typical examples of a series of World events that triggered urban large scale investments aiming to project the city into the global network[32]. Also the most recent urban development program in India, "Jawaharlal Nehru National Urban Renewal Mission" (JNNURM) constitutes a clear sign of this neoliberal planning trend. The main allocation of funding (79%) was done in the financing axes responsible for the development of large urban infrastructures (e.g. fly overs, tube, roads) on behalf of rehabilitation/rehousing processes or the development of basic infrastructures (water, sanitation and energy)[33]. Meanwhile the majority of the population remains in precarious housing or without adequate infrastructure, the city is one of the most polluted in the world and environmental caring capacities, such as water provision are on the brink of collapse.[34] [35] Many of Delhi landscape recent transformations carried out on the name sustainability, quality of life or environmental concerns have even contributed to the expulsion of a set of urban realities, demonstrating a clear de-articulation between social justice and environmental and economic concerns. The small industries considered polluting were relocated or eliminated from the metropolis centre leading to the loss of two million jobs. Simultaneously 3 million homes were demolished in exchange for resettlement (only for a portion of eligible families) in the city outskirts, far away from employment sources[36]. Instead of promoting a balanced social, environmental and economic development, polices, financing programs and planning instruments seem to pursuit an 'exportable urban image' similar to those of the western global cities. In this context, Sustainability, Resilience or Smart Cities, are perceived as part of a 'symbolic urbanism', one that is serving mainly economic growth through the development of new urbanizations, designs and technologies for the upper and middle classes. One the other hand, a huge part of the population, have been, once again, forgotten in the plans[37]. A paradigmatic example of how concepts can be ill-applied is the Indian Smart Cities program. Related to the automation of services, such as waste management and mobility, it will be implemented only in Lutyens 'New Delhi', the part of the city that is better served by services and that is occupied by a political an economic elite that represents only 2% of the city population.[38] In what concerns participation mechanisms (introduced by 74 Indian Constitutional Amendment) that could lead to a more inclusive city, problems have emerged: pre-defined agendas that don't match communities 'real problems', participation processes that are manipulated by powerful economic players or biased by cast, gender or religion issues and, finally, the transference of public responsibilities and accountability to communities or private companies.[39] [40] [41]

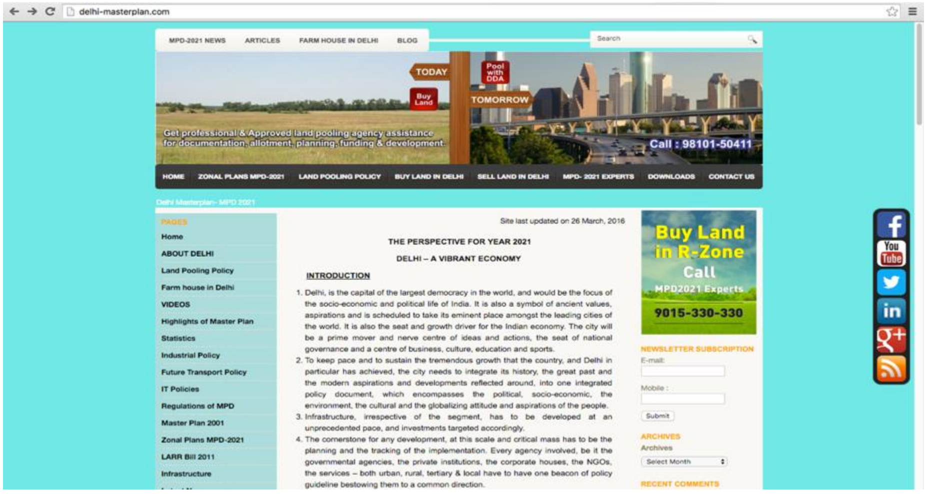

Fig 4. Delhi Master Plan 2021 Online website. Delhi Development Authority

	Colonialism	Partition and Independence	Globalization
Development model	Colonialist. Moved by British empire interests. Discrimination based on nationality, race, social status or religion	State interventionism as a way of generating redistribution of capital in society and the diversification of the economy.	Neoliberal adjustment introduced in the 90's by FMI. Cities as engines of growth. Imbalance between rural and urban development
Governance and Public Polices	Colonialist-driven, Indian had minimal influence in policy or decision making in central or local government. Top-Down	Social-driven policies (food security, education, job creation, provision of public services) focused on specific groups with some 'political voice'. Top-Down with public consultation	Market-driven policies in several sectors, transportation, water, waste, housing (PPP). Friendly environment to Investment through decentralization and deregulation. Top-Down & Bottom up (State withdraw from public assistance)
Urban Planning	New Delhi Lutyens Plan Planning oriented to the symbolic representation of colonial power. Influence of western city models, 'Garden City Movement' (Ebenezer Howard) - Lutyens Plan for New Delhi	Master Plan Delhi 1962, National Capital Region Planning Board Act (1984), Master Plan Delhi 2001 Planning oriented through principles of zoning, functionality, urban regeneration and public land ownership Influence of Ford Foundation, American School of Planning and Indian development policies in the early decades of independence	Master Plan Delhi 2021 Planning oriented to investment and global projection. Preference is given to infrastructures able to follow intensive urbanization processes on behalf of rehabilitation or rehousing processes Influence of IMF and World Bank
Urban Vulnerabilities	Socio-spatial discrimination based on nationality, race, social status or religion Bipolar City - New Delhi (Planned for government and administrators) vs Old Delhi (not addressed by planning systems). Lack of infrastructures, public services, health issues	Constraints in proper development of urban land. Maladjustment between the plan and the Indian reality. Exclusion of the poorest community's livelihoods through the peripheralisation of their dwellings, small industries and commerce. Subversive City- Expansion of un unplanned city parallel to the planned city in response to population needs. Plus- pollution, mobility issues	Socio-spatial segregation based on income, education, caste and religion. Exclusionary city – Poverty enclaves coexist side by side with wealthy exclusionary enclaves Plus- scarcity of resources and environmental threats.

Fig 5. Synthesis of Delhi urban transformations. Sebastião Santos, Maria de Fátima Ferreiro, Cristina Sousa

CONCLUDING REMARKS. WHAT PATHES FOR A SUSTAINABLE URBAN PLANNING TODAY?

Like other megacities in the world, Delhi presents many social, economic, and environmental problems. The urban planning history of Delhi is a history of reproduction of inequalities, a failure in terms of urban balance and integration and a case where the visibility of global interests and forces allows their acknowledgement and analysis. The Indian colonial period influenced the polarization between a Mughal-city (Old-Delhi) and the colonial capital (New-Delhi) promoting a racial and social hierarchy in urban development. The post-independence period was marked by the discrepancy between the rigid modernist plan, based on public control over land and the rise of a 'subversive urbanism' that emerged from unattended population needs. Finally, the global financial system, determined the unbalance between urban-rural development and the uneven spatiality's of the metropolis, where poverty enclaves coexist side by side with wealthy exclusionary enclaves. Successive planning models were influenced by different 'agents', first through colonization processes, after through knowledge or modernization exchange processes and finally through market liberalization promoted by global institutions. Planning practice have been 'captured' by distinct interests, has addressed mainly a small part of the population and ignored a vast majority of the communities and their livelihoods in the urban development process. This triggered an 'spontaneous' city (with an associated network of vulnerabilities) with which 'bridges' have never been truly established.[42] The transference and manipulation of urban planning models, polices, and practices from the global North to the global South as part of colonialism or modernization is not a new discovery. What we may question today is if urban planning models, practices, polices and legislation, whether in the Global South or the Global North, aren't still being captured, having as a consequence, the social, economic and political oblivion of large part of populations? In a globalized word, cities are seen increasingly dependent on territorial competitiveness, capital attraction and market-driven strategies. Simultaneously, uneven geographic development, social-spatial segregation, dispossession or environmental problems are no more limited to national boundaries, but co-exist, within global cities and territories.[43] Migration is one of the main signs of social and territorial vulnerability, such as limited access to housing, employment, resources or decision-making processes: Rural population in India migrates to cities due to the loss of their livelihoods, inhabitants of global city centres are expulsed by increasing rents or real state prices, the population of de-industrialized cities (due to industry dislocation) is 'oblige' to leave in search of employment, leaving behind 'unviable cities' and threats to democratic systems (e.g. Detroit in the U.S). Saskia Sassen refers to the generalization of "social, economic and biospheric expulsions" and to the importance of looking "at the extremes of a system in order to analyse trends that can be revealed in more moderate ways within the system itself."[44] Delhi has an "extreme-case study" reminds us about the urgency of critically analysing the growing 'geographies of injustice', considering planning and even knowledge production, not only solution-driven, or technical instruments, but as domains that can be instrumentalized by power. Identifying the underlying causes of planning options today and depicting trends in what concerns a 'normative colonization' of concepts (e.g. Sustainability, Resilience), models (e.g. Participative governance) and practices (Public polices, legislation, Planning Instruments) will be one possible path to envision a more sustainable future for cities and territories around the world.[45]

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LOCAL PEOPLE EXPERIENCE OF STREET AND URBAN VITALITY IN NEW NON-CENTRAL RESIDENTIAL AREAS. CASE STUDIES IN MADRID AND EDINBURGH

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INTRODUCTION

Active and lively streets are indicators of successful communities[i].
The provision of mixed uses and concentration of diverse people and activities are perceived as necessary conditions for vitality at the street level[2]. Active streets help promote sustainable and healthy behaviours such as walkability[3]. Most research on urban vitality has focussed on city centres[4] with less attention has been paid to non-central residential areas. There is a lack of understanding of how residents experience street vitality or how vitality can be integrated into urban design interventions at the local level. This paper reports on ongoing research that explores the concept of vitality in the case of non-central residential areas. It addresses the questions of what vitality means for local people and how they experience vitality in their everyday lives. These questions are addressed through a qualitative approach including multiple methods: participant observation (26), walking interviews with residents (24) and semi-structured interviews with residents (11), local small businesses (12) and stakeholders (10). The research is underpinned by a comparative case study approach in Madrid (Valdebebas) and Edinburgh (Granton Waterfront), focusing on mixed- use areas (mainly residential, retail and offices uses) in an intermediate stage of redevelopment in which new residential buildings live together within vacant plots.
By examining local people perceptions and experiences of vitality in their everyday lives, this research suggests that street vitality is required to create a sense of place and wellbeing. Despite the increasing mobility and specialization of contemporary lifestyles, everyday spaces and opportunities near home are essential to encourage walkability and allow for contact between diverse people, helping create an inclusive sense of community. A variety of services and facilities and the quality of urban design are necessary elements to build street and urban vitality.

URBAN VITALITY IN NON-CENTRAL AREAS

Vitality in the context of urban design has been defined as the main goal of city planning and the principal characteristic which distinguish successful urban areas[5]. A successful urban area can be recognised by a dynamic mixture of activities and street life. Those are the visible elements which shape the vitality of a place. For Montgomery[6] the concept of vitality defines the life and culture of cities around the interactions between activities and the public realm. Jacobs[7] defines vitality as a product of concentration of diverse people and activities overlapping across time and space. Jacobs stresses the concept of diversity as the main generator of vitality, where people with different tastes, skills and needs living in close proximity are able to support a mixture of uses and activities which strengthen social networks and ties.
Vitality has been explored at different spatial scales including the city district and street level. Most of the research about vitality has focused on city centres. Less attention has been paid to non-central

residential areas. However, the benefits of vitality, as well as the experience of diversity and variety are not exclusive of city centres. Non-central areas of the city also deserve attention because they been the focus of development, regeneration and new housing developments in European cities during the last two decades[8]. There has been a concerted effort to attract new population groups into these areas and a promise to integrate vitality and place yet the extent to which this has been achieved has been under-explored.

Vitality in non-central areas is only possible within compact urban forms which allow for concentration of people and contemplate variety of functions and building forms (including residential) as well as streets with active building frontages. Within these conditions people will use spaces at different times and for different purposes and reasons, which will help develop a variety of meanings and understandings of place, and will also help increase choice and opportunities for everyone[9]. Furthermore a local provision of diverse facilities and activities at walking distance increases local autonomy which benefits the community in terms of health, social inclusion and environmental sustainability.[10]

There is no consensus on what constitutes an appropriate balance between bustling mixed use and quiet residential streets in non-central residential areas. Is it not clear what constitutes the appropriate balance between the degree of mixture of uses and activities, their scale, location and visibility, as well as the necessary critical mass population able to support them. This research covers this gap by exploring the meaning and experience of vitality for local people in non-central residential areas.

Studies about vitality have been criticised for idealizing traditional neighbourhood life with its local corner shops[11]. Contemporary ways of life tend to be based on hyper mobility and the increased specialisation of leisure activities, which make the concentration of activities and walkability at local level more difficult to achieve[12]. Moreover, research about vitality lacks consideration of the permanent tensions between the appropriation and use of space for individual and social purposes and the domination of space through private property and social power. It neither considers the economic rhythms of accumulation, expansion and contraction embedded within capitalist processes of production of space[13]. For Carmona[14] it is necessary to look at processes of everyday use and management, which continue to shape places long after those who originally designed them have left.

CASE STUDIES: MADRID-EDINBURGH

During the last decade many European cities have expanded following sustainability principles by creating large scale, mixed use, compact residential neighbourhoods in non-central locations, aiming for "*walkable and vibrant places in which to live and work*"[15]. This research focuses on those urban forms. In order to take a closer look into the process of development of vitality, a specific intermediate stage of redevelopment has being selected. This the early stage of construction completion in which new residents are settling in and new activities are emerging. At this stage, the specific dynamics of the place are still emerging, whereas negotiation between stakeholders, new users and inhabitants is still taking place. This is the stage in which street and neighbourhood vitality is starting to emerge.

Two case studies in different contexts and settings have being selected. They both correspond to new residential areas in an intermediate stage of redevelopment in non-central locations of two capital cities: Madrid (Spain) and Edinburgh (Scotland, UK). Despite climate, social and cultural differences, both cities have a strong focus on cultural life and street vitality at a city centre level. They both have developed, at the beginning of the XIX century, visions for their peripheries which included the creation of large scale mixed use, compact residential neighbourhoods organized around high-scale perimeter block of flats. Many of those areas are currently in an intermediate stage of development in which new residential buildings live together within vacant plots.

Figure 1. Valdebebas (left) Granton Waterfront (right), 2017.

The selected residential area in Madrid is Valdebebas, a green field located in the affluent North of Madrid, nearby the airport. The development of Valdebebas started in the late 90s through a sole Master Plan[16]. It contemplated 12,500 housing units in 413 ha together with retail, offices, facilities and services. Around 4,000 housing units have been built[17] and the estimated population is 5,534 people[18].

Granton Waterfront, in Edinburgh, regenerates industrial and popular waterfront area. An initial Master Plan, 2001 for the whole area[19] fell apart due to fragmented landownership[20]. It proposed up to 6,500 residential units, as well as retail, offices, facilities and services over a site of 140 ha. There are at present three different areas of redevelopment[21]. Around 1,300 housing units have been built[22] and the current estimated population is 2,083 people[23].

This research aim to explore how similar physical structures located in two different contexts and settings are used and experienced in different ways. This will help stablish common vs differentiating factors, as well as local vs global factors which lay behind the construction of vitality[24]. Examining two different contexts will provide the opportunity to gain more detailed understanding of behaviours, attitudes and experiences across countries with offer lessons for planning and development[25]. By doing so, this research will contribute to the development of urban design theories and strategies able to take into account the specificities of the local context.

METHODOLOGY

A qualitative approach, informed by an ethnographical framework, was undertaken. This comprised participant observation (26) and interviews with local people (35 residents, including 24 walking interviews and 12 local small businesses). Ten additional interviews were undertaken with relevant stakeholders who were involved in the redevelopment (land owners, land developers, public authority, property development companies, architects and landscape designers). Participant observation included participation in public meetings, community activities and events and observation of public spaces.[26]

Walking interviews (24) were undertaken with residents, involving accompanying them in an everyday walkthrough the area of study. Interviews with residents who were unable to complete the walk were undertaken at their homes or in a public location of their choosing. Small scale independent local businesses in the area were also interviewed.

Participant recruitment was undertaken with the help of local organizations via leaflets, letters by post[27], social media and snowball sampling. Participants were selected with the criteria of maximizing diversity and mirroring the current population profiles (in terms of age, gender, social and economic groups). All of the interviews have been audio recorded and transcribed for analysis. The qualitative data was recorded, collated and thematically analyzed using Braun and Clarke's five stage thematic analysis approach[28]. NVivo qualitative data analysis software was used to organize, manage, code and categorize the data.

FINDINGS

The thematic analysis identified five main aspects that contribute to a sense of vitality within the neighbourhoods: 1, Balance between quietness and vibrant street life; 2, Engagement, social hubs and local businesses; 3, Sustainable connections; 4, Proper management of place transitions; 5, Civic participation.

Figure 2. Valdebebas (left) Granton Waterfront (right), 2017.

Balancing Vitality and Street Life

Everyday experiences of people living in non-central areas, both in Madrid and Edinburgh, demonstrate that street vitality involved a complex balance between quietness and vibrant street life. This is of special importance in the urban form of study (compact & mixed-use), in which many residents expect to combine the benefits of quiet non-central living with a certain degree of street life.

> *"What you want is reasonable quiet but not rowdy. A good balance, you don´t want the rowdiness."*(Middle age man, Edinburgh)
> *"I feel overwhelmed when there are 5 or 6 people in the sidewalk and I have to navigate around them. I am no longer used to navigating around many people. I think that this will never happen here because of the wide avenues. (...) What I'll love to see are people coming to work in here (...) to see people around. If I stay at home one morning because I am on leave or I am sick, I don't want to open the window and see an empty place, silence."* (Young woman, Madrid*)*

For many participants, such as the previous one, the balance should be on bringing opportunities to attract more people locally, however avoiding the overcrowding associated to city centers. The need to see people around is central on residents understanding of vitality. This builds on the human need of enjoyment through mutual understanding, learning and engagement gained by watching other people.

> *"Then you go for a walk and, you know, you see other people walking, families with prams going for a big walk, people running, cycling…everything, you know? Then these is what encourages you, in case you are probably not so used to physical activity, then, now I will do it! Because, at the end you do what you see them doing, you know?"* (Young woman, Madrid)

Moreover, the opportunity to see people and activities around make people feel connected. This is of particular importance for those who were less mobile, such as the elderly, who cannot access city centres easily.

> *"… It was fascinating watching them what they´ve got up to and, you know? So, you know, is interesting to see because I am on my own now, you get bored of your own company, you know?* (…)T*here is just this mixture of small businesses, not that they are commercial business. They are not particularly for the public. And I think that is nice. I like this because the stuff that happens here most of the time"(*Retired man, Edinburgh)

Social Hubs, Engagement and Vitality

Green areas -when properly designed- become hubs of vitality by offering a wide range of open space activities. Residents benefit from encountering biodiversity and diversity of people. Activities and facilities are necessary for vitality and sense of community. They help meeting people locally and feeling connected with the community. In both places many residents miss the proximity to activities and third places. The lack of activity and difficulties for encounters in the vicinity make people feel sad and even depressed.

> *"I decided to join the yoga classes just with the purpose of meeting new people in the area, because, otherwise, I have nobody to talk to, and that is sad"* (Young woman, Madrid)
> *"I can get depressed in looking out there (...) where you go? I just have to get in the car and go out. I couldn´t, there is no like a café or anything I can even go in here. And look, why would you go up and sit in a supermarket café?"* (Middle age man, Edinburgh)

For many residents, local small cafes, restaurants and shops act as social hubs. However the experience of big superstores is less social because buying food is understood as a primary need. Moreover, many residents prefer to shop far away in order to access their favourite chain when it is not located nearby their homes. The variety of the commercial activity, including small local businesses, is central for vitality in Valdebebas and Granton Waterfront. However, small local businesses are emerging very slowly in both cases. Many local entrepreneurs I have meet have set up their independent business as a way to develop their own personal project (not for profit) and to escape the restrictions of working for big companies. Many also live locally, which allows them to balance work and personal life. They complain about business insecurity due to lack of affordable premises and the slow pace of redevelopments.

> *"There is a lovely big building (...) that has been empty since it was put up. There is nothing in it, but it´s too expensive to use for anything. So put the price down and we´ll move in!"*(Young entrepreneur woman, Edinburgh)

Vitality and Connectedness

Local people perceptions in relation to connections with the city centre differ in Madrid and Edinburgh. Whereas in Edinburgh most interviewees find that the area is well served by public transport, most residents in Madrid complain that the area is still poorly connected by public transport. In both places, residents prefer public transport for their leisure activities, but they will only commute to work by public transport when cheaper and faster than private car.

> *"The car is always more convenient, except if there is a traffic jam…but in 15 minutes we can be at work by car. However, by public transport it may be well 30 minutes"* (Young woman, MAD)
> *"If I am going into town I always take the bus because I don´t like driving, really. And the buses are so easy, I can be in the West End in no time at all"* (Retired man, ED)

In Edinburgh many residents take advantage of an easy commute away for leisure activities, which widen the variety of opportunities available. However, many interviewees would prefer local leisure options, which would facilitate their everyday movements and would help them meet their neighbours. In Madrid difficulties for sustainable ways of transport makes people depend on their cars for most movements. This creates sense of unsafety due to high speeds and lack of pedestrians around. Moreover, less «eyes on the street»[29] create sense of insecurity. These aspects have negative impact on street vitality.

> *"There are not many crossings, big avenues, empty streets…and drivers tend to go at speed and even to race! Because they are not used to see pedestrians around. This is a real danger in here"*(Young man, Madrid)

The importance of managing place transitions for vitality

The intermediate stage of development complicates the emergence of street vitality in both case study areas. In the case of Valdebebas (Madrid) the urban design of streets and parks came before buildings were completed. Few resources were allocated to maintain a vast amount of urban furniture and greenery with no residents nearby. This situation led to vandalism. In contrast, in Granton Waterfront (Edinburgh) residential buildings came first and residents expected quality urban design to follow. Without it, they have stopped using undeveloped places where antisocial behaviours are characteristic. In both places residents report how maintenance related problems prevent them from using streets and green areas. This is one of the reasons why many owners of private flats are not living in the areas yet. They are waiting until it becomes more attractive (including better connections and facilities). However, this is not an option for residents of affordable homes, which have little choice about where they live. This situation explains how non-well planned implementations can have disproportionate impact on the most vulnerable.

In the case of Edinburgh many residents complain about lack of public investment. This makes them feel unable to change things, which creates sense of insecurity. This is of special importance at an intermediate stage of development in which the future successfulness of the area is still at compromise.

> *"They (landowners and public authority) don't, I think ,have spent enough money here to kind of improve things (…) If I could turn back the clock and not have moved here I´ll probably would rather not have moved now that I know. Had I moved here and within a few months they started making it look a bit better and a couple of shops or something sprang up, which would make it a little bit busier, and the sense that there is a bit of a community, I would have even bought it. But not now (…) you don't feel you are part of something, you just feel you are kind of existing against"* (Young man, Edinburgh)

The case of Madrid is quite different. Development has going on since the first residents moved in. Residents have high expectations on the area. They even feel responsible for the successful future of the place. These build on their sense of belonging and sense of place.

> *"We were the first inhabitants of this place (…).If I see litter in the city centre I don´t mind as much as I mind in here (…).This character of this place is very nice (…) with the time this feeling of belonging to the place will probably change, but now you feel that the place belongs to you and that you need to do something for it, in order to get more activity to come here."* (Young couple, Madrid)

The reason for these contrasted feelings between Madrid and Edinburgh lies in the pace of development. Residents in Edinburgh have being living in an intermediate stage of completion for many years, whereas residents in Madrid have seen development progress since they moved in, which gives them confidence on the future success of the place. Moreover, in Valdebebas good urban design has been implemented before building construction and has been equally distributed, covering the whole area. In Granton Waterfront quality urban design has being unequal among the various areas of redevelopment. Furthermore, planning applications are constantly changing, which make residents feel more insecure about the future of the place. These problematics suggest the importance of effectively phasing regeneration implementations.

Vitality and civic participation

For many residents in both cases vitality means power to influence decision making at the local level. They comment on how taking part in decision making would help them build their sense of place. However, they complain about difficulties in making their voices being heard and in understanding power structures. They claim for more transparency in their relationship with local politics.

> *"It took me two years of e-mail and phone calls to get two bins put. And they´ve even put those in a stupid place!"* (Young man, Edinburgh)

In Madrid there is more active participation in local issues through a very active Neighbour´s Association. This is not the case in Edinburgh, where no local structures have emerged yet.

CONCLUSIONS

This research expands our understanding on street and urban vitality from the everyday life experience of local people. Vitality in non-central urban areas is a concept in tension, between the quietness of non-central living and the complexities of city living. Non-central areas require a certain degree of street life and apparent vitality in order to create an inclusive sense of community and a positive sense of place. Despite the increasing mobility and specialization of contemporary urban lifestyles, everyday spaces and variety of opportunities near home are essential to allow for contact between diverse people, which in turn helps create an inclusive sense of community. Moreover, quality urban design and attractive frontages are necessary to create street vitality, which encourages walkability and helps promote healthy life styles. All these contribute to resident´s wellbeing.

By looking at intermediate stages of development, this research finds out that development's implementation should be carefully phased taking into account the time span perspective of local people. Short periods of time from the point of view of land developers can be seeing as too large from the point of view of the people living in the middle of an area of redevelopment with vacant sites nearby and no activity around. When the processes of development are too long, public spaces tend to become underused and the vitality of the place is reduced.

By contrasting two case studies in different contexts and settings, this research acknowledge that both places share many local problematics associated to everyday life, good urban design and vitality. This builds on the theory that despite the huge differences of local contexts and settings, the difficulties for vitality are of global neoliberal economic order. This aligns with theories about the incompatibility of urban sustainability and neoliberalism[30].

This research uses walking interview as a mean to explore ambience urban design and architectural aspects while walking along with residents[31]. However, comments about orientation, patterns of airflow or shadow haven't come along during the conversations. Further research-beyond this paper-will explore the reasons for the difficulties to gain information about the influence of ambience aspects in vitality.

ENDNOTES

[i] Many authors have being exploring these, such as Jacobs (1961); Gehl (1987); Bentley (1985).
[2] John Montgomery, "Making a city: Urbanity, vitality and urban design," *Journal of Urban Design* 3(1) (1998): 93–116.
[3] These have being suggested by Eyles & Williams (2008) and Andrews et al. (2012) among others.
[4] Montgomery, John, "Editorial Urban Vitality and the Culture of Cities," *Planning Practice & Research* 10(2) (1995):101-110
[5] Jane Jacobs*, The life and death of great American cities* (New York: Random House, 1961).
[6] John Montgomery, "Making a city: Urbanity, vitality and urban design," *Journal of Urban Design* 3(1) (1998): 93–116.
[7] Jane Jacobs, The life and death of great American cities (New York: Random House, 1961), 147.

[8] Stanley D. Brunn et al. eds, *Cities of the world: world regional urban development* (Oxford: Rowman & Littlefield, 2003).
[9] Ian Bentley et al, *Responsive environments* (London: Routledge, 1985).
[10] Hug Barton et al., *Shaping neighbourhoods: for local health and global sustainability* (London: Routledge, 2013)
[11] James G. Mellon, "Visions of the Livable City: Reflections on the Jacobs-Mumford Debate," *Ethics Place and Environment* 12(1) (2009): 39.
[12] Hug Barton et al., *Shaping neighbourhoods: for local health and global sustainability* (London: Routledge, 2013), 3.
[13] Henry Lefebvre, *The production of space* (Oxford: Blackwell, 1991).
[14] Mathew Carmona, "The Place-shaping Continuum: A Theory of Urban Design Process," *Journal of Urban Design* 19(1) (2014): 2-36
[15] Various Master plans for both Valdebebas and Granton Waterfront regenerations talk about these.
[16] Agreement among private landowners permitted the development of the whole area with a sole Master Plan (Plan General Valdebebas, 2013).
[17] Construction work started in 2006 and the first housing blocks were finished in 2013.
[18] 56% of households are young adults (between 30 and 44 years old, mostly living in couples and families (Data from Padron Municipal, 2016, Madrid City Council).
[19] Llewelyn-Davies Master Plan, 2001.
[20] John Punter, ed., *Urban design and the British urban renaissance* (London: Routledge, 2010).
[21] Forthquarter, owned by Gas Company; Central Area and North Shore, owned by public authority; and Granton Harbour owned by port authority.
[22] Construction works started in 2003, and the first residents moved in during 2007.
[23] The majority of households are people living alone (40%), young adults (29%) and families (23%)(Data Scotland Census, 2011).
[24] As Bryman (2012, p.402) explains, conducting qualitative research in two settings can be helpful in identifying the significance of context and the ways in which it influences behaviours and ways of thinking.
[25] Quilgars et al. (2009) explain the potential significance of cross-national qualitative research in responding to globalization pressures
[26] Full immersion during 3 months each case, between Dec.2015 and Sept. 2016. Observation has being undertaken at different times of the day, including number of people, activities at street level, climatic conditions, noise and other characteristics of the environment.
[27] Random selection of addresses.
[28] Victoria Clarke and Braun Virginia, "Teaching thematic analysis: Overcoming challenges and developing strategies for effective learning." *The psychologist* 26, no. 2 (2013): 120-123.
[29] Jane Jacobs, The life and death of great American cities (New York: Random House, 1961)
[30] See comments such as the following *"The neoliberal project of 'growth first' seems to conflict ideologically and materially with the principles and practices of urban sustainability"* (While, 2004) and *"Under current conditions of urban neoliberalism no sustainable development is possible (…) "It is simply impossible to reconcile the principles of neoliberalism and sustainability towards a coherent form of urban development"* (Mössner, 2015)
[30] Interviewees were free to choose the route along the public places they use in their everyday lives at the local level. There were specific questions designed to open up conversation about ambience issues.

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HUMAN-CENTERED APPROACH TOWARDS ADOPTION OF GREEN HOMES IN JORDAN

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INTRODUCTION

Even though many developed countries have made commitments to build more Zero Net Energy houses in the next decades, the question posited in this paper is what hinders the developing countries, especially Jordan, from greening its residential sector? Advocating green homes construction is widely welcomed in theory, but in reality the ambitious talk supersedes a slow walk where the implementation lags behind. As many reasons for such delay present themselves in technological and regulatory barriers, rarely is attention directed to explore the social, cultural and human barriers. In this paper, some cognitive barriers propounded by the discipline of environmental psychology are explored and applied to the context of Jordan's housing sector.

Architecture, Sustainability and Culture

Since the Brundtland Report, the framing of sustainability has been conceptualized as various evolutionary paradigms; from 'the three spheres', to the nested model, and recognizing 'culture' as an influential factor, thus highlighting the dynamism and culturally specific conception of the human factor in all of sustainability's pillars. By the time environmentalism and sustainability entered the conscious discourse; sustainable architecture emerged as a school of thought. As architecture is a dynamic discipline that imbibes from the advancement of other fields, sustainability resonated in many designed built environments that augmented human, social and cultural realms.

Architecture in Jordan, as in many developing countries, adopted the construction methods of modernism's technological innovation in the last century. And even though the world sprang in rebellion against the reductive universality of modernism during the 1970s and 1980s, resulting in revival of vernacular architecture in the West, the developing world did not react as rebelliously[1]. In fact, as the industrialized countries developed an appreciation for the climatic responsiveness of vernacular architecture and infused these techniques into contemporary architecture at different scales, the developing world tended to marginalize its vernacular wisdom for an expression of status and progress afforded by modern architecture and increased consumption, thus distancing itself from environmental conservation. Hagan elaborated on this dilemma: "In the developing

world, as long as cultural identity and variety are identified with the pre-modern, and the pre-modern with inferiority, deprivation or sentimentality, then the championing of a differentiation based on the traditional vernacular remains problematic, whatever its environmental, social or economic advantages".[2] Accordingly, the aesthetic appetite for 'modernity as status' in the developing nations represented a departing cultural attitude from historic precedents which resulted in increased environmental footprint of buildings. Figure 1 is a view from Amman, the capital city of Jordan[3], showing the influence of generic aesthetics with a substantial environmental impact.

Figure 1. View of Amman

Since residences comprise 82% of buildings built in Jordan[4], the paper focused on this sector for its environmental implications. In addition to the cultural aspect as a potential hindrance to adopting architectural sustainability, there exist human and social barriers. An understanding of the latter challenges are derived in this paper from the field of environmental psychology and applied more specifically to the context of Jordanian housing stakeholders; architects, homeowners, contractors, and regulating authorities.

Pro-environmental Values, Attitudes and Behaviors

Two frameworks from environmental psychology were linked in this paper to explicate how the various stakeholders involved can be nudged towards pro-environmental behaviors. The first framework is the **'Value-Attitude-Behavior (VAB)'** model that arranges a hierarchy of cognitions driving human behavior[5]. Figure 2 shows the inverted pyramid of the cognitions that include values, value orientations, attitudes and norms, and behavioral intentions.[6]

Values are usually culturally constructed and are tied to one's identity, resistant to change and general compared to the specificity of behaviors. Hence, certain values amongst a group of people can be shared but manifest variation in individual behaviors.[7] To obtain measurable results in changing behaviors to be pro-environment, many environmental psychologists advocate targeting

behavioral change that produces results in the short-term, due to the relative resistance of changing values and strong attitudes[8]. However, experiments showed that short-term behavioral change can revert back to its previous condition if attitudes are not addressed[9]. Attitudes can be strengthened by providing *direct experience*[10]. Even though values and attitudes are harder to change than behaviors, Crompton and Kasser urge not to exclude these deeper frames: "But campaigns focused primarily on simple and painless behavior changes may well work against the emergence of a set of goals and motivations that will lead to more systemic adoption of pro-environmental behavioral choices."[11] Comparatively, social norms can inspire important behavioral changes shown by many cases such as anti-littering, encouraged use of public transit and reduced electricity consumption when receiving feedback from neighbors[12].

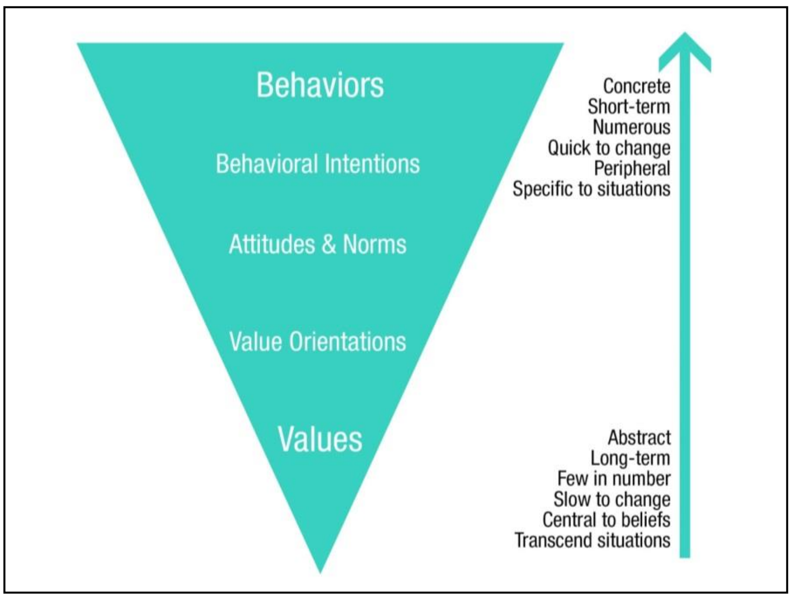

Figure 2. Value-Attitude-Behavior Model {Adapted from Vaske & Donnelly (1999) and Fulton et al. (1996)}

The second framework is based on **'environmental fixes'** that aim to fix environmental problems, explicated by Thomas Heberlein in his book 'Navigating Environmental Attitudes'. The fixes need to operate in tandem and are based on understanding attitudes and behaviors of the stakeholders involved in the analyzed sector. Figure 3 abstractly represents the interaction of the two frameworks to foster pro-environmental behaviors.

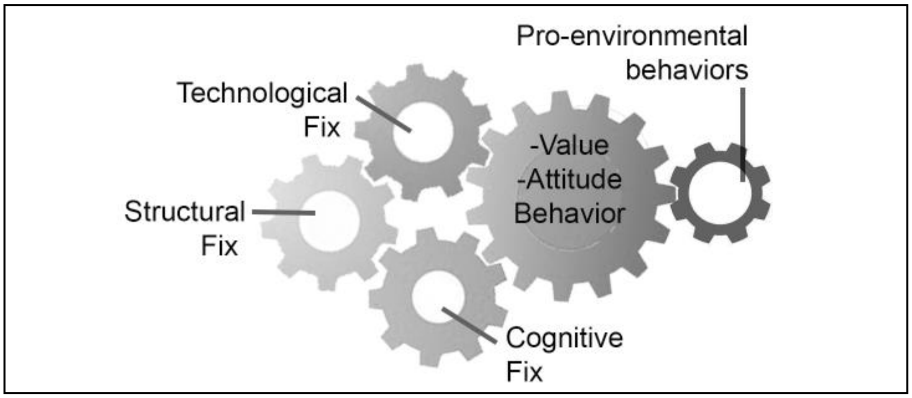

Figure 3. Role of Environmental Fixes in driving Human Behavior based on VAB model of stakeholders to become more pro-environmental (Illustration by Author)

The environmental fixes include[13]:

1) The Technological Fix tries to change the environment directly by use of technology. For example: Green building solutions, energy efficiency equipment, and retrofitting.
2) The Structural Fix tries to change human behavior by changing the structure of the situation. For example: Policies, taxes, and incentives.
3) The Cognitive Fix tries to change human behavior via information. For example: education, and raising awareness.

An integrative understanding of the interactions of these fixes is essential to analyze the underlying attitudes and behaviors. In the 2013 survey of various Jordanian engineering firms about their attitudes regarding green buildings, it was shown that "lack of knowledge about sustainable design, perceived high cost, laws and regulations, construction costs, lack of demand, and the limited number of demonstration sites are the primary obstacles"[14]. The aforementioned challenges exhibit the need of conjoined resolution in technological, structural, and cognitive aspects via VAB analysis of Jordanian housing stakeholders, to render homes closer to a more actualized sustainability.

Green Homes in Jordan and Technological Fixes

As Jordan imports nearly 98% of its energy[15] and is ranked third in the world in risk of water security[16], the resultant environmental, economic and social stresses are taxing. Whilst Jordan currently has seven LEED certified buildings, none of them residential nonetheless; it shows that the technology is readily available but not widespread. To incorporate technological fixes in the housing sector architects are the main stakeholders responsible for incorporating culturally relevant green design and engaging their prospective homeowners, aiming to prompt pro-environmental behaviors and values.

The aesthetic departure of contemporary building design from the vernacular brought about the abandonment of long withstanding climatic and passive design which ultimately produced a disconnection between users and nature. Traditional architecture reacted to its climate and mediated a unique cultural vocabulary of place. Fathy recognized the link between architecture, nature and culture by saying: "Nowadays we never think about what we are losing by not reacting to nature; but if you take the solutions to climatology in the past, such as the windcatcher...and the marble salsabil with carvings of waves on them for the water to trickle over on its way to the fountain, you will find that they create culture. With today's air conditioning, you have removed [that] culture completely."[17] The ramifications of this disconnection shows in some parts of Amman, where many generic-looking midrise residential blocks, shown in Figure 4, abandoned many of the passive climatic solutions of the past, which ultimately produced 'placeless' aesthetics.

Figure 4. A view of a residential zone in Southern Amman (Photo by Author)

However, a serious investigation of the vernacular architecture need not be oblivious to the current technological advancements to achieve resource efficient building performance. In fact, according to Hagan, "Environmental architecture that uses hybrid strategies and mixes western technologies with indigenous traditions therefore has a better chance of acceptance than the entirely traditional."[18] Figure 5 highlights some vernacular architectural passive strategies, such as partly-fixed and partly-operable high windows that are optimal for ventilation and daylighting, with the use of wooden shutters for shading and privacy. In Figure 6, modern homes use horizontal fully-operable sliding windows, which can cause less daylight in deeper rooms and more air infiltration, using no shading devices and relying on tinted glass to attain privacy which has proved to cause overheating in the summer. As modern technology needs to be negotiated in

its appropriate form of adoption to Jordanian climate and culture, the passive solutions of the past can be assimilated and hybridized into the design of green contemporary homes. Since attitudes are both affective and cognitive, architects' and homeowners' aesthetic tendencies in Jordan need not collide with embracing place and enhancing local identity into the design, which can still communicate contemporary zeitgeist by employing hybrid climatically and culturally suitable technological fixes.

Figure 5. An early 20th century house in Amman showing multipartite high windows for effective daylighting and ventilation along with wooden shutters (Photo by Author)

Figure 6. Contemporary homes in Amman use horizontal tinted-glass sliding windows. Even though the view shows the southern façade, most of the windows are not shaded. (Photo by Author)

The process of designing homes requires high level of engagement between the client and architect. From a situational analysis that targeted homeowners, conducted by the Jordan Green Building Council (JGBC) in 2013, around 60% of the respondents indicated that the design consultant did not suggest any energy and water saving ideas[19]. The results of the survey highlight the necessity of not only equipping architects with the technological know-how of green design but bringing these solutions to the forefront as homeowners are included in the design process. Even after ensuring these green design strategies are integrated in the building, users bear the responsibility of efficient operation of their household. Technological fixes on their own are not enough in a green building if they bypass human behavior altogether. The consequences of this bypass can be observed in 'the rebound effect'[20]. To counter this problem, some green building rating systems like LEED for Homes mandates the submittal of a 'Homeowner Education Manual' as a prerequisite, and encourages logging of consumption data to ensure the sustainability of a green home. Such informed engagement of homeowners during the design process, having a manual at hand, and receiving feedback information of consumption patterns aim to provide *direct experience* that strengthens their pro-environmental attitudes for green living with actions that are less probable to fall into the rebound influence.

To supplement values and attitudes change mentioned previously, architects can design spaces that prompt direct behavioral change without requiring users' conscious attentiveness. Nudge theory in behavioral science mentions the "status-quo bias" or 'default' as a strategy to nudge people towards a certain action without expecting them to intentionally change their behavior[21]. So that a home that has a number of fixed windows, or automated shades at certain hours of the day will achieve higher thermal comfort compared to having all windows operable or requiring the users to actively move the shades respectively. This reinforces the responsibility borne by the architect to conceive a home that affords mutual support between the user and the building through user education and default design, thus concurrently inculcating positive attitudes along with pro-environmental behaviors.

Green Homes in Jordan and Structural Fixes

To achieve sustainable resource conservation, Heberlein highlights the importance of regulations to enforce attitudes through experience. He states: "Structural fixes give people experience, and direct experiences can change to create new attitudes."[22] And it is when structural fixes are enforced long enough that new behavioral norms can be observed, such that if tax sanctions were lifted, mandated initially to induce pro-environmental behaviors, people maintained their consequent behaviors as a social norm. This norm creation leads to effectively gained positive attitudes that will likely change behaviors on the longer-term[23]. For green homes to become a reality in Jordan, regulating authorities need to address three issues from a VAB stance by understanding the attitudes of the stakeholders involved, such as housing developers, the decision makers, and homeowners.

The first issue is the presence of a maladaptive norm amongst housing developers and contractors of non-code compliance relating to thermal insulation and energy conserving buildings codes; a norm that is reinforced due to the lack of a code enforcing entity. In fact, only 5% of homes in

Jordan are thermally wall-insulated[24]. The lack of thermal insulation, as shown in Figure 7, has environmental, economic and social ramifications affecting the health and wellbeing of inhabitants. Raising awareness about the importance of thermal insulation as a cognitive fix for housing developers produced little behavioral change, according to a two-year (2012-2014) project, conducted by the JGBC. Even though actual behavioral change was difficult to measure due to the short project duration compared to buildings' lifecycle, about a third of the housing developers who attended the awareness sessions mentioned that they would comply if penalties were effectuated. In this case, for the Jordanian housing development stakeholders, a structural fix will produce more tangible results compared to the benign efforts of 'raising awareness'[25].

Figure 7. A view of two houses in Amman under construction lacking thermal insulation (Photo by Author)

Secondly, decision makers place higher importance in enacting policies about Energy Efficiency (EE) and Renewable Energy (RE)[26] while neglecting more impactful policies that 'reduce the need for energy' such as use of passive design strategies[27]. In a typical Jordanian household, space heating and cooling coupled with water heating comprise around 64% of energy consumption, while lighting and appliances combined consume around 19%[28] as shown in Figure 8. The distorted priorities cause confusion when homeowners resort to install PVs and buy energy saving lighting and appliances, while their homes leak heat from improper design and insufficient insulation. Structural and cognitive fixes need to be coherently designed and assessed after implementation to remedy unintentional biases in attitudes and behaviors.

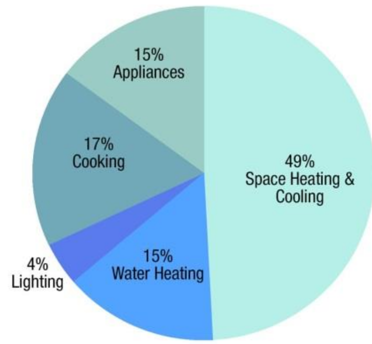

Figure 8. Energy consumption percentage in a typical Jordanian household

Thirdly, pro-environmental behaviors within a household are usually economically instigated in which homeowners are urged to decrease their energy usage as electricity prices rise. Nevertheless, other resources that are not attached to economic savings and are not monetized for their environmental benefits should be addressed by structural fixes that aim to instill positive values and attitudes for conserving water, sorting waste and increasing green cover to mention a few. Compared to a US citizen's average share of water amounting to 9,000 m^3 per capita[29], a Jordanian's share was 151 m^3 in 2010 and is projected to decrease by the coming years[30]. In the face of such chronic scarcity, the built environment has a significant impact to ameliorate and conserve this precious resource. As merely 0.1% of homes in Jordan have rainwater collection cisterns[31], the government could reintroduce the regulations that used to be enacted but halted in the last two decades, which mandate and incentivize homes to harvest rainwater. Such approach establishes *direct experience* and interaction between the users and the de-commodification of a natural resource such as rainwater, thus promoting positive attitudes that are likely to translate as water-conserving behaviors. Ultimately, reviving the vernacular tradition of rainwater catchment into modern home design by architects ascribes a hybrid technological fix in concert with the structural and cognitive fixes.

Green Homes in Jordan and Cognitive Fixes

Environmental problems are most often relegated as 'education problems', but as various environmental psychology studies showed the solutions are more complex than relying simplistically on 'raising awareness' which aim to change values and attitudes. Real solutions often require all three fixes simultaneously crafted with a thorough understanding of the VAB model of the various stakeholders. Heberlein surmises: "We have faith in attitudes as solutions to environmental problems because we think behaviors are perfect reflections of attitudes. They aren't. Context, setting, and norms – all outside the individual – have much more influence on what we do"[32]. Design of the built environment requires inclusion of cognitive understanding of

how the design of 'default' contexts can nudge specific behavioral changes, but such approach should be coupled by strengthening positive attitudes such as the provision of *direct experience*, despite attitudes' relative lesser influence on producing desired behaviors. As automation and physical aspects of the buildings offer a default solution for direct behavioral responses cognitively, so as a designed milieu with a sense of place aims to foster pro-environmental attitudes affectively.

The emotive value of place identity can be architecturally and urbanistically investigated from vernacular traditions, where Figures 9 and 10 offer some examples from older parts of Amman. In fact, Kellert writes on the need for the green building movement to embrace the significance of biophilic and aesthetic design of buildings within a "culturally and ecologically relevant context"[33], an orientation that has not been adopted in entirety by the green building scene. In their literature review of the relation between place attachment, community identification, and pro-environmental engagement, Carrus et al found a positive link between place attachment and pro-environmental behavior - as long as the people's economic wellbeing was not threatened - by concluding that 'place-attached individuals might be more likely to protect their place, to engage in civic activities that are beneficial to the local environment, and to appreciate and protect the natural resources present in their daily life settings, as well as to be more resilient in coping with environmental risks.'[34] Thereupon, Jordanian housing stakeholders can foster rootedness to one's place drawing from the ecological, cultural and historic heritage of the community, which in turn cultivates a *direct experience* for attitudes that can ultimately be more inclined to conserve these resources.

Figure 9. View from the Roman amphitheater in Amman downtown (Photo by Author)

Figure 10. A house's relation with its front yard garden in old Amman (Photo by Author)

Humans' relation with nature has been severely undermined by perceiving earth as an infinite economic repository for continual consumptive behavior[35], a term coined by Foster et al. as 'the ecological rift'[36]. Industrialization and the quantitative view of natural resources produced a human attitude that is exploitive of nature as a 'commodity', which in turn generated a human-nature disconnection. As Environmental movements strive to promote positive attitudes and behaviors, campaigning should be designed to nourish appreciation of nature for its own right. McCauley cautions that "Conservationists may believe that the best way to meaningfully engage policy-makers…is to translate the intrinsic worth of nature into the language of economics. But this is patently untrue – akin to saying that civil rights advocates would have been more effective if they provided economic justifications for racial integration"[37]. This perception of valuing nature intrinsically has been reflected in reframing sustainability's paradigm in the form of the 'nested model'. Such intrinsic proclivity for nature was penned by Aldo Leopold in the last century where "… a land ethic changes the role of Homo sapiens from conqueror of the land-community to plain member and citizen of it."[38] And so, developing an affective environmental attitude toward the natural world is argued to promote pro-environmental behaviors[39] and "Change is more likely to happen when people reconnect _ with each other, and with the biosphere _ in rich, real-world contexts .."[40]. Not only can integrating nature in the design of Jordanian built environments nurture positive environmental attitudes for its users but can also offer adaptive solutions to the effects of climate change, such as desertification, wherein 1.1% of Jordan's land area is forestry compared to the world average of 31.8%.[41] Not until home design in Jordan had embraced *biophilia* and *oikophilia* could inhabitants perceive themselves in unison with nature and context, become more environmentally inclined to preserve it and achieve sustainability.

CONCLUSION

Sustainable architectures have been categorized by several commentators to adopt a range of attitudes from the ecologically sensitive to the technologically responsive. For instance, Lloyd Jones posited that there are two contrasting schools of thought driving environmental architecture; one that adopts a *cultural-fix* which emphasizes the prerequisite need to change a society's environmentally maladaptive values and behaviors, and another which utilizes technology as a *Techno-fix* to solve environmental problems leaving the society's norms intact[42]. Many green building rating systems have focused on the techno-fix as means to improve performance metrics of the building, without integrating the human factor after the building is constructed. In order to achieve the overarching goal of sustainability, the green building movement needs to reconcile its focus on quantitative performance data to inclusion of qualitative aspects such as human behavior, aesthetics, cultural context and biophilia as a design imperative.

The paper explored the proposed solutions needed to attain sustainability in the housing sector in Jordan based on the VAB model and the three environmental fixes as shown in Figure 11. Technological fixes highlighted anchoring contemporary design to the local context, by integrating automation and 'default' settings with derived vernacular passive strategies to holistically account for the cultural, social, economic and environmental sustainability in buildings. As sustainability is considered a dynamic contextual process and not an end-product per se, architects in Jordan should engage their clients in sustainable design decisions and infuse instructions of efficient operation after construction[43]. And so when users receive information of their consumptive behaviors either from installed data loggers or from utility bills that offer normative feedback of households' comparative performance, they become cognitively incentivized to decrease their consumption. The combination of fixed-physical settings and user-informing design aims to prompt pro-environmental behavioral and attitude change in inhabitants respectively. Structural fixes promote norm creation which if designed well can produce pro-environmental attitudes and behaviors once removed. In Jordan, structural fixes herald enforcing energy conserving building codes to establish a code-compliant norm among housing developers, revisiting the synergies between existing policies by decision makers to venerate otherwise marginalized more environmentally impactful policies, and introducing regulations that urge resource conservation such as water and green cover from a top-down approach instead of relying on bottom-up individual attempts from homeowners. Consequently, well-conceived synergetic structural fixes would accord positive social norms that would more visibly tip maladaptive status-quos towards positive behavioral change.

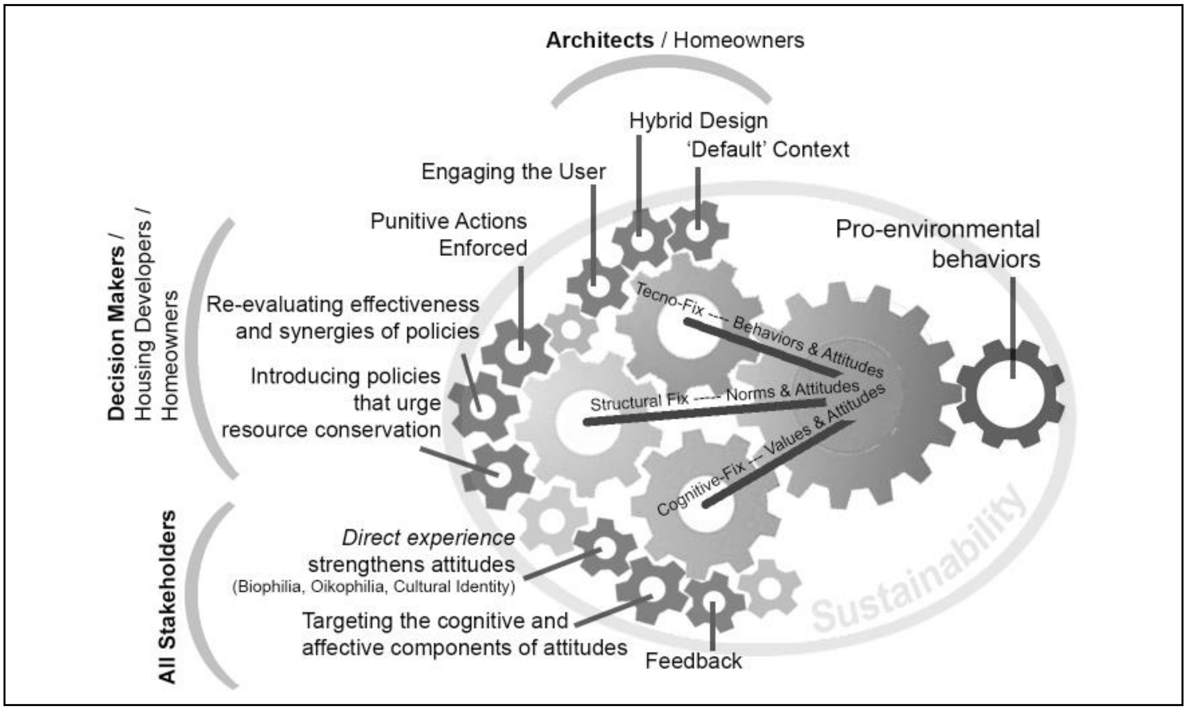

Figure 11. Environmental fixes designed to steer housing stakeholders in Jordan according to the VAB model to attain sustainability (Illustration by Author)

Finally, as cognitive fixes pursue education and raising awareness to solve environmental problems, they are not enough on their own. The fragility of relying merely on providing information and consequently expecting behavioral change has been shown to be a fallacy in environmental psychology research. In fact, cognitive fixes need to be inscribed with other fixes (technological and structural) to delineate the dynamically variable cognitions of human values, attitudes, norms and behaviors into the process of sustainability. Thus, each locale, sector, community and stakeholder manifests specificities that require careful analysis when information is designed to motivate behavioral change. It has been shown that environmental messaging needs to strengthen positive attitudes of recipients which are likely to lead to corresponding behaviors. The link between values/attitudes and behaviors is not a direct one, as many environmental psychologists pinpointed, but the efforts of targeting attitude change should not be dismissed altogether. Equally important, environmental campaigning needs to forge a valuation of nature as part of humans' biosphere, and not as a commodity to be extracted endlessly. Such ethos can be augmented by technological and structural fixes wherein nature is re-integrated into the urban context as a direct experience that develops biophilic attitudes. In addition to designing an ecological built environment, place attachment theory offers a psychological insight into the significance of correlation between place-identifying cultivated attitudes and pro-environmental behaviors. It would be worth exploring for a future study to gauge the level of place-attachment at various Jordanian communities to corroborate existing environmental attitudes, and insightfully

design an environmental messaging campaign based on findings. At the end, information is a powerful tool to motivate sustainable actions when it stems from understanding the VAB model of various stakeholders, so much so that it forms the scaffolding for an integrated cohesive design of the environmental fixes.

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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally
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FACES OF BIOPHILIA IN CONTEMPORARY TURKISH ARCHITECTURE

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1. INTRODUCTION TO BIOPHILIA

Biophilic design is proposed by biologist E. O. Wilson in 1984. Hypothesis is underlined human need to contact with nature and living spaces. Word of biophilia means 'love of life' which relate with both flora and fauna.(Fig.1) Living structure in our built environment is,Wilson deliberated, that biophilia was not only aesthetic preference but also major necessity for people such as water, food and air. . Evidence accumulates shows that contemporary people generally spend their 90% of time in indoor built environement. Greenery in environment is the need for spaces where human live in. A survey of why we prefer to have green elements in our built environment includes to contribute our mental health in a positive way and also improving building performances such as humidity and optimizing the heating.

Kellert argues that the idea of 'biophilia' is related with an understanding of human evolution, where for more than 99% of our species history we biologically developed in an adaptive response to natural not artificial or human created forces. Researches shows that human body and human mental want to contact with nature. The human body, mind, and senses evolved in an a bio-centric not human engineered or invented world. [1]

Figure 1. A passage in Beyoglu İstanbul.

According to Salingaros, there are two main strands of conjecture help to explain the biophilic effects on human that inherited memory and biological structure of human being. First source of the biophilic effect that instinctual is thought to come from inherited memory from human evolution and development in the our environment. The environment compose of open grazing land, trees, sunlight, water, animals, floras, etc. Human ancestors relied on information which experimented from these natural elements and nature. We fistly became human in that setting, geometrical and environmental qualities were genetically encoding. Second important source is biological structure that geometrical rules of biological forms with which we share a pattern. There are parallel relation between living mechanism and basic organization of biological systems. Concept of ‘biophilia’ shows us the common points of geometrical properties and elements of landscape with complex structures. From past to now, researches pointed that human sensory organs and systems which are evolved to respond natural geometries and natural reactions which are qualified with scaling, symmetrical formation, colors and fractals. Our biophilic instincts affected by positive aspects (food, nature, friends) more than negative aspects (threats) in the environment. Human perceptual systems generate positive emotions from surroundings.[2]

Samuel and Sarah explains that biophilia is related with passion of nature. Human nature is about turning back to nature. We feel good in nature. In addition of that our physical and mental well-being depends on with the natural environment. Biophilic design struggles the negative effects of urban zone heat and improves the human physical and mental comfort to create a healthy human life. It has abilities which to reduce stress, to aid recovery from illnesses and to raise academic performances. It affects our personal well-being, productivity and even relationships with others. Especially office spaces, design should motivate the workers.[3]

Sorrento states that the term ‘biophilia’ may be a relatively new one. But the concept is not new. From past to now, people generally use greener spaces in their homes and urban areas. During the time, we have major transformation between personal areas and natural world. At that time, our homes are integrated with our natural elements. Because of that, interiors are influenced by nature and properties of natural environments. Biophilic design is generally about nature and natural elements which are related with materials and forms.[4]

2. BIOPHILIA IN OLD TURKISH ARCHITECTURE

According to Omer “*Islam teaches that environment is part of the universal web of creation. Islamic unique perception of man and his position on earth necessitated the formation of a compelling and comprehensive view of the natural environment as well. This is so because man totally depends on nature for his survival. Also, nature is a ground for man's realization of his spiritual purpose on earth. Simply put, man is an integral part of the total natural setting. Man is nature himself, sustaining nature means sustaining his self, damaging nature means damaging his self and his prospects of a civilizational triumph.*” [5]

From early ages, Islam reflect the idea that human being belongs to nature. This idea is the base of using nature in architecture. Parker & Richards rightly observed that “*The implications of the concept of man as the vicegerent (khalifah) and his interaction with nature for architecture are both ideological and practical. To begin with, humans are not the only creatures that build. Many a creature that we classify low down the hierarchy of the animal kingdom, such as bees and ants, build elaborate structures. However, it has been suggested that it is awareness and imagination that single out humaus as superior to other animals in architectural output.*”[6]

Islam promotes to idea of preserving human and their wellbeing, mental and physical health, respect to nature. Multidimensional messages of Islam was generally used by the Ottomans in any case,

especially in architecture and urban design. At the core of the identity of Ottoman architecture lies the concepts of human and the nature (environment). According to researches, architecture and natural environment was inseperable in Ottoman architecture. Some important signs and elements shows us most of architectural examples include natural elements and some indirect experiences of nature such as natural light, natural landscapes, water supply which are attributes of biophilia. For example, The great architect Sinan built lots of building and also he designed urban areas. In that relation, Saoud mentioned: "*His constructions created harmony between architecture and landscape, a concept, which did not surface in Europe until 16th century. His choice of site, magnitude, form, and material of his buildings were employed as ingredients enhancing the beauty of the overall image of the city.*" [7]

Besides the architecture, there are many of urban design examples which designed in Ottoman such as gardens and parks (mesire). As mentioned in Atasoy "*Ottoman gardens, quite naturally, are thought of first within the general framework of Islamic gardens. Ottoman gardens were not strictly formal, neither were they disorganized. Ottomans sought practical solutions that suited the topography, dimensions, climate, and in general, the ambient conditions of the garden's location rather than adhering to a particular set of fixed rules, and their first principle was to integrate gardens with nature. They enriched and embellished what nature already provided, creating gardens wherever running water existed rather than building watercourses, and planting trees and installing flowerbeds so as to preserve the appearance of natural development of the setting.*" [8]

There are some important palaces and privy gardens as biophilic examples that the Ottomans created in different places such as Topkapı Palace, Dolmabahçe Palace and urban design of Kağıthane (mesire). As reported by Aksoy, said about features of Topkapı Palace : "*In the period from the conquest of Istanbul to the beginning of the Tulip Revolution (1976), a significant development of the Garden Art has standed out. Topkapı Palace is one of the most considerable trace of this period. Also, Topkapı Palace is one of the biggest palaces of the world. The palace has five atrium gardens which come into monumental value like constructions in times. For this reason, they are a part of the historical, cultural landscape and architecture of Istanbul. Palace gardens have a complex feature, functionally and aesthetically, which is coming from the design of the herbal and architectural elements, either combined or distinct. They also have a form of documentary as they reflect the concept of outdoor life of the past, and bring it so far*." [9] (Fig.2&3)

Figure 2. Topkapı Palace / İstanbul

Figure 3. Gülhane Park near the Topkapı Palace / İstanbul

The same author further remarked: "*Turkish gardens can be subdivided into two categories. The first group is made up of large-scale green areas like vegetable gardens, parks for public recreation (mesire), and meadows. As for the second group, it is made up of small and enclosed areas like house, mansion, and palace gardens. As time went by, the Dolmabahce Palace Gardens, which we could define as being an aesthetical manifestation in the guise of historic parks and gardens of the sociological environmental development, acquired a value as a monument, exactly as if they had been buildings, and in this way they became part of Istanbul's historical and cultural landscape and heritage. The Dolmabahc¸e Palace Gardens, which have complex characteristics from both functional and aesthetical points of view, resulting from the integration of botanical and architectural elements, have acquired a documentary characteristic in that they express and transfer to our day in a concrete way the conception of outdoor life of the past.*" [10] (Fig.4)

Figure 4. Dolmabahçe Palace Garden / İstanbul

Cerasi states that: "*D'Ohsson recounts that the main parks and mesire belonging to the Sultan or to the other members of Court were opened to the public on certain days of the week. This would explain in the modest extent of the gardens immediately pertaiming to the imperial kiosks and the open volumetric arrangement, without any precise zoning, of the 'parks' as a whole. Each complex is surrounded by open spaces arranged in a summary or naturistic form so that they participate both in the town's 'public' space ad in the complex itself. Kağıthane (the 'fresh waters of Europe') is an examplary case for the social and cultural history of the Ottoman*." [11] (Fig.5)

Figure 5. Kağıthane / İstanbul

3. TYPES OF CONTEMPORARY BIOPHILIA

As Kellert argues that *the practice of biophilic design involves the application of varying design strategies, what we refer to as experiences and attributes. The choice of which design applications to employ inevitably varies depending on a project's circumstances and constraints including particular building and landscape uses, project size, varying economic, logistical and regulatory factors, as well as cultural and ecological conditions. People tend to prefer landscapes with spreading trees, an open understory, the presence of water, forested edges, and other features characteristic of a savannah-type setting important in human evolution.*[12]

In terms of rapidly increasing population, urban planners and architect worked on to protect nature and wildlife and designing landscaped gardens and nature reserves. They also offer their residential zones community gardens as well as install greener roofs and living walls. In addition of these implementions, city provide the vertical vegetable farms. These greenery concepts provide the human health and well-being. Biophilic concepts extend beyond the walls of buildings and can include site planning, community and land use planning issues as well.

Affects and importance of greenery in buildings pointed by Söğüt & Şenol: "*Based on World Bank statistics the 73% of population Turkey lives in cities. This high ratio has negatively effecting life quality with degraded urban fabric; unbalanced structural elements and green areas. The green roof and façade determined to be effective in enhancing quality of life. In these zones cities heat island effects can be lowered, and decreased relative moisture can be increased. By eliminating cold and hot winds effect the differences between urban living spaces and rural areas can be decreased for the favor of living quality. The green roof and façade also have significant benefits in capturing dust and suspended particulate matter. By holding a certain amount of rain water runoff can be avoided. Studies revealed traffic noise in cities are reduced with the soil and plant cover on green roofs. Along with increasing air quality, these areas provide support eliminating greenhouse gases by increasing oxygen amount, capturing dust and suspended particulate matter.*" [13] In Turkey, climate change affects on some important matters nowadays. Some studies have revealed that there is effect of large block of heat on urban areas in the western regions of Turkey. According to these effects, cities like İstanbul and İzmir have developed extensive stimulations for installation of green features, such as green rooftops and green walls. (Fig.6-Fig.7)

Figure 6. Green rooftop of Zorlu Center / İstanbul

Figure 7. Green walls of Point Bornova Shopping Mall / İzmir

The last years we have seen local authorities aimed to create an environment-friendly urban setting through a planned landscape development in urban areas involving the use of "naturalistic"styles. Professional interest in 'naturalistic' landscapes has certainly been very strong in Turkey. There was collected and analysed information about the different components of the landscape "public parks" and "recreation areas"often mentioned factors to make the city liveable, pleasant and attractive for its citizens.[14] In our country, there are lots of recreation areas where people spend their time such as Aşık Veysel Recreation Area and Konak square in İzmir. (Fig.8&9)

Figure 8. Aşık Veysel Recreation Area in İzmir

Figure 9. Konak Square in İzmir

4. CONTEMPORARY EXAMPLES IN TURKEY

4.1. AGORA Shopping Mall - İzmir

A 90,000 square meter rectangle mall forms the heart of the project and is complemented by a series of shared green spaces, including parking areas. *The word 'Agora' is Greek for 'open place of assembly' and, early in the history of Greece. Later the Agora defined the open-air, often tented, marketplace of a city where merchants had their shops and where craftsmen made and sold their wares.*[15] According to this concept, the mall have two different atrium and public spaces with greenery in front of the mall which these are need to improve the lifestyles of urban people and there should be a special focus on the consideration of environmental impact of human activities. (Fig.10&11)

Figure 10. Building surrounding of Agora Shopping Mall / İzmir

Designers favor a lighter, natural color palette and more natural light for these common spaces in their mall renovations. This is a clear indication that green spaces can increase the physical and psychological wellbeing of visitors and workers of mall. In another research conducted in İzmir showed that the more time people spend outdoors in urban green spaces, the less they are affected by stress.

Figure 11. Atrium of AGORA Shopping Mall / İzmir

4.2. Turkcell AR-GE Building - İstanbul

The structure, planned as a technology center building of a private telecommunication company, is located in Gebze TÜBİTAK Research Center Technology Free Zone. The building, designed and built by Erginoğlu - Çalışlar Architecture, is planned as a single storey from entrance to four-storey building in working areas in the direction of land position. (Fig.12) The area which covered the land is regained with green roof to nature and the roof using as a natural recreation area. The vertical circulation area is designed in the middle of the building to ensure maximum use of the natural light. Turkcell AR-GE building has a remarkable feature in terms of example of faces of biophilia in architecture in Turkey with its interesting shape, most importantly sloping and flat green roofs. Extensive (rare) greening has been used in the terrace area of a total of 2500 square meters of the building, which is designed to be able to walk on the roof and even grass skiing. (Fig.13)

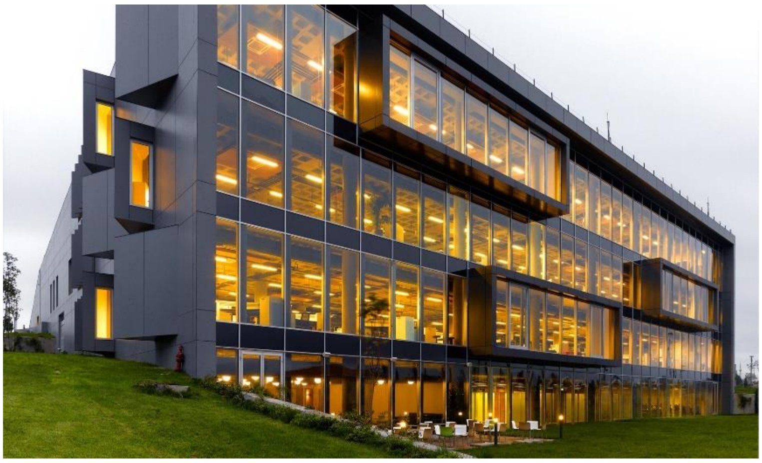

Figure 12. Offices of Turkcell AR-GE Building / İstanbul

Figure 13. Green roof of Turkcell AR-GE Building / İstanbul

4.3. Point Bornova Housing and Shopping Center - İzmir

Point Bornova Housing and Shopping Center project is the great example of combining biophilia and city concept which designed by DerinYeşil Architecture&Consultancy and HOK. Shopping and entertainment streets with 52.000 square meters public areas, 37 storeyed residential towers located on the middle of these streets and 260.000 square meters closed area with the biggest mixed usage in İzmir. (Fig.14) Three shopping and entertainment streets with "sea", "mountain" and "city" concepts built around a triangular scheme provide the ground floor circulation by embracing the housing tower, while the corridors and balconies that circulate on the first and second floors are connected by bridges to watch these curved streets.

In terms of sustainability targets of the project, green wall area has been planned to provide thermal insulation while minimizing project footprint with the architectural decisions for mass settlement, orientation, passive heating-cooling systems, material selection, energy efficient design from the concept project stage. Local and durable plant choices have been moved to these green roofs as well as to the green walls of the interior. (Fig.15)

Figure 14. Building surrounding of Point Bornova Shopping Mall in İzmir

Figure 15. Interior of Point Bornova Shopping Centre in İzmir

5. CONCLUSION

This paper focuses the relation between living organisms and built environment (architecture) in Turkey. The aim of this work is to review three types of greenery, which are green landscape, green roofs and living walls as biophilia in the Turkish buildings in order to interaction between people and nature. So, it is important to understand the main social facts about biophilia and how people react these green concepts. There are three main analyzes for understanding the concept of 'biophilia' and how Turkey attitude the 'biophilia'. Firstly, Turkish old and vernacular architectural examples are analyzed. How the concept of 'biophilia' was applied and it shaped in Ottoman architecture. According to researches, nature was prevailing in Ottoman architecture. Signs and elements shows us most of architectural examples include natural elements such as natural light, natural landscapes, water supply which are related with biophilia. After the analyzing the past, paper focused on types of contemporary examples in Turkey. And then, some main examples analyzed which have green elements in Turkey. In addition, the study examines the social aspects in relation of biophilia. Public interaction with green buildings and green elements analyzed. It will continue with field studies for analyzing the interaction of people in terms of three types of green building features, then questionnaire will be done some architects and designers for analyzing the underlying reasons which cause of applying biophilic elements in Turkey. Main expectation of this research is to evaluate some examples in Turkey for analyzing that how biophilia concept applied to built environment. In addition, a framework will be constructed emphasizing the social contribution of human and engagement with biophilia.

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SUSTAINABLE PLANNING FOR FUTURE CITIES: A CASE STUDY OF NEW DELHI

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INTRODUCTION

This paper introduces the concept of a Resource Performance Index (RPI) as an alternative to land-use based city planning. It posits that energy and other resources need to be distributed more equitably and that a planning framework based on a Resource Performance Index provides the necessary parameters for a range of sustainable growth patterns. To achieve environmental, social and economic sustainability, planning of cities must be demand based, bottom up and within the city's ability to provide utilities.

Using RPI (defined as resources consumed per square meter per year) as the primary planning tool, planners can effectively plan energy, water and waste disposal systems to reflect actual and future growth patterns. Individual residents (and localities), freed from land-use and FAR restrictions, can develop a range of functions and forms suited to demand at various scales within the applicable resource allowances. Efficient, low resource consuming buildings would be able to achieve proportionately greater built area than energy intensive structures.

Space Syntax literature clearly demonstrates the correlation of the public realm network with movement patterns, and is used to identify least-energy accessible centres at the local, intermediate and global scales. Additional resource allowance is made for these areas.

The outcome of such a framework ensures bottom up development, where each individual (and locality) determines the best use of resources on their site, with environmental benefits such as more efficient buildings, growth within limits and reduced number of journeys; social benefits such as localisation of appropriate functions and integration of private property within the public realm; and economic benefits such as increased FAR for efficient buildings.

The framework is articulated in the case of New Delhi

SUSTAINABILITY

Much literature is available on the definition of sustainability, and particularly in the area of sustainable development. While this paper does not set out current discourse on the subject in detail, it is critical to establish the three basic sets of *services* provided by the natural world, which include the provision of resources for human activities; the absorption and recycling of wastes caused by those human activities;

and the provision of additional ecological *services* (such as climate regulation, pollination and soil fertility)[1]

Porritt also establishes four key concepts or system conditions that must be collectively met for society to be able to live sustainably within the Earth's supporting biosphere. These key elements can be classified as minimising material extraction; minimising the need for absorption and recycling of wastes; managing and optimizing the use of resources; and equity in using our resources that the needs of all humanity are met or stand the best chance of being met.

Thus, we can identify the primary goal of a sustainable city as:

A City whose ecological footprint is within the ecological limits of its region and the planet and which promotes equity amongst its citizens.

The Arcadis sustainable cities index report[2] states that "today, cities dominate in population numbers (54% of the total), economic output (70-80%), energy consumption (80%) and greenhouse gas production (80%)". It further declares that in a rapidly urbanizing world, the way in which cities are planned, built, operated and redefined has a huge social, environmental and economic impact. City leaders need to find ways to balance the demands of generating strong financial returns, being an attractive place for people to live and work in, whilst also limiting their damage to the environment.

While the report uniquely presents the current scenario in terms of urban sustainability, it leaves for city government the task of developing effective frameworks to improve their sustainable credentials.

The key question that arises is why do cities consume so much? Is there something about the manner in which city planning is imagined that results in unbridled consumption?

A preliminary analysis of planning regimes suggests that whichever the existing system – be it comprehensive planning, land use planning, strategic/systems planning or participatory planning – the method by which the plan delivers its vision is an inherently unsustainable one. Typically, such plans implement their vision by identifying either a specific use or a range of uses for particular plots of land, coupled with development controls which limit the shape and size of the development. In any such system, economic pressures will generally encourage developments which maximise profitability often at the expense of social or environmental concerns. For example, a residential development having a fixed volume will naturally gravitate towards solutions for the highest economic strata the market and location can support. Given a fixed plot, and by extension a fixed floor plate, and a choice of say 3 smaller, low-cost units or 1 high-cost unit, the typical response within a capitalist system will be to develop the single high-cost unit to maximise profitability, often leading to a mismatch between supply and demand.

This has fundamental social and environmental ramifications, with social objectives directly challenged by the need to maximise profitability.

In some cases, these social and environmental concerns are recognised and managed by the state, with green building criteria, mandatory requirements for green spaces, community infrastructure and social housing. However, this often results in yet another layer of rules and regulations over an inherently unsustainable capitalist development model.

Another fundamental issue with existing planning systems is the distribution of urban opportunity in terms of access to the movement economy.[3] Most systems, however participatory, emerge with a fixed vision of how the city will be. This is at odds with the nature of social and spatial dynamics wherein cities and societies are in a constant state of flux.

The need then is to reverse the relationship between building form and consumption. Rather than imposing limits to the building envelope and allowing laissez faire consumption, a sustainable solution

to the problem of cities may be to impose limits to consumption and allow built forms to emerge as a response to urban economics within a controlled consumption framework

RESOURCE PERFORMANCE INDEX

Taking this idea further, the role of the city planner would be therefore to assess the resource requirements of the city and plan its equitable distribution across the city. The primary form of development control would be a **Resource Performance Index (RPI)** measured in units per square metre of site area per year for all resources consumed. The RPI would include primary city utilities like electricity and power, water, gas and sewage and can be extended to provision of green spaces, maintaining biodiversity, engagement with public space and provision of street parking, etc. The provisions of the RPI would vary, with lower limits set for residential areas and higher limits for commercial areas.

Within such a framework, every plot within the city would permit any form of development provided the total resource demand remains within the parameters set by the RPI. Thus, on any given site, the site owner/developer has the flexibility to determine whether the building(s) is most valuable as a shop, office, residence, institute or a combination of them (mixed use). Resource availability being equal on all similar sites across the city, the emergent mix of actual functions will be more responsive to actual, changing demand. Assuming all plots can be developed as shops, only those which respond to actual demand for specific types of retail will thrive, and other plots will naturally develop alternatives in response to demand for other functions. Thus, such a system will not only respond to current demand, but also retain the flexibility to adjust to saturation and changes in demand over time.

The volume of the building is also a derivative of its resource consumption. With the absence of building controls in the form of Floor Area Ratio (FAR), ground coverage, height restrictions and mandatory setbacks, a variety of building envelopes would result. Here, a building consuming a higher degree of resource per square meter site area would per force be a smaller building, while one aggressively pursuing passive heating and cooling systems, green technologies, water harvesting, waste management and on-site power generation would be able to achieve much higher built area available for personal use, rent or sale. Thus, energy and resource efficient buildings, would achieve a higher FAR; and self-generated/managed resources like solar panels, wind mills, water recycling and harvesting, sewage and waste management on site would all add to the available resource pool and result in even greater built area. The corollary of this is that on similar sites there is the potential to achieve vastly different built forms: a two storey, high consuming, single family residence, or multiple storeys of lower consuming affordable housing. The choice remains the prerogative of the entrepreneurial site owner and would typically be a response to demand at various scales. Such a system would permit a multitude of spatial variations engendered by social, cultural and economic factors, responding to actual demand. However, the development of such varied emergent patterns does not affect the primary means of planning. This is to say that though different building functions and forms may emerge, the basic plan determinant—resource delivery—does not require constant adjustment.

The primary driver, then, is the individual, who determines the form and function optimally suited to a particular site. A secondary layer—local bodies, resident's welfare associations or *mohalla sabhas*—would be the prime drivers of neighbourhood development. They would manage neighbourhood level

resource, plan neighbourhood level interventions, and provide the necessary oversight of individual plot owners. The tertiary level—the city planner—would provide the necessary enabling framework.

SPACE

This enabling framework is typically a Land-Use Plan. This identifies a residential background with specific zones identified for commercial, industrial, institutional and other activities. All buildings within these zones must meet the specific functional mix prescribed. Utilities are provided in greater and lesser volumes to these areas to meet their demand.

This paper suggests an alternative way to identify foreground and background networks using space syntax methodologies. Hillier articulates the need to bring the 'syntactic concepts of structure… to bear explicitly on the problem of sustainability'.[4] He says 'the dual generic form of the city brought to light by syntax, as a foreground network of linked centres at all scales set into a background network of largely residential space, seems already to be created by the interaction of economic and social factors, against a background of the minimisation of the energy required for movement through the creation of what we might call general accessibility, that is the accessibility of all points in the system to and from all others'[5]. The generic form of cities fundamentally comprises of a foreground (highly accessible) network of centres set against a background (less accessible) network at all scales, and such a pattern where centrality is diffused everywhere in the system is found in most cities. Hillier further posits that these foreground structures form a 'movement economy'[6] and it is the reciprocal forces of space and movement and the multiplier effects on both that arise from patterns of land use and building densities that give cities their characteristic structures.

Thus, imagining the city as a network of local, intermediate and global centres set against a background of mainly residential spaces can provide the theoretical framework to distribute resources in a least cost manner. There are a number of advantages to such a system. Unlike zoning where an entire urban block or precinct is deemed commercial (or high resource consuming), here only those specific parts of the network that meet some minimum criteria of general accessibility are identified for a higher RPI. Secondly, these areas directly respond to the structure of the city as it is, and not as some sort of idealized model or subjective understanding of where the city centre or business district should be. Thirdly, these areas are objectively identified and not subject to political pressure.

Thus, balance is required between the resources available to the city and their equitable distribution through the city. The first step is to identify the scales or radii at which foreground networks exist; second, to determine the minimum spatial value which would qualify to be part of the foreground network at that scale; and finally to evaluate the proportion of resource to be distributed to the foreground network at each scale.

This process inherently provides city planners the means and opportunity to empirically evaluate the relationship between space, movement, function, density and multiplier effects independently and fine tune the system to respond to the environmental, social and economic realities of the city and incorporate their vision for the city within the plan.

THE CASE OF DELHI

Delhi is in essence, a high-density, poly-centric city, ringed around a low density core occupied by the machinery of governance. The Masterplan[7] (Figure 1) sets out land usage distribution for the city and identifies development controls in the form of setbacks, F.A.R and height restrictions. 70% of the city is built up of which approximately 70% is residential, and 30% includes commercial, industrial and other facilities. Implementation of the plan is haphazard at best and as such the city reflects both planned and emergent patterns.

An axial map[8] has been prepared reflecting the public space structure in Delhi and its surroundings. This has been converted to a segment map in line with reading distance by the least angle method.[9] The primary spatial measure used is Normalised Angular Choice (NACH)[10] measured at various scales. The resultant spatial character (Figure 2) has been compared with actual observed built use characteristics.

Figure 1: Master Plan for Delhi (Source: Delhi Development Authority)

It was found that the highest order of non-residential activity aligned with spaces that had high values of Normalised Angular Choice at radius N and at radius 5km, suggesting that streets able to access diverse high-order movement attracted the highest intensity of activity. The next order of intensity was found where a street had exceptionally high radius N or radius 5km NACH values indicative of singular high order movement. Low order non-residential activity was observed at the overlap of high 1km and 2km NACH values, again indicative of a diversity of local movement patterns. The distribution of these values are illustrated in Figure 3, and tabulated in Table 1 below.

Table 1: RPI allocations (Source: Author)

Sr.No.	NACH radius	Cut off Value	No. of Lines	% city area	RPI classification
1	N	1.08	3053	11.16	RPI 3
and	5km	1.08			
2	N	1.4	4508	7.26	RPI 2
or	5km	1.35			
3	2km	1.26	22612	18.87	RPI 1
and	1km	1.25			
4	n/a	n/a	17545	62.72	RPI 0

Urban blocks have been created by 'subtracting' the axial lines from a background assuming an average road with of 20m. These urban blocks are given an RPI value as the maximum RPI value available on the line segments immediately proximate. Several blocks identified for future development have areas well in excess of 1 million sq m, and all such areas have been subsequently devalued to an RPI of 0. It is envisaged that these areas can be revalued once primary grids are in place.
The derived RPI values of these urban blocks have been represented in a proposed RPI Block Map (figure 4) graded from dark to light. The highest RPI value of 3 (coloured black) reflects the city level foreground network suitable for city level facilities. Similarly an RPI value of 2 (coloured dark grey) represents the intermediate (sub-city) centres, while RPI of 1 (coloured light grey) corresponds to local neighbourhood centres. All other areas have an RPI of 0 denoting the background (mainly residential) network of the city. Here, approximately 19% of the city forms the high resource consuming foreground network, with the remaining 81% forming the mainly residential background fabric.
This map, though similar in some respects to the land-use map, is based on natural accessibility patterns of the city network, clearly articulates the preferred corridors of commercial development in the city, provides an analytic approach to identifying these corridors and forms the primary tool for planning a sustainable city. (Figure 5)

Outcomes

The outcome of such a system affects the environment, society and the economy. It provides a single framework that ties these three strands of sustainable development together. Since the system embraces the idea that resources are finite it requires thinking at planetary, national and local levels simultaneously, and combines a high degree of control over consumption levels with substantial flexibility to the end users. While developing the individual parameters of the RPI, planners can take into account local climatic conditions, socially acceptable comfort conditions, dependence on resource consuming appliances, lifestyles and resource availability in addition to determining an equitable distribution pattern providing a baseline value to the general background network and higher resource densities to foreground networks.
Economically, it allows demand and supply mechanisms at all scales to optimize the emergent patterns of built form, providing for a greater variety of economic activities and opportunities located to maximize efficiency and economic returns. It also allows traditionally low-profit but lower-consuming sectors like social housing to compete effectively with high-profit, high-consuming sectors. Socially, the system actively rewards low-consuming lifestyles, facilitates the provision of a variety of building functions where most needed, equitably redistributes resources and encourages decision making at the local level. Ecologically, this approach sets limits to resource consumption and waste, actively rewards low-consuming buildings, renewables and recycling, provides for localization of economic activity and as a result reduces travel distance, time and number of vehicular journeys. Considering that city functions are distributed according to demand at various scales, it is most likely that local demands will be met at the most appropriate locations locally and city level demands at suitable locations globally, substantially reducing the need for vehicular and long distance public transport journeys. Particular to the case of Delhi, as of 2011, is that the modal mix indicates only 30% of all journey is by personal vehicles reduced from 36% in 2001.[11] RITES differs slightly, identifying the 2011 share as 40%.[12] However, the reality is that both population and car ownership per person has risen exponentially.[13] This is characterized by high pollution, road congestion and parking shortage.[14] Considering that the primary

variable is the total number of journeys, and that more short journeys are undertaken than long ones, it seems reasonable to suggest that in a situation where most origin destination pairs are closely located (due to demand and supply mechanisms) the total number of trips required would substantially reduce.
Further, such a system allows a high degree of responsiveness and flexibility without the need for substantive 'updates' of the plan. A sustainable masterplan as proposed objectively identifies the most accessible areas at various scales and pairs them with resource consumption limits. Adjustments to the resource 'allowance' alone would be adequate to respond to changing urban demands, new technologies or revised international commitments. For example, were additional housing a priority, the resource share of RPI-0 could be increased. Alternatively, an increased allowance for RPI-1 areas would facilitate expansion of local and community centres. The system also utilizes a single genotype to effect a large number of phenotypes, providing substantial flexibility in determining and adapting building form and function to changes in demand and supply.
Using New Delhi as a case study, this paper demonstrates that such a framework is possible, and in general can well reflect actual emergent patterns of development.

Table 2: Sample Resource Performance Index Chart (Source: Author)

Resource Zone	Area %	Area (Mill sqm)	Energy (EnPI)	Water (WPI)	Sewage (SPI)	Green% (GPI)	Public Interface	On Street Parking
Zone 0	60%	726.4	40			25	Low height boundary walls permitted (say)	On road
Zone 1	21%	264.8	45			25	Active Façade, no boundary walls (say)	On road
Zone 2	8%	92.3	100			35	Active Façade, no boundary walls (say)	1 layer
Zone 3	11%	139.0	200			50	Active Façade, no boundary walls (say)	2 layers

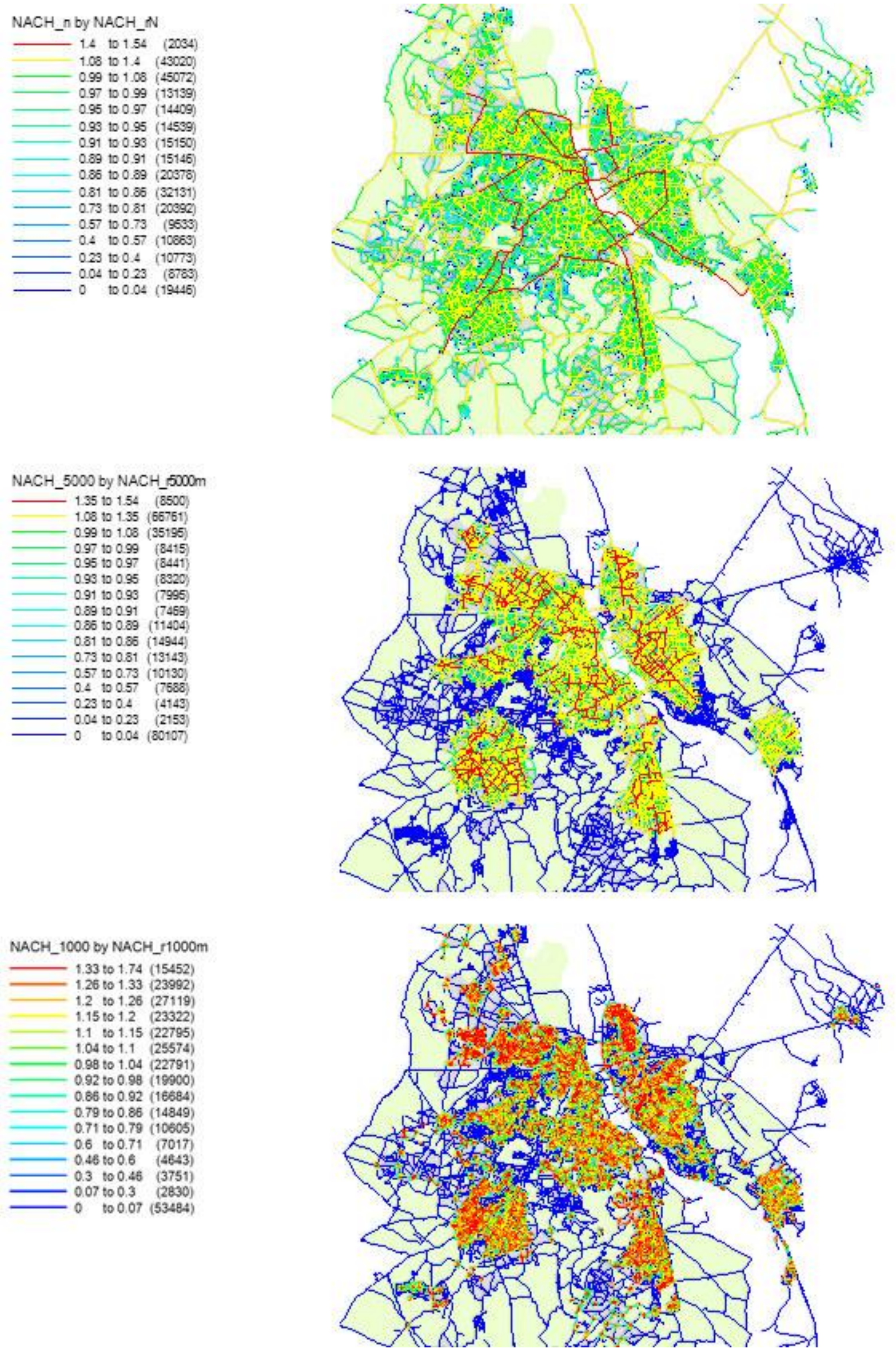

Figure 2: Normalised Angular Choice for New Delhi National Capital Region at A. radius N, B. radius 5km and C. radius 1km (Source: Author)

Figure 3: Central Delhi Segment Map with RPI Values (Source: Author)

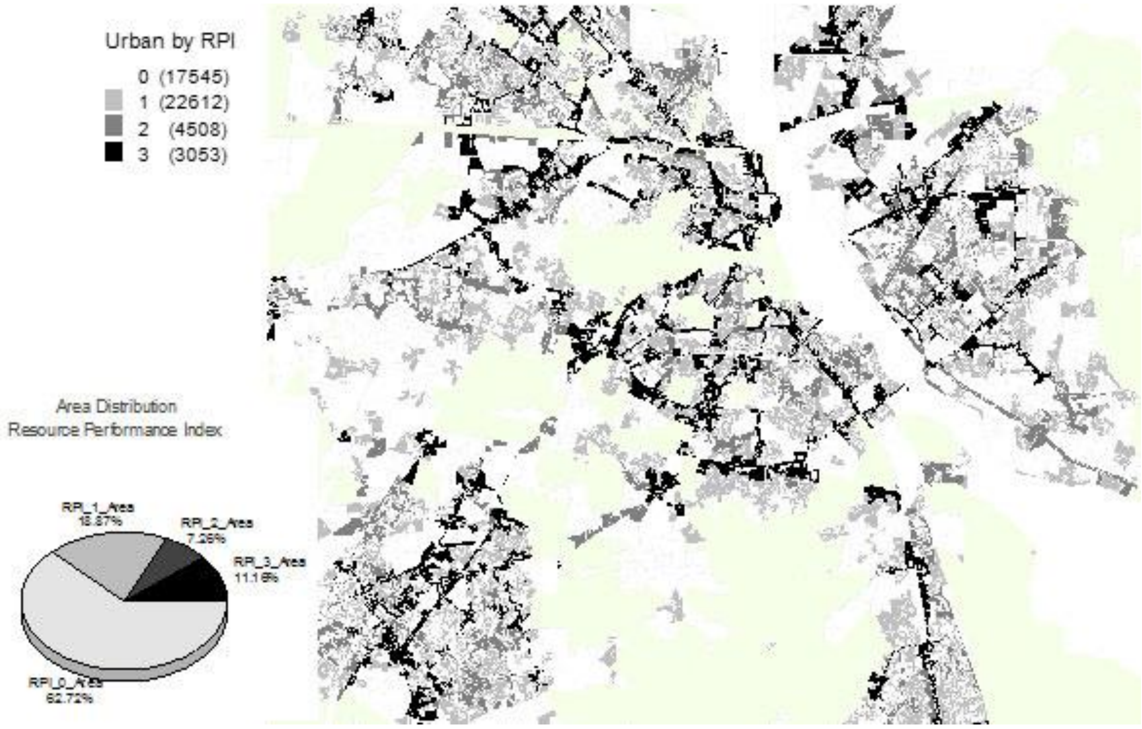

Figure 4: Central Delhi Urban Blocks with RPI Values (Source: Author)

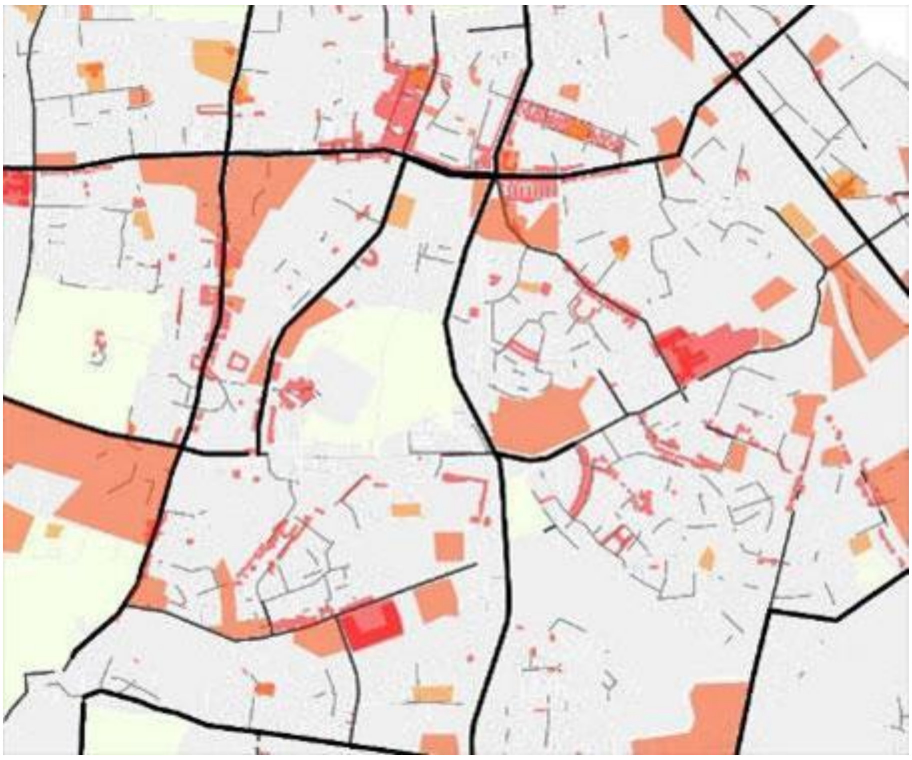

Figure 5: Detail of South Delhi showing alignment between Spatial Modelling and observed Non-Residential building uses. (Source: Author)

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SUSTAINABLE 'HOUSING QUALITY' IN TERMS OF INSTALLATIONS AND INFRASTRUCTURE

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INTRODUCTION

The idea of sustainability is one of the most vital topics in today's agenda in every field. Recent communities have tended to consume more than what they produce. We need to urgently develop new approaches, initiatives and programmes to use the existing ones in a more effective way without over consuming. In recent years, governments and organisations have been developing some national and international programmes for providing sustainability in the cities. These programmes are generally focusing on existing building stock that is a very important source in terms of social, cultural and economic sustainability. Sustaining this stock is directly related with its quality. To ensure the sustainability idea, it is necessary to improve spatial quality in urban areas.

There are different types of buildings in existing stock in urban areas. A large part of this stock has been formed with residential buildings from different terms and has several quality problems. The main causes of the problems are related with physical, structural and infrastructural deterioration that occurred over time. For sustaining the quality, firstly, these problems should be understood and solved. This study focuses on *'housing quality'* in terms of installations and infrastructure and aimed to understand *'how the installing and infrastructural problems can affect housing/spatial quality?'* Installation and infrastructural problems are common physically in existing housing stock. Some reasons can be listed about the problems: short lifespan of materials, improper use, deteriorations, climate change, etc. Whatever the reason, it is important to understand user behaviours and tendencies for solving problems on this issue. Examining and understanding the maintenance behaviours and tendencies and quality perceptions of the users are important for developing an approach for improving housing quality. A field study was conducted in the *4th Levent Housing Estate* that was built in the 1950s in Istanbul with modern architectural ideas. The site has been listed as an 'urban protected area' since 2008. The 4th Levent Housing Estate, in which can be seen physical deterioration and functional changes, has significant spatial quality problems. The study focused on installations and infrastructural problems related with spatial quality.

A literature review on the relationship between sustainability and spatial quality was conducted. Different refurbishment examples from European countries were examined in terms of installations and infrastructural problems along with their solutions. To understand the effects of physical problems such as installations and infrastructural problems on housing quality, a questionnaire was conducted

with the users of this modern housing estate (4th Levent Neighbourhood). The main aim of the study is to understand and discuss the housing quality perception and relation with many physical factors such as water, electricity, gas, heating and cooling installation and infrastructure problems and maintenance behaviour effects on housing quality.

SUSTAINABLE HOUSING QUALITY

Quality of space and perception of spatial quality

The concept of *'quality'* is very complex and has many definitions in different professions. Quality means 'features of products' which meet customers/users' needs and thereby provide customers/users' satisfaction.[1] It is a kind of conformance to specification if a product that conforms to specifications can meet customer's needs. In architecture, the most important factor is user satisfaction on building performance and expectations.[2] Building performance can be tested with these expectations. Performance of the building/space can be lower or higher than the expectations or can be equal with them. If the performance level is higher than the expectations, users can be satisfied with the building/space/environment, and they call it *'qualified'*. Especially for housing studies, it is pointed out that that the performance level effects on user satisfaction.[3, 4] Housing quality is also related with user characteristics and behaviour, and they determine the spatial quality level.[5] The environment can be perceived with both sense organs and feelings. While perception of physical situations of the buildings with the 5 senses is mostly objective, perception of the space with feelings cannot be objective. The perception of the quality is very individual.[6, 7] It is important to understand the characteristics and feelings of users while determining the spatial quality.

Recent studies show that, for understanding housing quality, both objective and subjective factors are important, and both physical and moral parameters should be researched.[8] It can be said that one of the most important actors is the user of the place in housing quality research. So their ideas on their houses, memories and relations with the place need to be understood along with comments on the physical facts.

Design and spatial aspects, atmosphere and appropriateness are qualities that are very difficult to assess. Aspects such as the functional requirements of a building and their long-term adaptability are also criteria difficult to assess. Various approaches for quality assessment systems can be seen. The Housing Quality Barometer is one of the systems used, developed by the Department of Design and Energy Efficient Construction at the Technische Universität Darmstadt in 2009. The system was developed to assess sustainable residential qualities in urban rental apartment buildings in Germany. The idea of developing the system stems from the insufficiency of existing approaches to the quality assessment. The criteria were selected and quantified according to specific legal, social and cultural contexts, to establish a transparent and comprehensive approach [9]

Sustainability idea and housing quality

The term *'housing quality'* is not only for an individual case; it is also an important issue in terms of sustainability in community and governmental levels. Sustainability goals are often presented in terms of the "three E's" -environment, economy, and equity- which in a sustainable society would all be enhanced. The sustainability idea first occurred with ecology, today the term is related with ecological, cultural, social and economy aspects. Especially, ecological problems that increased with the Industrial Revolution, and running out of the natural sources have addressed the need for an idea to sustain the world. In the 1920s, with this aim, the sustainability programmes started to be developed in

every respect. Sustainability means ‘a different using method without consumption of the sources’.[10] While Reboratti relates the term sustainability with protection, Gilman relates it with the effective using and defines it as the ability to keep going over the long haul.[11]

There is a strong relationship in terms of responsibility between the generations. Sustainability helps to create and protect this relationship and is related with using methods more than protection. It aims to create a balance with use and protection.

The concept of sustainable behaviour reflects the particular interest of environmental psychology in the idea of sustainability. The effects of this behaviour should not only be evaluated in terms of the bio-physical dimension of the environment; but also considering the economic, social and political benefits of sustainable behaviour. Sustainable behaviour started to be assessed considering its impact on human well-being and quality of life. This clearly implies that sustainable behaviour positively influences the physical environment as much as it affects human quality of life.[12] Even if used properly, building components undergo ageing and wear. In choosing the materials and type of construction, which must be as durable as possible and satisfy not only technical but also aesthetic requirements, the designer should be aware that the components are not just installed, but may be modified, replaced or serviced many times during the life cycle of the building. It must be simple to upgrade or replace components. Technical requirements may change in the future, components that are more efficient may be developed and out-of-date technology replaced. [9]

In recent years, sustainability of the spatial quality has gained importance, and national and international organisations have developed some programmes especially on existing building stock that is very important as a cultural, economic and spatial source in the urban areas. The stock has several quality problems such as structural, infrastructural, material deterioration, ageing. These are mostly related with improper use, short life span of the materials and other external factors. For sustaining the quality first, the problems should be solved and the lifespan of the building should be extended with some governmental programmes or proper individual initiatives. Users’ behaviour and tendencies on protection and maintenance are also very important to understand the quality problems and develop solutions. Installations and infrastructural problems are very physical problems that can be retained by everyone with basic observations. However, in some cases, users tend to perceive their houses as highly qualified although there are some physical problems like infrastructure.[13] It can be said that the users cannot think only with physical parameters. It is all about the perception of the housing quality.

While examining housing quality, first we need to understand the characteristics (age, gender, education, etc.) of the users and their behaviours on their houses and ideas about the houses. Housing quality directly affects quality of life.[14] Quality of life depends not only on the physical and on the social “quality” of the environment but is also a result of the way people interact with their environment.[15]

Housing quality problems can cause certain health problems both physically and psychologically.[16] The quality of the houses is related with functional, environmental, aesthetic, health and physiological well-being needs.

RETROFITTING AND REFURBISHMENT APPROACHES IN EUROPEAN COUNTRIES

The refurbishment or regeneration approaches enhancing the spatial quality have positive effects on the housing stock and their users. For recent housing stock, it can be listed as mostly modern period apartments that were built between 1930 and 1970, housing blocks that were built by Soviet Socialist governments and other mass-housing projects.

In this part of the study, 17 different refurbishment projects from 7 European countries (Germany, Denmark, United Kingdom, Netherlands, France, Sweden) were examined in terms of spatial quality sustainability.
These projects were developed and realised by different groups that included several actors in a participative way. Common features of the European examples can be listed as focusing on users' characteristics, ownership status, maintenance ideas and participative tendencies.[17]

Policies and implementations on housing quality in Europe

There are certain programmes and initiatives aiming to improve housing quality that have been implemented by national and international organisations. They also provide convenience and encouragements in these implementations. The concept of *'spatial quality'* is an important term in these countries in regard to social-cultural-economic-ecologic sustainability. If a building can stay alive for many years, it will serve different generations. In recent years, European countries have especially focused on existing housing stock and their quality improvements with EU programmes and EU financial funds. Also, national laws on architecture have helped to improve spatial quality on both urban and building scales. With the 1977 law on architecture in France, high quality architecture through education, service, advice, and implementation was promoted. It was pointed out that the level of quality of space should be increased.[18] In 2007, Denmark introduced its first national architectural policy that focused on architectural quality, spatial quality, existing stocks and better conditions. In Germany, with the report on building culture, the initial situation and recommendations were presented. In 2000, the European Union had a meeting -"The European Forum on Architectural Policies in Europe", and they emphasised that the environmental quality is important for the next generations. These types of policies have focused on quality on the existing building stock and the new. One of the most important programmes is the *'Leipzig Charter of Sustainable European Cities'* on which the countries agreed in 2007. These initiatives and organisations by governments and authorities have helped increase the quality in urban areas.[19]
Beside these programmes, some special regulations for housing quality in existing stock have been developed. In the Netherlands, there is a building decree file - the Dutch Building Decree *(Bouwbesluit).* According to this file, a building should present no danger to residents, users or to the environment. Therefore, the government has recorded certain requirements for health, safety, usability, energy efficiency and the environment in the Building Decree in 2010. The government wanted to take under control the quality of the existing stock. In the United Kingdom, there is an information pack about the housing buildings. The *'Home Information Pack' (HIP)* has become compulsory for residential sales. It is introduced as a kit where all the information about the house and land properties, energy certificates, construction, guarantees and existing conditions of the house is in it. It is like an identity card of the building. In Germany, existing stock quality requirements have been related with energy efficiency issues, and they are mostly about refurbishments and retrofitting implementations. The *'Passiv Haus'* programme is important to improve the quality. The authorities can be forced to prepare a building passport. Many European countries are developing instruments that describe quality aspects. *Hausakte* in Germany, *Libro Del Edifico* in Spain, and *Fasciolo Del Fabbricato* in Italy are the recent building files.[19] In 2013 the European Union prepared a new regulation book called the EPDM. Today there are certain certification programmes such as LEED and BREEAM. Although they are focusing on energy efficiency, they make significant contributions to sustainable housing quality in the existing stock.

Retrofitting and refurbishment examples from European countries

In recent years, users and authorities have focused on refurbishment projects for providing sustainable housing quality in existing stock. Because of the needs and advantages of new technologies, users have wanted to make renovations, refurbishments. In particular, rising energy efficiency issues have addressed some actual needs. Therefore, users have changed sanitary (plumbing) installations, gas and electricity installations and heating and cooling system equipment of their houses. Many of them were because of required new building/regulations. The main aims of these regulations can be listed as: using maximum benefit from the natural sources such as sun and wind, minimising the consumption of natural sources and energy. They could be with professional teams or by do-it-yourself projects (self-help projects).

Burton[20] listed the main implementations as improving the thermal isolation system of the building envelop, improving acoustic isolation in the building, improving the thermal capacity, benefiting from sun and wind energy, regulating optimum levels of light and controls. He emphasised the different expectations and tendencies of the users on these types of refurbishment projects.

In Smethwick, England, several renovations were made in 2010 for improving the housing quality of the Thompson Garden Sandwell project that was built in the 1960s. Before and during the refurbishment project, the city council met with the users/dwellers of the apartments and got their ideas about spatial quality and recommendations for improvements. Then the findings were analysed, and the problems and necessities were seen. With the refurbishment of electricity installations, communications (phone system), isolation elements on the roof and facades were renewed, cooling and ventilation systems were changed with new ones as illustrated in Figure 1.[20]

Figure 1. Smethwick refurbishment project.[20]

In Denmark, many refurbishment projects were handled with a sustainability idea for improving housing quality. Governmental authorities and civil organisations prepared a programme called the 2050 scenario for sustainable Denmark. With this programme, they offer renovations of the existing housing stock for a better life. In addition, they focus on smart house technologies.

In Paris, France, at Le Pretre Housing block refurbishment, many spatial changes were done according to the user surveys. Before and during the refurbishment projects, a survey was conducted with the users and their spatial quality ideas and recommendations were learnt. The findings of the survey show that the spatial quality idea of the users was related not only to the dimensions and functions of the

spaces but also to the related effective use and adaptation capability with new technologies and needs. For improving quality, beside the spatial volume additions, electricity and plumbing systems were renewed as illustrated in Figure 2.[21]

Figure 2. La Torre Bois Le Pretre. [21]

Sweden is also rich in its mass housing projects that were built with a million homes programme in the 1960 and 70 period. Users have been showing efforts to cope with the spatial quality problems many of them caused by a short lifespan of the materials. When surveys were conducted with the users of these houses, it was shown that the most problematic issues are installations in the building. Many of the users complained about installations. The authorities offered three different refurbishment packages for the users, all of which included installation renovations.

Another project in Sweden is the Alingsas refurbishment project. Before refurbishment, a survey was conducted with the users, and the most problematic issue was seen as the heating and cooling system. The refurbishment projects were done according to Passive Haus techniques.[20]

When we looked at the examples, it was seen that equipment was installed to minimise water usage, and provide domestic hot water and an active cooling system, an efficient space heating and a ventilation system. Burton[20] warned that there should be in a programmatic approach; otherwise, it can cause some risks of the existing situation. Water and electricity installations are potential problems of the houses. Besides that, for improving quality according to the sustainability idea, water management and electricity efficiency and supply are very important factors. Minimising water use can provide new installing equipment connected with bath, kitchen, etc., and the same idea is acceptable for electricity, gas and heating and cooling systems.[22] If any solution cannot be produced for solving these common installations and infrastructural problems, they can cause problems with other elements of the building and affect housing quality.

We look at the projects, physical and technical renovations, mainly on problems related with the building façade, heating and cooling system, installations and infrastructure illustrated in Figure 3.

Neighbourhood Scale Renovations	Building Scale Renovations	Apartment Scale Renovations
Density-Reorganising Buildings	Facade Renovations	Interior Space Refurbishment
Landscape & Transportation	Energy Efficiency Adaptations	Installation and Infrastructure

Figure 3. Summary of European Refurbishment Project.

It can be said that for providing sustainability, the spatial quality problems should be solved in existing housing stock. However, the authorised programmes, such as energy efficiency, and several certificates are valuable for improving the quality; there is a necessity to develop a programme to understand users' behaviours and tendencies. Different users have several expectations and needs.

FIELD STUDY: USER SATISFACTION ON INSTALLATIONS AND INFRASTRUCTURE

This study aims to understand the relationship between the housing quality idea in terms of installations and infrastructure. How do the users' perception/idea of spatial quality change relate with infrastructure and installation problems? What kind of ideas and approaches do they have on quality related with these issues?

The 4th Levent Housing Estate

Research was conducted in the Levent neighbourhood that was designed and built in the 1950s. The neighbourhood is one of the earliest modern architecture and urban planning examples in Turkey. It was built in four sections, 1st, 2nd, 3rd and 4th Levent are illustrated in Figures 4, 5. The area was listed as an 'urban protected area' in 2008. With its modern architecture heritage value, today the 4th Levent Housing Estate has many spatial quality problems that can be observed physically. Deteriorations and lack of adaptation to actual needs have become threats for sustainability of the neighbourhood. As a listed area, it is urgent to search and analyse the problems and user behaviours to improve the quality of space.

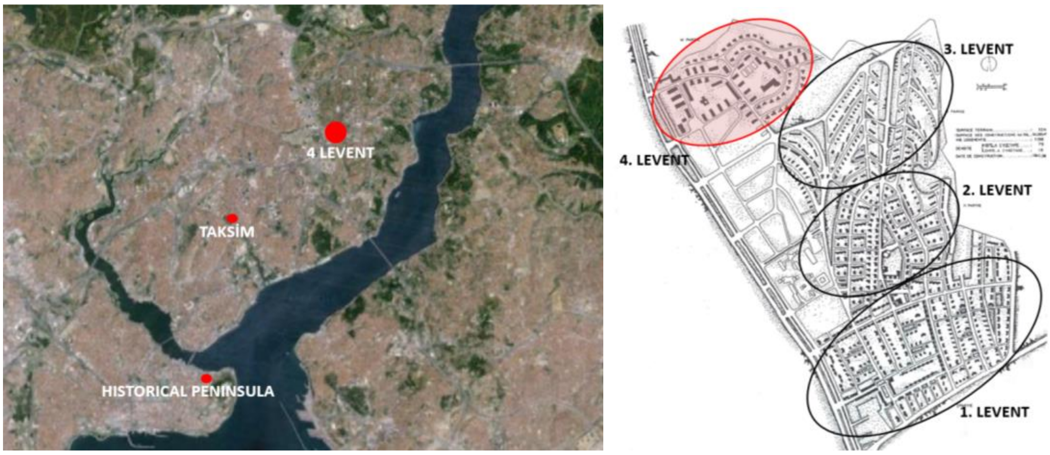

Figure 4. Levent Housing Settlement.[23]

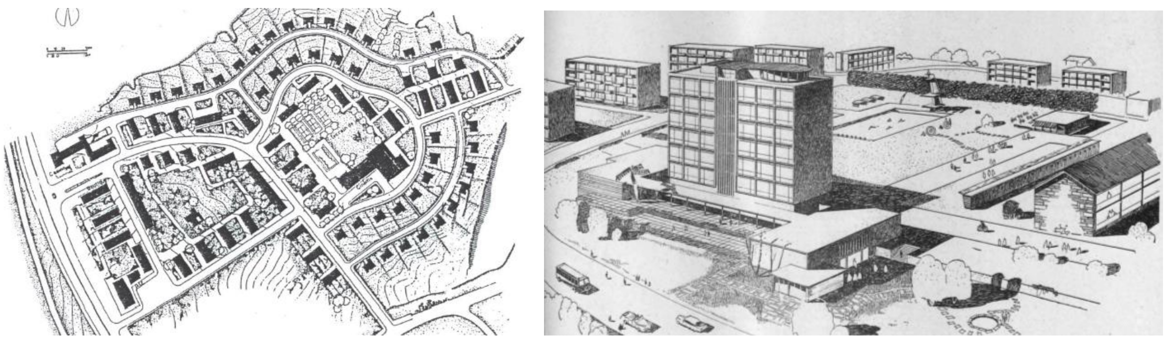

Figure 5: 4th Levent Housing Estate [23].

Since the 2000s, the area has been one of the most valuable/popular financial districts. With the changes, the economic value of the land has increased. Many skyscrapers as mix-use buildings including residences, shopping areas and offices were built. Today the area is under the pressure of the huge buildings, human and traffic density that is caused by the users of these building complexes. While the economic value of the land has been increasing, on the other hand, physical and social changes have negatively affected the 4th Levent housing estate. New large-scale buildings have given harm to the unity of neighbourhood and community feeling. In parallel with the changing user profile, spaces, plan organisations, and use of the neighbourhood/buildings and flats have changed. The neighbourhood has started to lose its identity. In addition, the deteriorations, improper use, and short-term lifespan of the materials have caused several spatial quality problems.

Site observations and questionnaire with residents

The area has lived through several changes over time. Users have tried to solve quality problems with their individual initiatives. Site observation is one of the most necessary parts of this research to reveal the problems with focusing on these interventions before analysation and discussion. During the study in the 2013-2015 period, a systematic observation was done on 47 buildings and 317 apartments in the site. With this observation, interventions by users were listed as: insulation board covering on the façade of the apartment and painting, air-conditioner application, adding volume for the rooms – closing the open parts of the balconies (partly or completely), window and door changes for security and installations and infrastructural changes.

The study focused on the quality problems in the neighbourhood, building and apartment scale in terms of installations and infrastructure. Several interventions on the buildings have been retained and are illustrated in Figure 6.

Figure 6. Interventions in the 4th Levent Estate.

There have been certain interventions related with electrical, water and gas installations, heating and cooling installations and infrastructure. It can be said that the users who are living in the apartments have struggled with some problems in three different scales: neighbourhood, building and flat. A questionnaire was conducted with users based on the results of the site observations. The questionnaire was made with 40 residence users in the neighbourhood to understand the installation and

infrastructural problems and how they affect the spatial quality idea on the users' flats. The questionnaire was made in 3 different scales aiming to discuss the quality perception of the users, installations and infrastructure problems, user satisfaction and maintenance, renovation of these installations and usage behaviour and tendencies.

Findings of the questionnaire

The questionnaire was made with 40 residents. It was seen that 52.5% of the residents are women. Residents mostly (40%) are older than 65. Educational information of the profile was searched and found that 42.5% of the residents are graduated from university. It was seen that most of the users have a higher education and 37.5% of the residents are retired. While looking at the ownership status, it was seen that there are two types of ownership: tenants and owners. 70% of the residents consist of owners. The ownership factor is important to show maintenance behaviour. The tenants' period of time to stay in the neighbourhood is less than that of the owners. It was seen that 47.5% of the residents have been living in the settlement for 31 years or more.

To understand the quality idea of the users and their thoughts about their spaces, satisfaction levels were looked at on 3 different scales.

According to the results of the questionnaire, 45% of the users are satisfied with the neighbourhood while 50% of them are partially satisfied and 5% of them are not satisfied with the neighbourhood spatial quality, shown in Figure 7.

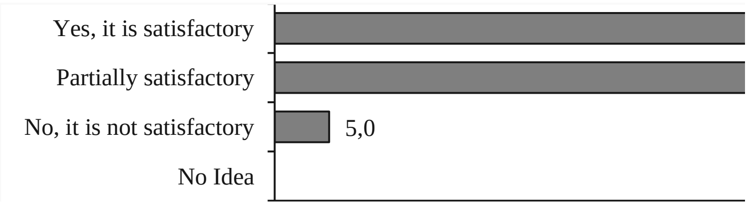

Figure 7. Satisfaction with neighbourhood.

The most important problems were listed as in the neighbourhood scale: 10% electricity problems, 5% infrastructure and 5% water installation problems. When we researched about infrastructure problems in the neighbourhood scale, 25% of the users reported that they are not satisfied with the existing infrastructure system and one of the biggest problems is infrastructure while 30% of them reported that they are highly satisfied with the system.

In the building scale, similar questions were asked to learn about the quality idea. It was seen that 7.5% of the users are not satisfied with the electricity installations while 10% are not satisfied with the heating and cooling systems and 7.5% are not satisfied with the water installations. Also, 30% of the users are happy with all these installations. 15% of the users listed the problems in their buildings generally as water and electricity based. The question was asked *'How many times in a year does your apartment management do maintenance on your building?* For the question, different answers were received, 22.5% of the residents replied that they were doing maintenance once a year. The percentages of the users that were doing maintenance in a 2-5 year period in residences is 25% as illustrated in Figure 8.

Figure 8. Maintenance Behaviour.

In flat (unit) scale, 7.5% of the users are not satisfied with the electricity installations while 12.5% are not satisfied with the water installations, 7.5% of them are not satisfied with the heating and cooling systems. 12.5% of the users listed the problems as electricity and water problems.

There are several money funds for maintenance and repairs of existing building stock. In the European Union some well-organised programmes serve for improving spatial quality, such as SHELTER and FRESH projects for renovating and promoting energy efficiency. Although there is no common fund for these kinds of renovations in Turkey, banks and private financial institutions provide small credits for residents to use for repair and maintenance. In the research, it was asked to learn about the residents' expenses and funding use for renovation and changes, "*Do you have any information about special maintenance credits and have you ever used them for your apartment?"* in Figure 9.

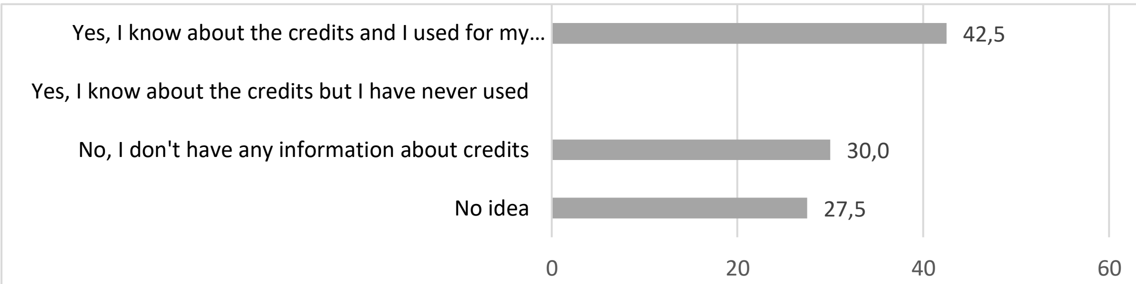

Figure 9: Credit use for maintenance and repair

According to the results as seen in Figure 9, most of the users have known about the credits. Those in the know have used the credits at least once. Even though 42% of residents are aware of the credit facilities, 30% of them do not have any information. It is obvious that if people can have these types of private, national or international financial supports, it is possible to increase the renovation tendencies on the existing stock.

Now, we can see different types of interventions on existing housing stock. Users want to solve their own spatial problems with individual initiatives, implementations, so they tend to apply different solutions within their own ideas. Receiving help from a design and implementation (repair) team is important to protect the unity of the design and the spatial quality of the apartment and building. In the research period, the question was asked to the residents, "*Have you ever used professional help from a design and construction/implementation team?" in Figure 10.*

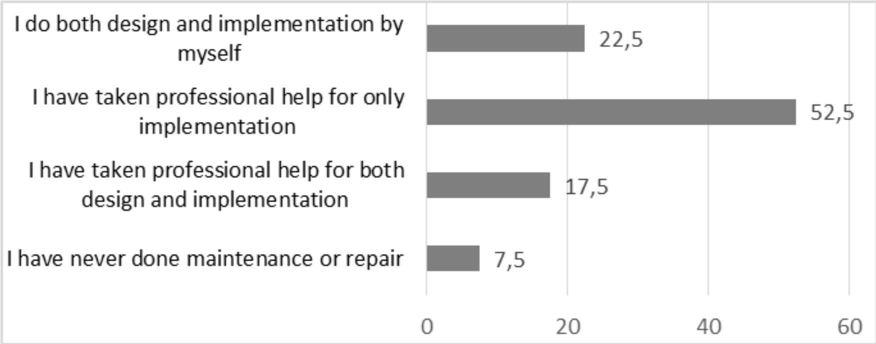

Figure 10: Professional help.

According to the results, it can be said that the users tend to mostly use professional help (52.5%) for implementation. The residents who thought they did not need any professional support for maintanence and repair are 22.5% of the users. It shows that the users have no idea about the importance of systematical maintenance and repair by both design and implementation professionals.
At the end of the questionnaire, a specific question was asked: *Do you think that your flat is qualified?* According to the answers, 65% of them replied yes, while 22.5% of them are partially happy and nobody replied no. It shows that spatial quality is not only determined by physical facts. With these problems, the question *'Do you think your flat has spatial quality?'*, 65% of the residents replied they think that their flats are qualified. It is important that the spatial quality is not related with only the physically observational factors. The other social, cultural and economic factors are important to affect the spatial quality.

In-depth interviews

After site observations on 47 blocks and 316 apartments and questionnaires with 40 residents, in-depth interviews were realised with 4 users who accepted to meet with the interviewers. It was planned to talk about their neighbourhoods, apartments (buildings) and flats with a historical view. Early period and current situations have been compared in terms of spatial quality related with installing equipment and infrastructure systems. These interviews were made in 2015, 55 years after the construction of the neighbourhood and its buildings.
The first user, (**U1**), is 80 years old, retired and has been living in the neighbourhood since the time when the construction was completed. The second user (**U2**) is an 82-year-old retired woman who has been living in the neighbourhood for 55 years. The third user (**U3**) is 89 years old, retired, moved 5 years ago from the neighbourhood and the last one (**U4**) is 38 years old, a businessman who is still living in the area. Three of them have lived at least 55 years in the neighbourhood so they have had a chance to compare past and recent situations of the houses and the settlement.
U1 has been living in the area as a tenant since 1962 and he bought his residence. He saw all the changes in the neighbourhood. He emphasised that the area was constructed and completed with qualified materials. He said that he never used the electrical and water installations in his house. But he said that the most important ongoing problem is the infrastructural problems caused by increasing density of the skyscrapers in the neighbourhood. He recently added an air conditioner for heating and cooling. He focused on the construction materials and installation equipment that were very qualified. He is satisfied with the quality of the neighbourhood, block and his flat.

U2 has been living in the neighbourhood in the same apartment for 63 years. She determined that the most important problem on the site is the infrastructural problems that were caused by the new buildings in the neighbourhood. She appreciated the design and building methods and materials that have been used for many years. She focused on the maintenance necessity of the buildings, apartments. Renovation/refurbishment should be organised for the neighbourhood according to the actual needs related with new technologies. She is not satisfied with the quality of the neighbourhood but she is satisfied with the apartment building and flat.

U3 lived in the area from 1959 to 2005. He saw all the changes of the neighbourhood. He moved to another neighbourhood far from 4th Levent because of the crowded human and traffic density. While he was talking about his house in the neighbourhood, he focused on the construction and material quality. He said that from the windows to the heating system, all the materials and equipment were qualified. All the installations were imported from different countries for this project. He wanted to renovate the electricity installation, and when he researched the installation and technical equipment, he saw that these were very qualified equipment. After that, he did not change the system and the equipment. He is not satisfied with the quality of the neighbourhood while he is satisfied with the quality level of his block and his flat.

U4 moved into the neighbourhood after the 1999 Marmara earthquake because he wanted to live in the neighbourhood. He said that all the materials were qualified when they were constructed but today after years, all the installations need to be repaired or renovated. He is satisfied with the quality of neighbourhood, block and his flat.

The users focused on infrastructure problems that occurred by crowded and new buildings on the site. Infrastructure planning was made for a less dense neighbourhood but today in the area there are many buildings that are very dense and the existing infrastructure is not enough for the recent density. Also, users who gave interviews criticised the maintenance needs/ renovation tenancy. They are satisfied with the quality of the materials but are aware that all the materials need maintenance and repair.

In summary of the field study, it can be said that users are one of the most important actors for sustaining spatial quality, but if they repair or do maintenance within an organisation in a participative way, they can provide long-life spatial quality in neighbourhood and building scale. According to the results of questionnaires and in-depth interviews, infrastructure and installations are important factors for spatial quality, but they are not enough to evaluate user satisfaction level. It needs to research and understand other social, cultural and psychological factors on spatial quality.

FINDINGS AND DISCUSSION

It can be said that users/dwellers are the most important actors on spatial quality studies. This study aimed to understand *'how the installing and infrastructural problems can affect housing quality.'* After a literature review and research on the quality studies related with refurbishment, site observations, questionnaires and in-depth interviews were done.

As a result of the European experience examination, some facts were understood that can be listed as: installation and infrastructural problems are important problems in sustainability. And they are related with material lifespan, deterioration and improper use. They affect the perception of the housing quality more or less.

While asking the users about their problems with the housing, they generally focus on basic electricity, water, gas, cooling and heating problems, but as these problems are physical problems, they can also list their social or physiological problems. Spatial quality relates to both physical and social problems.

With the site observations, some interventions were seen in the neighbourhood, apartment buildings and flats. With these interventions, it was understood that there can be some quality problems where users struggle individually. Users wanted to improve the housing quality with new technologies. Some of them changed the electricity and water, gas, cooling and heating installations. To learn the relationship between the housing quality and installing and infrastructure, a questionnaire was conducted with the users in 3 different scales, and the results showed that these issues are related with housing quality, but to how much effect? The answer to this question is up to the users' behaviour and tendencies. Perception of housing quality is directly related with user profile and their characteristics. In some cases, these physical problems can cause a decrease of quality while in some cases they are not important.
Sustainability of housing quality is related with equipment and their maintenance and renovation.

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PRACTICING FACADE RENOVATION OF DANISH BUILDINGS BUILT BETWEEN 1960 AND 1980

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INTRODUCTION

Modern architecture evolved less than a century ago to reconcile an idealized vision of society with the force of the Industrial Revolution. The task, then, was to rediscover the true path of architecture to unearth forms suited to the needs and aspirations of modern industrial societies.[1] In the post-Second World war era, the ambitions of the modernists and their 'strong sense of social responsibility in that architecture should raise the living conditions of the masses' seemed enormously progressive and promising.[2]

In those post-war years, a higher degree of industrialization was necessary in Denmark to meet the anticipated expansion in all sectors of society, both public and private.[3] Many advantages were gained through the industrialization of building components; for example, reductions in building cost and the reduced need for bricklayers. The traditional and individual approach to building planning was abandoned in order to make use of the advantages of industrialization through mass production, with repetition and rationalization leading to standardization and categorization[4,] however, at the same time many problems occurred regarding the quality of the construction, and these must now be resolved through renovation.[5]

The focus of this research study is on encircling how architectural firms deal with the problems facing buildings that were built between 1960 and 1980. These problems will be investigated through interviews in order to discover the ways in which they were treated during the renovation process, in addition to investigating the architectural improvement of the facades. The study provides an overview of the different approaches and strategies that were used in the building renovations. The paper goes on to discuss the design process, including potential issues with integrating stakeholders in this process.

METHOD

The work in this paper depends on qualitative research methods, namely interviews and site visits. Interviews were carried out with different architectural firms that are involved in building renovation. The interviews covered different subjects related to facade renovation, including both aesthetic and technical aspects. There were also some site visits to a number of buildings built between 1960 and 1980.

THE INTERVIEWS

Interviews were made with seven architectural firms that are involved in the work of building renovation (see Table 1). The focus in the interviews was on facade renovation of buildings built in the sixties and the seventies of the last century. The same twenty-five questions were used in the interviews with the seven architectural firms (see Appendix 1). The questions covered different elements of the design process, such as aesthetic, environmental, technical, functional and economic aspects. The questions

were divided into three groups relating to the building owner, the architectural firm and the outcome. In some of the interviews there was a focus on a single building, while others looked more generally at a number of different projects (see Table 2). The buildings investigated were categorized according to function as office, institutional and residential buildings; however, the majority of the studied cases are residential buildings.

Table 1. The seven architectural firms that were interviewed for their work in building renovation

	Architectural firm	Location	Interviewed architect
1	Vandkunsten	Krudtløbsvej 14 / 1439 København K	Søren Nielsen
2	C.F. Møller Danmark A/S	Strandvejen 17 9000 Aalborg	Christian P. Gadegaard
3	PLH Arkitekter	Vermundsgade 38K, 2100 København	Henrik Lind
4	NOVA5 arkitekter	Æbeløgade 4, 2100 København Ø	Thomas Dahl
5	Pålsson Arkitekter A/S	Svanevej 26 A, 2400 København	Karsten Pålsson
6	RUBOW Arkitekter	Bredgade 25X, 1260 København	Britt Nemmøe
7	Friborg Og Lassen A/S	Vesterbrogade 124 B, 1620 København V	Karl Huggenberger

Table 2. Different projects that were focused on through the interviews with the seven architectural firms

	Architectural firm	The renovation project	Address	Year of construction
1	Vandkunsten	All the renovation projects in general		1960–1980
2	C.F. Møller Danmark A/S	High rise building in Magisterparken	Magisterparken, 9000 Aalborg	1964
3	PLH Arkitekter	Tobaksfabrikken	Tobaksvejen 4, 2860 Søborg	the 1950s
4	NOVA5 arkitekter	All the renovation projects in general		1960–1980
5	Pålsson Arkitekter A/S	Building in Lundtoftegade	Lundtoftegade 9–81 København N	the 1960s
6	RUBOW Arkitekter	All the renovation projects in general		1960–1980
7	Friborg Og Lassen A/S	All the renovation projects in general		1960–1980

The Building Owner

The type of communication between the architectural firm and the building owner as an important stakeholder differs from case to case. Almost all the renovation projects by the architectural firm *Vandkunsten* were based on competitions, while for the other architectural firms interviewed there was direct contact with the building owners at early stages of the design process. In many of the interview cases, the building owner complained about things, which can be seen and sensed, such as mould and also cracks in some concrete components, where they showed their worries regarding the durability of these components. There were other complaints regarding lack of insulation and ineffective windows, but they don't go to more abstract level of talking about indoor climate and energy saving, when discussing residential buildings. Some of the building owners' wishes were to raise the standard of the building to look like a new building to attract new tenants, as with the buildings renovated by *C.F. Møller A/S* and *PLH Arkitekter*. Most of the building owners did not ask for a specific expression for the facade and left that to the architects, but they did have a desire to improve the visual appearance of the facades. In many projects the building owner asked for a low-cost solution, but as expensive as was required to achieve the purpose intended.

The Architectural Firm

This group of questions investigates the role of the architectural firm in the design process. In general, the design process has been achieved through an integrated method, as reported by almost all the interviewed architects. There were some issues with the engineers because they start late in the process, according to the understanding of *Vandkunusten*. This delay of starting in the process might mean that they are not really integrated in the design process, but otherwise there were site visits and common work with the engineers to analyse the projects and brainstorm in a collaborative way. According to *PLH Arkitekter*, there are sometimes different approaches with different focus areas when working with the engineers, and there was always a need to balance the input data from all parts. The same firm also mentioned that there were workshops from the beginning of the projects to make a common plan. Referring to the different focusing areas by the firm might show that it is a sizeable aspect and it can be challenging for the firm to create a correct balance in the input data from all parts leading to an integration and a harmony between the different areas. *NOVA5 arkitekter* reported that the engineers gave the architects some limits, and *RUBOW Arkitekter* mentioned that there were some problems related to old-fashioned thinking from the engineers; nevertheless, the two firms agreed the work was done via an integrated method and the architects were able to describe their wishes and discuss them with the engineers. Claiming that the work was done via an integrated method, might not in fact be a real integration when referring to the old-fashioned thinking from the engineers.

Different architectural approaches were discussed with the architectural firms. How to deal with a building when it is considered an architectural success was a topic that *Vandkunsten* focused on. This consideration is made according to different qualities such as rhythm, facade expression and architectural elements of the facade. As a result, the facade might not be changed significantly but the renovation may implement other strategies, like adding some shades or new canopies. *C.F. Møller Danmark A/S* discussed an aesthetic approach to how to bind a group of buildings together by using similar materials in an aesthetic way. The firm also focused on creating different levels of scale to influence how observers understand the buildings when approaching them. Keeping the expression of the facade as it was originally with minimal change was an approach taken by *PLH Arkitekter* when renovating a building in a low conservation category. In such cases, only the outside parts are considered and internal re-insulation is implemented. *Pålsson Arkitekter A/S* focused on transparency and how to make the inhabitants feel safe, and there was an approach of creating something to enhance the whole

street image, encouraging the building user to feel proud about the area. The expression of one facade took inspiration from an old stream alongside the building to inform young people about the location's history and create an identity for the building. *RUBOW Arkitekter* focused on the relation between the old and the new style, and how to support the old style by giving it a 'twist' so it looks like it has a relationship with the original period, but still has a contemporary expression. There was an agreement between almost all the architectural firms regarding the importance of the old style and how to deal with it when renovating the buildings.

The technical element of the design has a high priority in defining the choice of renovation strategy and the properties of the building components, especially the windows. External re-insulation was the ideal strategy for renovation, as expressed by almost all the interviewed firms. Internal re-insulation is, according to *Vandkunsten*, considered to be very complicated, risky, and hard to suggest even when it makes sense. In Spite of this compilation, *PLH Arkitekter* has successfully used internal re-insulation to retain the expression of a building which has a low conservation category. Demolition of non-load-bearing facades was a decision taken by *NOVA5 arkitekter* in some renovated buildings in conjunction with adding lightweight prefabricated elements, which is a concept that *Vandkunsten* has also proposed in some projects. Using prefabricated facade elements transported to the site and fixed there is frequently used by *RUBOW Arkitekter* and *Friborg Og Lassen A/S*, where the last layer of cladding is added on site.

Daylight was an important factor and taken into particular consideration when renovating schools and residential buildings. However, *Vandkunsten* revealed that this is not significant when renovating residential buildings built between 1960 and 1980 where there is adequate daylight. Instead, the focus is on the social element through directing the windows toward the entrance of the building.

Figure 1 Different levels of scale to understand a renovated residential building in Aalborg, when approaching to it, designed by C.F. Møller Danmark A/S. The view breaks down into smaller parts and there are always new things to see when approaching to it.

Source: C.F. Møller Danmark A/S.[6]

Figure 2 Focus on transparency for the renovation of a residential building in Copenhagen, by Pålsson Arkitekter A/S, and making the inhabitants feel safer (by using stair towers covered with glass) and proud, where the street picture is improved. The glass facade is historically inspired from an old stream that was in the area.

Source: Pålsson Arkitekter A/S.[7]

Environmentally, there were many concerns among the firms regarding the correct choice of materials and recycling the old ones. The average lifetime of the materials was an important parameter used by *Vandkunsten*. As an example, slate, which has a lifetime of about 120 years, is good environmentally and can be used again. The firm was also keen on using wood, which is a renewable resource and can also be recycled. *C.F. Møller Danmark A/S* focused on sorting the old materials so that they can be used again, especially metallic materials, but they were not concerned about the impact of new materials on the environment. *PLH Arkitekter* takes this impact into consideration only when the building owner demands it. Brick and slate are typically used by *NOVA5 arkitekter* because they can be reused or recycled.

The Outcomes

The results of renovating these building facades are varied. Regarding cladding materials, *Vandkunsten* usually uses lightweight ones, and sometimes the firm uses hard insulation with reinforced plaster. In general, the firm does not paint the facade, but it uses different materials which have their own colours. *NOVA5 arkitekter* sometimes uses fibre cement panels for the facade cladding or plasterwork incorporating insulation, while *Pålsson Arkitekter A/S* prefers not to use these materials because they attract dirt. *Friborg og Lassen A/S* uses metal panels, but they are not frequently used by *RUBOW Arkitekter* because they do not give the building a ‘natural’ feeling. Ceramics are durable, as pointed out by *Pålsson Arkitekter A/S*, but *Vandkunsten* does not use them because of the high price.

Three-layer glass windows are usually used by *C.F. Møller Danmark A/S* and *Pålsson Arkitekter A/S*, while *Vandkunsten* prefers not to use this type of window because they need more maintenance, are heavy, absorb a lot of light and, since there are two chambers, there is also an increased risk of damage. External shading devices are used by almost all the interviewed firms; however, *NOVA5 arkitekter* observed that it is not good to use movable ones in schools. *Vandkunsten* occasionally uses awnings, while *PLH Arkitekter* sometimes uses roller blinds.

It can be noticed that the architects speak a lot about materials, not so much about indoor climate and energy savings. These issues may be a bit too abstract to the architects too as to the building owners. The architects like to focus on the aesthetic potentials of materials, and maybe they sometimes use environmental arguments for the choice of materials though having aesthetic agendas.

DISCUSSION

The design process, in general, was achieved through an integrated method with the participation of all stakeholders. There was integration between the architects, engineers and the building owner, who described his wishes and demands in the early stages of the design process. The building owners usually complain about things, which can be seen and sensed, such as mould, but they don't go to more abstract level of talking about indoor climate and energy saving. Regarding the architects and engineers, there was a possibility of some disagreements or problems between them due to different priorities, perception of limitations, and approaches that have different focus areas. The architects also had their own objectives, but there was an attempt to solve these problems for the sake of the final goal. In some cases, claiming that the work was done via an integrated method, might not be a real integration when referring to the old-fashioned thinking from the engineers. In some other cases, the delay of starting in the design process by the engineers might mean that they are not really participating in the actual design, but rather doing calculations and verifications on finished designs. There were no problems regarding communication with the construction companies.

The interviews showed that the technical and economic aspects have high priority. The building owner had a focus on economy and what might be gained from constructing a new facade, by adding insulation to the facade or choosing new energy-efficient windows. The building owner wanted the renovation to end with a more contemporary façade, but he didn't go to more abstract level of talking about indoor climate and energy saving. There was also focus on the durability of the materials and solving problems with mould or cracking in some parts of the facade.

Different architectural approaches were discussed through the interviews. There was a focus on when to consider the existing building architecture as successful, and therefore when to preserve the old style of the building. However, maintaining the old style did not preclude giving the facade a contemporary expression.

Environmentally, there was a focus on the choice of materials including their average lifetime and also the opportunity to recycle the old materials. There were always environmental arguments for the choice of materials, but on the other hand, there are so many different environmental arguments for using materials that there is almost always an argument that can fit to a specific material.

CONCLUSION

Almost all the renovation projects were able to use a method involving integrating all the stakeholders in the design process from the early stages without any major problems. This reflects the importance all the different architectural firms place on implementing this method in the design process. This method was successfully implemented in spite of differences in the focus areas and priorities among some of the stakeholders. The most used strategy in the renovation projects was external re-insulation, and where this was the case, technical and economic aspects had high priority. However, in some renovation cases, internal re-insulation was also a successful strategy. Different architectural approaches were followed in the cases discussed by the interviewees according to the building requirements, or the need to preserve an existing style and the surroundings. There was a focus on evaluating the old style of the building and how to give it a contemporary expression. There was also a focus on daylight in the renovated buildings, with the possibility of enlarging the windows. Environmentally the focus was on the lifetime of the materials and the possibility of recycling the old ones.

The interviews were only with architectural firms to show their meanings of different topics. It might potentially be a very good idea also to interview engineering firms to have their meanings on the integration of the design process and to have more focus on the technical part of the design.

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APPENDIX 1

A list of the questions asked during the interviews with the seven architectural firms:

The building owner

- What are the main problems as defined by the building owner?
- What are the building owner`s wishes and demands for the building?
- What are the building owner’s priorities in the facade renovation: technical, aesthetic, functional and economic?
- Has the building owner asked for a special expression of the facade?
- Has the building owner expressed any economic constraints or limitations?
- Has the building owner expressed considerations on total economy?
- Has the building owner expressed any knowledge of the potentials of energy efficient solutions for renovation in the long range?

The architectural firm

- What are your main concerns when renovating the building?
- How do you generally prioritize between technical, aesthetic, functional and economic aspects?
- Can you define or explain your aesthetic approach to building renovation?
- Do you have in-house knowledge on engineering concerns, which was used in the renovation or have you collaborated with an engineering firm?
- How are the co-operation organized between you and engineering firms? Is it through a specific design process that defines the role of each part in the working team?
- Are there any problems regarding achieving multidisciplinary work when integrating architectural and engineering knowledge together?
- What design strategies are decided for the facade renovation: external or internal re-insulation, double-skin facade and curtain walls?

- What are the physical aspects of the renovation: LCA for materials, the thermal mass of materials, window area, orientation of windows, utilization of daylight, solar heat gain, insulation, air tightness of the envelope?
- Which tools are used for the design or to predict the performance of a specific design solution?
- Are there any economic calculations for the cost of the renovation and the economic benefits due to the saved energy after the renovation? If so which economic models were used?

The results

- What are the most important changes in the facade after the renovation?
- Have you changed the architecture of the façade not only technically but also aesthetically?
- If so, why? Is there need for another expression?
- Which cladding materials are used and why?
- Which types of windows are used and are there any change in the area of the windows after the renovation?
- What kinds of shading devices are used?
- Are there columns in the facade and did it affect the decisions made for the renovation?
- How is the treatment of the old façade materials? Are they recycled? Are there any impacts from used building materials on the environment?

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EVALUATING SUSTAINABLE ARCHITECTURAL SOLUTIONS SUCH AS MULTI-ANGLED FAÇADES IN SPECIFIC URBAN CONTEXTS

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INTRODUCTION

The multi-angled façade system described here is part of an interdisciplinary study situated within the fields of architectural design and engineering, with a focus on studying and analysing the architectural and technical potential of different renovation strategies.

A multi-angled façade system can be used for a renovation of façades of different orientations, proposing the use of two different orientations of windows in each façade to optimize the use of solar radiation and daylight through the façades, depending on the appropriate window properties and the solar shading control system. This is achieved by designing the geometry of the façade in a close integration of architectural and engineering concerns. Two shading control systems, depending on either solar radiation intensity or operative temperature, are used in this system according to the window orientation. The specific emphasis in this study is on the renovation of the façades of buildings built between 1960 and 1980.

Aesthetically, the multi-angled façade must relate to the urban context in which it is implemented. This paper focuses on the use of multi-angled façade systems in specific urban contexts and analyses their architectural relations to surrounding buildings. The aim of the paper is to structure and qualify discussions about, and architectural evaluations of, the use of multi-angled façades in given urban contexts to further the implementation of sustainable solutions in ways that may architecturally improve the local environment. This is combined with a presentation of the sustainable potential of this façade system in a holistic perspective.

METHOD

A review of the available literature has been performed to investigate the advantages and potential applications of multi-angled façade systems. A qualitative research/ phenomenological method is applied to provide deeper understanding of the implications of implementing this façade system on existing buildings, and to investigate what the impacts of this phenomenon – the renovated façade – may be in an urban context. The study also uses a simulation research method to visualise office buildings renovated with a multi-angled façade system, using the software packages AutoCad, 3D Max and Photoshop. The simulation has been performed in three specific urban contexts, all in Copenhagen: a densely developed traditional part of the city; a densely developed modern part; and a less dense area with, detached buildings.

THE POTENTIAL OF MULTI-ANGLED FAÇADE SYSTEMS

The technical potential

Different scenarios were previously simulated for an office room, and the results show that there is a large potential saving in primary energy consumption when renovating with a multi-angled façade system. The difference in total primary energy consumption between renovating with an energy-efficient flat façade and a multi-angled façade varies between 4.9 and 6.5 kWh/(m^2•year), depending on the orientation of the façade.[1]

The more the façade is oriented to the south, the greater the energy saved. A large part of the saved energy is for electrical lighting: between about 1.4 and 1.8 kWh/(m^2•year) compared with renovating with an energy-efficient flat façade. This is because there is greater daylight penetration through a multi-angled façade, through the large part oriented more to the north. There is also greater energy saving for heating with a multi-angled façade system, about 1.1 to 3.1 kWh/(m^2•year) compared with renovating with an energy efficient flat façade. The situation where the large part of the multi-angled façade is oriented more to the north and the small part of the multi-angled façade more to the south is preferred as it has a significant impact on primary energy consumption, which is lower by about 5.9 kWh/(m^2•year) than if the large part of the multi-angled façade is more to the south and the small part of the multi-angled façade is more to the north, due to less ventilation demands.[2]

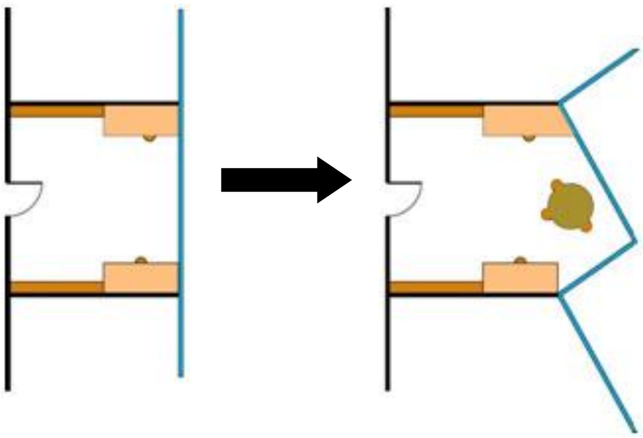

Figure 1: Renovating the flat façade of a cell-office room to a multi-angled façade

In all the scenarios, the number of overheating hours inside the office room exceeding 26^{0}C are below 100 and the number of overheating hours exceeding 27^{0}C are below 25 hours thus fulfilling the Danish Building Regulations. This is achieved through the correct control of the shading device, the use of a VAV ventilation system and mechanical nighttime ventilation.[3]

The architectural potential

Using a multi-angled façade provides many potential architectural benefits. Functionally, the multi-angled façade increases the area of the office room and provides more space.

There are also many potential aesthetic advantages provided by multi-angled façades. For example, from inside, the multi-angled façade in general provides more daylight to the office room, which has better rendering, leading to improved optical quality and a positive impact on indoor climate. Multi-angled façades provide a better visual quality for the users inside the office room. A very big advantage may be that, while having the solar shading shut on one part of the room façade, another part of the façade may have no shading, thus continuing to provide daylight and views to the outside on sunny days. The

multi-angled solution also provides an interesting façade with a more dynamic form from the outside. This will be focused upon in the coming sections in order to evaluate how these façades are perceived from the outside in different urban contexts.

THE USE OF MULTI-ANGLED FAÇADES IN GIVEN URBAN CONTEXTS: EVALUATION AND DISCUSSION

The evaluation of multi-angled façades has been achieved in two ways: The first method was by studying real cases of buildings in Denmark through interviews with the designers. The second method was through a virtual simulation of the post-renovation façades of office buildings built between 1960 and 1980.

Discussing the use of multi-angled façades in real projects in Denmark

Evaluating and discussing the use of multi-angled façades in a sample of buildings in Denmark was achieved with the help of interviews carried out with the designers of these buildings. Three buildings were chosen as case studies, as described below.

Horten Headquarters designed by 3XN

There was a focus, when designing the Danish Law Firm Horten's new head office, on the quality of the surrounding area. There was a canal to the north and office buildings on other sides, so the most attractive orientation was to the north. By directing the building to this orientation, it was also possible to block the sun from the south and minimise the duration for which the shading devices are shut down.[3] The designer tried to create a visual and optical quality for the people inside the office building and improve the indoor thermal climate.

There was a focus on the correct choice of cladding materials for the building. The designers believed that using natural stone sourced from Italy with a beige colour could create an expression of trust,[5] and thus succeeded in creating an expression that suits the function of the company.

An interesting characteristic of this building façade is that when viewers come from the south they will only see a stone façade, and when they approach from the north they will see only glass, while from the east and west they will see a pattern combining glass and stone.[6] This sudden change in the façade when moving around it gives a feeling of interest to the viewers.

Figure 2: Horten Headquarters designed by 3XN, Hellerup, Denmark
Source: 3XN website, http://www.3xn.com.[4]

Figure 3: The interesting pattern of the façade which is based on the repetition of more than one element[8]

The designers tried to create a pattern based on the repetition of more than one element, thus creating a dynamic form for the façade which was mirrored in the façade on the other side of the building.[7] However, the designers also attempted to avoid creating an expression that might be boring if repeating one element only in a simple way.

On the other side of the canal there is a shopping centre where people can sit and enjoy the view across to the Horten office building, so the appearance of the façade is important for the street and the viewers on the other side of the canal.[9] This reflects the impact of the façade design on the people working or shopping in the surrounding areas.

The Niels Bohr Institute designed by Vilhelm-Lauritzen

The Niels Bohr Institute is part of Copenhagen University. The building has a double skin façade where the external part consists of a combination of glass pyramids arranged in a multi-angled way.

The building is a part of a city context in Copenhagen, where there are many façades with ornamental relief. The designers tried to create a relief and a modern kind of ornamentation, and the pyramid system was developed to achieve this.[10] Thus, the method of interpreting the pyramids in a modern way distinguished the expression of the façade.

For those who can interpret it, the way the pyramids are placed and rotated can express Pi (3.14). In general, perceiving the building from a long distance can present a highly-organised impression, while when coming closer to it the observer can be presented with a disorganized expression.[11] The difference between the two situations can give the observer a dynamic feeling.

Figure 4: The Niels Bohr Institute designed by Vilhelm-Lauritzen

Because it is a city building, people will always perceive it through a street view and therefore in a street perspective. Another important aspect is lighting, including daylight and artificial lighting. During the day, daylight is reflected to different orientations when it falls on the pyramids. During the night, the expression of the building is totally different; local people will see the horizontal light from inside, and the pyramids disappear during the dark hours.[12] The change of the expression of the building during day and night is a unique concept of its design.

The Culture Yard designed by AART

The vision behind the Culture Yard is to provide a setting for a vibrant cultural life and preserve the identity and historical value of its former shipyard location.[13] This will increase satisfaction among the local population through preserving their heritage.

In order to create a coherent expression and interlink the existing buildings, a multifaceted façade of glass, steel and sheets was developed based on triangles in different geometric expressions, where all design elements are designed individually. The transparent façade also reinforces the relation between inside and outside.[14] Local people or the visitors can enjoy the magnificent sea view and view of Kronborg Castle from every floor of the building.

The façade encloses the yard in a distinctive atmosphere, as the dazzling and dramatic play of lines generates a sense of spaciousness. Although the façade is made of hundreds of lines and triangles it appears as one big volume, generating a sense of place and time.[15]

Figure 5: The multi-angled façade of The Culture Yard[16]

Virtual simulation of the façades of office buildings built between 1960 and 1980 following their renovation

Three cases of office buildings built between 1960 and 1980 are virtually simulated to evaluate architecturally the impact of renovating them with multi-angled façades to surrounding buildings in different urban contexts. The architectural evaluation is based upon six of the main constituents of architecture: form, style, rhythm, transparency, colour and texture of both the multi-angled facade and the urban context. The configuration of the multi-angled façades of the three real cases described above, is based primarily on aesthetic considerations, while the configuration of the virtual simulated façades is based primarily on economic and environmental considerations, in particular reducing energy consumption and improving the indoor climate.

An office building attached to a traditional building.

The neighbouring building attached to the newly renovated office building has a traditional style. Concerning the form, the multi-angled facade has a more dynamic form and the proportion of the windows to the parapets of the renovated building is very different from the small window units in the traditional building. The size of the whole renovated building is much larger than the traditional building. Concerning the style, the neighbouring building has a traditional style with arched windows and with a symmetry around a central vertical axis of the front facade, while the renovated facade has a modern style and sharply angled facade units. Concerning the rhythm, the repetition of the facade units can create a kind of a rhythm, which is very different from the rigid symmetric facade and the rhythm it might express. Concerning the transparency, the new facade elements, are much more transparent than the traditional building with its large area of solid walls.
Concerning colour and texture, the traditional building has a sharp red colour which is different from the brown colour (not sharp but a little dark)of the renovated facade as in Figure 8 and also different from the light coloured facade (not sharp but light) as in Figure 9. There is no texture in the red painted wall of the traditional facade, while the cladding materials (fibre cement plates) might have a texture or a pattern on them.

Figure 6: Three perspectives for the attached office building to a traditional building before the virtual simulation

Figure 7: A perspective for the attached office building to a traditional building before the virtual simulation

Figure 8: A perspective for the attached office building after the virtual simulation with brown cladding material (fibre cement plates)

Figure 9: A perspective for the attached office building after the virtual simulation with light colored cladding material (fibre cement plates)

An office building attached to a modern building.

The renovated office building with a multi-angled façade is attached to a building with a modern style. Concerning the form, the renovated building has a more dynamic form. There is also similarity regarding the height of the two buildings and the continuity of parallel rows (windows and parapets) between the two buildings. The proportions of the facade elements (between windows and parapets) are almost the same between the two buildings. Concerning the style, both of the two buildings have a modern style. Concerning the transparency, both buildings have a high transparency. Concerning the rhythm, it is deeper in the renovated facade while it is simpler in the neighbouring facade (only horizontal lines)
Concerning colour and texture, it is possible to create a similarity between the cladding materials of the two buildings. In the case of using different colours on both sides of the multi-angled units, the expression will be sharper and the difference will increase with the neighbouring building as shown in figure 13.

Figure 10: Two perspectives for the attached office building to a modern building before the virtual simulation

Figure 11: A perspective for the attached office building to a modern building before the virtual simulation

Figure 12: A perspective for the attached office building after the virtual simulation. The same cladding materials are used on both sides of the multi-angle units

Figure 13: A perspective for the attached office building after the virtual simulation. Two different types of cladding materialsare used on both sides of the multi-angle units

An office building detached from a neighbouring building.

The renovated office-building facade with multi-angled units is detached from the surrounding buildings. The closest buildings to the detached building front facade are across the street. Concerning the form, the front façade after the renovation has a more dynamic form compared to the building to the right. The proportions of the facade elements are different in the renovated facade compared to the buildings across the street to the left (which has also columns) and to the right (which also has separate squared windows). Concerning the style, the renovated facade has a modern style and it is different from the building to the right across the street, which presumably built in the forties or the fifties of the last century. Concerning the rhythm, there is a kind of similarity between the renovated facade and the building to the left across the street regarding the repetition of the facade elements, which gives a rhythm

to the façades. Concerning the transparency, the renovated facade has more transparency compared to both buildings to the left and right across the street. Concerning colour and texture, the renovated facade has much lighter colours compared to both buildings to the left and right across the street. The texture of the fibre cement panels used in the renovation has a kind of a pattern and is different from the texture of the brick used in the building to the left across the street.

The relation between the renovated facade and the two side facades of the same building is not disturbed by adding the multi-angled units. This is due to the use of the same cladding materials (see Figure 18). It is possible to use different cladding materials on the multi-angled units but in a careful way without disturbing the continuity between the side and the front facades (see Figure 19).

Figure 14: Two perspectives for the detached office building’s front façade before the virtual simulation

Figure 15: The two side facades of the office building before the renovation, which are detached from the surrounding buildings

Figure 16: A front perspective for the detached office building before the virtual simulation

Figure 17: A front perspective for the detached office building after the virtual simulation

Figure 18: A side perspective for the detached office building after the virtual simulation

Figure 19: A side perspective for the detached office building after the virtual simulation, where the multi-angled façade units have different cladding materials.

DISCUSSION

This paper presents an interdisciplinary study situated within the fields of architectural design and engineering focused on analysing the architectural and technical potential of multi-angled façades. From the technical side, the optical and visual potential can be considered to get important benefits from this

system. These two potentials provide the possibility of more daylight in the building, and also the consideration that, while having solar shading closed on one part of the room façade, another part of the façade may have no shading, thus providing daylight and views to the outside on sunny days. This will have an impact on the atmosphere and the activity of the employees inside the office room, which will result in increased productivity for the company. There are other potential technical benefits, such as reducing energy consumption and improving the indoor climate.

From the aesthetic side, the configuration of multi-angled units provides an interesting façade with a dynamic external form in some cases or it might give a noisy expression in some other cases. Different façade cladding concepts are possible, such as the use of contrast and harmony between the two-façade parts through appropriate selection of materials and colours.

Different parameters can affect the acceptance of the renovated building in an urban context and its relation to the surrounding buildings, like whether it is physically datached or attached, the size, form, style, rhythm, transparency, colour and texture and some other properties. When the renovated building is attached to other buildings, careful decisions need to be made regarding the chosen materials to create visual matching with surrounding buildings in the urban context. Having the renovated building attached to a traditional building might create a profound contrast between both buildings' façade designs. The renovated building might be dominating the traditional building, and the latter might have an interesting style that needs to be preserved or maybe only shown without disturbance from other different styles. In this case, the concept of using multi-angled facade might not be suitable. In the case of there being no dominance and there are similarities between the two buildings regarding the size or shape, a careful choice of cladding materials can be made to create harmony or visual matching between the two building expressions. Having the renovated building detached from the surrounding buildings gives more freedom in the design of the new façade's dimensions, colour and texture.

CONCLUSION

The multi-angled façade has considerable technical potential, especially optical and visual, which can lead to improved indoor climate and increase the productivity of the employees. The configuration of the multi-angled façade might be interesting and dynamic, but not as creative as the configuration of the three real cases discussed in the paper. This is due to the greater focus on the technical potential, which affects the configuration of the façade. Having the building detached or attached to neighbouring buildings can have an influence on the freedom of the designer when choosing the cladding materials and deciding their colour, texture and other properties. The choice of cladding materials is important in order to create a kind of harmony between the renovated and the neighbouring buildings and not to be significantly different or in contrast. Having the renovated building attached to a building with a modern style helps the renovated building to be more accepted in an urban context compared to an attachment to a traditional building, which might create some problems concerning the traditional style.

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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally

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SUSTAINABILITY IN METROPOLITAN PLANNING: URBAN ECOLOGY, A DIFFERENT PERSPECTIVE ON URBAN DISPERSION

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INTRODUCTION

It has been twenty-five years since the concept of sustainable development was established as a goal at UN Conference Rio 92 and the technical line of thought that sees nature as raw material for growth and development still prevails: neither the primacy of space modeling characteristics, nor the sustainability premises have come to the necessary status to acquire better results in the society-nature relationship.

Starting in the last decades of the 20th century, urban processes have been guided by the restructuring in the capitalist way of production and accumulation: adjusted to the specificities of the economic sectors leading local development. The progressive advance in communication and information technologies (TICs), the ease and speed in the transportation of people and cargo, the increase of new global logistics systems along with economic, tax, and location advantages, allowed national and international corporations more location options. Urban processes of concentration and dispersion come together in the metropolitan expansion, locally and globally.

The cities' efforts towards their insertion into global economic circuits consider no resistance to territorial specialization and adaptations and even tributary and financial incentives including flexibility in the regulatory requirements could be made. International corporations act as real agents of territorial restructuring.

The disperse urbanization creates empty spaces between fragments and imposes exceptional disruption in urban infrastructure systems. It also requires more structured urban support and establishes new standards to daily mobility, even though it increases gas consumption. Not surprisingly, it alters the hierarchy of cities and promotes the formation of new centralities. Regardless of having an urban environmental plan, previously elaborated, the effects and impacts are eye opening because of evident environmental compromises.

Under these conditions of disperse occupations, invading into the countryside, theorists of urbanism speculate about a new global spatial order (Marcuse & Van Kempen, 2000), or even anticipate the end of cities as we know. In fact, there are indications of a new way of territorial organization, still to be well understood, related to this phase of evident shift from the industrial capitalist metropolis to another configuration, consequence of the restructuring of the capitalist way of production, understood as a postmetropolis transition by Soja (2000).

Summarizing the historical process

Salvador is one of the oldest cities in Brazil, founded in 1549; it was the first capital city of Brazil until 1763. Today it is the center of a metropolitan region with 3.6 million inhabitants, the third largest city by population in Brazil with 2,7 million inhabitants.
Located on the shores of a bay, Salvador had political-administrative and commercial functions, Figure 01. Its economy was structured with an agro-mercantile character, founded initially in the sugarcane industry, integrated in trade flows of European capitalism which arrived to the capital city by sea. However, despite this condition and its dynamism, Salvador's development did not advance more rapidly until the mid-19th century. Due to political decisions in the 1950's, economic growth was launched based on the industrial development founded on oil extraction and its refining processes, and the first industrial district was implemented - CIA[i]. The city started to experience strong urbanization, albeit with a local increase in social problems that characterize these processes nationally.
During the 70's, the second development leap happened with investments on the chemical and petrochemical industry, and a new industrial complex, COPEC[ii], was implemented. Both industrial complexes were located approximately 20/25 km from the old city center. This initiative consolidated Salvador as a commercial and service hub and has benefited a net of cities around the capital city. A process of metropolization brought with it a high degree of complexity: increased commuting to reach the industrial centers and huge discrepancy between all types of urban infrastructure that did not allow workers to live near their jobs. Salvador transformed rapidly into a city region around the 90's. Simultaneously, the free land inside the city came to extinction, enhancing the city's urban density, today around 9.227inhabitants/km2, when it started to export population to neighboring municipalities. Nowadays, the city region is the seventh in population and the ninth in GDP in Brazil.

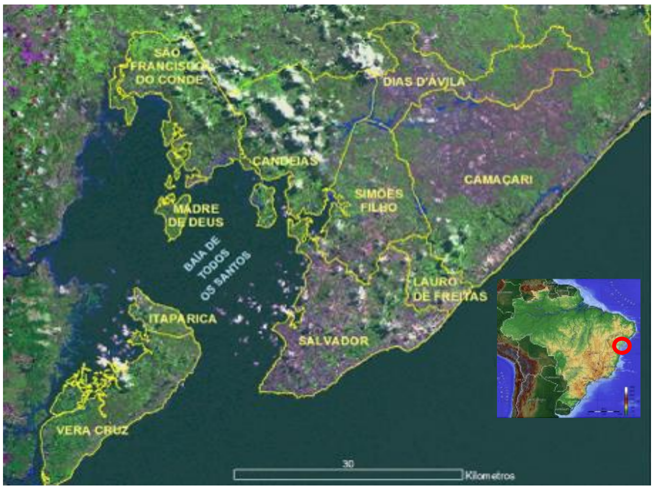

Figure 01: Metropolitan Region of Salvador, Bahia, Brazil.
Source: Google maps.

During the 90's, Salvador maintained a light level of growth. At the Metropolitan Region of Salvador (RMS), the supply of infrastructure and urban equipment was concentrated at the capital city. This discrepancy was an unquestionable force of attraction, limiting regional growth as its force of expansion was not strong enough to improve dynamism to the region under its influence.
This scenario has been changing. Industry and tourism are the two main economic sectors with enough strength to intensify regional economic dynamics and they are primarily situated outside the capital city. Their demand for urban support, infrastructure, roads and equipment, has forced the improvement of urban services at the cities and localities in the region, consequently changing mobility patterns.

Both economic sectors generated a disperse urban fabric as a product of the real estate market for the middle and higher income classes, concentrated on the coast and more recently closer to the inner cities. As they promote an idealized attraction because of employment opportunities, spontaneous occupations blossom in areas of risk and of environmental preservation, expanding disperse urbanization within the region.
Although Salvador grew in a slower rhythm in relation to other cities, almost indicating stabilization, it concentrated around 75% of the regional population. However, a projection exercise shows a probable equalization between capital city and other cities' population in a horizon of approximately thirty years, if the growth rates of the last decade were maintained. Economic activities and the urban metropolitan space expanded, and they would have advanced significantly over the regional territory if the last decade had been of prosperity.

Contemporary regional-urban spatiality

The regional scale
Regarding considerations of the local urban processes, besides bibliographic research, data about the decades 1991/2000 and 2000/2010 were crucial to understand if the general process of dispersive urbanization was happening as a particular expression of the postmetropolis transition (Soja, 2000) in this peripheral region, such as: the geolocation of new urbanized areas, industry plants and the tourism sector; socioeconomic profile; urban parameters of new fabric; and, information regarding the flow of public transportation. In addition, the research on the mobility of the RMS[iii], which includes information about in/out transportation, have enabled significant interpretations of the socio-spatial metropolitan structure.
Concentrating on the resultant spatiality formed by the macroeconomic process at the Salvador region, given the irrefutable territorial structuring capacity of the road and transportation systems, the expansion has been oriented by the road axis, confirming initial short (25km) vectors direction, before the 1980´s, expanding to distances upper then 100km, as shown at Figure 02
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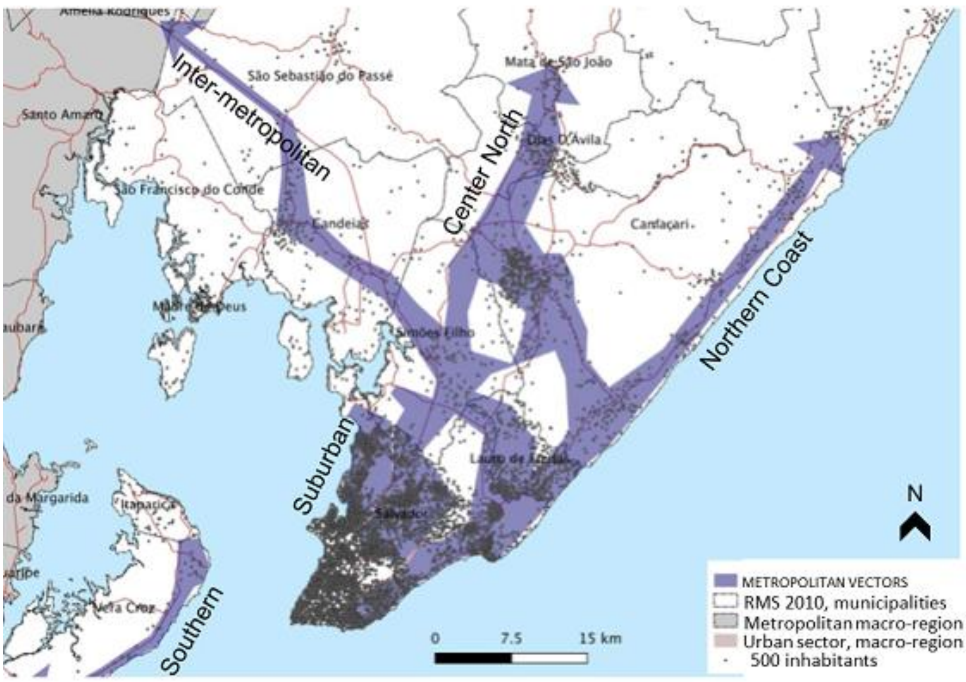

Figure 02: Metropolitan vectors of expansion.
Source: IBGE; LCAD.

In short, the expansion based on road and transportation axis directions, as it discharges the environmental specificities, account for threats and also characterize them as axis of problematic and severe environmental damages, where ecosystem services have been seriously affected, and the continuous damages are expected to keep its pace if nothing comes up to reverse its course.
The GIS mapping process revealed that, cumulatively, the urban fragments complete the vectors of expansion defined by the sequence of cities, along the road axis. Figure 03, shows the spatial aspect of the new urban fabric produced since 1991, by decades, but, although spread out they reinforce the vector directions.

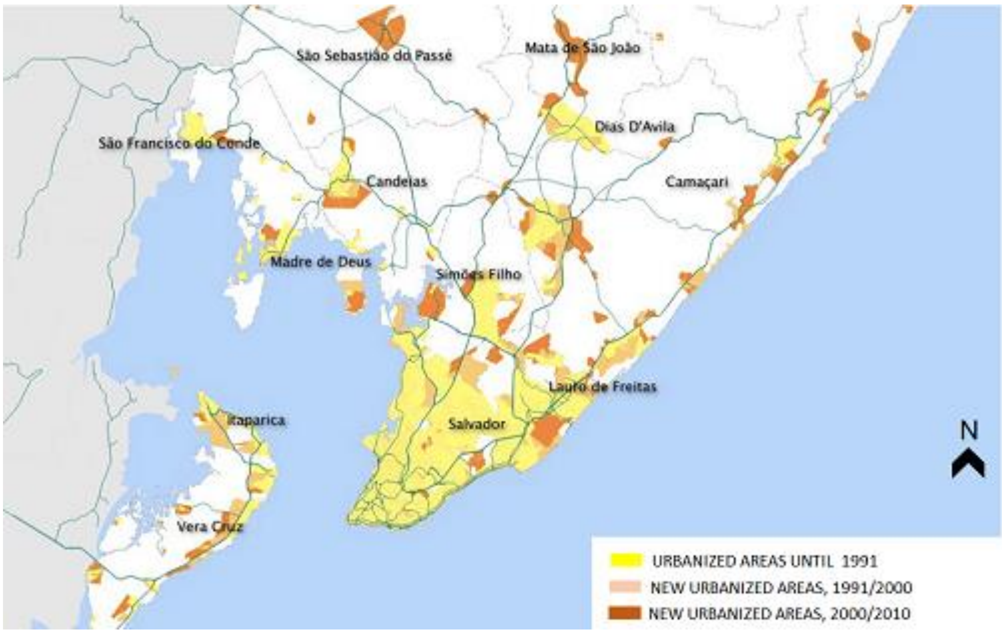

Figure 03: Metropolis sprawl, 1991, 2000 and 2010
Source: IBGE, 2000; LCAD.

The new fragmented areas summed up to 302 km2, almost the same continental area of the capital city. The new fragments have an average area of 0.5 km2 and maximum of 1.5 km2. These formations are very different from what a mere expansion of continuous urbanized area used to be. A new way of growth is launched, pulverized urban areas within the regional space as a local trend, repeating a standard that has been also observed at a global scale.
The urbanized new polygons have different kinds of insertions: expansions in the frontier of the urban fabric, occupations along the roads, and isolated areas. Figures 04, 05, 06 exemplify them. As seen below the census polygons (red line) have an occupation between 18% to 27%, what means a first dispersive indicator of the urbanization standard and corresponds to an average density of 7,88 inhab/ha

Figure 04: Occupancy in the frontier of existing urban fabric.
Source: IBGE; Google Earth; LCAD.

Figure 05: Occupancy along the road connectors.
Source: IBGE; Google Earth; LCAD.

Figure 06: Occupancy as isolated areas.
Source: IBGE; Google Earth; LCAD.

The urban fabric scale

The research findings show that there, predominantly, lives a population of the lowest socioeconomic profile and demographics: 38,9% has no income; 55% earns 1 to 5 SM[iv], 5,6% earns 5 to 10 SM and 0,6 earns more than 20 SM; average schooling time of 8 years; 40% unemployed; and 37,7% of family responsible has no formal instruction or the basic level uncompleted.

The parameters of the urban fabric correspond: 98% of lots have 180m2 to 220 m2, and just 2% have more than 4000m2, showing a close correspondence to the demographics figures. The average construction parameter is about 136 m2/dwelling (median), what means the dwelling have 1 or 2 floors.

Density of dwellings are between 17 dw/ha (median) to a maximum of 58 dw/ha, which corresponds to a density population of 235 to 412 inhab/ha (population occupation taxes of 3,7 inhab/dw), demonstrating that although disperse at the territory, the urban fabric reproduces an urban standard of urbanization.

Using the Spacematrix methodology (Haupt and Pont, 2009) to calculate the fabric spatial attributes we find the residual privately issued land (PIL) reaches until 300% of the area effectively occupied, considering a similar standard of urban fabric density, which means that, if no plan gives direction, this area is quite attractive to urbanization expansion. The emptiness will mean the open space will be tagged for future real estate projects.

Those urban parameters are correlated to landscapes images like these in the Figures 07, 08, 09 below.

Figure 07. Urban fabric type 01, Density - 20 dw/ha.
Source: Google Maps; LCAD.

Figure 08: Urban fabric type 02, Density - 29 dw/ha.
Source: Google Maps; LCAD

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Figure 09: Urban fabric, type 03, 46 dw/ha
Source: Google Maps; LCAD.

The supply of infrastructure and urban equipment such as school, health, and access to transportation systems is a huge difficulty concerning the disperse urbanization. Nevertheless, it is clear, according to the socioeconomic figures exposed, that sustainability has its highest challenge in the social dimension and economic inclusion for the part of the population that is socially excluded.
A regional planning diagnosis, Metropolitan PDTS[v] (2010), conducted with community participants, registers a high demand for job opportunities within urban agriculture, rendering one more ingredient to consider when thinking about sustainability. The region's environmental conditions show not a privileged qualification for agriculture, and, comparing to other metropolitan regions in the northeast of Brazil, Salvador is the one that has fewer locations of agriculture activities (CARVALHO et al., 2001).

Disperse urbanization and sustainability

Coming back to the perspective of sustainability, what instigates the urban search for innovation and socio-environmental improvements is to uncover: firstly, the meaning of sustainability for a city/metropolis into a dispersive process as characterized, and secondly, how to identify options in order to guide the metropolitan expansion.
Considering the focus on a sustainable mode of territorial organization, the concept of urban ecology brings alternatives for the hardest urban questions found at the expansion vectors: maintenance of the resilient capability to deal with waste and effluents' destination, the limited use of land as a consequence of fragmented occupation, the low productivity of natural spaces, degradation from mining in open pits causing soil erosion and river silting, and the loss of vegetation coverage among others. Urban ecology brings concepts for a spatial logic that creates a better balance in the relation between society and nature. It also brings answers so that the main society demand – socioeconomic insertion - can blossom.
Starting with the first question, the approximation, at the right scale, of the metropolitan space to a preliminary reading of its physical configuration is crucial. One must appreciate the available

resources and characteristics that could lead on to an evaluation of the environment potentials, limits, and the tensions of urban growth on the environment. With the sense of an essential reading, trying to identify the defining elements of the environmental structure and what they imply as determinations for the territorial organization, a schematic representation of the basic forces of regional space structuration reveals the conflict: the urbanization structure based on the road systems and the natural structure of the environment, considering water basins as the most adequate unit for planning and fostering sustainability, Figure 10.

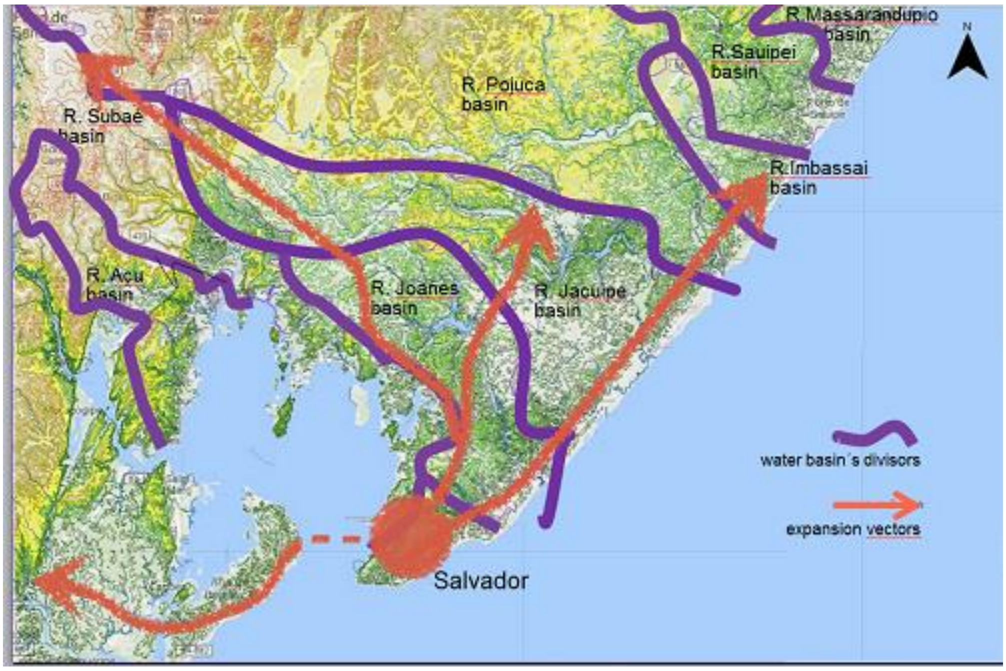

Figure 10: Urbanization based on road axis versus geo-environmental structure at RMS.Source: Google Physical; SRTMDA EMBRAPA; LCAD.

It can be observed that the direction of the vectors trespasses transversally all the hydrographic basins, an evidence that they were established in a direction that ignores the geo-environmental structure. The schematic design above, visually, evidences the obvious. In detail, the occupations along the vectors pressure water reservoirs and become successive obstacles that obstruct the hydrologic and hydrogeological flows, also as a result of strong topographic interferences imposed from these criteria for implantation.

In the perspective of regional sustainable development, the urban ecology argument is chosen as a development bias focused on the politics of territorial organization to be understood and constructed socially as a guidance for the turn of sustainability, in synchrony with concepts of Spatial Turn and Urban Metabolism (Low, 2013) and (Rogers, 2005) and productivity of the territories (Leff, 2004). Actually, it is possible to predict an inversion in the spatial strategy as following.

The second part of the question, about the options to guide the metropolitan expansion through improving sustainability, means to promote economic and social justice, giving a chance to all, to have subsistence conditions, the necessary amount and safe, as to be ecologically responsible, as reinforced in each UN- Summit since 1992 that we all are in debt to achieve.

With this challenge that demands organizational and spatial strategy, Istanbul, Arnavutköy´s master plan, inspires the solution for the RMS, giving answers to both questions. This plan conceives a stimulating idea by integrating urban areas as parts of a socio-ecological system where sustainability means protection of water basins from any occupation that trespasses it or compromises agriculture

potential areas, putting a stop to the sprawl pressure, keeping any urban occupation restrict to the highest levels of natural topography. The strong use of land for agriculture gives an answer to the social demand for jobs and preserves against real estate speculation. In a closed cycle, urbanization becomes a source of water for agriculture and consumption, where effluents processes fertilize the soil giving feasibility to urban agriculture, inside the water basins, and thus creating a new economic activity, intensive in the demand for labor force and productive. The city becomes a provider of the necessary resources for agriculture and a form of protection to the water basins. The urban density and the protection resources are seen as integrated parts of a unique system: a virtuous type of urbanization appears.

CONCLUSION

The RMS represents one more example of the spatial reorganization trend, related to the restructuring of the macroeconomic scenario and capitalist reproduction system, since the 1990's, reproducing the disperse pattern of expansion, but, just partially and with huge differences in its particularities. Although the context fits with the post-metropolitan characterization by Soja (2000), the resultant spatiality effectively can't be literally attributed to, or exclusively to these movements of displacement of international capital objectively.

A pulverized new urbanized area came to be a new organizational model after the 1990's, but the socioeconomic reality seen in the urban fabric studies distinguish this process at an important, but peripheral, metropolitan region of the northeast coast of Brazil.

In an indirect way, segments of the population may have mobilized through an idealized opportunity of jobs, as was verified in some interviews that were also made, but essentially reflects an effort of engagement that doesn't happen as a function of causes that have already been referred: low qualification, low schooling time, low regional economic dynamic, and an inexplicable state of perplexity that have been keeping the region without a solution for at least its main social problem.

Through a spatial strategy, the two main socio-environmental challenges can be faced. Firstly by enhancing the possibility to fit the geo-environmental characteristics to environment preservation and secondly through the new conception of productive urbanization, applying urban ecology principles, as demonstrated at Istanbul's master plan, it is possible to generate jobs suitable to the population's socioeconomic profile. When considering both structuring forces, the road and transportation system, along with the geo-environmental structure, as pre-existent, the territorial occupation strategy can result in a schematic design as shown in Figure 10. It indicates a possible reversion to a regional spatial order, from the guidance of road axis to a guidance defined by the topographic lines, water basin's divisors, certainly without trying to be conclusive for just counting on the main spatial indications.

Figure 11: Metropolitan expansion based on the geo-environmental structure.
Source: Google Physical; SRTMDA EMBRAPA; Self elaborated.

The design simplifies complex situations, but in its simplicity it evidences what society intends to value, pointing to a direction to where regional planning of a metropolis, that gradually undoes its own concentrated form by dispersing in its territory, may go. A new form of organization that searches to find its way of amplified sustainability: social, economic, cultural, environmental, ecologic, territorial, domestically and internationally political (Sachs 2002).

The cycle of endless damage to environmental patrimony and social exclusion has chance to be disrupted. The answer comes from the potential use of urbanization integrated as a social system to a socio-ecological one: urbanization as a long-lasting source of socioeconomic and environmental well-being. Finally, a more qualified standard of urbanization, in synchrony to the New Agenda, HABITAT III, 2016, can be expected in the days to come.

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Endnote

[i] CIA- Industrial Centre of Aratu.
[ii] COPEC – Petrochemical Complex of Camaçari.
[iii] Accomplished by Infrastructure State of Bahia Office.
[iv] SM - The Minimum Salary corresponds to USD $285,70.
[v] Metropolitan PTDS – Territorial Plan for Sustainable Development, RMS, 2010.

AMPS, Architecture_MPS; London South Bank University
09—10 February 2017

THE SUSTAINABILITY CHALLENGE: HOW MULTI-CULTURAL AND INTERDISCIPLINARY GROUPS OF MASTER STUDENTS ACHIEVE SUSTAINABLE ARCHITECTURE IN SHANGHAI

Marius Korsnes, Wang Yu, Gabriele Lobaccaro, Amin Moazami & Salvatore Carlucci

INTRODUCTION

The extent to which sustainability as a concept can be helpful from an educational perspective has been up for debate the past 15 years, since the concept has prescriptive tendencies and is fraught with conflicting values, norms, interests, and reality constructions.[1] Wals and Jickling argue that sustainability is productive to use as an organising concept as long as it is clear that the concept has several shortcomings, and that it does not represent a 'single right vision or best way to sustain the Earth or what kind of Earth should be sustained'.[2] In other words, using sustainability as an organising framework involves addressing ethical questions about how Earth's resources should be shared. In that regard, sustainability is also about issues such as 'cultural identities, social and environmental equity, respect, society-nature relationships and tensions between intrinsic and instrumental values'.[3] This implies that a more participatory, pluralistic, and emancipatory approach is a central task for sustainability education.[4] Thus, this paper asks: how is sustainability agreed upon in an interdisciplinary and multi-cultural setting?

The paper presents results from an interdisciplinary and multi-cultural summer school on 'Sustainable Energy in Cities' (SEniC) held in Shanghai in July 2016. All the student groups dealt with the same task: designing a research facility for a small group of researchers based on the Jiuduansha Wetland Islands in Pudong, Shanghai. The wetland islands emerged in 1950s at the mouth of the Yangtze River, and they are fragile and pristine islands with high ecosystem service value representative of coastal ecosystems in eastern China. They are also sensitive to global climate change (e.g., extreme weather events such as monsoon and sea level rise) and were therefore seen to be an interesting case study where future climate change effects necessarily had to be considered in the final design. We study how the four groups arrived upon their definition of sustainability by analysing their interpretive and collaborative process during the two-week summer school.

SUSTAINABILITY, DIVERSITY AND EDUCATION

In much sustainability education research in the past years, the central message appears to be that in order to achieve sustainable outcomes there is a need to open up for feedback from several perspectives and actors through different experimental methods.[5] Yet, how can such diversity and experimentation be facilitated in education? Indeed, it appears that institutional inertia and rigid traditional disciplinary boundaries pose considerable challenges to sustainability education.[6] Studies going into detail about the practical challenges in teaching sustainability point out that threats to career development of academics, lacking confidence to teach about a vague concept such as sustainability, and agreeing on what types of competencies are important to teach for problem solving efforts are some of the principal inhibitors.[7] Another challenge is interpersonal competence, that is, the ability to facilitate collaborative and participatory research is a key competence, and is identified as inadequate in case-studies of sustainability-oriented educational programmes.[8] Dam-Mieras et al. conclude that a significant barrier in generating innovative learning environments is to facilitate mutual trust and

understanding between people.[9] Moreover, they point out that language barriers can prevent the development of intercultural and interdisciplinary work. Moore suggests seven recommendations for creating sustainability education at the university level, two of which being to ‘promote and practice collaboration’ and to ‘focus on personal and social sustainability’.[10]

This emphasis on language, interpersonal and collaborative perspectives shows that sustainability is interpretive: something that must be agreed upon in each case. This also implies that ‘teaching about sustainability presupposes that those who teach consider themselves learners as well’.[11] Lessons from research on collaborative learning points to the importance of the social and interactive dimension, particularly in facilitating the ‘co-construction of knowledge and meaning and mutually shared sense making’.[12] In other words, competences relevant for sustainability must be determined collectively. This puts an extra emphasis on facilitating communication and making sure that there are no opinions that matter more than others, including those of the professors and teachers involved.

METHODS AND DATA

This paper is based on data collected during the International Summer School on ‘Sustainable Energy in Cities’ (SEniC) in Shanghai 2016. The 2016 summer school was a collaborative effort between three universities: the Norwegian University of Science and Technology (NTNU, Trondheim, Norway), Shanghai Jiaotong University (SJTU, Shanghai, China), and Tsinghua University (THU, Beijing, China). The summer school was grounded on three main pillars:

1. *Experts in teams*: interdisciplinary training of students and staff in teamwork, which used group work and games as a way to facilitate cross-cultural and interdisciplinary learning.
2. *Triple helix*: collaboration between industry, government and university. In this project, the local industry and municipality officials suggested specific challenges for the students to address and solve in cooperation with teachers from the involved universities.
3. *Out of the lab, into the city*: The students and teachers went on fieldtrips in order to gather empirical evidence and developing solutions that are tailored to and useful for the city.

The 2016 SEniC summer school was set up with seventeen relevant lectures given by professors from eight universities in the morning while during the afternoon the groups’ work was coordinated by a teacher team composed by four researchers and one professor from NTNU. The group work sessions included interactive techniques that aimed at facilitating teamwork and ‘creative-thinking’, including group games, daily newsletters and excursions. The different disciplinary backgrounds of the involved master students were: architecture, civil and mechanical engineering, industrial ecology, renewable energy engineering and social science. The students were divided into four groups with mixed disciplinary and cultural backgrounds, and with an equal gender share: seven male and two female students in each group. The groups were all given the same task consisting in designing a research facility for a small group of researchers at the Jiuduansha Wetland approximately 6 km outside of the Pudong Airport, Shanghai and the same design package made of design specifications and a video presentation of the flora and fauna of the Wetland. The design specifications were to create a facility for 2-5 researchers who could live there for few days, with a space-limitation of 150-200 m^2, and with mixed use of living and working space (housing, office and laboratory).

The data collected during the two weeks of summer school were: (1) recordings of some of the group work discussions, (2) a variety of pictures and videos taken both by the students and the teachers’ team, (3) meeting notes, (4) observation, and (5) a survey conducted at the end of the stay with feedback about the students’ satisfaction and perception about the summer school’s organization, conduction and learning experience. This paper is also based on an analysis of the student deliverables: a final presentation at the end of the summer school and a report in which design choices,

energy strategies and calculations as well as social impacts of their final proposal were explained in detail.

DESIGN CHOICES AND JUSTIFICATIONS

In this section, we present the design choices of each group and their strategies as well as a short description of the groups' discussion process that led to the different designs. Figure 1 shows an overview of the final designs developed by each group. Group 1 chose a more moveable design solution characterized by jack-up vessels as a design inspiration. Group 2 developed a fixed installation inspired by the local birds-nests. Group 3 ended up with a fixed installation that was inspired by the surrounding sea-climate, and finally, Group 4 designed a fixed installation intended to serve as a landmark between Shanghai city and the wetland islands, with the purpose to sensitize Shanghai citizens to the fragile wetland islands.

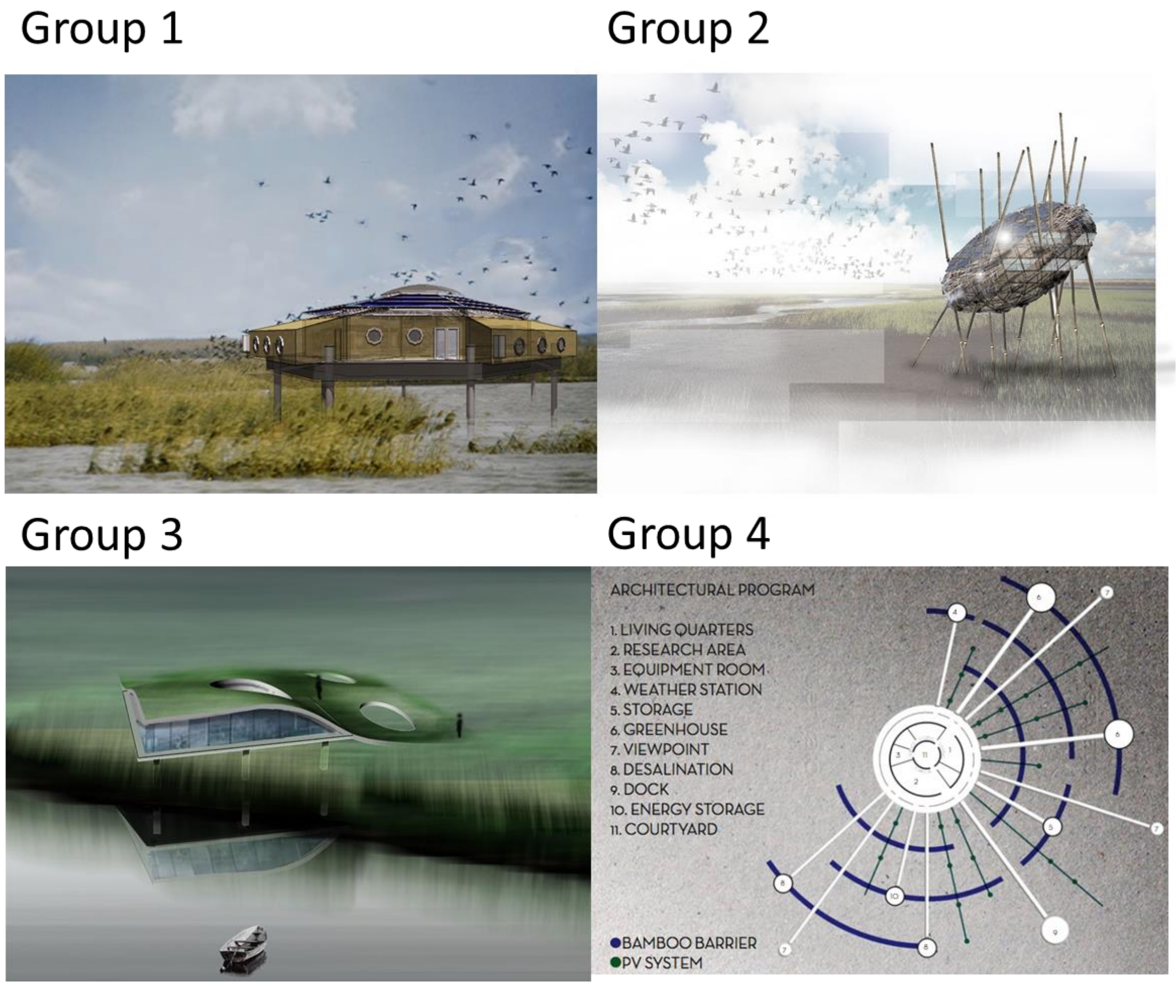

Figure 1: The final concepts of each group

Group 1: ReFLEX

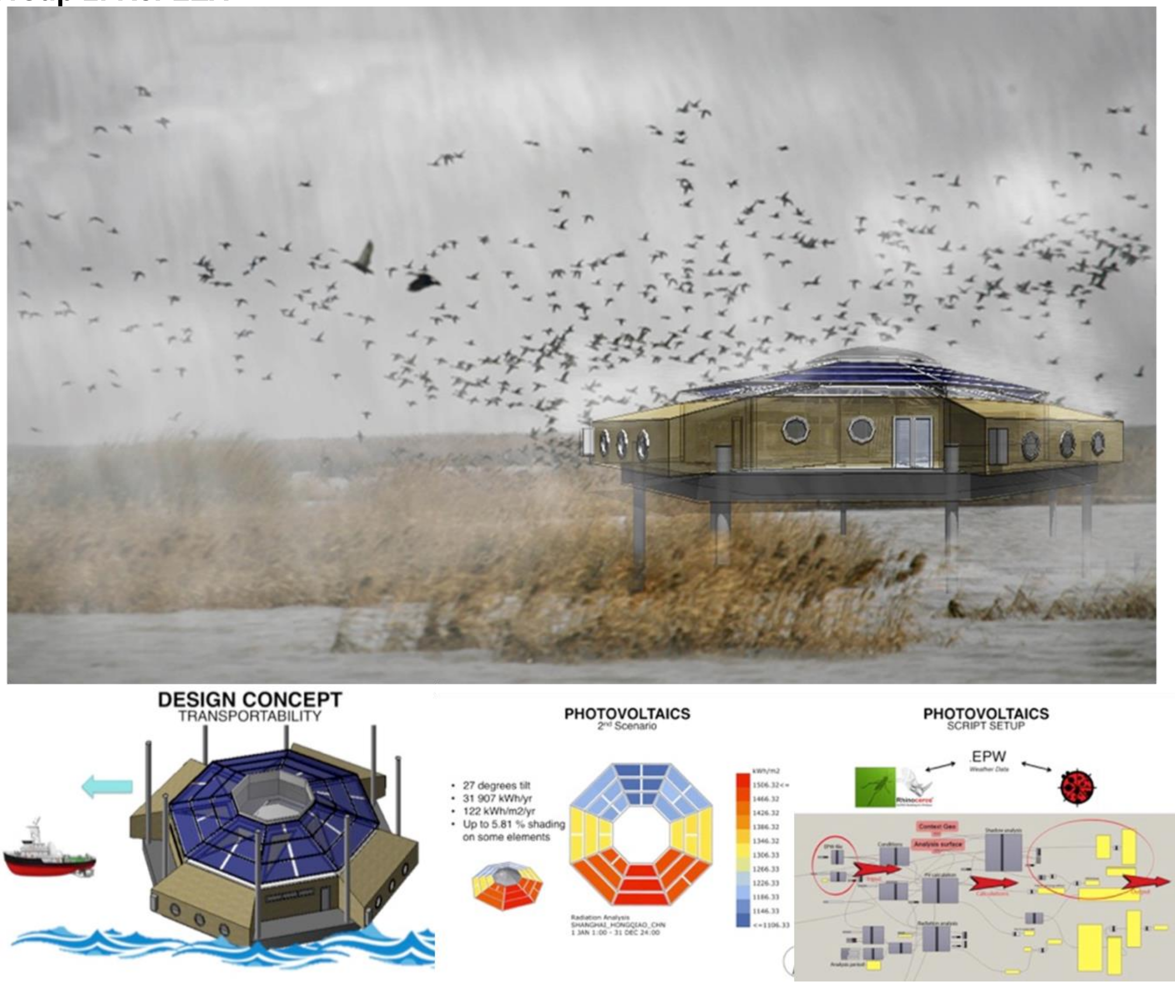

Figure 2: Group 1 design details

Group 1 ended up with a transportable and flexible design that was intended to cause a minimal impact on the wetland islands. The design driver of the project is the flexibility in which different modules could be interchanged depending on the usage and the needs of the research facility and the researchers. Four of the modules are fixed, while four can be interchanged. The facility is transportable by using ‘barge technology combined with a jack-up leg system to be able to raise and lower the building’ (Final report, Group 1). Group 1 got this flexible idea early in the design process and they developed it during the entire period of the summer school. The idea of transportability came through a discussion of how to best preserve the islands, as well as being able to move out in case of typhoons and bad weather. Around this idea the students discussed how to achieve the design. Their idea of flexibility and transportability strongly impacted the technological solutions chosen, as they had to rely on a floating solution which implied solutions for everything from the engines that would drive the jack-up legs to the floating capacities of the barge and technological detail of the building envelope.

Group 2: HongYingPiaoMiaoGe Research Center

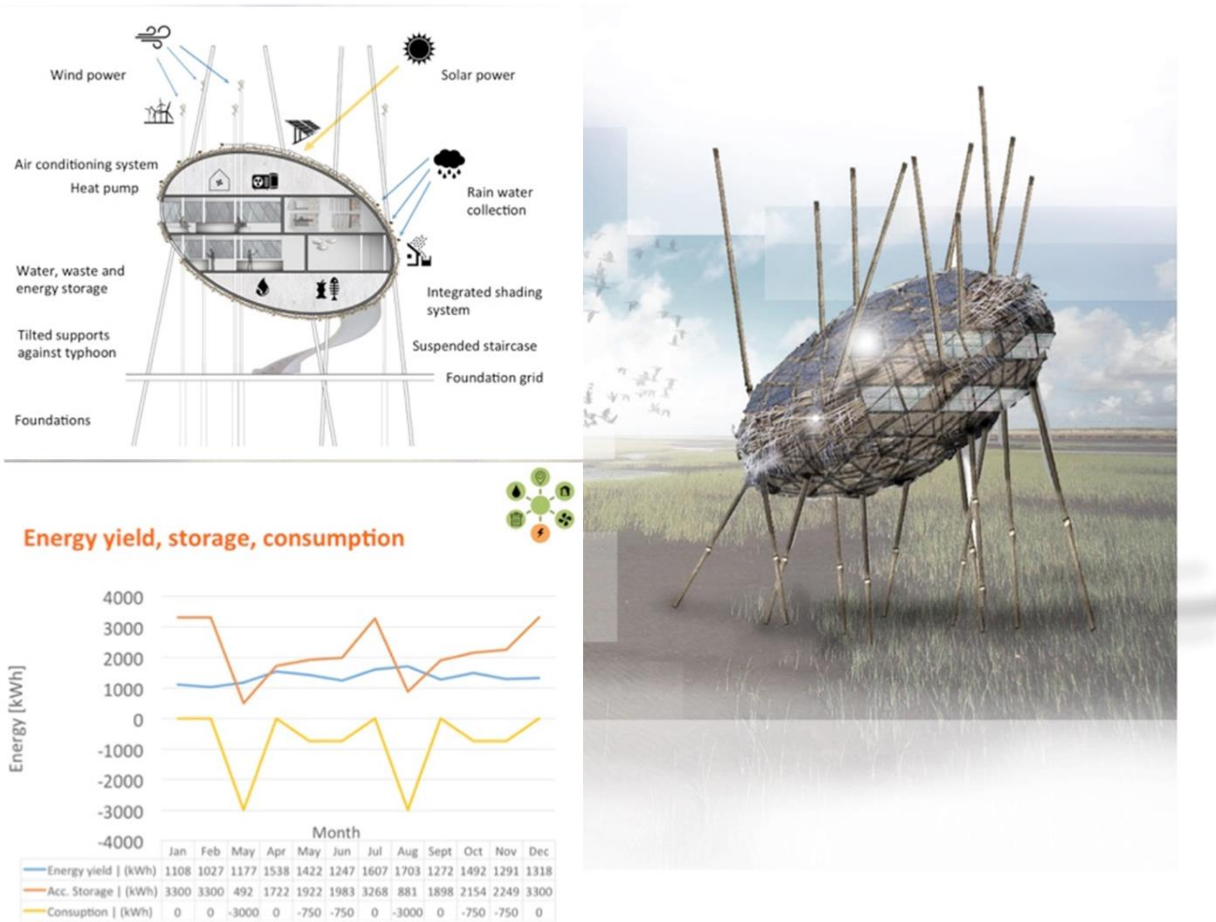

Figure 3: Group 2 design details

Three guiding principles were guiding this group's design approach: research, preservation and awareness. As the final report of Group 2 explains, the design:

> represents a bird's nest, elevated, held up and protected by humans, as to emphasize its importance to the island and the beauty of its surroundings. The shape's similarities to an egg that is breeding life and will eventually hatch, symbolizes the power that successful research inside the egg can contribute to.

Moreover, 'raising awareness among the public' was important to emphasise for this group, and also justified the design choice, which 'masters the art of standing out as a landmark and architectural spire' (Final report, Group 2). Group 2 was inspired by the local environment on the wetland islands described in the video provided with the design package. The group came up with the first idea of a nest, and much effort was focused into trying to get a buildable and functional design. This very strong first idea caused complications regarding the interior design and space zoning. The presence of what we call an intermediary person being able to speak both English and Mandarin fluently was beneficial for how the team worked together.

Group 3: The Green Wave

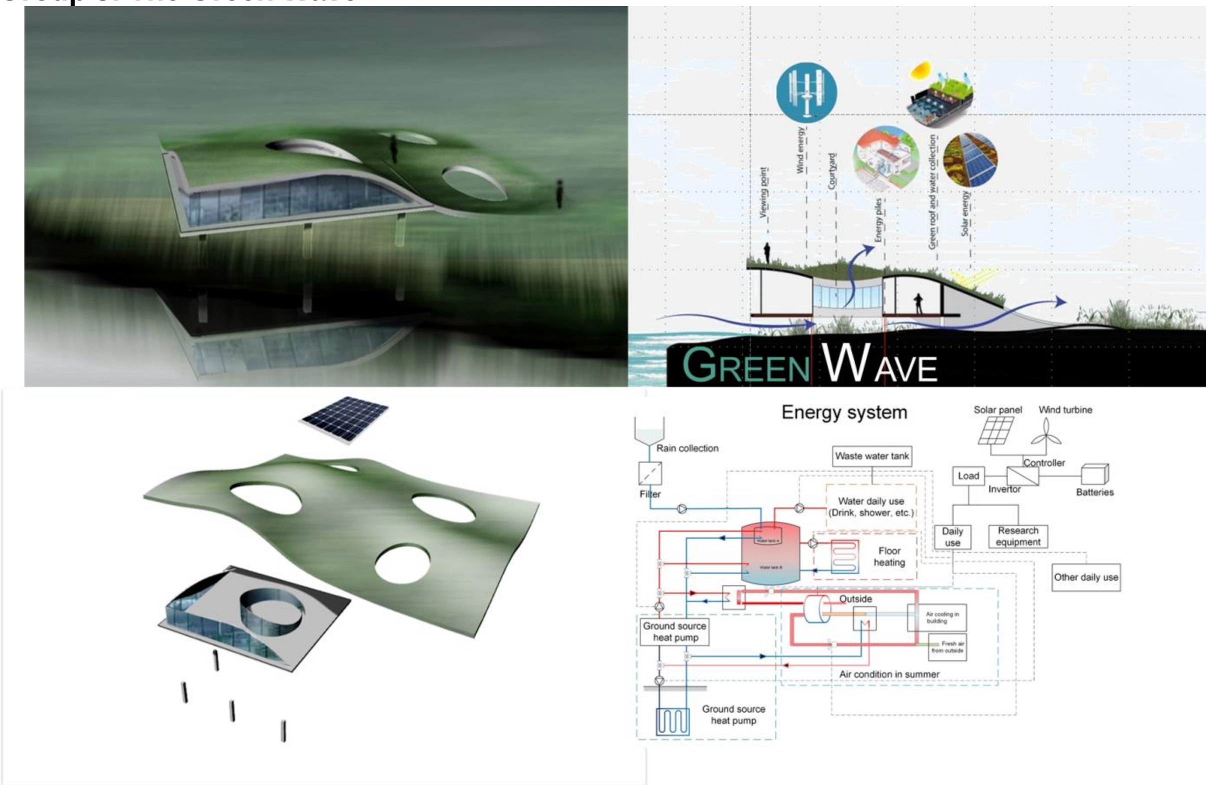

Figure 4: Group 3 design details

This group had as a main design objective to blend in with nature within an area dominated by a monsoon season, which creates high wave risk, sea level rise and the deposit of sandy sediments. For this reason, their design inspiration was 'the waves and how the waves can create land' (Final report, Group 3). They also argued that the researchers should have a 'high-quality comfort', meaning that they should not only have the bare minimum to survive out there, but should be safe and comfortable during their stay at the research facility. Group 3 also had an intermediary person mastering Chinese and English fully, something which appeared to make the group work better together from the start.

Group 4: Jiuduansha Lotus Research Station

Figure 5: Group 4 design details

Similar to the other groups, this group emphasised research, preservation and minimum impact on the islands in their design choices. However, they based their design on two principles: (i) the research facility should be a landmark in which the Shanghai citizens could recognize themselves, and (2) they considered loneliness to be 'one of the main concerns for users inhabiting this building […] since they find themselves isolated in a secluded area from civilization' (Final report, Group 4). For this reason, they developed a floor plan 'that promotes social interaction'. Moreover, this group was inspired by a local type of architecture called the 'tolou typology', particular for Southern China. The members of this group struggled to build social relationships during the first week, and worked somewhat independently on the architectural concept and the engineering strategies. The idea of the landmark appears to have been something the two architects of the group were pushing through. After a meeting with the teacher team in which the issues of disciplinary integration and leadership were brought up, the group worked better as a team the second week, and were able to agree on several important aspects of the design, such as the siting and the purpose as a landmark. The presence of an intermediary could have improved the communication level and the cooperation within the group during the entire period of the summer school by avoiding misunderstandings.

AGREEING ON SUSTAINABILITY

Taking as point of departure that sustainability is an interpretive and interactive process depending on the outcome of how well the groups were integrated, we now discuss what type of consensus of sustainability the groups reached, and how they got there.

Each of the four groups chose a different design approach, and different types of active and passive systems. In terms of microgeneration technologies to power and heat the facilities, they all chose a similar set-up: a mixture of PV, small wind turbines, battery storage and/or fuel cells. Another important feature for the four groups' assessments of the sustainability of the research facility was the siting of the facility (see Figure 6). Group 1 thought that there should not be any fixed installations in such pristine area. They decided to design a floating installation that could be pulled out to the islands when needed, and also moved around according to weather and research needs in other locations. Group 2 and 3 decided to locate their facility at roughly the same place, namely close to an already existing installation on the islands with boat landing facilities already in place. It was argued that this would create minimum impact since infrastructures already were in place. Both groups were inspired by local environment and materials, such as the local reed, sand, and changing climate conditions in the area, and were seeking to 'blend in with the nature, to be one with nature and to not disturb it more than necessary' (Final report, Group 3). Group 4 chose an altogether different approach by locating the research facility in the sea between Shanghai and the islands. It was argued that this location would not create any impact at all, and it would also create an additional purpose: to serve as a landmark visible from Shanghai that would inform citizens about the presence of a fragile and pristine natural environment represented by the wetland islands. They wanted to make the city connect with the island and create a relation between them.

The four groups chose two main siting strategies connected to their understanding of sustainability: Group 2 and 3 went with a type of intervention but with the aim to 'blend in'. Group 1 was very clear about non-intervention and Group 4 intended to create a new connection and relationship with the city. Both latter designs were thus opening up for other purposes than strictly being research facilities for these particular wetland islands. Reaching this sort of consensus in each group about how to interpret sustainability was a rather cumbersome process. The main challenges as documented both through the group discussion and in the final survey was the language barriers that existed, particularly for the Asian students. The presence of an intermediary person in the group was of great advantage. For example, Group 3 discovered early on that there was another building on the wetland islands, and this finding shaped their design and decision about siting. This was achieved in large part because the group had a student who mastered both English and Chinese, giving members of the whole group access to a larger amount of information in Chinese. However, despite having an intermediary person, during the next phases of the design process this group struggled for some time to come up with the final design. In other words, the initial advantage of an intermediary was not enough to create a well-functioning team.

On average, the European students were much more talkative from the outset, but they soon realised they had to give space to the Asian students in order to draw from their expertise in the project. A shared experience was that no one was expert in doing this particular task, and they had to build on each other's knowledge in order to find good solutions. Asian students were more cautious about saying their opinion, but the practical and hands-on situation appeared to aid them. One Korean engineering student put it this way:

> The summer school is very useful for me because usually I just solve problems on my computer or in my lab, and I usually start with calculations first and then find a solution to an equation, but

> this is not the same: there is no equation here. We have to talk and communicate, and I feel that this is very helpful to me.

The group games that were organised also speeded up the process of getting to know each other and were useful in building trust between members quickly. Since language barriers were prominent and impeded the collaborative process, the group games made the students feel more relaxed about making mistakes and knowing that they would have the chance to be heard and explain themselves.

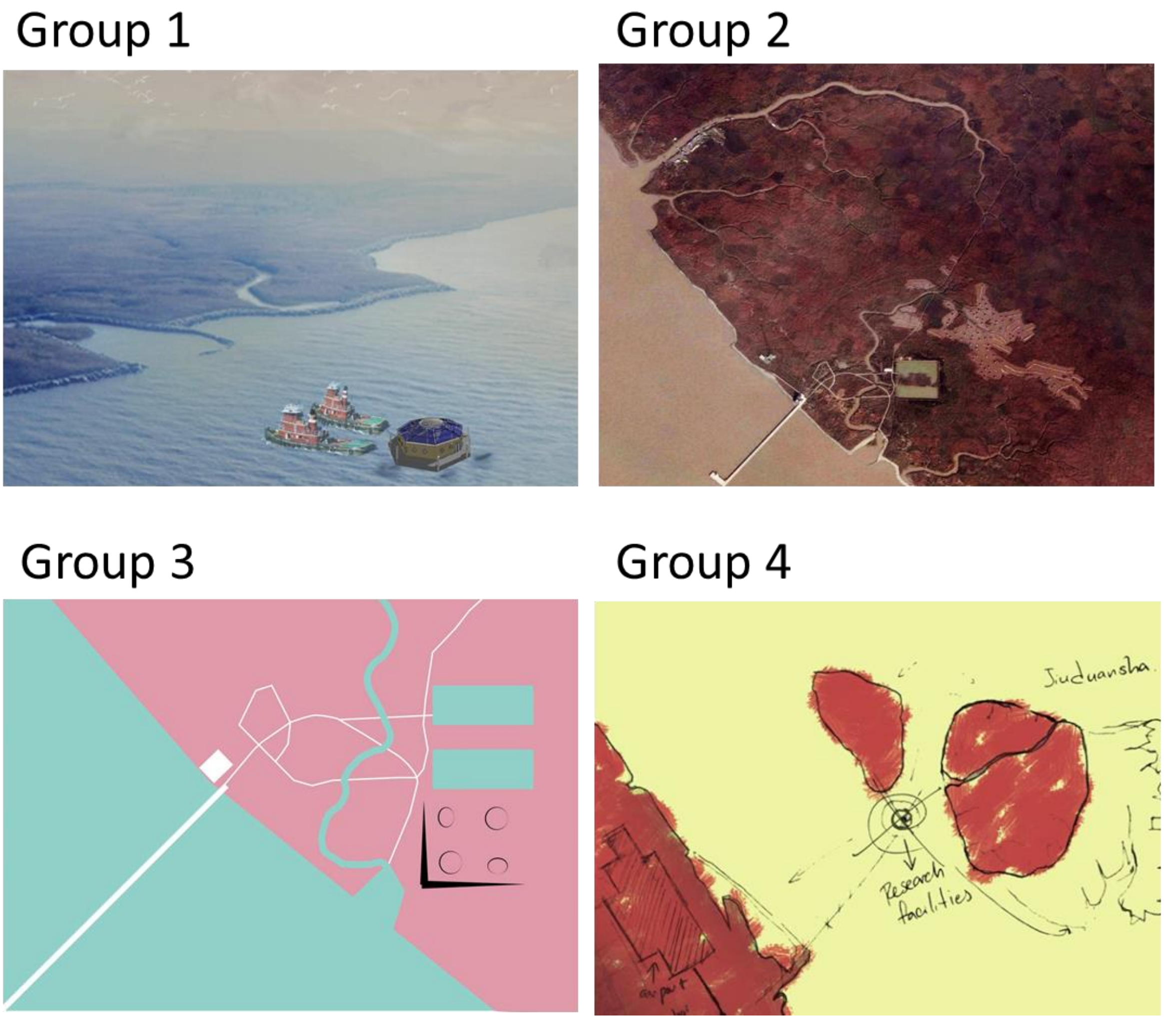

Figure 6: The different siting strategies chosen by the groups

CONCLUSIONS

What we can conclude from this research is that there was great diversity in the proposed solutions, and each solution provided well-grounded arguments for their choice. Therefore, what is sustainable depends on the assumptions made and the process in which the end result is reached. For the four groups of this summer school, we saw priorities ranging between different matters of concern: ‘blend-in’ or no intervention, fixed or floating installations, high comfort or a bare minimum of energy production, a landmark or more functional designs. Group 2 won the final design competition with a jury consisting of representatives from research, industry and the local municipality that considered building the research facility. It is possible that they won because it was the most visually appealing concept or because the group performed better during the final presentation, and not because it was the

most sustainable design. Such considerations should also be taken into account when assessing the sustainability of a chosen architecture.

When dealing with sustainability the learning effects from meeting new ideas, ways of doing things, disciplines and cultural backgrounds contribute immensely to what sustainability is or can be in each case. Arguably, a sustainable project is not achieved unless all parties have taken part in the design process. In the summer school, this experience was manifested in the importance of these master students gaining a mutual understanding of what they wanted to achieve, before they embarked on their final design. The mutual understanding was sometimes facilitated by what we call an intermediary person that masters both English and Mandarin. Nevertheless, arriving upon different choices, for instance, of whether to go for a fixed installation or a landmark was a process marked by a constant re-negotiation of their mutual understanding. Hence, the sustainability of these four designs was always anchored in the agreements and consensus they were able to achieve within their group.

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[2] Ibid. 224

[3] Ibid. 223

[4] Ibid. 226

[5] See e.g., Rietje van Dam-Mieras, Angelique Lansu, Marco Rieckmann and Gerd Michelsen, "Development of an interdisciplinary, intercultural master's program on sustainability: Learning from the richness of diversity," *Innovative Higher Education* 32(5) (2008); Kerry Shephard, "Higher education for sustainability: seeking affective learning outcomes," *International Journal of Sustainability in Higher Education* 9 (1) (2008); Ralf Hansmann, "'Sustainability learning': an introduction to the concept and its motivational aspects," *Sustainability* 2(9) (2010); and Benjamin Karatzoglou, "An in-depth literature review of the evolving roles and contributions of universities to education for sustainable development," *Journal of Cleaner Production* 49 (2013)

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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally

AMPS, Architecture_MPS; London South Bank University
09—10 February, 2017

YOUNGER INDUSTRIAL AREAS AS AGENTS FOR SUSTAINABLE URBAN TRANSFORMATION

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INTRODUCTION

This paper puts forward a critic on the practice of expanding the urban fabric for new housing instead of looking into the possibilities of transforming existing areas in chance. The paper builds on a Ph.D. project in progress called: Uncertain conditions – spatial strategies for younger industrial areas. The subject field is younger industrial areas designated by the planning authorities for a future urban renewal, but face an uncertain and long transformation process. Today, depending on the areas' geographic and economic context, two overall reactions can be seen: Either the areas are cleared for redevelopment - or ignored. On the base of an design-oriented mapping of the areas the paper argues it might close an opportunity to utilized the areas to shape future sustainable urban communities in terms of diversity and cohabitation in programs, housing and biodiversity, new green connections, appropriation and stronger local economies.

A design oriented contribution to an interdisciplinary field

Understanding the practices that produce the areas calls for an acknowledgement of the heterogeneous world of hybrids[1] and relations between the areas' actors. It could be the building morphology, stakeholders, political decision makers, technological progress, logistics, changes in the real estate marked, the planning act etc. Acknowledging this, the aim of this paper is to contribute to this interdisciplinary field with a design oriented perspective.

This perspective is here positioned in three fields of research. First, it is theoretically based in the field of landscape urbanism[2]. This thinking is linked both with the field of actor network theory[3] and lined with an understanding of the landscape, not as an object, but as a process or open work[4].

The method for gathering information is case-based and includes desk-top research, on-site registration, interviews and walks on location with local stakeholders, municipal planners, an industrial consultant and a biologist. The information is categorized in thematic maps using five qualitative objectives to sort the information across the methods. On the base of these mappings the paper aims to contribute to the discussion on how to recycle the postmodern urban landscape. It falls in three parts of the paper. A case-based mapping of the urban landscape value in younger industrial areas and a reflection on how these findings can open an opportunity for a sustainable transformation process and examples from related international projects point that point towards references for inspiration.

YOUNGER INDUSTRIAL AREAS REVISITED

The paradigm of functional planning founds the ideological background of establishing the industrial areas with a utility-oriented economic aim in the 1950'es [5]. Political prioritized as crucial areas for the economic strength both locally and nationally the areas are placed on former farmland 1-3 km outside the historic centre, close to efficient infrastructure[6]. The areas are designated for industrial development and isolated to prevent environmental hazards with neighbouring urban activities (e.g. housing) [7]. Built to serve the industries the building typology consists mainly of prefabricated warehouses, smaller offices and affiliated private homes. The layout of plots and infrastructure is rational structured with gaps for expansion, security and environmental zones and outdoor storage[8]. This structural and functional typology is found in most western developing countries, of course with numerous local variations.

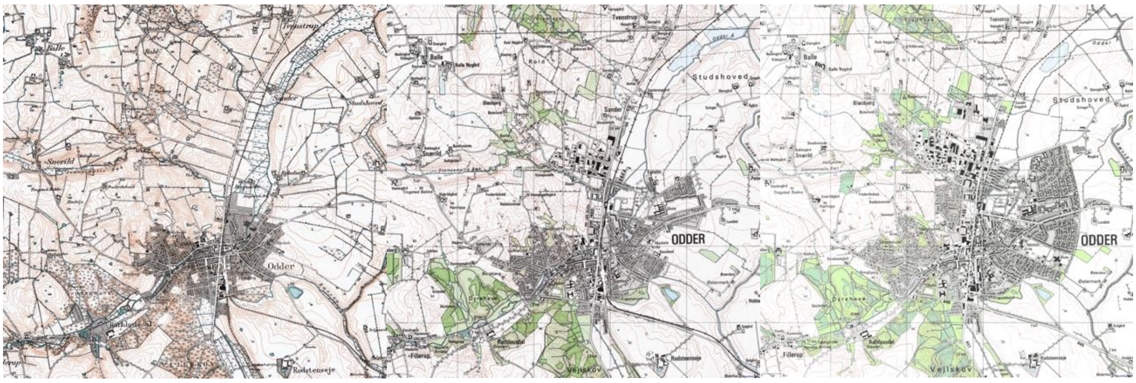

Figure 1: Development of the industrial area; Odder North. Map (left): 1902-1972: Map (centre): 1953-176. Map (right): 1981-2001.

From mono-functional industrial area to multifunctional use

The change today can be read as a continuation of that history, from a local reconfiguration moving workshops from the city centre to the industrial areas. To today where industries are highly influenced by the global forces' impact on industrial structures and challenging some as prosperous industrial areas. In Denmark, figures show a vacancy of buildings equivalent to 25.000 homes. Although the impression of deindustrialisation and the increasing abandonment seems to be the protagonist in the public voice figures points towards additional observations. Low-tech industries increase staff numbers[9] and vacancies are decreasing[10]. The current decrease is a response to the national economy picking up. What statistics does not show is that while it is true that some buildings do attract new industries others industrial buildings are now occupied with new functions.

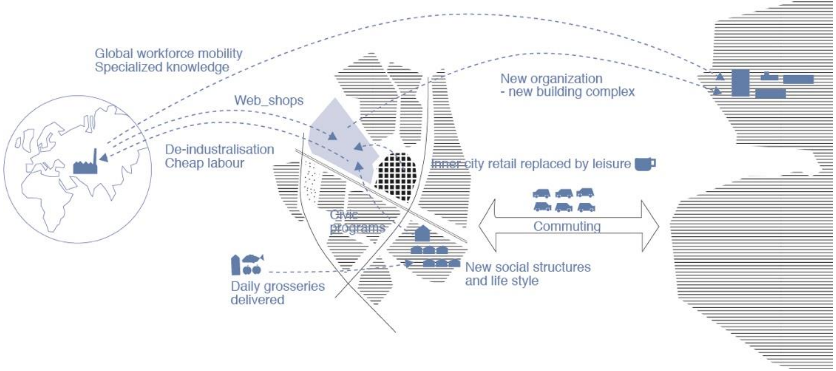

Figure 2: Diagram representing a few of the dynamics creating the transformation in industrial areas

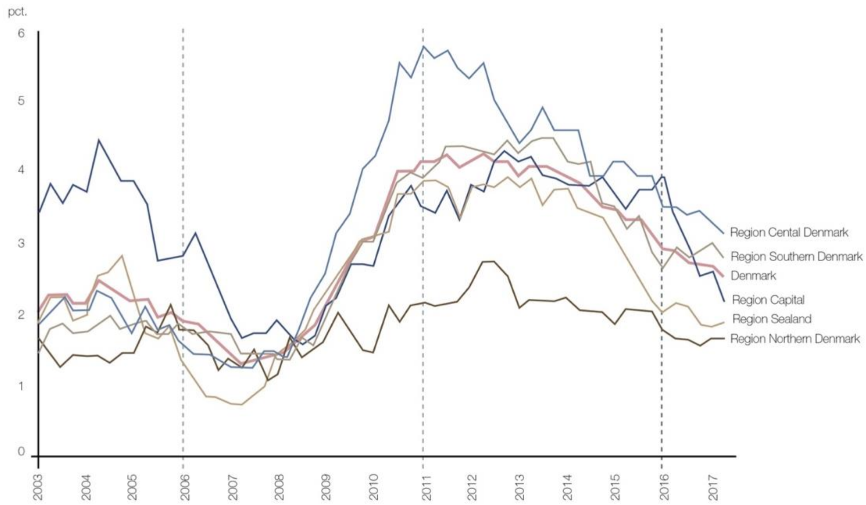

Figure 3: The chart shows the development in vacancy since 2003 and how these both follow the local and global economy. In 2017 the vacancy correspond to appx. 25.000 housing units.

Looking at the areas today it is a heterotopic scene of expensive cars parked in front of a newly expanded building, while the neighbouring plot has been abandon for years and plants are going wild. Few meters down another building a holds a store for reuse, on the next street a workshop is transformed to a fitness centre and another building is now a dance studio. A former print-shop has become a socio-economic drop-in centre and an obsolete building is used as a hangout for alcoholics and teenagers skating and making art exhibitions. From being a clear, defined typology as an industrial area, the area is changing into a multifunctional enclave with a wide diversity of people.

Figure 4: Three different situations in industrial areas in Denmark. Left: Abandon buildings, Center: Reuse for new civic activities Right: Prosperous industry

UNDERSTADING THE AREAS VALUES ANEW

Instead of preserving the idea of the industrial areas as a mono-functional area and assess it as such it is more productive to redefine the areas according to the current situation and its possible values[11]. As if it is a new typology part of the contemporary urban fabric[12].

The following presents the city of Odder as a case. It is one of three case studies conducted in the Ph.D. project represent three different urban situations for younger industrial sites. The case in Odder demonstrates how the situation and the possible values can be made legible by mapping the areas using the five objectives: Appropriation; cohabitation; connectivity; diversity and porosity. The objectives are described in the article: Qualifying Urban Landscapes written by Tom Nielsen, Morten Daugaard and Thomas J. Clemmensen. They are developed on works of urbanists Thomas Sievert, Paola Viganò og Franchos Ascher.

In the following section the objectives are presented first, secondly how the objectives are translated to specific registration and finally the actual mappings and a short reflection on the findings.

The industrial area in the city of Odder as a case

The city of Odder is appx. 12.000 inhabitants and representative for smaller cities in many ways. It is placed 30 km south of Denmark second largest city Aarhus.
It is expecting a growth of 50-60 new houses per year and the municipality has reclaimed farmland in the periphery to accommodate the new housing areas. This practice raise the question if being aware of possible values in the areas change could open for a transformation of the area to be utilized to create a new type of development, including housing. The benefits would be reuse of the existing infrastructure; proximity to the services in the inner city, the light rail and create a new type of mixed area combining industry, housing and new recreational and civic programs.

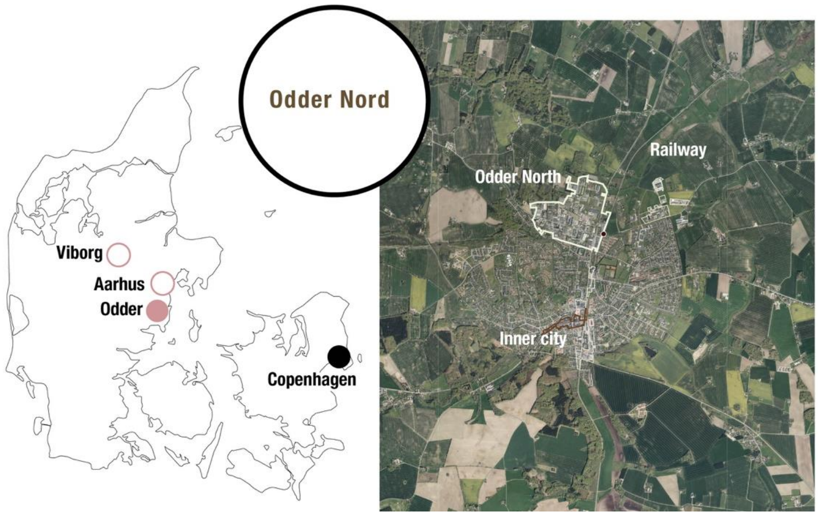

Figure 5: The three case studies behind this paper are placed in the Central Region of Jytland, Denmark. They represent three different urban situations. In this paper presents the findings in the smaller city of Odder North.

Figure 6: The city is solving the needs for housing by expanding the urban fabric into farmland (dark green). Could a transformation of the industrial area in the north of the city (blue) include some of the housing instead?

Mapping appropriation

Appropriation describes the possibility for people to interact with their environment and its material qualities[13]. If the urban landscape is to be recognized as a part of the cultural world, and not merely a landscape of instrumental interest it is necessary to create a socio-aesthetic engagement. Signs of appropriation might not be obvious. However, taking a closer look appropriation can be noticed in three different ways: a) The building or outdoor area is designed or taken special care of b) The users are taking ownership through alternative use or c) inhabiting the area to accommodate their individual needs. What is interesting to notice here is that the aesthetics from gardens in single family houses and is transferred. Outdoor areas along the front side are maintained like a garden, with cultivated front side to the 'main street' and a messy backside for storage.

Figure 7: Appropriation in the industrial areas can read in e.g. careful maintenance of the outdoor area (almost like a garden), alternative use (Cross fitness) and inhabitation of the outdoor areas for individual need (storage).

Figure 8: Mapping the types of appropriations gives an indication of a front stage along the largest street where maintenance of the outdoor areas is high and a back stage, where the areas are inhabited for individual needs often in a pragmatic or instrumental way.

Mapping cohabitation

Cohabitation addresses the ability of the area to 'house' a variety of lifestyles, cultures, activities and interest[14]. The objective is to blend different urban environments at an appropriate scale. Mapping the programs reveals a diversity of activities. Here categorized in production, workshop, storage, retail, non-profit programs and sports. The sports and non-profit programs are often open to a wide range of people and functions as 'nodes' in the area. From being mono-functional, the mapping shows a diverse area.

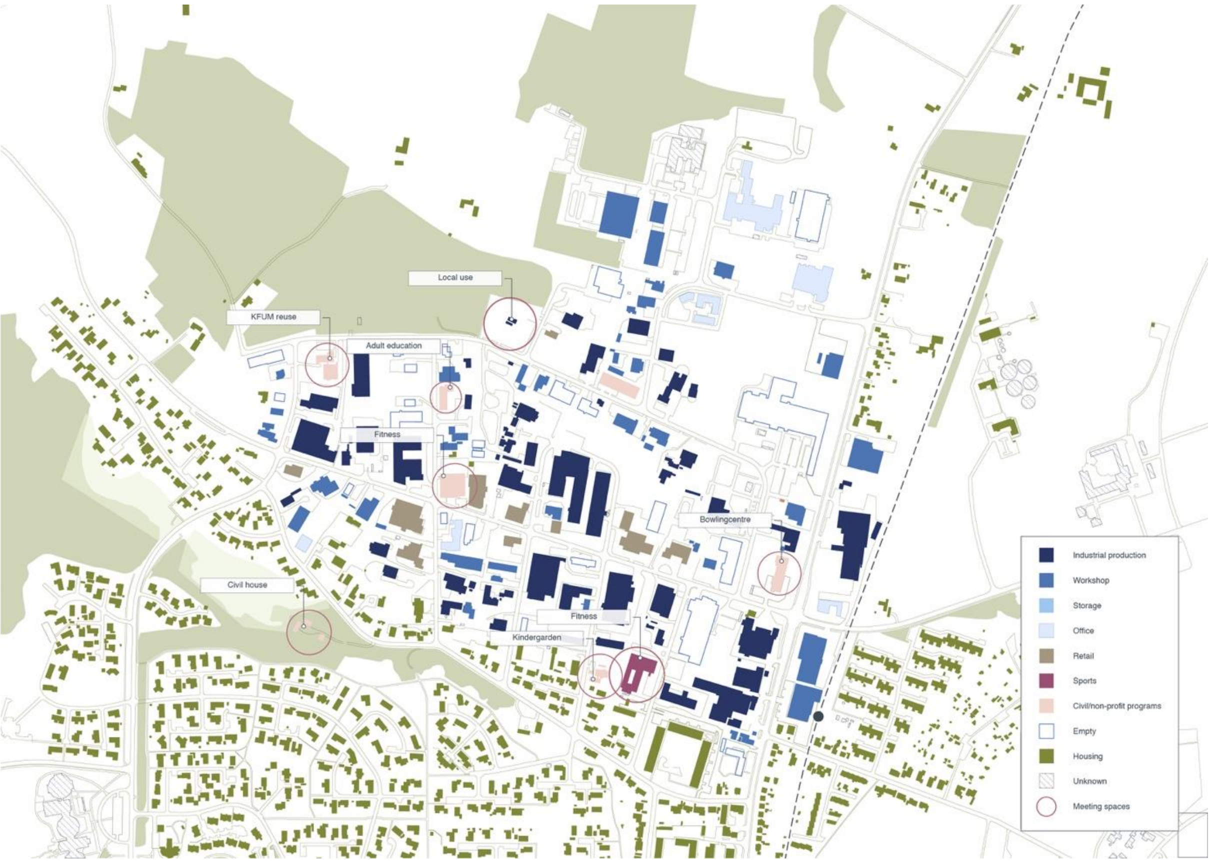

Figure 9: Mapping the different programs in the areas gives an impression of a diverse area in a sea of family housing (green).

To understand the interaction between the programs, their relations/interaction within the area were mapped though walks and interviews. They reveal a network of local relations within the groups, but it also shows lack of interactions bridging the groups. It also shows the programs with the largest network is the one having been there for longest. This calls for an interest on the potential of strengthening and creating collaborations between e.g. the education for young adults and need of skilled labour in the industries.

Figure 10: Mapping the interaction between the activities in the area. Left: Non-profit reuse store (5 years). Middle: Cross fitness (12 years). Right: Production industry (more than 25 years)

Mapping connectivity

The objective; Connection is concerned with the how between different elements in urban landscape can be related with physical spaces that connects across scales and zones. Some connections are double coded and can work as ’glue’ between the urban elements and functions. The mappings are concern first with the current existing connections and landscapes and secondly with the possible connections (fairly) easy to establish or double code.

Figure 11: Mapping the connectivity –(left) formal connections and (right) possible new connections.

Figure 12: Example of a possible path using the existing infrastructure and gaps in between buildings.

Mapping diversity

The objective; Diversity address the areas the ability to accommodate a rich variation of biological diversity in different types of landscape. Biological qualities are usual not a part of the understanding of these areas, however walks and registrations with a biologist show a rich diversity including protected plants. Lack management creates self-grown biotopes, other plants feeds nutrition poor soil and insects live in the rubble. These findings open for a new thinking about the areas as possible areas to increase urban biodiversity.

Figure 13: Mapping the diversity of the landscape, possible corridors and sources for biological spread and soil conditions in the industrial sites

Mapping porosity

Porosity is described as the ability of "different structures to absorb movement and change"[15]. It is described by Paola Viganò and developed from her work with different metropolitan zones among these the competition Le Gran Paris[16]. The mappings of Odder has weight on the amount of open spaces, the capacity to absorb spatial and constructive transformation and finally a reflection on the areas capacity to hold water.

Figure 14: Left: Risk maps of flooding shows that the area is not high risk of being flooded, but the area just below (blue) is subject to flooding. Right: Large areas for parking and storage are covered with impenetrable surfaces. During heavy rainfalls the surfaces collects large amount of water stressing the sewage system.

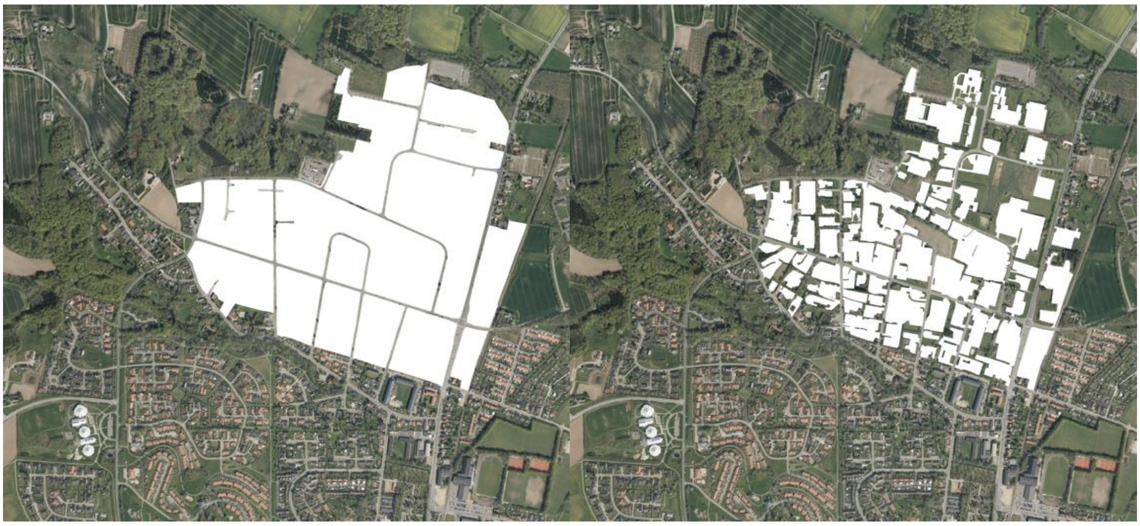

Figure 15: Left: Mapping the amount of free space. The area today consists of private plots only penetrated by roads. However. (Right) Extracting building and paved private surfaces creates at map of a penetrable fabric of roads, green belts, green alleys and open green spaces.

Figure 16: Mapping porosity – The capacity to absorb spatial and constructive transformation. With simple adaptions, the building structure are being transformed from industrial use to e.g. youth education (upper left), social economic reuse store (upper right), fitness centre (bottom left) and bowling run by volunteers (bottom right).

The mappings render the area's the possible porosity. The buildings adapt fairly easy to alternative functions of both civic, private and public use. At the moment, the adaption is happening randomly on individual basis. It is however easy to imagine that reducing barriers and improving permeability in the areas' landscape infrastructure could invite to collective changes and new uses, while preserving the individual entrepreneurship, drive and needs. Furthermore, the open green spaces hold the capacity to handle water locally relieve stress on the sewage system.

Findings across the mappings

A short conclusion to close this section on the mappings. They show the area holds potential for raising the diversity in biodiversity, programs. There is space for introducing housing, but solving environmental hazards and smaller transformations are necessary. The area holds possibilities for new green spaces and connections. They could host urban biodiversity and recreational spaces for the city and the new programs. The new programs are disconnected across the categories, but with interest from the stakeholders to investigate how they could benefit from each other creating a new base for a sustainable local economy.

POSSIBLE STRATEGIES FOR TRANSFORMATION

The many owners and stakeholders with different interest call for an agile transformation that can adapt to the uncertainty. This third part of the paper presents three examples on strategies for an agile transformation process. The three examples are also chosen to show how the mapped values could be developed and are of course are not exhaustive. They point towards ways of addressing a sustainable transformation with a spatial perspective. These should be supported by other initiatives, e. g. Entrepreneurial, social, cultural and economic incentives.

Organic 'micro-regeneration': City plots

Buiksloterham, a brownfield regeneration area close to Amsterdam city centre works with a concept called organic planning [17]. The process of the transformations consists of multiple activities, both cultural and activities involving the future actors in the planning process giving room for 'self-builders.' The area is divided in a 'game board' of larger plots with rules for programs and overall spatial principles. These plots are broken down into 'city plots,' and within these, the layout can grow organically as needs arise [18]. This organic strategy might be able to address the need for a slow regeneration keeping the existing activities.

Figure 17: Buiksloterham in 2015

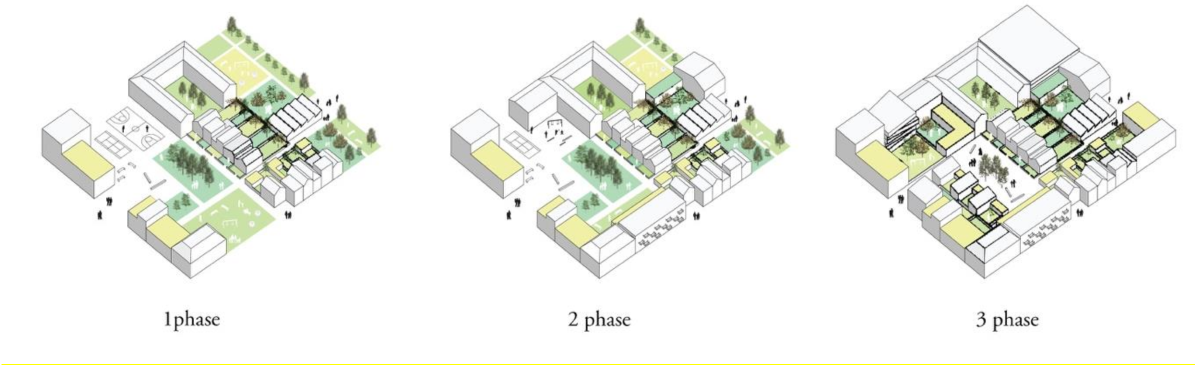

Figure 18: Redevelopment of the brownfield area Buiksloterham in Amsterdam divides the area into smaller city plots that grows organically.

Creating green spaces for the city

Introducing nature and landscape design in former industrial areas are widely used as a mediator to establishing a new identity, invite new users into the area and to create a new type of public spaces in an industrial area still partly functioning. This can be seen at the Naval Ship Yard, in Philadelphia, USA[19]. Here the overall masterplan is supported by a strong focus on landscape architecture[20]. Large areas still to be transformed are lightly maintained allowing room for wilderness and wildlife, while the open spaces close the new or converted buildings are carefully sculptured and design to foster new use and identity[21]. Using the mapped porosity in the industrial areas, the possible connections and nurturing the biodiversity diversity of the landscape could accommodate needs of the new users, the workers in the industries and give new green spaces and connections to the city as a whole.

Figure 19: Redevelopment of the brownfield area Buiksloterham in Amsterdam divides the area into smaller city plots that grows organically.

Addressing the need to include the existing and the new

When the Phillips factories began to move their activities 20 years ago it was decided to use Strijp-S to become a world leader in technology and innovation. Through partnerships, new companies are established and test new knowledge in energy, soil purification, parking, lighting in the city at the site. The Strijp-S organisation behind develop the area slowly by continuously supporting the activities, adding new qualities and allowing the physical framework to evolve. The industrial areas in focus here in this paper have a very different morphology and ownership. Still, inspiration can be taken in considering on how the established companies can develop through the new programs and network. This could be the source of developing a local sustainable economy and social capital.

Figure 20: Urban entrepreneurship in Strip-S in Eindhoven.

CONCLUDING REMARKS

The values and potentials mapped in the areas open an opportunity for a dialog on how to utilize the areas to shape future sustainable urban communities. The different mapping and suggested strategies point to the possibility for diversity and cohabitation in programs, e.g., through common industrial spaces, innovation and education programs with the aim of stronger local economies. With acknowledgement of the difficulty in handling the environmental hazard is seems spatial possible to introduce housing in smaller scales, alternative models for ownership and creating a strong identity around them. This identity could be supported by green spaces and corridors creating urban biodiversity and new recreational spaces and connections.

Figure 14: Water risk, Odder Municipality, with permission
Figure 18: Studioninedots, with permission
All other photos, maps and illustrations by the author.

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[3] In this article, the actor-network theory is mainly drawing on inspiration by the planner Robert Beauregard’s work on the relation between human and hon-human actors and planning. See Robert A. Beauregard, *Planning Matter: Acting with Things* (Chicago: The University of Chicago Press, 2015).
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[8] Photo-registration and observations in following industrial areas in Denmark: Aarhus South, Odder North, Viborg Baneby, Delika in Hammel, Vejle South and Odense habour. In additional to this interviews have been conducted with the planning authorities in the municipalities of Vejle, Odder, Hammel and Viborg.
[9] Jensen et al., *Den Grænseløse by*, 105–7.
[10] Mads Lindegaard, "Oline-ED Statistikken" (Dansk Ejendomsmæglerforening, 2016).
[11] The area's heterotopian character and atmosphere of sites in decay lead our minds to notions like Solá Morales: Terrain Vauge [11]or Alan Bergers: Drossscape [11]. The concepts and names carry values on how we perceive their both their current qualities and their possible futures. Are they worthless "wastelands" or prosperous "brachland" waiting for investment? In her book Beauty Redeemed Ellen Braae brings to our attention the caution needed when concepts are transferred[11]. Looking at younger Danish industrial areas they are different from e.g. the ruins of a larger production complex; the complexity of owners; the combination of abandoned and functional buildings; its detachment from the geology and topography of the place; lack of one identity; the rational layout of the area and individual neutral building typology. Thus it might be more productive initial to draw on Tom Nielsen's work with new typologies in the urban landscape and portray the younger industrial areas' current specific situation See Morales in: Cynthia C. Davidson and Anyone Corporation, eds., *Anyplace* (New York, N.Y. : Cambridge, Mass: Anyone Corp. ; MIT Press, 1995); Berger: in Waldheim, *The Landscape Urbanism Reader*, 202; and on transferring concepts in Braae, *Beauty Redeemed*, 47.
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[14] Ibid., 29.
[15] Ibid.
[16] Vigano distinguishes between five definitions on porosity: 1. Density of meaningful places; 2. The capacity to hold water structures; 3. The amount of open spaces; 4. The capacity to absorb spatial and constructive transformation; and 5. Accessibility. As some of the former mappings of Odder already include 1 and 5 the mapping has weight on 2, 3 and 4.
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[18] Interview with Arie van der Neut, partner at Ninedotstudio on their work with cityplot on Buiksloterham, Amsterdam. May 2015.
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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally

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09—10 February 2017

URBAN REDEVELOPMENT AND DILAPIDATED HOUSING REGENERATION IN HISTORICAL CITIES IN CHINA, INSIGHTS FROM XI'AN

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1. INTRODUCTION

Housing regeneration has always be a pondering issue in the historical cities in China. The rapidly expanding demand for housing and economic profits generated by real estate market, it's easy for Chinese cities fall into a large scale regeneration with no regards on the physical and socio-cultural environments, especially on the dilapidated housing which could be seen as the identity and cultural milieu for the communities. Without original housing space structure and local residents, a historical quarter is actually losing the roots of physical urban feature and local culture at the same time. Just like scholars pointing out[1], residents from these houses have a strong attachment to their place of residence, and this sense of community "glue" the concerned residents together and lead them to perceive and pass their relationships and knowledge on to following generations. This is the crucial part of heritage, which also make the culture unique and irreplaceable[2]. As Haberer[3] address in the "neighborhood approach", urban renewal is a social, financial, and organizational issue. Culture at the local level emerges as a key force to promote housing regeneration in the historical cities in China, such as Xi'an. Thus, The main points of this paper are

First, by going though the housing development in use in the past decades of China, reveals the top-down planning approach is widely used and the property-led approach might be the causes of large scale demolition and damages for the traditional housing and local culture.

Second, it also argues by the specific case of an historical city of Xi'an, concerning the housing development and planning methods specifically, it reveals the physical, social, economic challenges related to revitalization and rehabilitation of historical center in Xi'an focusing on dilapidated housing redevelopment issues.

Third, the paper proposing a culture sustainable approach which can be identify as a combination of bottom-up and top-down methodology with the involvement of addressing recent socio-economic and spatial considerations in the process of housing regeneration for historical cities.

2. BACKGROUND IN CHINA CONCERNING HOUSING DEVELOMENT

China's housing development is tied with several crucial points after the modernity. The first significant threshold points, is obviously the foundation of the central governor (Communist Party of China) in 1949, which has change the land ownership from private to state-owned. This provide

convenience to apply the urban planning theory into practice by that period if time. Influenced by the Soviet Union, theory of urban planning and management in China had a strong state-led feature. The so-called "Soviet model" was applied at every where in China, the cites in the country were composited by series clusters of state work-units. State work-units are more than just economic entities but, rather, are a special form of 'social organization'.[4]Every work-units works a integrated small scale city and society with all the urban functions including residence, commercial, education, business and so on.[5](Fig.1)

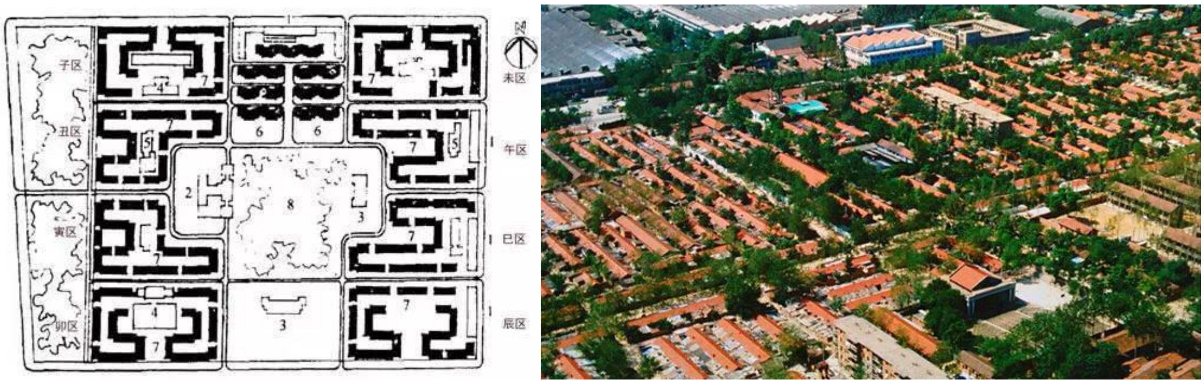


Figure 1. two typical work-unit housing projects: Beijing Baiwanzhuang and Xi'an Fangzhicheng[6]

In this way, the society was tightly managed by the state system through workplace affiliation.[7]. Housing during this period are designed within the work-unit more as fundamental infrastructure for the workplace and featured by the technical regulations[8] rather than the basic composition as urban elements for the city itself. The theoretical idea behind those designs were the concept of "Neighborhood Unit"[9], while the economical driving force is from the state, given 90% investments for housing projects are from the state.[10]

The urban development in China kept this track for 20 years until the Economic Reforms in 1978 changed China from foundations. Resources under the command system have been dispersed to the hands outside the work-unit system. Urban private businesses have emerged and created jobs that are no longer formally affiliated to a work-unit. [11] The change in urban space began after liased with state work-units to develop comprehensive 'planned' residential districts in the 1980s. [12] The work-unit system start to milt down, integration between workplace and residence has been transformed by large residential development projects. After 1978, the urbanization rate of China increased by 12.5 percent from 1978 to 1998 as compared to only 5.5 percent from 1952 to 1978.[13]

In the 1990s, the introduction of the central-local fiscal contract effectively started the decentralization of state power[14]. Local government has gained more discretion to arrange investment and to promote local growth: the enactment of the City Planning Act in 1989 gives municipalities the right to prepare urban plans, to issue land-use and building permits.[15] This is always considered to be the main channel of increasing necessary financial resources for local urban renewal projects, and the driving force for the massive large scale urban development.[16] Housing in the Chinese cities has been driven to a high speed road to booming since then and urban renewal activities have become a means to maximize economic returns because of the involvement of private developers. From the figures we could see that the living conditions for urban residents are certainly getting better, nonetheless, this achievement may come with price to pay, for instance, it pose tremendous challenges to the conservation of physical and socio-cultural environments in historic cities, like Xi'an. (Fig.2)

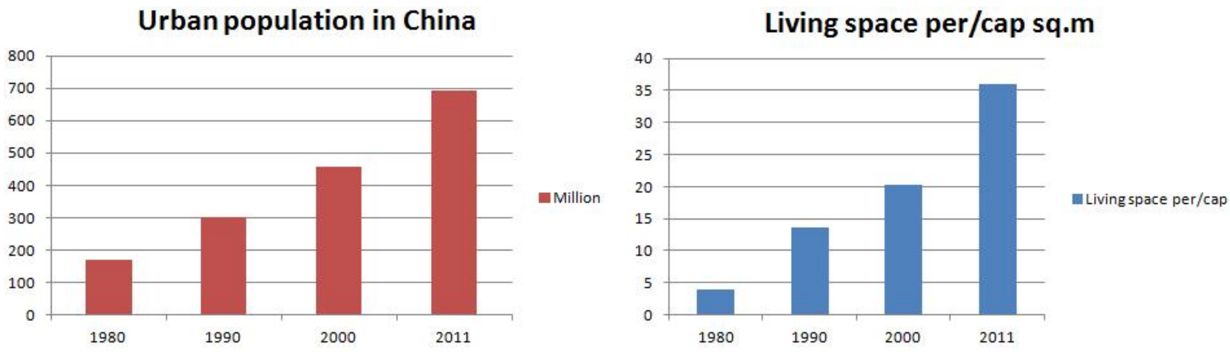


Figure 2. Urban population and average living space for urban inhabitants[17]

3. PRACTICE AND POLICIES IN XI'AN

Xi'an has a history of more than 3,000 years as a city and had functioned as China's capital city .[18] And was the announced on the first batch list of "National Historical and Cultural City"(NHCC) in 1982. Today as the capital of Shaanxi Province, Xi'an is the biggest industrial and commercial center, as well as the political and educational hub in the northwest region. Since the historic city center (from various dynasties) is overlapping with the contemporary geometry city center, it is very sensitive when comes to the urban renewal activities considering the conservation physical and socio-cultural environments. Conservation is a substantially important strategy in the regeneration of historic urban areas. Urban conservation practices focus not only on tangible elements such as heritage buildings and monuments but also on intangible elements such as indigenous lifestyles and customs[19]. Although Xi'an was announced as NHCC, today there is only the monuments stand as isolated objects inside the historic area of Xi'an. Housing, which are the basic elements to compose a featured city, experienced extensive and fast constructions and demolitions in Xi'an even in the historic areas inside the ancient city wall. Like the rest cities in China, local municipal governments seek to generate as much economic profit from local redevelopment projects as possible. densely populated inner city neighborhoods have been replaced by high-rise residential, or collective homogeneous compounds with standard design code which can provide more economic returns in short-range. The urban renewal process not only destroy the historic urban fabric but also consume a great amount of energy and resources especially, land.

3.1 Urban Housing development in Xi'an

From the Ming dynasty, the city of Xi'an was surrounded by the city wall[20] which is the physical boundary. The housing inside the wall is traditional courtyard houses constructed by traditional technology, until the beginning of 20th century. WWII is in fact stimulated the city to develop as a modern city in the sense of planning, construction, etc. [21]. After the Republican Revolution of 1911, the total floor area of housing is 1500,000 sq.m., and according to the data in 1949, the housing in total has reached to 2315,000 sq.m, while the average housing floor area is 3.32 sq.m [22]

1953-1978

From 1952, central government launched the "first five year plan" at national level, it mainly set up a foundation for socialist urban and infrastructural development. Xi'an stepped into "socialist construction period". Modern housing with state-ownership started to replacing the private ones. "Work-unit" concept was widely applied cross the city. Among all the housing projects in Xi'an, there are 82.3% of which are private ownership, until 1955, the private ownership in total have reduced to 35.2%, and it's continue to shrink down to 14.23%. [23] In this period, 296,000 sq.m housing was built in total.

1978-1990

This a period of breaking down the work-unit system and development at a common pace for the city. In 1980, the land ownership transformation has almost completed, inner city has no private land left. [24] From 1980-1990, there are 13000,000 sq.m housing built in 10 years, the average of living space has increased to 6.19 sq.m which is twice larger than 1950s in general. Nonetheless, registrations shows that there around 30000 people with no housing at all, and 13000 inhabitants with the living area less than 2 sq.m, and 45% of total housing are temporally structure urban slums[25.] This could be considered as the foreshadowing the demand of the housing regeneration of inner city.

1990-Now

With the decentralization of fiscal authority, local government of Xi’an have gained increasing autonomy over the economic development within their jurisdictions.[26.]. In 1990, the state leased the “Leasing and Transfer of the Right to the Use of the State-Owned Land” and “ Ordinance of Foreign Investments and State-Owned Land”[27] which remarks the total opening of real estate market and the beginning of property-led regeneration practice. Urban renewal programs during this period were largely characterized by the exchange between economic profits and land use rights.[28] In year of 1999, the ownership has got an official explanation as states owned/leased [29], with this act, the transformation had literally completed while the average living space per capital increases to 12.05 sq.m from 6.04 sq.m in 1995 in urban area Xi’an (Fig 3).

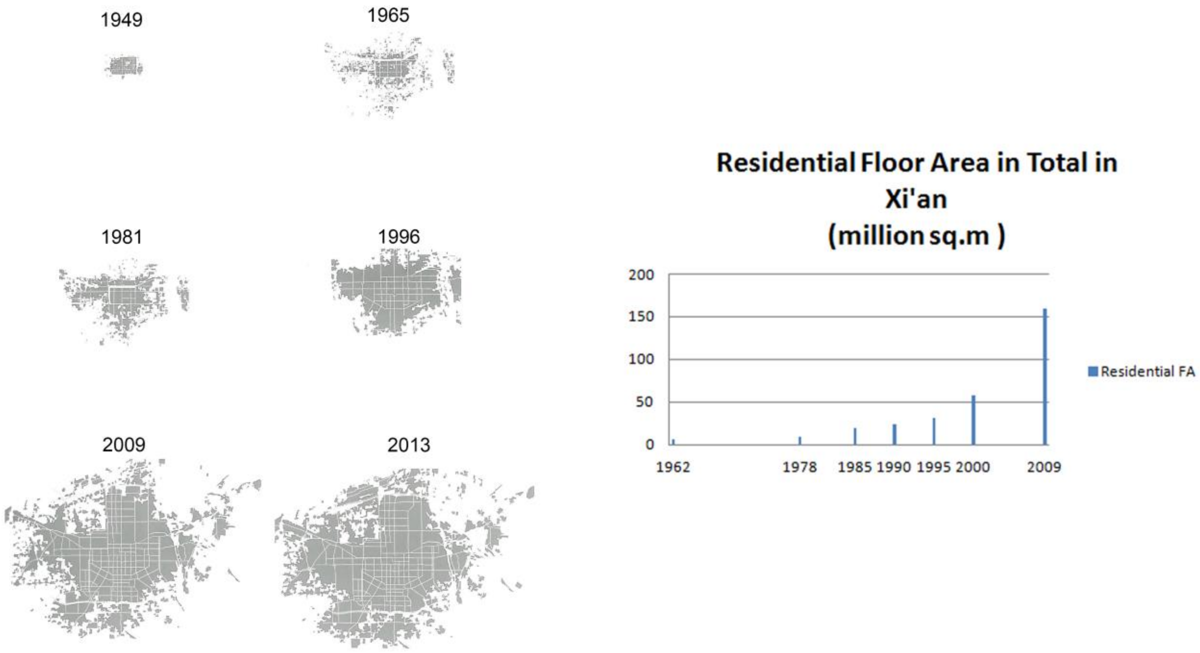


Figure 3. Fig Xi’an urbanization Urban region and housing growth in Xi’an since 1949[30]

3.2 Critiques on practice and method in use currently

In the practice, planning and development on the municipality level must follow the comprehensive master plan in general. A master plan usually has a planning horizon of 20 years and should consider long-range development strategies, includes the city’s development direction, the function of each district, land use layout, comprehensive transportation planning, construction forbidden areas, construction-constrained areas, and construction suitable areas, green land planning, tourism planning,

etc[31]. Regarding the administrative and management system in urban development, urban regeneration programs within the historic area fall under the responsibility of several local government agencies, including the Xi'an City Planning Bureau (XCPB), Xi'an Urban Construction Bureau (XUCB), and Xi'an Municipal Administration of Cultural Heritage (XMACH). Both XCPB and XUCB are responsible for the redevelopment projects of old residential areas. Beside, some of the cities, with historical significant, have to approved and supervised by Ministry of Housing and Urban Rural Development (MOHURD)[32] at the national level (Tab.1).

Table 1 Cities with Planning Supervisors Dispatched by the Central Government[33]

Year	Cities with Supervisors Dispatched by the Central Government
2006	Nanjing, Hangzhou , Xi'an, Kunming, Guilin
2007	Shijiazhuang, Taiyuan, Shenyang, Dalian, Xining, Lanzhou, Wuhan, Changsha, Guiyang, Nanning, Fuzhou, Xiamen
2008	Hohhot, Changchun, Harbin, Hefei, Nanchang, Jinan, Qingdao, Suzhou, Ningbo, Guangzhou, Shenzhen, Haikou, Chengdu, Chongqing, Lhasa, Yinchuan, Urumchi
2009	Handan, Baoding, Datong, Jilin, Daqing, Wuxi, Xuzhou, Changzhou, Zibo, Tai'an, Kaifeng, Luoyang, Anyang, Xiangfan, Jinzhou, Zhuhai, Liuzhou

According to Xi'an Master Plan 2004-2020, the metropolitan region will evolve into a polycentric structure, with 'one city, one axes, one belts and multiple centers'.[34] The urban layout highlighted by 9 parts refers to the "Magic Square" concept.[35]
(Fig.4)

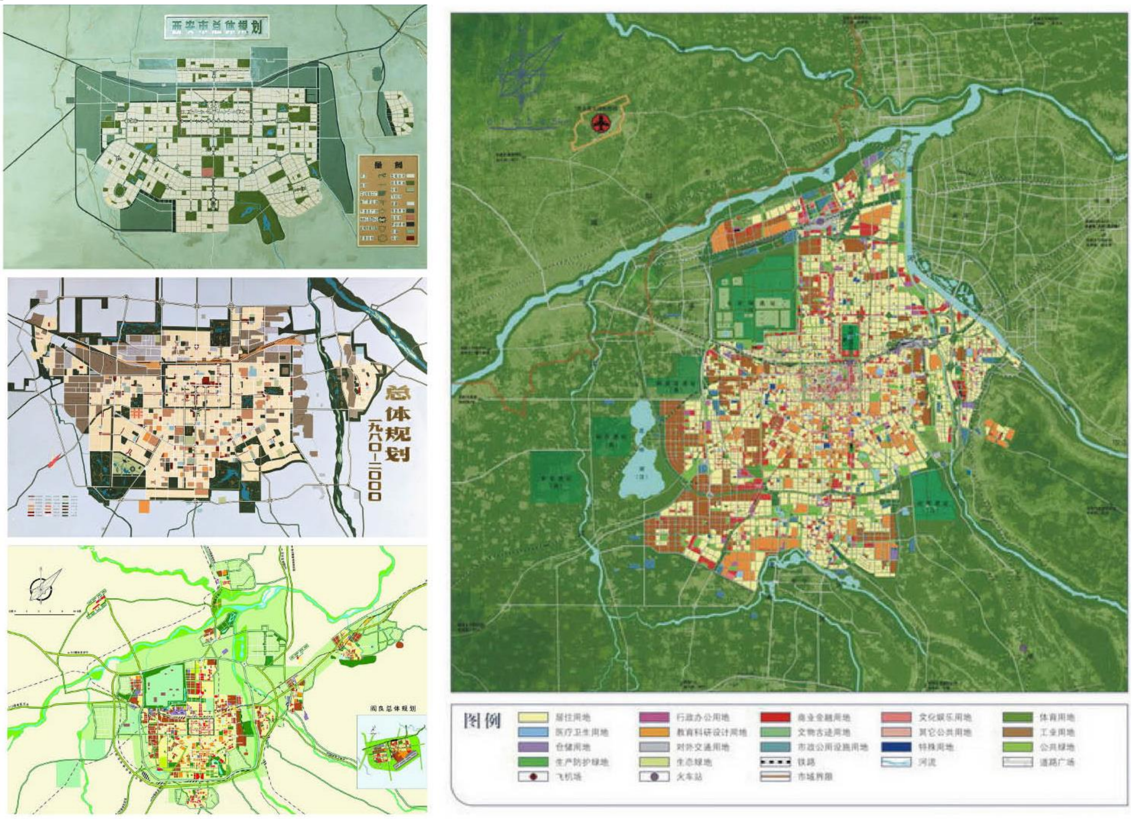
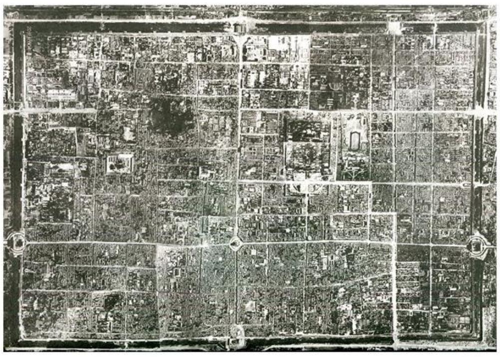


Figure 4. Four versions of Xi'an Comprehensive Master Plan[36]

It must be pointed out that for a historic city, the issue of heritage conservation was not raised to guide the historic city's development until the second master plan (1980-2000). In 1984, "The City Planning Ordinance", China's first urban planning regulation, was promulgated and enacted, creating a legal framework for the implementation of urban planning and management and so a fundamental change of the absence of guidance of urban planning.[37] Nevertheless, although heritage conservation was further underlined in Xi'an's third master plan (1995-2010), there is not much do when the projects' ultimate goal is "exchange for maximum profit" since property developers were encouraged to get involved in the redevelopment projects.

With the background of the massive property-led urban redevelopment practices all over China, in 1990, MOHURD initiated the Old and Dilapidated Housing Redevelopment (ODHR) program in Beijing, aiming to "accelerate old and dilapidated housing renewal and provide adequate dwellings for inner-city residents" .[38] It's a test trail before start housing redevelopment program country wide. Xi'an, among many historical cities in China, follows this movement. In the practice, it was driven by the property-led approach and the amphibious ordinance on the national level, the ODHR program basically swept out the plots of which most contains the traditional courtyard houses that are of 200-300 year history. Only few enough housing were kept in the Muslin area[39]. The rest of the city, the depilated old housing were replaced by brand new built standard collective compounds stands in rows. If we look at the figures, we could understand that it's very hard to even operate the process: From 1990-1995 in 5 years, Xi'an House Management Bureau has housing in registration total 2,181,700 sq.m, 5 years later, in the end of 1995, this figure has grown to 30,420,000 sq.m.[40] It was a disaster for historic urban fabric as well as the life style, custom and social network have been set up in centuries, especially inside the Xi'an Walled City. (Fig.5)



XWC in 1955

XWC in 2015

Figure 5. A comparison between the 1950s and 2015 in Xi'an Walled City[41]

Both the government and scholars have realized the problem and starts to make efforts to revise. In 2004, "Ordinance Regarding the Preservation of Historical and Cultural Cities, Towns and Villages (ORPHCC) as liased as a remedy. Ordinances including the key planning guidelines instructions as follows: (1) preservation of the overall style and features of conservation areas; (2) preservation of authentic historical features and heritage; (3) incremental renovation; (4) improvement of environmental quality and infrastructure as well as residents' living standard; (5) encouragement of public participation in conservation… [42] fall short of clarity and specification of how, this illegibility will certainly lead to a uneven consequences. Xi'an municipality promulgated and implemented the

ORPHCC program[43], in which regards the heights, FAR, restoration styles (material, color, style) and so on for regeneration in depilated housing districts. Under the slogan "reestablish the old as ancient (*xiu jiu ru jiu*) " as a vividly description. It in a way emphasized the architectural language only, but neglects the local residents and social network as the matrix of culture[44]. At the same time, regulations the ordinances given from the national level were rather general literal instructions, when they are interpreted by the comprehensive plan in the local level, it creates the real gap between the established urban conservation plan to the actually built forms.[45] Then, Xi'an put forward its latest fourth master plan (2008-2020). This master plan highlights both urban conservation and redevelopment policies. On the other hand, urban regeneration practices have tried very hard to reconstruct traditional cityscapes through wholesale redevelopment projects, which potentially boosted three to four times the original floor areas in the city to maximize financial returns.[46] (Fig.6)

Figure 6. In the 2000s, the Xi'an Municipality implemented another round of urban restoration inside the XWC, guided by the ORPHCC, the tool and outcome are rather superficial and uneven[47]

3.3 Challenges for Xi'an

Since the early 1990s, the expansion of the real estate sector as well as the entrepreneurial re-orientation of urban governance in Chinese cities has led to the prevalence of property-led urban redevelopment.[48] However, housing revitalization is being defined widely to include economic, social and physical development and aims to promote cultural aspects and historic preservation.[49] Thus, urban regeneration in Xi'an has to face the major physical, social and economic changes often at the cost of the traditional culture and local inhabitants' living environment.

3.3.1 Economic

As we mentioned before, a large scale regeneration is easier to operate from the authority point of view, which tends to benefit the local government and the developers. Local authorities is willing to given much attention to alternative proposals suggested by prominent planners and academics which may not bring the profits in short term, but still, they have to find a way to financing the renewal projects. On the one hand, mostly depilated housing regeneration process has led to the relocation of a large number of people most of whom are from the low socio economic groups. They consist of elderly people as well as low income, low skill and less educated families working in small enterprises of local governments, there is a urgent needs financing and creating jobs for these people. On another, the deteriorating environmental condition of the traditional neighborhood is cited as the reason for large scale redevelopment, however, few decision maker could have the vision to understand that urban regeneration dilapidated courtyard houses enabled local state to a facilitate revalorization and bring the bigger economical benefits in the long run. For example, efforts are usually conducted on a small scale and often focus on the most profitable projects, such as those portions of historic areas with tourist potential.[50]Proposals include small scale organic renewal or in situ up gradation projects,

which means less cost to the overall heritage of the city and also less relocation costs maybe the answer,[51] but in operation, local authorities have to connect the social and economical networks among the housing areas, thus the developments whereby the area is (re-)appropriated by groups that are economically more advantaged than their prior residents or users. It is a very challenging task.

3.3.2 Social

The first challenge on social point of view, is property rights and compensations. The Chinese policy on resettlement is set out in national, provincial and municipal laws and the government has evolved a system to pay compensation to the families which are relocated by the urban regeneration projects. Compensation varies, "ranging from more than 6 million Yuan ($75,000) for a high ranking official's home, to $ 10,000 to $ 50,000 for some affected families, to $ 0 if the residents do not cooperate with the developer in the relocation process" .[52] In Xi'an Old and Dilapidated Housing Redevelopment (ODHR) program, the policy for the local residents is "get what you had" (chai yi huan yi), which means that government will compensate the same amount of the living space before the renewed projects or you can cash it with money according the current real estate market price. Most of the residents would rather take the renewed apartments in a collective compounds since the relocated sites are normally where they lived before. Some will have to leave because of the high value land inside the wall, if they want to stay at same place before redevelopment, market pricing of the relocated space is unaffordable for the original residents.[53] This process is actually a destroy of the social networks which was built by the tradition residential spaces, and the internal and external linkage in the neighborhoods will also has to be reestablished. We have to understand, these people needs to be relocated very often includes elderly people as well as low income, low skill and less educated families who urgently needs a income source. Their source maybe lies in the original social network. However, during renovation of old neighborhoods, the land use rights of many private proprietors has not been recognized and duly compensated. This has led to a gap between the actual market value of the houses to be dismantled and the compensation to their owners. In many instances, real estate developers cheat the people by following the old rule which does not compensate for the land use right of private houses but when selling, they follow the new rule of market value by including the land use right. Compensation is very often for the built up area and not the plot area, which considerably undervalues the property[54]. The problem gets worse because the current property evaluating institutes are part of the government departments closely related to government and real estate developers. The number of such institutes is also limited, leaving people with few alternative property evaluation opportunities.[55]

The second one, is the involvement of participation from stakeholders. Normally, the principal actors involved in redevelopment are the following: 1) government departments at different levels; 2) property owners; 3) renters; and 4) the developers. Municipal and District governments are important actors. Despite large scale demolition and relocation, the involvement of the civil society institution is very marginal[56]. In China's urban contexts, the limits of residents' participation in planning and decision-making processes make it difficult for residents to 'voice out' collectively. The absence of intermediate civic organizations aggravates this situation.[57], some individual expectations would not help the general outcomes[58]. In Xi'an, public participation in the urban planning and regeneration process has also been limited to the stage of plan promulgation organized by local district governments[59]. When private developers are strongly encouraged by local authorities to get involved in the redevelopment projects, unfortunately there is very little room for the participation of local communities.

3.3.3 Physical

On the physical aspect, the first challenge is needs for upgrade the living condition of depilated house in the historic area of Xi'an, since there has been little effort to improve the build environment or for that matter to ascertain the cause of deterioration. As we mentioned before the compensation for the depilated housing policy is "get what you had". Before the ODHR project, most the living space per

resident is generally rather small (average living area of 6.19 sq.m). This fact led to the relocated housing from ODHR is accordingly small. (From the incomplete data from housing rental website and company, most of housing is blew 50 sq.m.) However, the living standard has improved constantly, by the new version of Design Code for Residential Buildings[60], the average housing space per capital should be at least 28 sq.m.[61] The clash between is obvious. Plus, there is limits on the capacity of inhabitants especially for the historic area of Xi'an according the ORPHCC program. The current policy the municipality is using now is to shrink down the population. [62](Fig.7)

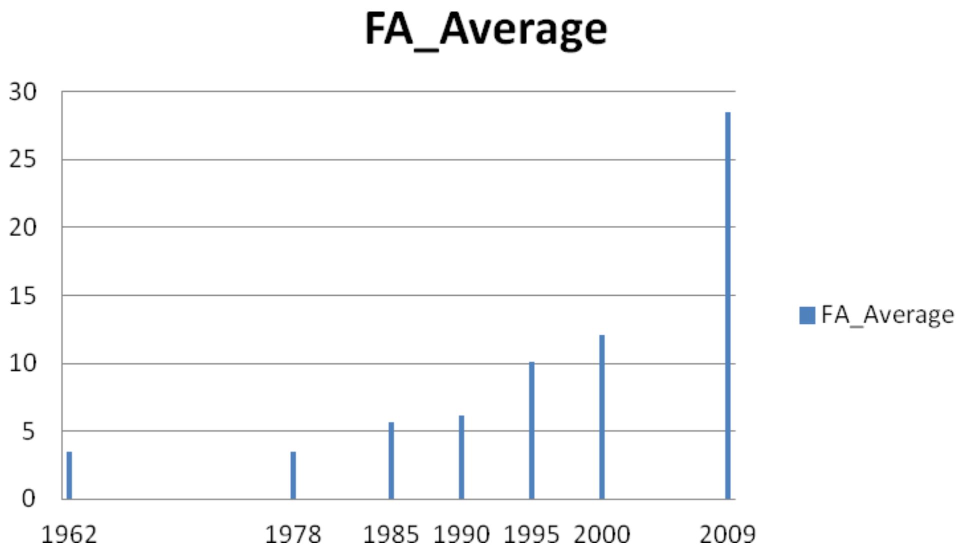


Figure 7. housing floor area in average sq.m/capital in Xi'an[63]

The second one is how to shape up for appearances city feature after revitalize the dilapidated housing as a historical ancient city, we have already lost the vastly featured courtyard housing in the ODHR program in Xi'an, now is time to facing another challenge to revitalize the depilated housing again, to preserve it's features as the cityscape. Since the land use rights have been transferred to private,[64] in order to improve the physical environment, inhabitants start to revalorize facilitate by their own. It is now interesting to note that some self-built practice in quietly undertaking in some potential area from the dilapidated house. The original plan is not considered the possibility, yet the local inhabitants start the regeneration base on the physical precondition. This urban transformation, officially, is actually a violation on the comprehensive master plan in a sense, yet it brings the feature to the site. (Fig.8)

Figure 8. Self-build practice and housing transformation

Nonetheless, these kind of physical environments improvement practice is limited and mostly revitalized by the private owner which the outcome can be very much uneven from the architecture point of view. How to guide this process without ruining the prosper phenomenon in the operational phase, is also very challenging.

4. ADOPTING CULTURE SUSTAINABLE DESIGN APPROACH

Culture and historical cities like Xi'an, must be a collective joint of all historic layers in the contemporary urban spaces. Regarding to housing regeneration, a culture sustainable design approach need to be adopted to guarantee the diversity and compactness of the city. It can involve the promotion of culture-based events and attractions along with encouraging the development of higher quality housing and retail, and the attraction of professional businesses to the area. It is highlighting the value of the matrix of local cultural, and actors to improve the physical environment and reconstruction of local cultural network.[65] We count on the cooperation of multi-aspects will form a solid foundation in participation and fulfillment of urban design and planning. (Fig.9)

Figure 9. Concept framework of culture sustainable housing regeneration

Through the micro level of the linkage between the variety of player and actors in the process, eventually could achieve the social interactions in the macro level. Any housing interventions should be the implemented from the neighborhood level, given awareness of local culture, then materialize into architecture and urban spaces based on the self- transformation occurs in the district. To achieve the housing transformation in the meso level, and finally urban transformation as culture featured city. here it needed to point out that a vision from top-down administration is a must; and many researches suggests that the less attention is being paid to this 'bottom-up' consciousness of inhabitants which has been formulated over many decades, the more chance culture sustainable approaches end with failure.[66]. So the real key is how well the projects are connected to the local residents' activities and culture facilities and a open mined vision. (Fig.10)

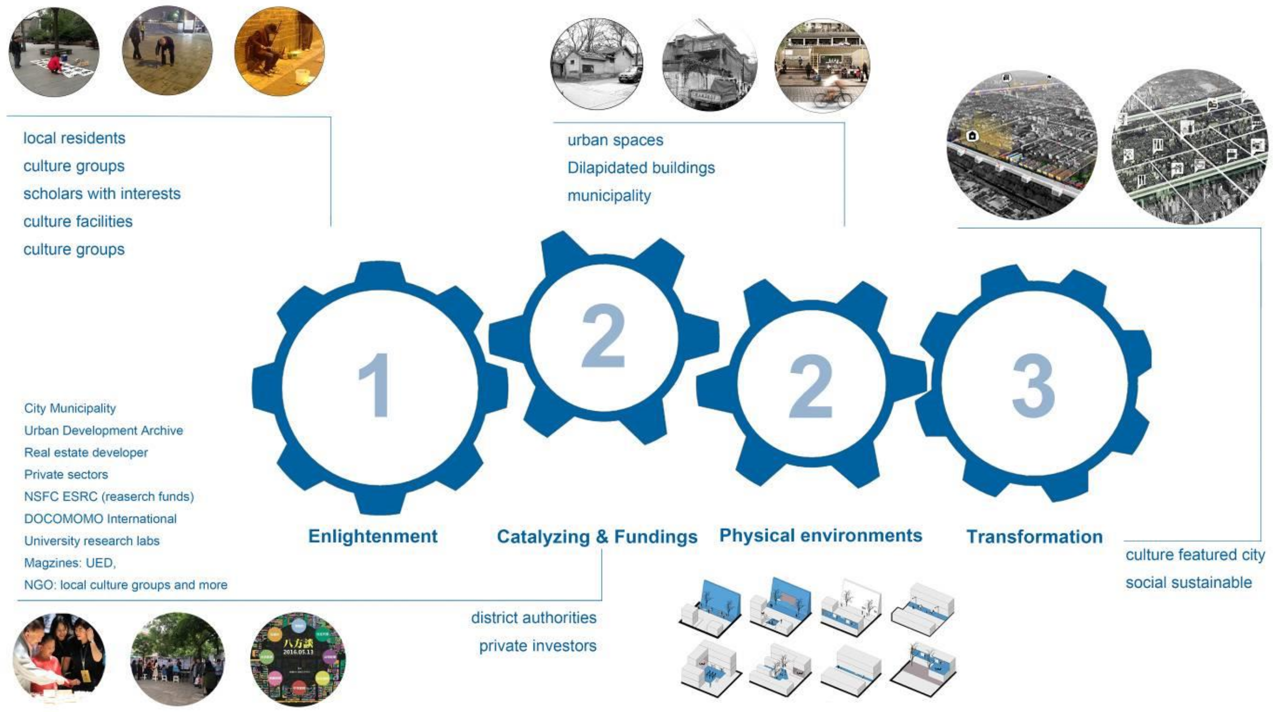


Figure. 10 Illustrating the process and stakeholders for regeneration

In the process, there are twofold needs to be highlighted.

First one is evaluation. In the debate over what precisely is worth preserving in the face of redevelopment in the historical cities. The depilated housing neighborhoods are the most recent battleground. That is, while towers, temples, and other monumental features are broadly accepted as worthy of preservation, the historic value of the city's vernacular residential environment is still being hotly debated[67]. (Fig.11)

Figure 11. depilated house inner city Xi'an [68]

In the past, the evaluation system is rather simple which implies a simply solution when the dilapidated house regeneration projects are stimulated. For instance, in the ORPHCC, preservations are only for traditional courtyard houses which marked as heritage in the officially documentation. There are rarely consideration to see the depilated houses community as intangible elements as a whole in the regeneration of historic urban areas. There are blind points on the values of those communities in the practice. Thus, at least 5 dimensions should be examined:(1) Historical and culture value; (2) Scientific value; (3) Usage value; (4) Environmental value; (5) Aesthetic and spiritual value
The second is knowledge gap between the decision maker's vision and expectation of inhabitants which implies the unsatisfied outcome may occur [69]. Survey, qualitative research design and observation techniques are required to identify key indicators in field work survey and specific case study site with solid data and information. A complete knowledge of multi-aspects from the target site is the key to success. Culture sustainable design tools and indicators are needed[70].

5. SUMMARY

With the case of Xi'an and a bit reflections in China's housing regeneration practices, we discuss the experiences on working methods, we are aware of it is important for the planners to set up a clear and integrity strategy to guide the intervention and regenerations. This plan has to be a combination of "top-down" and "bottom up" strategies from variously actors during the revitalization progress, which is shown in the (Fig. 12).

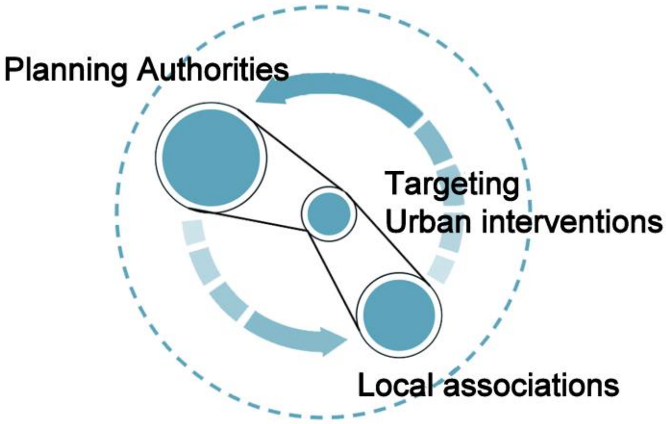


Figure 12. Illustration of regeneration process

Historical cities like Xi'an among many others in China, housing regeneration is of utmost important since it merges the sprit of local culture and historical city feature. A culture sustainable housing regeneration with multi-dimensions provide a new vision and working tools to keep the local residents stay in and effective participate throughout the whole process of regeneration projects. It requires good governance and vision for the planners to play the proactive role, to improve housing and living environment with local culture from inhabitants. It not only rebuilt cultural identity and urban diversity but also prevent culture devolution and gentrification in the historical cities areas.

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ARE BRANDED GATED COMMUNITIES SUSTAINABLE? ISTANBUL AS A CASE STUDY

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INTRODUCTION

Istanbul is a fairly unique city whose structure has survived many centuries. At present, the city is undergoing extensive change due to the burst of the economic bubble at the start of the 21st century, which led to an exponential increase in immigration of people with middle and upper incomes. These demographics spurred the interest of public and private investors, who initiated numerous development projects in the city, often involving the construction of gated communities. Such communities, with their artificial concepts or grouped apartment blocks, have thus become a major issue in urban planning.

Current housing policy allows many different types of large-scale projects that are not integrated into the urban fabric of Istanbul. More importantly, companies are starting to invest in projects with the aim of creating new behavioural patterns and an identity for each community. Venice-Istanbul is just one example of branding of a gated community: its architectural footprint is taken exactly from Venice. The project claims to offer a living experience similar to that of Venice; however, the problem is that the identity of the community becomes a brand and is thus transformed into a marketing strategy. Such a branding strategy dilutes the social and physical sustainability of the city, which is based on the recollection of the previous image of the city with its citizens and its rich history.

Gated communities enclose a physical and social structure, thereby forming an identity that is independent of the rest of the city. This paper aims to explore the identity of such gated communities by considering their sustainability in the case of the Atakent neighbourhood of Istanbul. We thus address the question of whether branded gated communities are sustainable.

‘COMMUNITY’ GATING

Gated communities are artefacts that aim to form both physical and communal identities. Blakely and Snyder define the term ‘gated community’ as ‘physical privatised areas with restricted entrance where outsiders and insiders exist’.[1] Other researchers applied various different assumptions in defining these new types of housing areas and came up with labels such as ‘gated enclaves’,[2] ‘enclosed neighbourhoods’,[3] ‘walled community’ and ‘retirement-lifestyle communities.’ The term ‘community,’ which is a social concept, is emphasised as a common denominator in the definition of this new residential concept. The concept of ‘community’ is widely used by sociologists, urban designers and urbanists, but different opinions exist regarding how to identify a group of people as a ‘community.’ Most scholars define ‘community’ as something rooted in territorial, spatial and generational togetherness.[4] Keller emphasises the spatial connotations in the term; the territory on

which a community lives generates proximity and a density that is conducive to other types of closeness. No matter the container—village, town or suburb—the community has a captured, delimited space that shapes the scale of collective life and the patterns of life created therein.[5] Based on this definition, people living in a given geographical region with physical limits can be defined as a community such as those that we call gated communities. In support of this statement is the fact that, from their first appearance, gated communities have claimed to provide this sense of community. Thus, investigating gated communities under the scope of social sustainability requires the broader issues of community and identity to be considered.

In the 1960s, early gated communities appeared in America to cater to retirees. Communities such as Leisure World were the first places where average Americans could wall themselves in.[6] The primary aim in the planning of such secure residential units complexes to collect people around a common interest such as golf, tennis and other sports to provide them with shared services. These developments involve a form of ownership in which home buyers also purchase shares in recreational centres, golf courses and other facilities.[7] Social cohesion and a sense of community were important features in the development of gated communities. In the late 1980s, upscale real estate speculation and the rising trend of conspicuous consumption saw a proliferation of gated communities around golf courses that were designed for exclusivity, prestige and leisure.[8] From the 1980s onwards, the gated-community model took root in many countries in Latin America, Asia, the Middle East and Africa, where, rather than seeking solely to create a sense of community living, it was transformed according to local needs and requirements.

GATED COMMUNITY IN ISTANBUL

Since the beginning of the 1980s, neoliberal economic and spatial-restructuring policies have targeted Istanbul with the aim of transforming it into Turkey's global city. State land has been put on the market as a major source of investment. Throughout this globalisation process, the city has seen the uncontrolled construction of new highways, skyscrapers, shopping centres and settlement units with the contribution of local and foreign investors. According to Bilgin, the main distinguishing feature of the post-1980 period is that large capital groups have begun to invest systematically in the construction sector and real estate.[9] Housing is becoming a consumption article, which means that, from an economic point of view, the market economy moves away from egalitarian politics and, from a social point of view, the market is explained by the consumption paradigm.[10] This cycle of consumption took its power from the free land, the growing construction sector and the increasing number of urban elites. Thus, gated communities with their artificial concepts or grouped apartment blocks have become a major planning issue.

Neoliberal urbanism, which has accompanied neoliberal economic restructuring, seeks to expand the role of market forces in the housing and real estate sectors, to privatise the provision of urban and social services and to increase the role of elites in shaping urban landscapes.[11] With a newfound lifestyle, the private sector has invested in developing gated communities which, starting in 2005, have offered a particular lifestyle for their residents.[12] Thus, gated communities have become a lifestyle choice for their residents and, inversely, the way in which their residents portray their lifestyle to others.

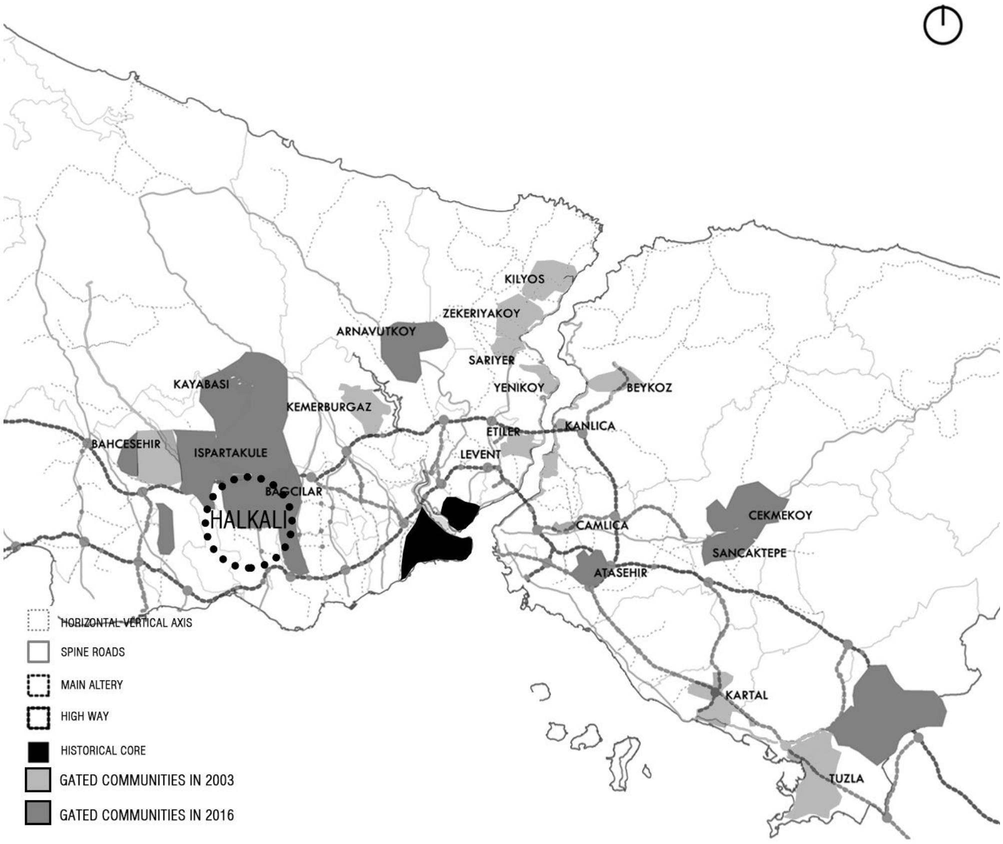

Figure 1. Map of Istanbul City.

In both Europe and Asia, the trend of gated communities as housing developments on the periphery of central business districts has increased over the last 20 years. Figure 1 shows that, as of 2003, gated communities in Istanbul have emerged in the north (Göktürk-Kemerburgaz, Zekeriyaköy-Demirciköy) and southwest (Bahçesehir, Büyükçekmece) on the European side and near the second Bosphorus Bridge (Beykoz) and in the north (Ömerli) on the Asian side.[13] By strengthening the links with the main roads on the west and east sides of Istanbul, gated communities, indicated in dark grey in Figure 1, have sprouted along this axis over the last 15 years.

According to the 2014 Istanbul Branded Housing Survey of the EVA Real Estate Appraisal, 1,007 housing projects exist in 34 regions of the city, with 430,000 branded houses in the city.[14] The report reveals 395,000 residential homes within 855 branded-housing projects in 2013, which represents an 18% increase in the number of residential housing projects in Istanbul over the year.[15] The present study concentrates on the Küçükçekmece District, which is the area enclosed by the red curve in Figure 3. This was chosen as the most concentrated region where physical and social fragmentation clearly threatens sustainable development.

The Atakent neighbourhood, which is delineated by red boundaries in Figure 2, is one of 21 districts connected to Küçükçekmece Municipality. As of 2000, gated communities have become the standard development pattern for the newly built residential areas in this neighbourhood. The satellite image acquired in 1982 (Figure 2, top panel) shows no housing developments in the area, which was devoted to agricultural land at the time. In 2006 (middle panel), a number of gated-community projects were implemented as a function of land availability. The satellite image in the lower panel of Figure 3 shows that, in 2017, a total of 27 gated communities exist in the Atakent neighbourhood. The gated communities in this area were created with a particular identity and envisaged the life of certain communities separated from their neighbouring communities by architecture and lifestyle.

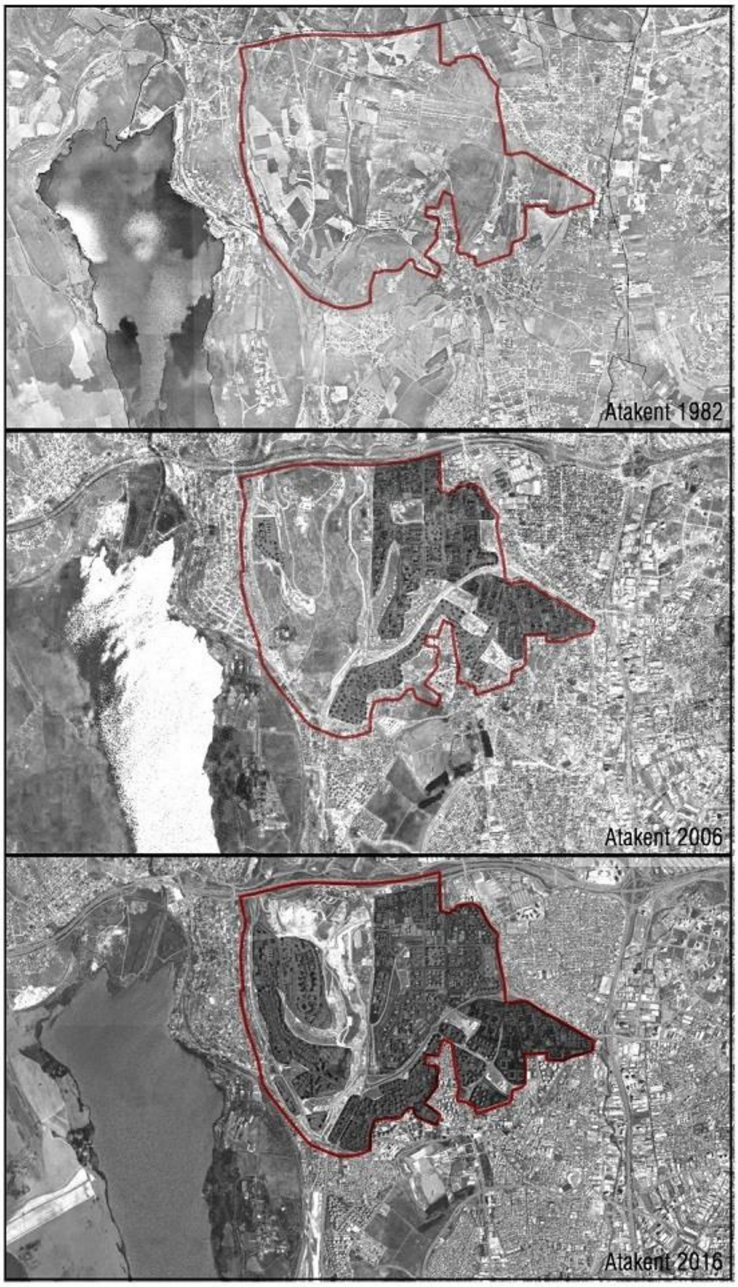

Figure 2. The red boundary indicates the Atakent Neighbourhood. The images shown in the top, middle and bottom panels were acquired in 1982, 2006 and 2017, respectively.

According to the 2008 population census, 34,452 people resided in the Atakent neighbourhood in 2008, rising to 88,956 in 2016.[16] In this research, 15 out of 27 Gated Communities in the province were found in detail. Figure 4 shows the architectural diversity of the applied projects. Projects have been culled since 2005 when the year of construction is considered. There is a total of 21,090 (see Figure 5) housing units in only 15 housing units in the district. This study shows that approximately 92% of the population in the Atakent neighbourhood lives in gated communities.

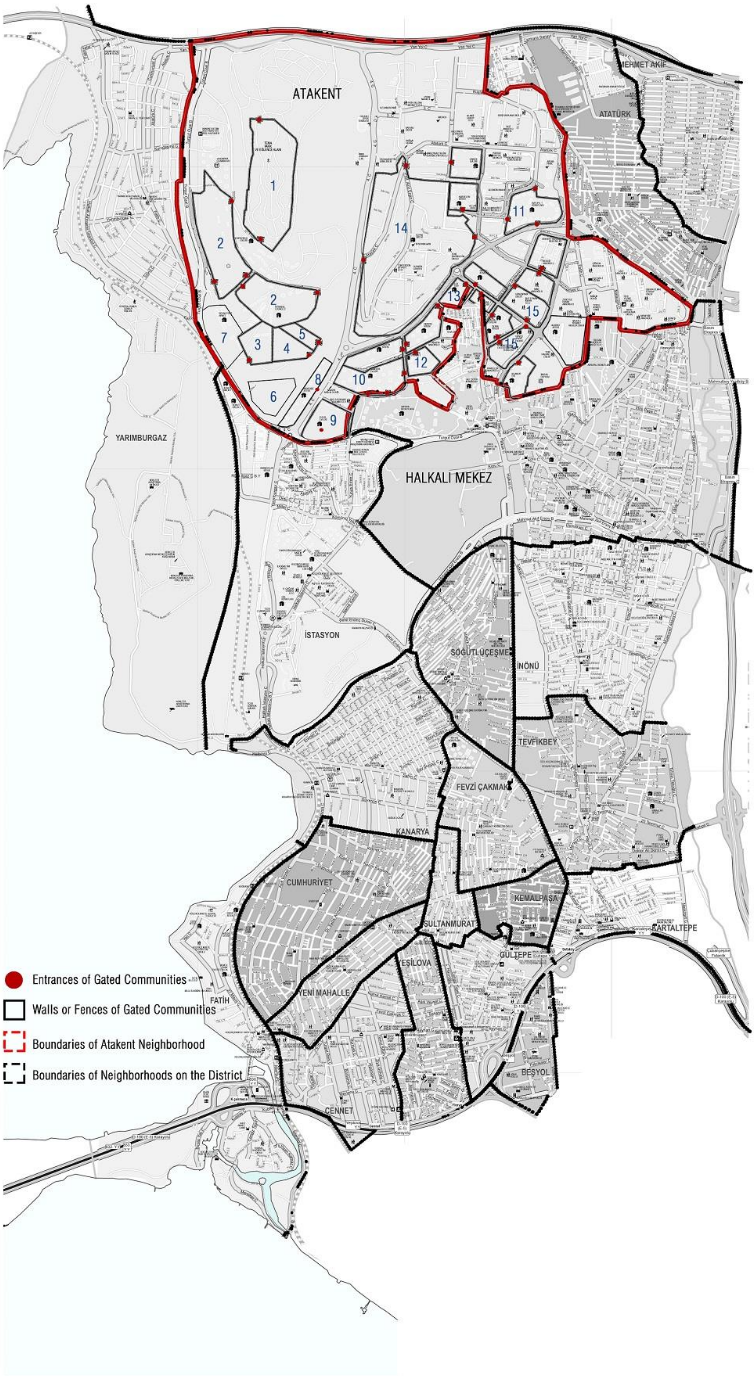

Figure 3. Map of Atakent gated community, Istanbul. The border of neighbourhoods is shown by a thick black line, walls are shown by thin black lines and gates are shown by red dots.

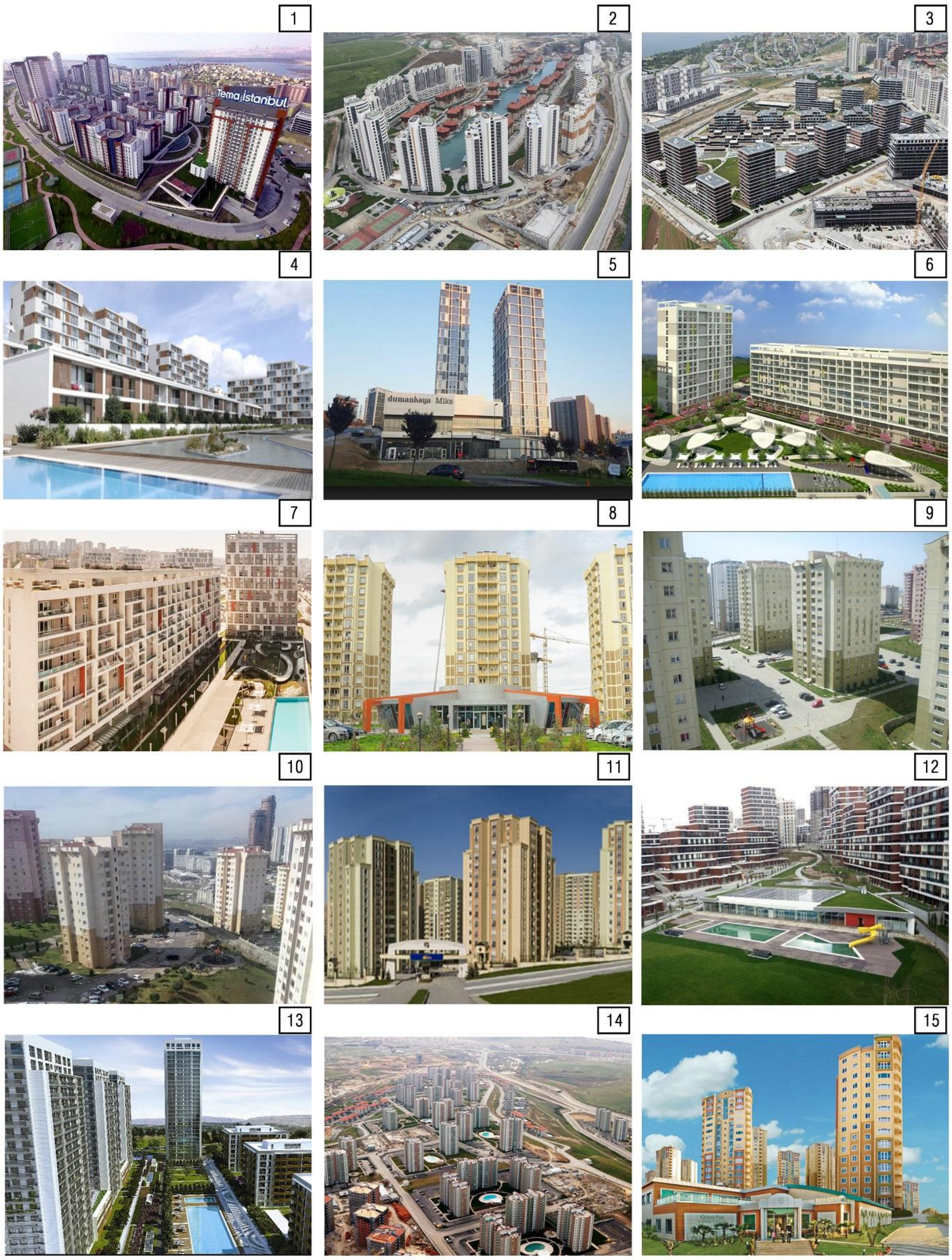

Figure 4. Physical appearances of Gated Communities.

	BRAND OF GATED COMMUNITIES	YEAR OF CONSTRUCTION	HOUSE UNITS
1	Tema Istanbul	2005	3.531
2	Bosporus City	2017	2.796
3	İstanbul Lounge2	2017	605
4	Dumankaya Konsept Halkali	2014	833
5	Dumankaya Miks	2014	657
6	Soyak Evostar	2013	1.000
7	Soyak Park Aparts	2014	1.121
8	Menekse Evleri	2006	784
9	Fulya Evleri	2006	1.108
10	Manolya EVleri	2007	1.480
11	Avrupa Konutlari 1	2006	1.368
12	İstanbul Lounge	2017	757
13	Elite City	2017	590
14	Soyak Olimpik Kent	2007	3.592
15	Gunes Park Evleri	2008	868
		TOTAL	21.090

Figure 5. Branded Gated Communities on the neighbourhood.

Privacy is one of the main features of the Atakent gated communities. In this neighbourhood, residential areas are enclosed by fences and several manned gates control the entrance. Security guards check entrances and exits 24 hours per day, 7 days per week. Any workers or visitors other than residents are asked for the reason for their visit. All facilities are located inside such communities and their use is restricted to residents and their visitors. As seen in Figure 3, the gated communities are surrounded by walls and with a few entrances (see red dots in Figure 3). Designed in this way, gated communities become structures entirely independent of the urban tissue. Integration with the city is fragile when we consider spatial connectivity.

The boundaries of gated communities are designed to separate insider from outsider, which creates tension between the two. Sardar claims that gated communities are a shining example of how not to provide security for a community, but rather to enhance and spread total insecurity by generating dysfunctional relationships. Studies have shown that societies marked by increasing equity have less to fear from internal social tensions.[17] Neighbourhoods with this characteristic are typified by communities that separate and demystify each other. In addition, note that people living in the centre of Atakent form a heterogeneous community, whereas the gated communities tend to form homogenous communities.

Spatial scale is another crucial feature of gated communities. Their desire to allow ambulatory access to social facilities within their boundaries limits their scale. In this case, the size and proximity make public spaces inside their boundaries accessible by walking. Some scholars claim that scale creates deeper ties between neighbours because of densification.[18] By obliging people to use the same common areas, they remain in constant communication with each other. The problem arises when we consider the neighbourhood scale, as seen in Figure 3, where no common public facilities are available. Thus, the social interaction in these communities is limited over the larger scale. The design elements that form the urban tissue in this case are primarily walls, entrances and highways.

The common structures, places and facilities within gated communities are managed by committees chosen by the titleholders. These committees also decide the management style. They are independent of the municipality and are responsible for providing services and security, the maintenance of the infrastructure and the implementation and supervision of the conduct of the housing complexes. In addition, users are actively involved in maintaining a physically healthy environment. Thus, the gated communities have an autonomous administration, which contributes positively to the environmental sustainability within the borders of the gated communities.

IDENTITY IN BRANDED GATED COMMUNITIES

Anderson is seeking answers to a question that most works on nationalist political movements did not ask: "what is the thing that pushes the humanitarian to kill other people, even to hate them?"[19] The author treats the concept of the nation as an imagined community that takes the place of ancient congregations such as dynastic realm and religion. He is explaining the base combiner of sociological entities and how it transformed into the concept of nation. According to Anderson, three institutions were the census, the map, and the museum profoundly shaped the way in which the colonial state imagined its dominion. In order to create national identity, collective memory has been evolved, selected or handed down in many aspects of life such as language, art, press, institutions, architecture and urban spaces. In the first time "identity" is associated with a limited geographical area, national identity and territorial form, and the nation became dominant mode of place identity.[20]

The term used to designate the place identity that emerged within the past two decades, has the more focused significance of 'place,' 'people' and 'meaning'.[21] Jenkins underlines that while the place can be based on recognizable physical features e.g. slope, orientation, vistas, there are also many tangible meanings and memories come by personal and highly individual reactions. He associated the fact that the design of space is more relational than subjective. According to Jenkins, in place identity, there is a relation based on similarity, and a relation based on differences.[22] How individuals define their identity by defining who they are similar to and who they are different from, are the same how to place identity considered.[23] Place identities are formed through emotions, meanings, experiences, memories and actions and growth by the social entities in which they placed. While referring to the identity of the place, the importance of cultural identity of the local community emphasized by Park, physical and sentimental distances reinforce each other, and the influences of local population distribution combined with the forces of class and race in the evolution of the social organization.[24] In this case, community reshapes the environment and gives an identity to the place. In a natural process, the identity of the community transforms the physical place and creates a natural boundary in the city. The identity of the place is defined within this process, which grows out of the community that it contains. A mutual interaction thus exists between cultural identity and identity of place.

'People identify with the places they live and identify places as different'.[25] With this quote, Adam claims that two aspects of identity work in opposition to one another. Whereas a new or transformed building or place may be highly distinctive or identifiable, it may undermine the particular character of a place that the community regards as a critical part of its identity. Conversely, that same distinctiveness may reinforce or even create an enhanced sense of identity.[26]

Architects and urban designers have been the mainstay of creating a place identity and modern inhabitants have come in search of unique identities. This approach has been most used in residential areas where the sense of belonging is an issue.

Gated communities are thus becoming prime examples for developers to examine how place and community create an identity, which is marketed as a branding strategy to future residents. Methods used for branding include creating a manifesto and logo, publishing a magazine, providing a unique physical environment and offering a particular social activity or a different lifestyle (see Figure 4).

The Venice-Istanbul gated-community project is another example of a branded gated community with an artificial concept (see Figure 6). With an architectural footprint taken exactly from that of Venice, the project purports to offer a living experience similar to that available in Venice, Italy. The project imitates Venice with its historical texture, water canals and architectural aesthetics. St. Mark's Campanile, which is one of the most recognisable symbols of Venice, is recreated in the centre of the project area as the primary visual feature. In addition, residents can travel through canals in gondolas whose drivers wear the same costume as their Venetian counterparts. The project manager claims that 'at Via Port Venezia you will truly experience the perfect Venetian life you see in movies. Cafe settings, you can pass enjoyable hours with your friends and family when you wish, and luxury restaurants will bring the flavour of Venice into your lives.'[27]

According to Park, physical and sentimental distances reinforce each other, and the influences of local population distribution combine with the influences of class and race in the evolution of the social organisation.[28] In this case, community reshapes the environment and gives an identity to the place. In a natural process, the identity of the community transforms the physical place and creates a natural boundary in the city. The identity of the place is defined within this process, which grows out of the community that it contains. Examples of such communities include the communities 'Chinatown,' 'Germantown' and 'Little Italy' that exist in many American cities as a result of immigration, rather than imitation, and reflect the cultural roots and traditions of their primary residents.[29]
Unlike gated communities, identity is being branded in real estate as a theme that imitates western cities. This artificial process had been starting by this application. Consumers purchase their houses to live alien lifestyles within an alien environment. China has even gone one step further by creating extensive themed communities that replicate identifiable western prototypes. Bosker underlines that developers recreate not only the superficial appearance of historical western cities, but also the 'feel' (i.e. the atmosphere and experiential colour) of the originals through such devices as foreign names, signage and lifestyle amenities. In such communities, millions of China's new economic elites shop in markets selling western foods, dine in western restaurants, navigate streets bearing western names, congregate in parks and squares with monuments to heroes of western culture and celebrate festivals and holidays lifted from alien traditions.[30] It would appear that the real estate market in China is on the same path to branded gated communities as in Turkey.

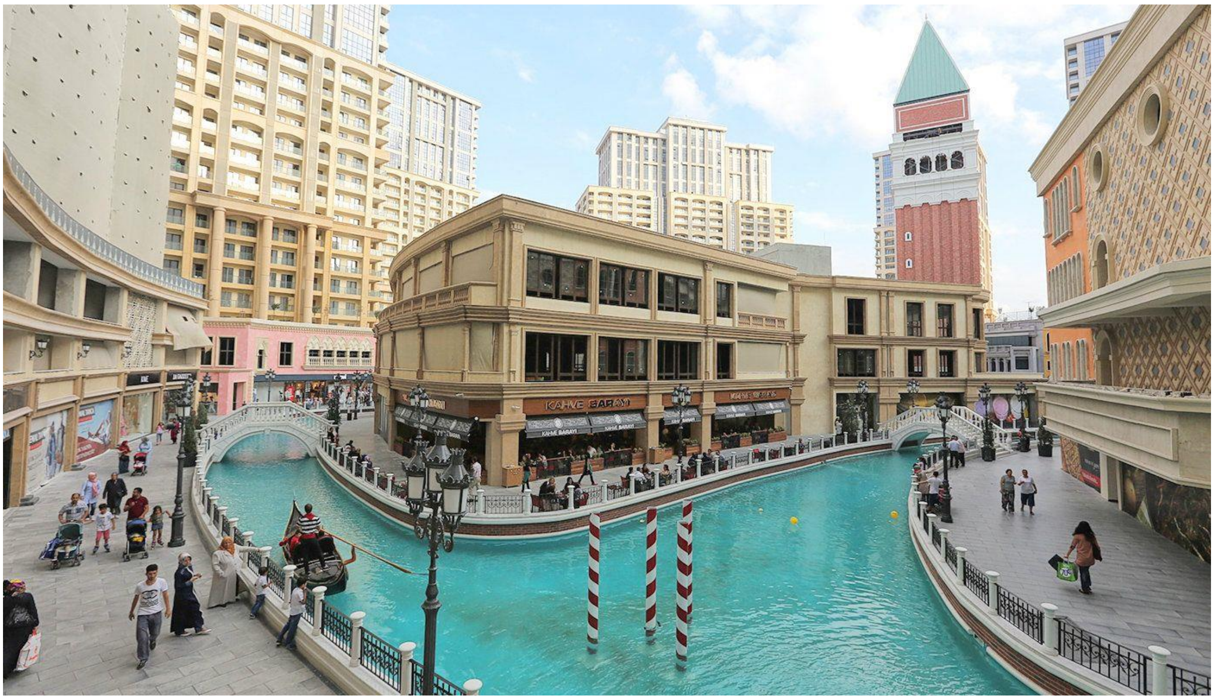

Figure 6. View of the gated community of Venice-Istanbul

CONCLUDING

The image of gated communities as imagined by urban designers or planners does not always match the traditions of the target audience. Through their introverted social and physical structures, gated communities develop 'artificial identities' for themselves detached from the identity of their host city.
Branded communities in Istanbul strive to incorporate a set of parameters related to their reputation. For instance, as each brand targets a specific group in society, it naturally creates an untold image to the perspective consumers. These sets of parameters create a collective community consciousness as they belong to similar societal group, traditions and even the expected etiquettes of its members to be in line with that of the brand image. Apart from these factors tied up with the image, the community members themselves share a sense of cohesion towards their responsibilities to their community. Brand loyalty reaches another level as members take allegiance with the brand of their choice and are willing to go out of the way in order to protect the image.
A result of the present case study is that each branded gated community tends to create their own identity. The primary factor behind this independence from the rest of the city is the physical limit (i.e. walls) constructed around the housing complex. In branded gated communities, these boundaries become social borders, despite being envisaged only as physical borders.
Gated communities have greatly damaged the urban fabric and development of Istanbul and have negatively impacted the lifestyle of city residents. These communities are not planned or designed to integrate into the surrounding urban areas, both spatially and socially. As a result, both environmental and cultural sustainability are degraded at the district level.
The most destructive gated communities are those with developer-created identity communities. In branded gated communities, social structure, lifestyle and values are made subservient to marketing strategy. Branding is becoming a new way to identify the place and community as a whole. The concept of sustainability must be considered for preservation of the characteristics that make every place a unique cultural environment with specific architectural constructions, rather than a formless group of imitations with artificial identities.
In this article, the concept of identity was examined from the viewpoint of social and physical sustainability. Finally, this study shows that the tendency to create identity via gated communities causes social and physical segregation at both the neighbourhood and the city scale.

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GREEN WALLS: AN EFFICIENT SOLUTION FOR HYGROTHERMAL, NOISE AND AIR POLLUTION CONTROL IN THE BUILDINGS

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INTRODUCTION

A building facade has two important functions: it's a representative element of the building's image when observed from the exterior, and it's a cover element for the interior, thus its importance can't be limited to its structural role, but to its influences on the space in and around the building [1].
With the challenges of climate changes and energy demands, designers started to develop new approaches to improve the environment quality in urban areas. One of these approaches is Vertical Gardens, which started to take an important place in the recent years. As the usage of Vegetation proves to have significant impacts on the urban environment, affecting considerably the thermal environment, noise levels, and air quality.
Vertical garden could be considered the starting point for growing plants on vertical surfaces and it is dated back to 2000 years ago, in the regions of the Mediterranean, but the real representation of the green walls, however, could not be noticed until the 18th and 19th century in Europe as climbing plants were used to add a decorative value to facades[2] .
The benefits of using vegetation for environmentally sustainable reasons became the subject of research and studies in the early eighties, and a lot of architects started following the steps of the SITE group, Emilio Ambasz and Hundertwasser who organised the first projects which revolved around nature and environment[3].
Besides describing the advantage and disadvantages of the implementation of green facades, this paper focus on the efficiency of the green walls regarding hygrothermal, noise and air pollution control in and around the buildings. The structure of this paper provides an introduction to the green wall systems and an overall analysis of their environmental and economic properties, leading to a conclusion that is based on an overall systemic review of different types of researches and studies.

GREEN WALLS

The Green Wall as a whole is built on the concept of applying vegetation on the vertical surfaces of the buildings. In the beginning, green walls were recognized as the facades that are simply covered with climbers such as Boston Ivy or English Ivy. However, nowadays green wall systems can be classified as green facades and living wall systems, according to their growing methods[4].

Green Facades

Green Facades are based on the using of climber plants that could be attached to the façade of the building either directly or indirectly on a supporting structure. Two categories could be recognized in green facades

Plants planted into the soil

The plants have their roots directly in the ground, allowing them to grow naturally from the soil - see Figure 1. Two kinds of plants could be noticed in this case[5]:

a) Plants that adhere directly to the wall surface and have the advantage of not needing a supporting structure system. Those plants need years to cover the whole façade and no watering system is required only natural sources are used, in some cases, it even occurs without human intervention.

b) Plant species without adhesive roots to be able to grow directly beside the buildings' facades, in this case, a supporting structure is required to help the plants cover the facades and grow. The usage of a supporting structure holds the advantage of offering a space between that structure and the wall that could be used for insulation and maintenance purposes.

Figure 1. Green façade using plants rooted in the ground - use of self-climbing plants, a) directly on wall, b) with supporting structure [6]

Plants planted in boxes

This solution requires the plants to be growing from an intermediate planting box with the soil in it. The usage of plant boxes can be explained due to multiple reasons, such as the lack of space under the building, or the height of the facades, for example to be able to cover an 8 floors tall building with green façade the usage of planting boxes is necessary, especially because climbing plants are estimated to reach a height of 25m, in practice 10m. However, it must be mentioned that this solution requires higher maintenance expenses unless it was installed on the balconies or on an accessible framework[4]. Again, there are two techniques of installing the plants, either directly or indirectly using a supporting structure - see Figure 2.

Figure 2. Green façade using plants rooted in the box a) planter box at the bottom with plants directly on the wall, b) planter box at the bottom with plants on supporting structure [6]

Living Wall Systems (LWS)

Living wall systems could be described as an advanced approach of the greening system, mainly constructed of modular panels which contain soils or other artificial growing mediums and different types of plants that don't only include climbers but other species such as shrubs, ferns, and groundcovers[4]. Living wall systems can be divided into two categories continuous and modular.

Continuous Living Wall System

Known as Vertical Gardens, this system doesn't require the usage of soil as it depends on a fabric layer that serves as a growing medium where plants could be rooted in. This system relies on hydroponic techniques to enable the plants to obtain nutrients through the irrigated water. The fabric layer is normally connected to some waterproof membrane layers and attached to a supporting system[7], see Figure 3.

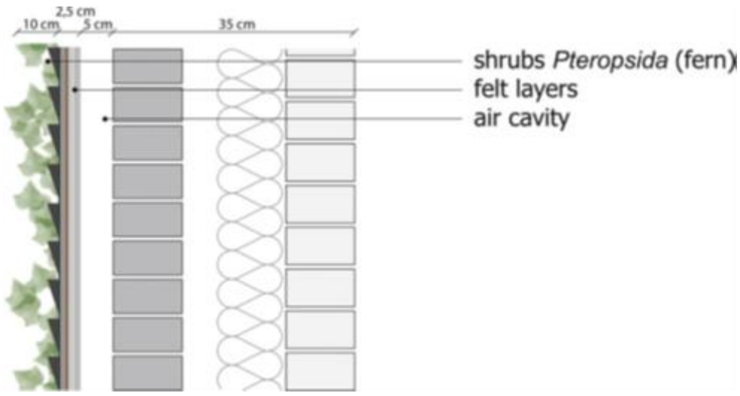

Figure 3. Continuous living wall system[7]

Modular Living Wall System

This system is composed of pre-vegetated panels that are placed on a structural wall. The modular panels could be inserted vertically or in an angle. The procedure of installing this system into the wall

structure is simple, as it includes compressing the substrate inside the horizontal panels and then planting the growing species in them, the irrigation system is normally located between the panels and water is drained through the whole façade and collected on the bottom[8]. The advantage of this system in providing extra planting depth and ease of replacing the dead plant than the continuous system, - see Figure 4.

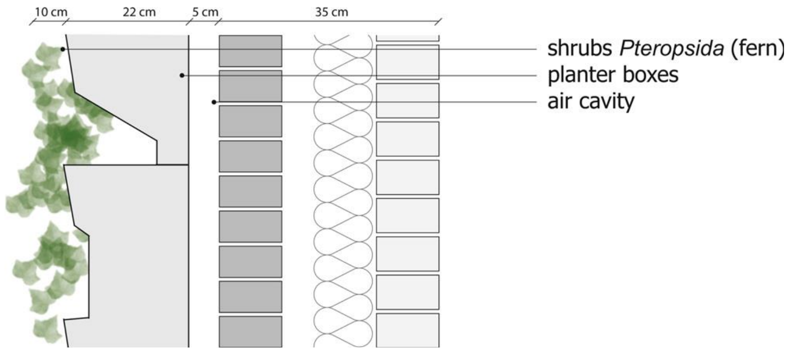

Figure 4. Modular Living wall system[7]

ADVANTAGES OF GREEN WALLS

It is important to realize the advantages connected to the implementation of vertical vegetation on the exterior of the building surfaces. In this study, the main focus will be on the advantages offered by green walls regarding noise pollution, air quality, and hygrothermal insulation. The advantages would be pointed out according to scientific applications and studies.

Thermal Insulation

Green facades could offer a significant amount of insulation if installed accurately. For example, in the study of Minke & Witter, it was proved that a 4cm gap between the structure of a 16cm thick green structure and the wall could raise the thermal insulation quality for the wall up to 30%[9]. Another study presented by Pacheco-Torgal et al, proved that the direct sunlight on a green façade is filtered and blocked by the leaves as 5-30% of the sunlight energy is reflected, 5-20% is used by the leaves for photosynthesis, 10-50% is transformed into heat, 20-40% is used for evaporation and about only 5-30% pass through the leaves[10]. This ability to block the direct sunlight provide a cooling effect in summer and reduce the energy use for air conditioning, while in the winter the system works on preventing the heat from escaping from inside the building as the evergreen vegetation keep the exterior part of the wall insulated - see Figure 5.

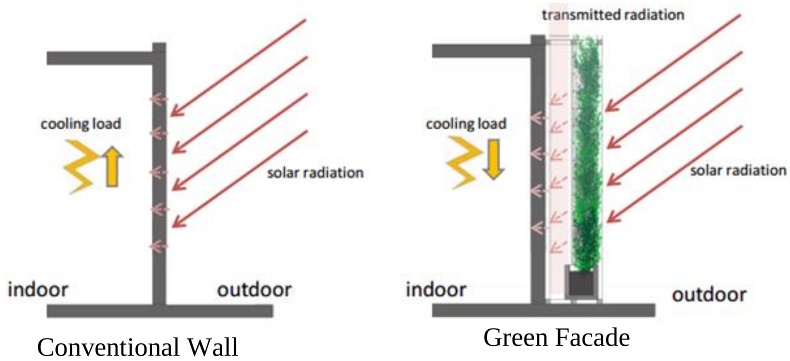

Figure 5. Difference between a conventional wall facade and a green façade [11]

The thermal performance and energy saving of green walls is measured by comparing four types of green walls and a bare wall of similar construction in both the Temperate climate and the Mediterranean climate, where the results showed that the green walls could effectively enhance the energy saving properties of the wall[7]. The estimated levels are described in Table 1.

Table 1. Energy saving (calculated with Termo 8.0) for heating, energy saving for cooling and temperature decrease for Mediterranean and temperate climate[7]

Greening Systems	Benefits	Mediterranean climate	Temperate climate
Direct green façade with English Ivy	Energy saving for heating	1.2%	1.2%
	Temperature decrease	4.5º C	2.6º C
	Energy saving for cooling	43%	-
Indirect green façade with English Ivy	Energy saving for heating	1.2%	1.2%
	Temperature decrease	4.5º C	2.6º C
	Energy saving for cooling	43%	-
LWS of HDPE modular divided into planter boxes	Energy saving for heating	6.3%	6.3%
	Temperature decrease	4.5º C	2.6º C
	Energy saving for cooling	43%	-
LWS felt layers	Energy saving for heating	4%	4%
	Temperature decrease	4.5º C	2.6º C
	Energy saving for cooling	43%	-

Regarding local temperature and the urban heat island effect, the impact of green roofs and green façade on the urban environment surrounding the buildings was modeled for nine cities during the hottest months with different climates (Athens, Beijing, Brasilia, Hong Kong, London, Montreal, Moscow, Mumbai, and Riyadh). The results showed that green walls could provide a significant contribution to the air temperature reduction, which poses an advantage for countries with a hotter climate[12].

Air Pollution Abatement

Urban air pollution has become one of the major factors of degradation concerning people´s quality of life. It is a problem which is likely to worsen mainly due to the imbalanced development of urban areas and the significant increase of people on the move, consequently increasing road traffic levels. Combustion engines are not totally efficient, the products of incomplete combustion are more complex and may include carbon monoxide (CO) and particulate matter (PM) containing carbon and other pollutants (i.e. NOx, VOC's). Particulate matter affects more people than any other pollutant. The most health-damaging particles are those with a diameter of 10 microns or less (PM10), which can penetrate and be lodged deep inside the lungs. A study performed by M. Köhler suggested that about 4% of the annual dust-fall in an inner-city area could be captured by implementing green facades on every possible surface[13]. For example, Boston Ivy could act as a trap of a range of metals (Al, Cd, Co, Cr, Cu, Fe, Ni, Pb) deposited in the air as particulate matter[2,14]. Another study performed by Sternberg, proved that the English Ivy facades in some historical buildings in Oxford acted as an effective particles trap, with a potential dust absorption rate of 2.9×10^{10} particles per m^2 for leaf upper-side. As a result, Ivy was considered to have a value in protecting historical buildings from air pollution[15]. Furthermore, in the purpose of evaluating the particulate disposition of the Ivy, a study was carried out near Bergan op Zoom in Netherland and included a cooperation between Ivy located on a sound

barrier near a busy street and Ivy growing naturally up a tree in a woodland. The final results proved that the particles loads were higher on the Ivy located near the busy road (1.47×10^{10} particles per m^2) compared to the particles loads on the woodland Ivy (8.72×10^{9} particles per m^2). Nevertheless, the results also concluded that the upper side of the leaves trapped particles twice more than the underside, and proved that English Ivy has a better performance in absorbing particles than painted metal, aluminum, glass, and paper [16], see Figure 6.

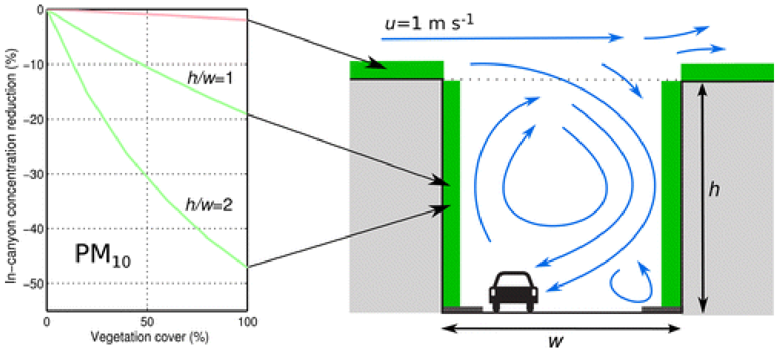

Figure 6 Green walls effect on the air quality in a street canyon[17]

Noise Abatement

Urban Noise is considered to be one of the major problems that emerged from the urban growth of cities. Although the exposure of communities to environmental noise is a worldwide concern, most cities are still subjected to noise levels that are a disturbance to human activities. For example, traffic noise can cause numerous health problems such as sleep disturbance, high blood pressure and psycho-physiological symptoms[18,19].

Although not all greenery systems exhibit a good noise reduction. However, most greenery systems offer high absorption levels that reach an average of 41% in 800Hz frequency and reduction levels of 4-9.9 dB for low to middle frequencies[20].

In the purpose of illustrating if the green envelope of the building could play a role in softening the urban environment around the building a simulated study was carried out in enclosed courtyards shielded from the road by buildings, where each courtyard was positioned at the center of a six-story tower block building and separated from each other by a crossroads, and a busy road was considered the noise source. The final results proved that green roofs offer a greater noise level reduction that could reach up to 7.5 dB, while green walls offer a smaller reduction and depend on the material used on the façade of the building facing the street [21].

In another study performed by SILENTVEG project, the absorbing and blockage properties of a living wall system, covered with Helichrysum thianschanicum was studied [22] . The results showed that if subjected to a direct source noise with a frequency between 100 Hz and 5000 Hz the living wall system was able to reduce the noise level to an average of 15 dB, which could reach an average of 18 dB if the spaces between the planted boxes were sealed. Additionally, that solution provides a ‘sound absorption coefficient’ of 0.40, i.e. it absorbs 40% of the sound emitted to the living wall system.

Compared to common structural wall materials the noise reduction reached by the living wall system could not be considered significant on the environment inside the building, where for example, the reduction caused by brick walls could range from 30 dB in low frequency to more than 50 dB in high frequency due to its reflection ability. However, regarding the noise absorption abilities of the living wall system, the study concludes that they provide different absorption characteristics than other

materials. Living wall system provides in most of the cases a better sound absorption than many conventional structural materials, mainly at low frequencies. Moreover, although, at high frequencies, the living wall system doesn't compete with materials such as fiberglass board, it also performs well[22]. Green walls have good potential to reduce noise levels in the surrounding environment and could be used effectively in public places, as they help to control noise reflections due to their absorption characteristics.

DISADVANTAGES OF GREEN WALLS

Although there are many benefits in reintroducing vegetation to the surface of urban buildings, some technical problems are faced during implementation.

Damaging Impact

Plants can't establish until some structural change has been made in the wall to allow colonization, and any structural damage by plants is mostly caused by trees rather than herbaceous species such as the climbers; whose damages are likely to happen really slowly allowing preventive actions to be taken[23]. However, it was found that Ivy (hedera helix) which is rooted directly in the crack and opposed to growing up as a climber could pose a real structural impact, and could cause a huge damage if not controlled[24] as illustrated in Figure 9. As a result, a lot of studies advice for the walls to be secured against lichens to prevent such case from happening.

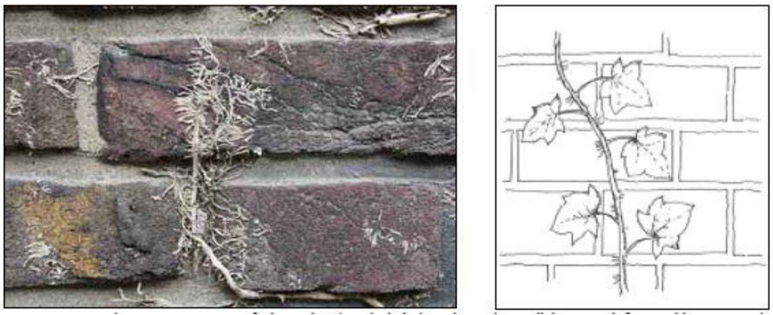

Figure 7. Roots of Ivy in the structure of the wall

Furthermore, the study of Mendonça and Amorim on living walls pointed to the fact that the modular type of living wall system could be the cause of some inconvenience with its irrigation system as it is located far from the modular and closer to the building wall, which can lead to some moisture to be formed on the interior of the building due to the poor installation of waterproof materials. Other concern also involves that the plants on green walls could grow rapidly without the right maintenance system which could lead to an increase in volume and pose a great weight on the structure, affecting its safety[8].

Green Walls Costs

Regarding maintenance, each type of plants requires a different irrigation method. For example, in some locations, the plants used could be non-dependent vine species that requires more attention, or in other cases, some plants species could be deciduous and some provide flowers and fruits which mean requiring some attention and maintenance. Most plants will give good benefits from being maintained on the long-term. It must be mentioned that in the case of the need for supporting structure extra attention must be given to make sure that the cables are well installed to ensure the plants mature. Furthermore, green facades can't assure a predefined behavior as it relies on living species and so it

can't be completely controlled, as they require skilled labor, increased costs to secure and maintain the supporting structure[8].

In the case of the costs of the supporting system, the green façade offers an affordable solution compared to other techniques such as the living wall system where more material is used, and a complicated irrigation system and more species are involved[25].

The costs of vertical greening system vary due to the variety of product available nowadays in the market, however, it is possible to give an approximate cost for some green walls systems, where the cost of installation of the direct green facades was found to ranges between 30-45 €/m^2 for grown climbing plants, and the cost of indirect green facades planted into the soil ranges between 40-75 €/m^2 with the supporting system included, with the possibility of reaching a higher price if planting boxes were included that ranges between 100-150 €/m^2 if the supporting system is made of plastic, up to 800 €/m^2 if the supporting system is made of zinc-coated steel. Also in the case of living wall system, the cost could significantly vary from 400 to 1200 €/m^2 depending on the system and materials used[6].

Discussion

Green walls systems provide a wide range of options that are associated with different levels of environmental benefits regarding the sound insulation, air quality and hygrothermal comfort, environmental burden, payback periods and costs, see Table 2.

Table 2. Green walls Environmental Burden and Potential Benefits

Wall Systems	Living Wall System	Direct green facade	Indirect green facade	Indirect green façade with planter boxes
Costs[6]	400-1200 €/m^2	30-45 €/m^2	35-70 €/m^2	100-150 €/m^2
Payback period (PBP)/ number of years [6]	>50 year	16 – 24 year	16-42 year	16->50 year
Environmental Burden[10]	120-580 kg eq.	-	150kg eq.	150kg eq.
Energy Saving Med. Climate for heating[7]	6.3%	1.2%	1.2%	1.2%
Energy Saving Med. Climate for cooling[7]	43%	43%	43%	43%
Energy Saving Temperate Climate for heating[7]	6.3%	1.2%	1.2%	1.2%
Sound insulation[20,22]	range between 15-18 dB reduction 40% absorption [22]	-	Reduction of 4-9.9 dB Sound absorption of 41% in 800 Hz frequency[20]	
Improving air quality	Offers High capacity for collecting particles Depending on the Plants Type, Structure, Location, Growing circumstances and Exhibition[16]			

Table 2 also shows the environmental and economic properties of different green wall systems. In order to determine the most effective system to be used, it is important to realize the benefits and limitations that each one offers. For example, the living wall system appears to offer the best environmental benefits but it has a higher environmental burden and installation costs, while the direct green facades costs are less but offers fewer benefits.

Therefore, when considering a green wall system, the process of deciding the best method must take in consideration multiple factors such as the investment that those systems are chosen for, the location of implementation and the economic ability.

CONCLUSION

The results from the conducted study provide an insight on the environmental and social efficiency of different systems of green walls. As the environmental analysis of the green walls make a worth noticing points regarding each system weakness and strength, as following: ´

- Direct green facades proved to have a low environmental burden, with a good level of noise abatement, and a good impact on air quality, with a payback period that ranges between 16 to 24 years, not forgetting its energy saving properties. It could be said that this type of greening could be considered sustainable and easy to establish, however, the damaging impact regarding the direct influence of planting on the wall structure must be taken in consideration.
- The indirect greening system showed some environmental burden while offering a better noise abatement than the direct green façade due to the possibility of adding insulation layer. Furthermore, indirect green facades show the same environmental benefits regarding energy saving and air quality improving as the direct facades with a payback that ranges in most cases between 16 to 42 years. Indirect green facades could be considered as a sustainable solution.
- Living wall system (LWS) showed the highest environmental burden due to the materials used and to the durability aspect. Furthermore, the living wall system, in general, is the most expensive system analyzed; as it has high installation costs for the pre-vegetated panels and maintenance costs for the whole system (panels to be replaced, plant species, and irrigation system). However, it provides better environmental solutions than the green facades, especially regarding the noise insulation and the thermal comfort.

Depending on what was mentioned earlier, the direct greening and the indirect greening systems could be considered as the preferred environmental solution that offers good noise and heat insulation, good air quality and reasonable maintenance needs. However, it must be highlighted that the living wall systems provide a wider range of species and structures, which make it easier to apply in some situation despite the economic and environmental burden.

In conclusion, vertical vegetation could be considered as an opportunity of achieving environmental sustainability inside the city envelope especially in highly dense areas, as it provides different types of plants and different installation system for different locations and materials, with different environmental backgrounds.

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ANALYSIS OF OPERATIONAL DATA ABOUT ENERGY AND WATER USES TO INFORM SOCIAL HOUSING DESIGN

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INTRODUCTION

In real operation, buildings rarely perform as predicted during the design phase. The mismatch between the expectations around the energy performance of new buildings and the real energy bills has been defined in the literature as the "performance gap"[1]. There has been a growing awareness that new low energy buildings in particular have unexpectedly high energy bills resulting in a significant disappointment of landlords. This fact becomes even more important when considering housing interventions for low-income people who are more vulnerable to energy poverty. Moreover, as minimum energy requirements become more stringent, housing is becoming more complex in terms of the technology of building systems needed to provide an adequate level of comfort while minimizing energy and water consumption[2].

As a result, interest in implementing feedback processes regarding the operation of buildings in real use conditions has increased. In the literature, these feedback processes have been defined since 1970s within the research field of the post occupancy evaluation (POE). POE is a systematic study of a building that allows the assessment of how well building match users' needs and expectations once it is occupied and the identification of ways to improve building design and performance[3,4]. In recent years, the POE is becoming part of the building process, as it helps to narrow the gap between design intents and actual building performance[5,6]. The importance of this approach is also demonstrated by the recent RIBA research "Learning from Projects" that investigates the results of construction projects to develop new insight for use by clients, architects and engineers[7].

POE can be structured as a multidimensional feedback process, through the use of qualitative (occupant survey, structured interviews, in field observations, etc.) and quantitative (physical measurements, building monitoring, etc.) instruments [8,9].

This research mainly focuses on quantitative data, investigating the opportunity to use monitored data acquired from a building monitoring system as an instrument to identify critical design and operational issues. These can subsequently be handed over to new design projects and can improve the actual management and operation of the building itself [10]. As in similar studies[11-12], data acquired so far are related to energy consumption, water consumption, indoor environmental parameters (air temperature and relative humidity), and occupant behaviour.

Future works will enlarge the analysis, including also socio-technical methods such as structured interviews or occupant survey.

Taking a case study approach, the work focuses on a large social housing intervention recently built in Northern Italy.

CASE STUDY

The case study is a social housing development completed in 2015 and promoted by an Italian landlord, who owns a large portfolio of similar buildings.

It consists of seven groups of apartment buildings, for a total of 323 flats, designed to achieve high environmental performance. All buildings are class A rated according to the Italian legislation D.Lgs. 192/05 e s.m.i., in effect at the time of construction, which took into account only the primary energy need for heating and domestic hot water (DHW).

The buildings have a surface to volume ratio equal to 0,5-0,6 and they are highly insulated. The exterior walls have an average U-value of 0,25 W/m^{2}K, the slabs on unconditioned spaces and the roofs of 0,24 W/m^{2}K and the windows of 1,8 W/m^{2}K. Buildings are designed to maximize the solar access in winter and the solar control in summer; south-facing flats have external loggias that also contribute to this aim.

Figure 1. Schematic view of the social housing intervention

High energy-efficient technologies, unusual for the residential sector, are installed. Each flat has radiant panels for heating and cooling, controlled by a single-zone programmable thermostat. Stairwell-centralized mechanical ventilation systems with active thermodynamic heat recovery supply fresh air to all flats served by the stairwell itself. In winter the system extracts exhausted air, from which it recovers energy by means of a reversible heat pump and supplies fresh air into occupied

spaces at a comfort temperature of at least the indoor air temperature; in summer, fresh air is cooled and dehumidified. The ventilation system is designed to operate continuously in constant volume mode (0,6 ACH), with no possibility of occupant control.
A system of underground closed-loop pipes distributes groundwater (supplied by four groundwater wells) to the seven local plants, one for each group of apartment buildings. Each local plant is made of a heat exchanger, which transfers heat from groundwater to technical water in a closed loop. This serves two reversible heat pumps which supply hot and refrigerated water for heating and cooling and DHW as well. In short, the settlement is all electric; no other energy sources are present.
A building monitoring system (BMS) is installed and allows, by means of the BACnet standard, the real-time collection and analysis of the building systems performance data and the energy and water consumptions of each flat.

METHODOLOGY

The installed BMS is able to provide a clear picture of all the building-related energy usage by integrating a variety of meters.
For each flat the data collected are as follows:

- Thermal energy consumption for heating and cooling, derived from the thermal energy meter installed within the user module of each flat
- Indoor air temperature and relative humidity derived from sensors installed within the conditioned volume
- Settings of the thermostats as set up by the occupants
- Volume of hot and cold water consumed, derived from a water meter installed on the supply pipes

For each local plant, a series of multimeters separately meter the electricity consumed by each heat pump and the total electricity consumed by the auxiliary components, mainly the water circulation pumps. Additional multimeters record the electricity consumption of the pumps that serve the groundwater loop.
Data related to a whole year were considered and aggregated in four seasons: winter (2015 October 15th – 2016 April 15th corresponding to the heating period), spring (2016 April 16th - 2016 June 15th), summer (2016 June 16th - 2016 September 15th corresponding to the cooling period), autumn (2016 September 16th - 2016 October 14th). In spring and autumn flats are not conditioned.
Rough data are analysed in order to:

- Check the operational energy rating of each flat, taking into account the actual energy use for heating, for cooling, for DHW and for ventilation; the operational energy rating is calculated normalizing the actual energy uses by basic factors such as the flat area (square meter of net floor area) and the heating degree days (HDD) in winter season; in this way the actual energy use of different apartment buildings can be compared to attended values and between each others;
- Assess the consumptions of DHW and cold water;
- Understand the occupant behaviour in managing the local control system
- Assess the indoor thermal comfort conditions within the occupied flats[13]
- Verify the HVAC system effectiveness based on the analysis of the failures in the first year of occupancy.

DISCUSSION

This section discusses the results of the analysis carried out, addressing the following questions.
Are the actual energy and water consumption comparable with the expected ones? Which is the weight of different energy uses in the individual energy bill? Are there significant differences in the heating and cooling costs due to design topics such as the orientation, the surface-to-volume ratio, the window-to-wall ratio, of each flat? Are the occupants aware of the energy issues by properly acting on their control devices, such as the thermostats? Does the energy system design fit with the variable energy demand of each flat during the year?
At the time of analysis the settlement was 52% occupied, with a total number of 168 flats still not rent.
The occupancy rate is an important issue in this type of intervention, since this scenario (buildings half-occupied) is typical in the first years of occupancy. Consider that the low occupancy rate could interfere with some of the performance data discussed below, such as the energy efficiency of the building systems, the effectiveness of maintenance activities, etc.
Results presented below are discussed focusing on the occupied flats of two apartment blocks, B and C.

Operational energy rating

Figure 2 reports the thermal energy demand for heating, cooling and DHW of each occupied flat, normalized per net floor area. As reported in Table 1, mean values for apartment block B and C are respectively 72,0 and 54,5 kWh/m^2 for heating, 13,0 and 11,3 kWh/m^2 for cooling and 30,8 and 33,0 kWh/m^2 for DHW, significantly different from the expected values.

Table 1. Comparison between actual and expected average values of heating, cooling and DHW demand

	Heating demand (kWh/m^2)	Performance gap (%)	Cooling demand (kWh/m^2)	Performance gap (%)	DHW demand (kWh/m^2)	Performance gap (%)
Apartment Block B - actual	72,0	+54%	13,0	-51%	30,8	+44%
Apartment Block B - expected	46,8		26,6		21,4	
Apartment Block C - actual	54,5	+21%	11,3	-57%	33,0	+49%
Apartment Block C - expected	44,9		26,1		22,1	

Expected values were calculated at the design stage according to the technical Italian Standards UNI TS 11300, which report a quasi-steady state method based on monthly average values. It's important to note that the expected heating energy demands were overestimated, since the energy model also included a sensible heat load for ventilation calculated considering a mechanical ventilation system with sensible heat recovery (sensible heat recovery efficiency of 70%). The expected heating energy demand is normalized to the heating degree-days of the winter season analysed (HDD equal to 2119, instead of the standard value for Milan 2404).
The expected energy demand for DHW is normalized to the actual average water temperature difference of 33°C, as in real operation. The DHW demand in kWh is calculated considering a multiplication factor of 0,038 kWh/l derived by an average temperature difference of 33°C between

the temperature of water supplied by the water-main (15°C) and the temperature of DHW produced by the heat pump (48°C).

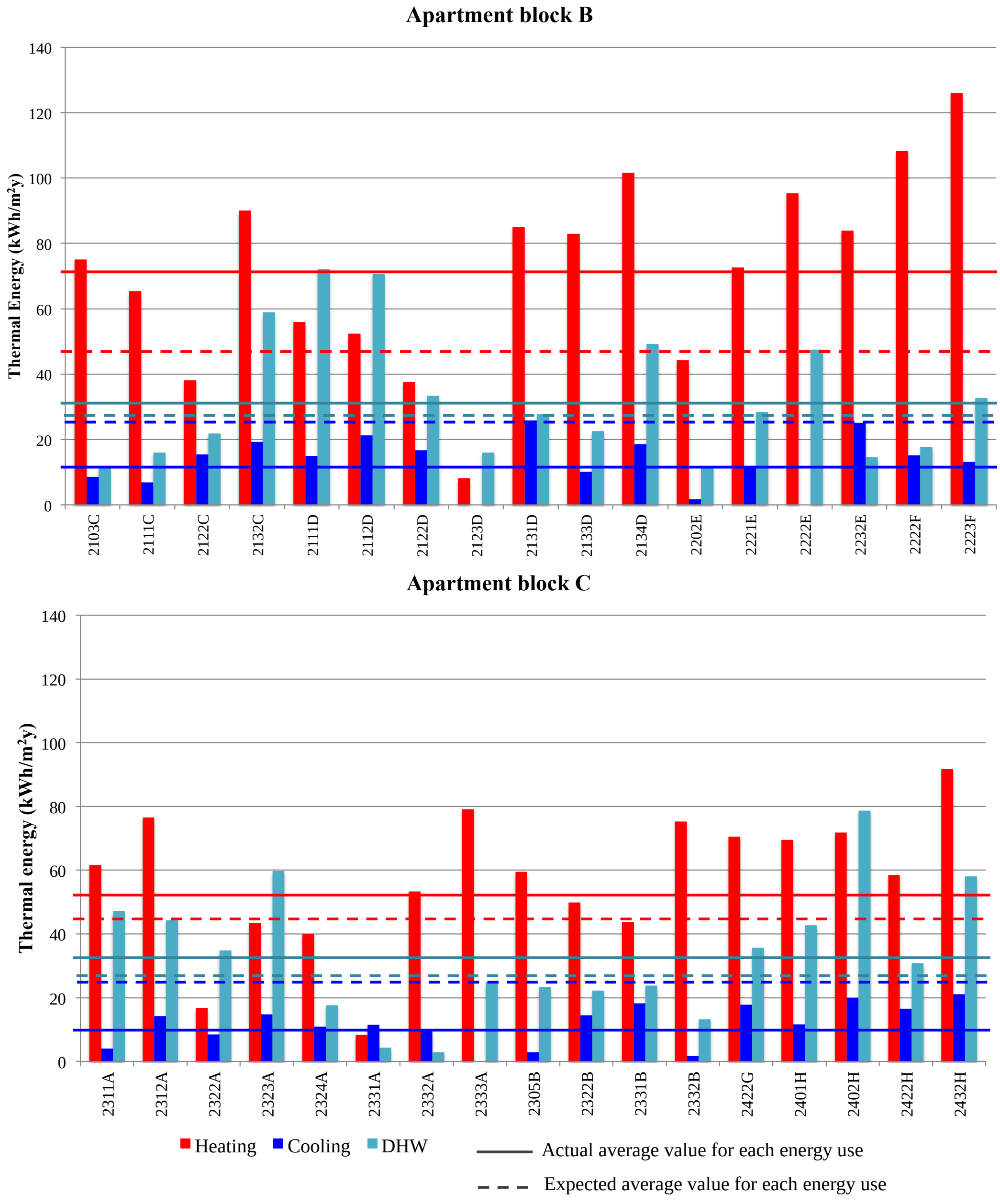


Figure 2. Thermal energy consumption for heating, cooling and DHW of occupied flats in apartment Block B and C

Investigating the causes of the measured performance gap is challenging. Based on the data already analysed, some hypothesis can be done as follows.
The heating load is mainly due to the heat losses through the building envelope since the ventilation load is totally covered by the thermodynamic heat recovery. In winter, the measured indoor air temperature is on average 1,1°C higher than 20°C, the value assumed in the standard calculations, causing a higher consumption of respectively 17% and 12% than the expected. The heat losses

towards the unoccupied flats are not considered relevant since they are heated at 15-16°C and party walls and slabs are insulated (maximum thermal transmittance equal to 0.8 W/m^2K).
Surely the actual heating energy demands are too high as well as the variability of the measured values compared to the average. The variability could also be related to design features, such as the orientation, the surface/volume ratio, the window-to-wall ratio, the level of insulation, the building airtightness. Further investigations on the thermal performance of the building envelope should be carried out in the future.
The actual energy demands for cooling are lower than expected as the real cooling period is reduced to three months. However, occupants set the air temperature setpoint at 25°C, a value lower than one considered in the standard design calculations (26°C).
The average total daily water consumption is in a range between 114 and 120 l/p. The DHW consumption is between 50 and 54 l/p, on average 44-49% higher than the DHW demand calculated according to the UNI TS 11300:2. As in Figure 1, the energy demands for DHW are very different for each flat and none correlation of water consumption values seems to be reasonable, neither per net floor area nor per number of occupants. Similarly to other literature cases[14], DHW consumption could vary by a maximum factor of 4.5 between flats with the same number of occupant. The impact of individual consumption pattern seems to be fundamental and further investigation with structured interviews or questionnaire have to be carried out to better address this topic.
Passing to analyse the measured data at each local plant, the total electrical energy consumption related to heating, cooling, DHW and ventilation is available.
Table 2 reports the specific annual electrical energy consumption related to apartment block B and C for heating, cooling, and DHW. These values take into account the total electrical energy consumption of heat pumps and auxiliary components (water circulation pumps, well and groundwater loop circulation pumps) that weight in a range between 15% and 30% on the electricity consumption for heating, cooling and DHW uses. Moreover, in Table 2 the electrical energy consumptions due to the active thermodynamic heat recovery ventilation system, which include both the electricity for fans (air circulation) and packaged heat pumps (air treatment) is reported.

Table 2. Actual consumption of electrical energy and operating costs for heating, cooling, ventilation and DHW

	Heating	**Cooling**	**DHW**	**Ventilation**	**Total electrical energy consumption**
Apartment Block B - actual	54,5 kWh/m^2	20,4 kWh/m^2	29,3 kWh/m^2	29,2 kWh/m^2	**133,4 kWh/m^2**
	41%	15%	22%	22%	100%
Apartment Block C - actual	37,2 kWh/m^2	19,2 kWh/m^2	31,1 kWh/m^2	27,4 kWh/m^2	**114,8 kWh/m^2**
	32%	17%	27%	24%	100%

The average total electrical energy consumption for apartment block B and C is respectively 133,4 and 114,8 kWh/m^2, with a greater incidence of heating (respectively 41% and 32%) followed by DHW (respectively 22% and 27%), ventilation (respectively 22% and 24%) and cooling (respectively 15% and 17%).
Electricity consumption for heating, cooling and DHW is very high if compared to the thermal energy demand in Table 1. The seasonal energy efficiency **ε** of the energy system, calculated as the ratio of

the sum of useful energy output (heating, cooling and DHW as measured by the metering devices of each flat) to the electrical energy input of the related heat pumps in the local plants, is significant lower than the expected. The seasonal energy efficiency **ε** takes into account the "involuntary" energy consumption that is the energy losses due to the primary and secondary distribution of the heating, cooling and DHW systems and the storage of DHW. Seasonal values for apartment block B and C, reported in Table 3, are much lower than expected considering the design SCOP and SEER of the heat pumps (respectively 4,65 and 6,5), and the expected incidence of the heat losses of the entire distribution system.

*Table 3. Seasonal energy efficiency ratio **ε** of the building systems*

	Winter ε_H **(kWh$_t$/kWh$_e$)**	**Spring** ε_{ACS} **(kWh$_t$/kWh$_e$)**	**Summer** ε_C **(kWh$_t$/kWh$_e$)**	**Autumn** ε_{ACS} **(kWh$_t$/kWh$_e$)**
Apartment block B local plant	1,75	0,65	0,87	0,51
Apartment block C local plant	1,95	0,55	0,84	0,56

Also the electrical energy consumption for ventilation is higher considering the expected efficiency of the active thermodynamic ventilation unit (SCOP/SEER of about 8 as declared by the producer) and the installed electrical power of the fans (about 0.3 Wh/m^3). Since the ventilation is at constant volume mode, occupants have no possibility to act on the ventilation system functioning and performance. The low occupancy rate of the buildings probably impacts on the operational energy efficiency of the ventilation units, since the return air of ventilation is at a lower temperature than the optimum.
Further investigation on the real performance of the heat pumps and ventilation units through functional and performance tests are required.
Starting from the thermal energy demand for heating, cooling and DHW of occupied flat as in Figure 2 and the seasonal energy efficiency of the building system of each local plant as in Table 3, it is possible to calculate the specific annual electricity consumption allocated to each flat for heating, cooling and DHW. Adding the electricity consumption for ventilation, shared per net floor area, the total electricity consumption related to each flat is derived, as reported in Figure 3.

Energy bills

Table 4 reports the operating energy costs for heating, cooling, ventilation and DHW. The considered costs of electrical energy is 0.18 €/kWh. The total operating energy costs, excluding those associated to unregulated energy uses, are 24,1 for apartment block B and 20,6 €/m^2 for apartment block C. They are significant higher than expected: the total operating energy cost is 2 times higher than a similar intervention of the same landlord; the costs for heating and DHW are 4-5 times higher than those calculated at the design stage.

Table 4. Operating energy costs for heating, cooling, ventilation and DHW

	Heating	**Cooling**	**DHW**	**Ventilation**	**Total operating energy costs**
Apartment Block B	9,8 €/m^2	3,7 €/m^2	5,3 €/m^2	5,3 €/m^2	**24,1 €/m^2**
Apartment Block C	6,7 €/m^2	3,4 €/m^2	5,6 €/m^2	4,9 €/m^2	**20,6 €/m^2**

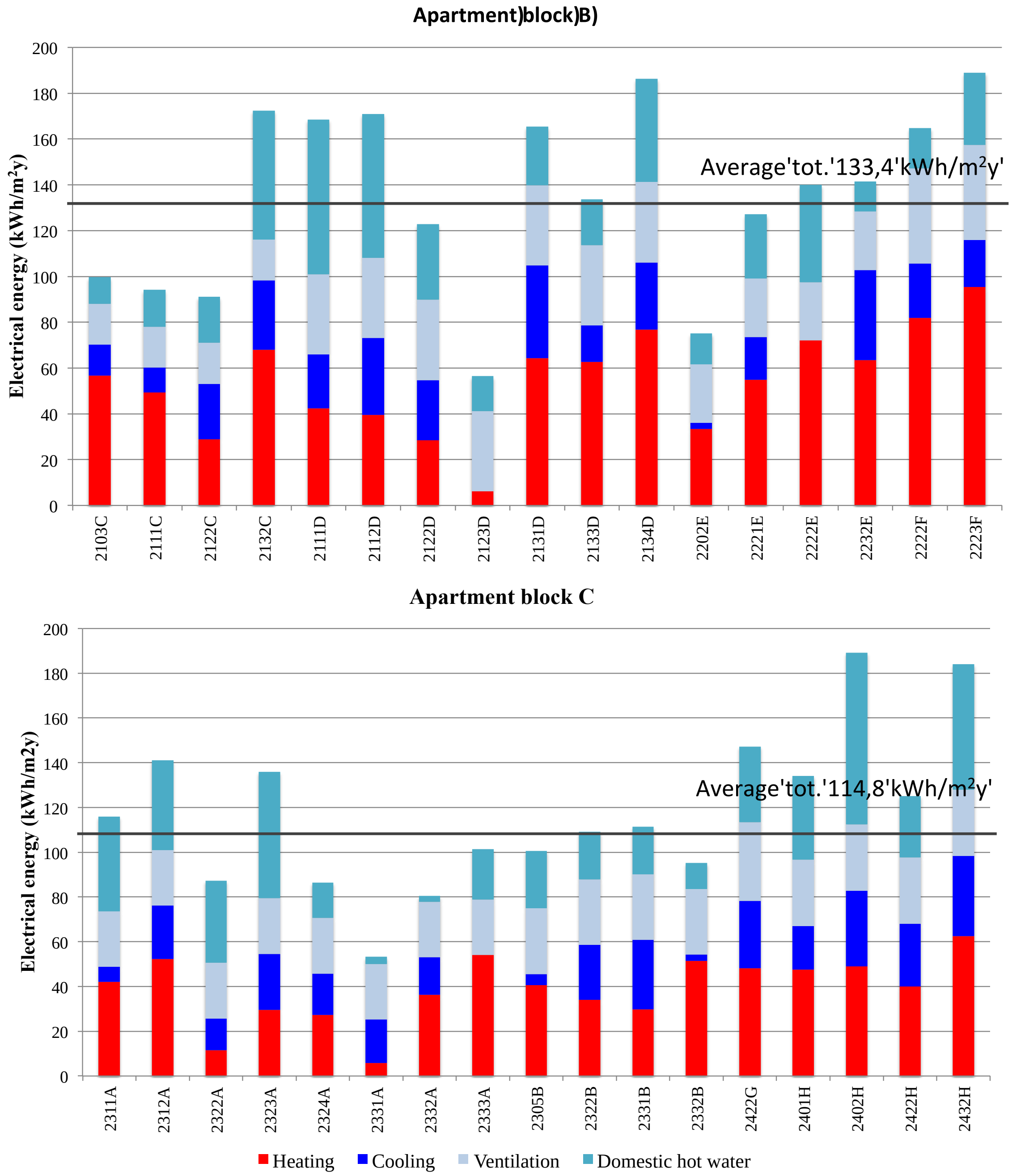


Figure 3. Electrical energy consumption for heating, cooling, ventilation and DHW of occupied flat in apartment Block B and C

Occupant behavior and indoor hygrothermal comfort conditions

During the delivery phase, future occupants were not informed about the setting modes of the heating and cooling system. .

Occupant behaviour is a key factor in establishing how efficiently a building is operating. The BMS provides data about the individual settings of the thermostats, both the setpoint values and the mode of operation set up. On average, during the heating/cooling period, most of the occupants (67% in heating

period) keep the thermostat up to manual mode, setting a unique setpoint value for indoor air temperature. The other 33% set the thermostat mainly in automatic mode, programming different setpoint values according to the occupancy hours. Setpoint values in manual and automatic mode (in occupied hours) are mostly equal to 21-22°C in winter and 25°C in summer.
It's remarkable that in mid seasons and in summer, occupants are used to open windows even though both mechanical ventilation system and cooling system are in operation.
The BMS records with 10 minutes time-step the hygrothermal conditions of each flat.
Figure 4 shows an example of the annual trend of the temperature and the relative humidity of the indoor air (respectively red and green lines) and air temperature setpoint (dark red line); blue line represent the setting mode of the thermostat allowing to understand when the heating/cooling system is switched off probably due to no occupancy of the flat.

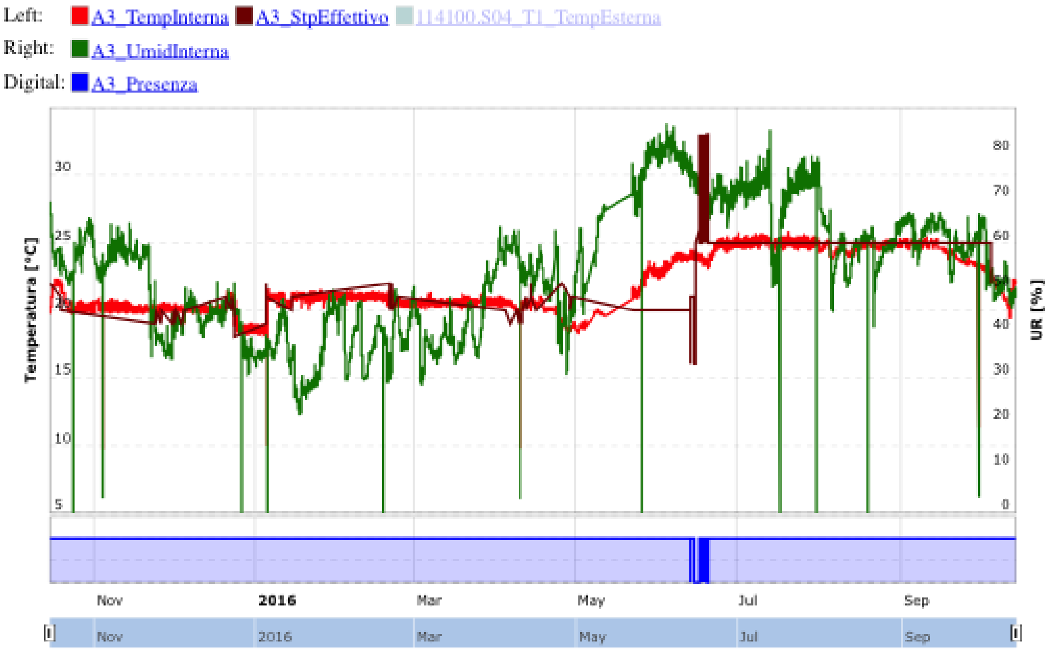


Figure 4. Annual trend of indoor environmental parameter in flat 2103C (apartment block B) as reported by the BMS system

Figure 5-6-7 show an example of the analysis of the indoor hygrothermal conditions. In figure 5, red lines represent the range of comfort condition, meanwhile each blue dot represents measured data of the indoor air temperature and relative humidity at a specific moment. In winter the air relative humidity is lower than 40% for 36% of hours, reaching a minimum value of 22%, meanwhile the air temperature tends to be always higher than 20°C with an average value of 20,4°C. Figure 6 and 7 represent the absolute and cumulative frequency of the measured data in summer and middle seasons. In summer the air temperature is always lower than 26°C driven by the cooling system set at 25°C, meanwhile the relative humidity is greater than 60% for 80% of the time with a maximum value of 85%. This state may cause problem of condensation on the radiant panels. In spring and autumn, when the heating/cooling system is switched off, the indoor air temperature is within the comfort range (20°C<T<26°C) for 66% of the time, and lower than 20 °C for the remaining hours, meanwhile the relative humidity vary with a great extension.

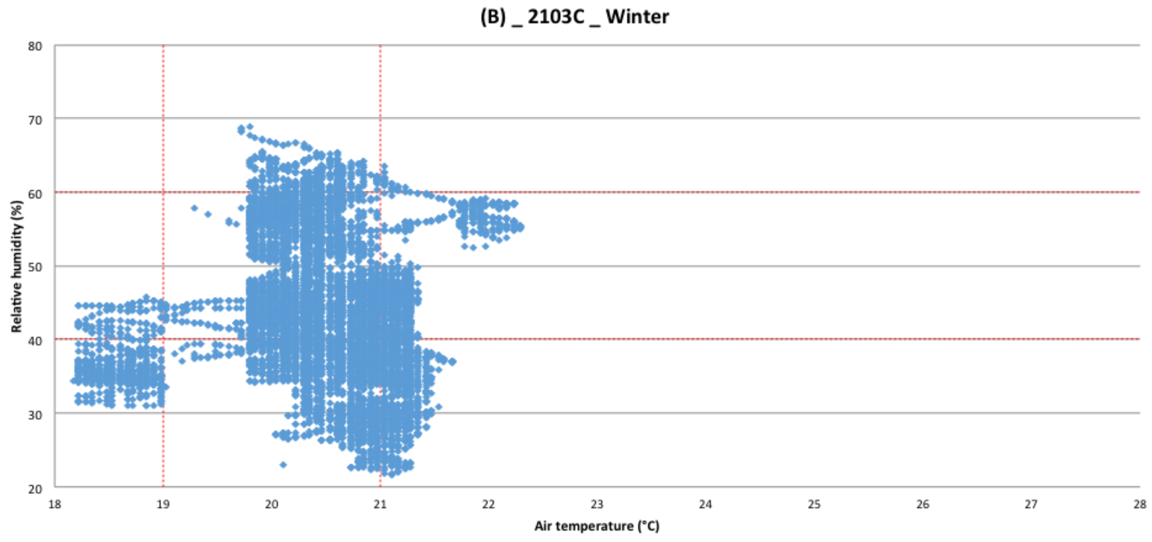
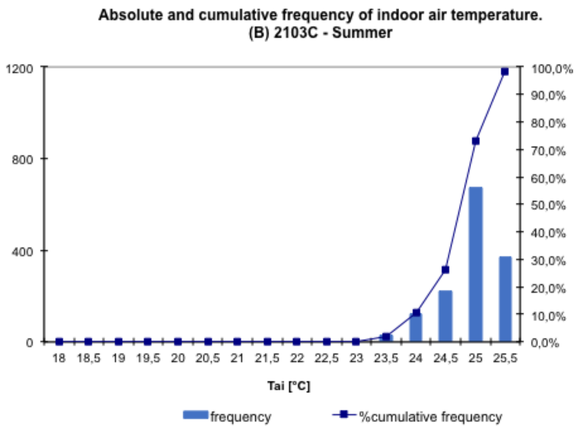


Figure 5. Example of indoor air temperature and relative humidity in winter season for apartment 2103C



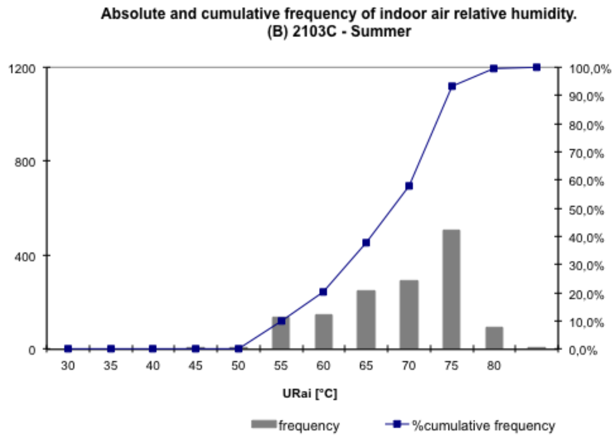
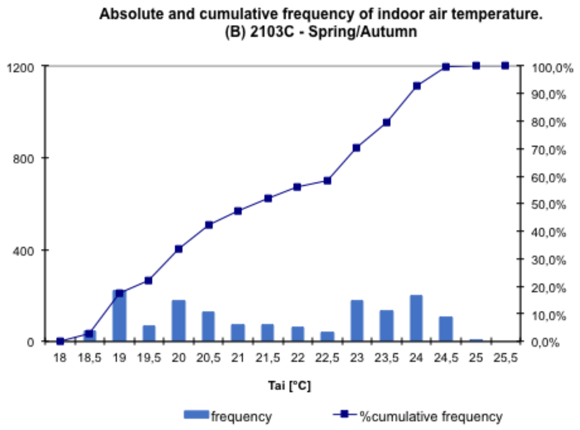


Figure 6. Example of indoor air temperature (left) and relative humidity (right) statistical assessment in summer season for apartment 2103C



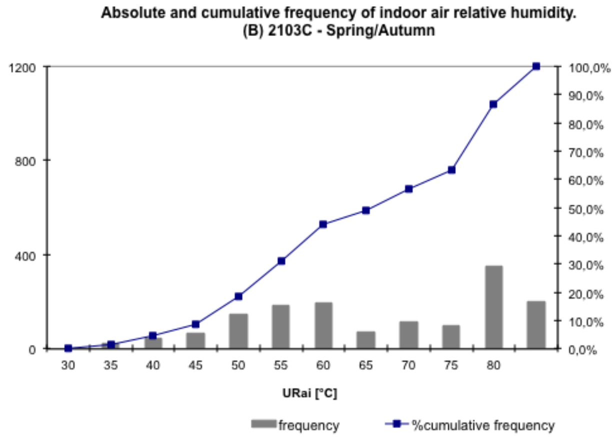


Figure 7. Example of indoor air temperature (left) and relative humidity (right) statistical assessment in spring and autumn seasons for apartment 2103C

HVAC system effectiveness

Data provided by the BMS allow investigating the effectiveness of the building system in terms of flexibility, efficiency and reliability.

Whereas the overall energy performance of the building is lower than expected, a retrocommissioning process should be implemented to understand the causes, tune the system and improve the overall energy performance.

Beyond any consideration related to operating energy costs, the heating and cooling system is able to satisfy the occupant requirements, since no significant complaints have been recorded. Instead, the ventilation strategy has shown some deficiencies. The adopted solution is unsuitable to serve group of flats in part occupied and unoccupied for two main reasons: the impossibility to exclude ventilation in some units and the repeated recorded dysfunctions due to the block of the active thermodynamic recovery system when working in conditions slightly different than expected (average temperature of exhausted air from flats too low or too high).

CONCLUDING REMARKS

In this article, the assessment is based on quantitative investigations (energy and environmental monitoring). The paper demonstrates how in-field monitored data can be used to get feedback for the improvement of the operation and the design of new residential buildings. Moreover, by analysing energy and water consumption a set of evidence-based benchmark values for similar types of intervention can be developed.

Nevertheless, a comprehensive approach should be taken. Investigative tools aimed at understanding occupant perception, habits and expectations need to be integrated in the methodology. This could lead to a better comprehension of the causes of the performance gap and could give feedback information to increase the robustness of new design projects[15].

Lessons learnt from this case study can be summarized as follows.

- Increasing occupant awareness could lead to a reduction of the energy and water consumption, by adjusting the thermostat better and rationalizing water consumption; however, in this case, a large part of the energy consumption seems to be related to the overall energy efficiency of the building system, rather than to the occupant behavior.
- A major consideration of the trend of relative humidity within flats should be useful to improve comfort levels and to avoid condensation phenomena on radiant panels in summer.
- A proper energy performance assessment of the buildings has to be carried out at the design stage to improve the reliability of results and thus the landlords and future tenants become aware of the expected operational costs.
- Higher equality in heating and cooling demand between flats should be addressed at the design stage to equalize the expected operational energy costs.
- Central HVAC systems are a good choice in multifamily buildings, but the flexibility of operation is a fundamental requirement; each tenant should be able to locally control not only heating and cooling but also ventilation to adjust modes of operation to their own needs; moreover it should be possible to turn off the HVAC system in unoccupied flats without compromising the building system performance.
- Improving the quality of the design and construction process, by implementing quality processes such as the commissioning or the soft-landing, should be considered by the landlord in order to reduce system failures and underperformance in operation.

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(RE)FORMATION OF MALAYSIAN CONVENTIONAL HOUSING DESIGN IN LANDSLIDE-PRONE AREAS VIA ALGORITHMIC REMODELLING OF FORM

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INTRODUCTION

Malaysia by coordinate is situated outside the Pacific Ring of Fire, surrounded by shallow oceans and surrounded by neighbouring countries of Indonesia in the west, Singapore in the south, Thailand in north and the Philippines in the east, which makes her free from major natural disasters of earthquake, volcano eruption, typhoon and tsunami. Despite its geographical privilege, the nation suffers from the intense tropical rain with annual precipitation of more than 3000mm, triggering the disasters of flood, sink hole, and catastrophic landslide[1].

The disaster on the 1st of May 1961 in Cameron Highlands was the first recorded case of fatal landslide tragedy in the post-independence Malaysia. The event had caused a row of village houses destroyed, injured victims and deaths. Landslide tragedies appear on the national headlines regularly[2], with the most remembered including the doomed Highland Towers in 1993 killing 48 occupants under the rubble, Pos Dipang tragedy in 1995 which has claimed 44 lives, Bukit Antarabangsa tragedies in 1999 and 2002, and the recent in Felcra Orphanage killing innocent orphans and caretakers who were sleeping in their dorm at the time of the disaster occurrence.

In comparison to other types of natural disasters such as flood, earthquake and tsunami, landslide is an impulsive disaster where the sudden erosion could happen within split seconds without gradual sign to allow ample time for building occupants to evacuate. There is a need for a landslide resistant home to be the last standing barrier to protect the occupants during the event of disaster.

LANDSLIDE IN MALAYSIA

Referring to Figure 1, Peninsula Malaysia Land Erosion Risk Map released by the Malaysian Department of Agriculture shows more than 80% of the total area in the Peninsula is at the high and very high level of landslide risk.

Based on the Universal Soil Loss Equation (USLE) there are 6 factors contributing to soil erosion: rainfall erosivity, soil erodibility, slope length, slope steepness, slope cover management, and conservation practice. According to the I-Geo Disaster Research Centre Malaysia (I-GEO), the largest factors that trigger tropical landslide in Malaysia are the rainfall and soil[3]. Receiving high annual precipitation on vulnerable soil, these 2 factors are uncontrollable act of nature.

In response, Malaysia has developed innovative tools in the last 2 decades to take precautions for annual landslide tragedy including;

i) ROM Scale for measurement of soil erodibility based on EI_{ROM}
ii) ROSE Index for rainfall erosivity values
iii) Rainfall-Soil Chart to forecast the erosion induced landslide risk level
iv) Annual Landslide Risk Calendar in landslide-prone areas
v) Landslide Directory for Malaysian highland areas

These tools do aid in preparation towards the annual disaster and became the reference in determining the types of protection needed on slope either retaining walls, concrete lining, natural turfing and others. But under extreme circumstances such as when the landslide-prone areas receive excessive amount of rainfall than usual, or human-error problems such as faulty drainage outlet and ponding, these slope protection will result in failure and ends up in a tragedy hitting every standing object along its descending path as recorded in history. Such situation is when architecture shall step into the scene to provide a building which able to resist the landslide force and protect its inhabitants.
When the prediction of future landslide location is known, as well as the estimated hazardous months, the level of landslide risk, and the intensity of displaced soil are also known, the next step is to model a landslide resistant house using these predictive information.

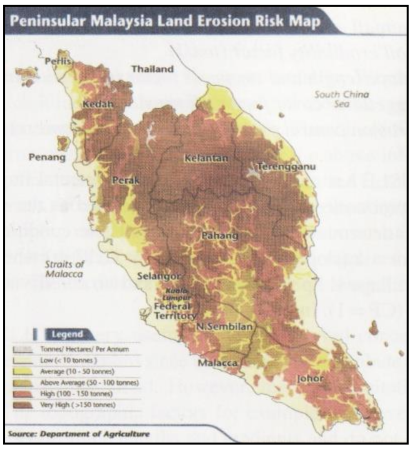

Figure 1. Peninsula Malaysia land erosion risk map. Source: Malaysian Department of Agriculture.

Table 1. Landslide tragedies with the number of death in the state of Selangor from 1993-2011. Source: Malaysian Department of Works.

No	Date	Landslide location	Death
1	11/12/1993	Highland Towers	48
2	30/06/1995	Genting Highlands exit	44
3	25/12/1997	KM17 AKLEH Highway	3
4	15/05/1999	Bukit Antarabangsa	1
5	02/11/2002	Taman Hillview	7
6	31/05/2006	Kampung Pasir	4
7	30/11/2008	Ulu Yam Perdana	2
8	06/12/2008	Taman Bukit Mewah	5
9	21/05/2011	Hulu Langat	16
		TOTAL	**130**

NO	DATE	LOCATION	ROM SCALE	ROSE INDEX	RISK LEVEL
1	11 Dec 93	Highland Tower	15	868	CL3
2	07 Dec 94	Kg.Raja, Tanah Rata Cameron Highland, Pahang	55	1169	CL7
3	28 Nov 98	Bukit Awana, Paya Terubong Penang	5	1875	VHL6
4	15 May 99	Bukit Antarabangsa, Ulu Kelang	7	1157	HL5
5	20 Nov 02	Taman Hillview	4	2574	CL6
6	08 Jan 06	Taman Pusing, Ipoh	2	1326	HL3

Figure 2. Rainfall-Soil Chart showing landslide tragedy with regards to landslide risk level combining the factor of rain erosivity (ROSE Index) and soil erodibility (ROM Scale). (HL = high level, CL = Critical level). Source: IRCDIP.

RELATIVITY IN TRADITIONAL AND MODERN HOUSING TYPOLOGY

The Malaysian traditional house design in the past had similar regional style like other South East Asian countries. Houses were built with timber on stilts construction for centuries for protection against flood, theft, and predators; high-pitched roof with local shingles for heat transfer and ventilation; large openings to maximise daylight and social connectivity; rectangular arrangement on plans and elevations conforming to the available building technology at the time, and an overall north-arrow form[4].

The rise of Modernism in the 1960s resulted in the replacement of modern materials in the Malaysian architectural scene such as the prefabricated concrete, but the typical Malaysian houses today are arguably 'traditional' for still incorporating those characteristics from the past. Though no longer being held on stilts for safety reasons, this suits the current situation of no wild predators roaming in cities, the usage of security gates and circuit camera to prevent theft, as well as water irrigation and drainage system to control flood. Such conventional design is widely built throughout the nation by architects to date, including in the landslide-prone area resulting in a catastrophic destruction in the event of the disaster for not being made responsive towards it.

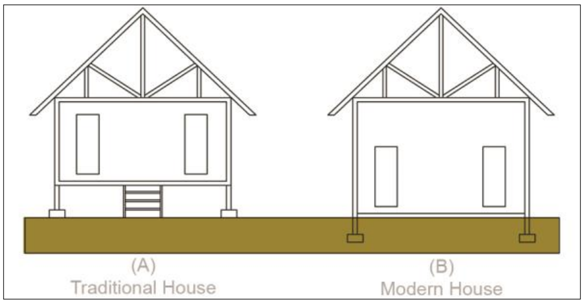

Figure 3. Comparison of a traditional house in Malaysia (A) with a typical Malaysian modern house (B). Source: Aimee Roslan Atelier.

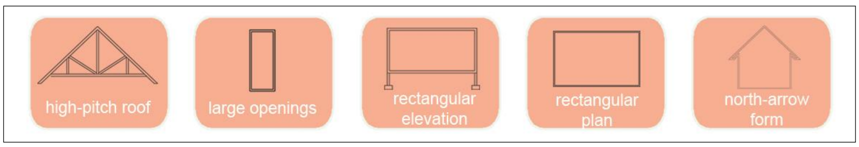

Figure 4. The unchanged major traditional elements of the past which are incorporated in today's modern house design in Malaysia have made the latter is still in fact 'traditional'. Source: Aimee Roslan Atelier.

Irrelevancy of Traditional Design Characters in Landslide-Prone Areas

An ideal house designed in the landslide-prone area in Malaysia should cater for landslide events with these requirements:

i) Able to resist the potential landslide force, long enough to act as a bunk before help arrives.
ii) The material shall be of a high-tensile strength and antiballistic.
iii) Made of durable non-weathered material against intense tropical rain and heat to be used in a long run.

However, the analysis made on damaged residential buildings during landslide tragedies in Malaysia shows that each of them was designed incorporating the traditional characteristics as in Figure 4 and typical housing typology widely built in landslide-prone area today does not fit the requirements above[5]. The current typical material of brick, timber, and concrete have a very low tensile strength, making them to be unable to react to sudden force and potentially fall into structural failure. These materials too are easily weathered, causing gradual damages from the intense tropical rain and concentrated heat.

What has caused this design to end up in structural failure? This scenario is explainable by the principle of physics, which many local designers are unaware of. The traditional design, whether in the past or present context are vulnerable to any sudden imposed force due to its high-stress concentration character. The elements of angular high-pitched roof, rectangular plans and elevations, rectangular openings, boxy walls, columns, beams and the north-arrow form – these are all consisting sharp angles. An angular object contains many stress concentration points, which would expose the object to rupture easier to any imposed force in comparison to a non-angular object with curve or rounded corners.

The theory of stress concentration was made known after the event of De Havilland Comet plane crash in 1950s where 3 of their planes breaking up during mid-flight. Design flaws came from the dangerous stresses at sharp corners on the planes' square windows which brought the tendency to crack when being subjected to an intense force such as in the air. The Comet was extensively redesigned with oval windows and structural reinforcement, followed by other manufacturers heeded the lessons learned from the Comet while developing their own aircraft. As we see on planes today, windows are chamfered with rounded corners and all most angled surfaces replaced with curves[6]. Since then, designers were made aware of the effect of stress concentration in design especially on objects which are being concentrated to force.

Sharp-angled elements being used on major building elements from wall to the roof, including the section facing the hazardous slope; resulting to a multiple high stress concentration surfaces which has answered why these houses were severely destroyed for being unable to resist the landslide momentum. It can be encapsulated that such design is not catered for landslide event, unable to resist the subjected force and therefore irrelevant to be built in landslide-prone areas.

Ever since the primitive days, human built their homes from caves or on trees for safety, from disasters, extreme weather, and predators. A building's main purpose has always been to protect its inhabitants. From the landslide tragedies in Malaysia that have claimed many lives to date, a conclusive inference is raised; these conventional design characteristics have failed the sole purpose of a 'home' by not doing what they were supposed to do - to protect the occupants. A remodelling of building design has to be instigated in response to the problem.

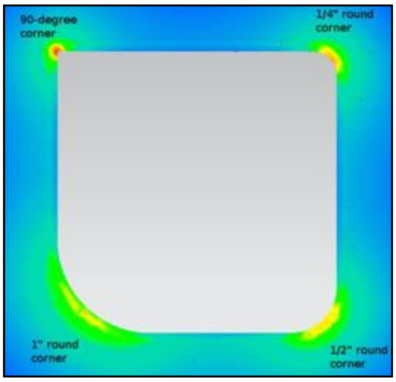

Figure 5. Image showing the intensities of stress concentration of 4 different corners on a surface. 90 degree corner highlights the highest stress (rendered in red) while the corner with the largest radius in lowest stress. Source: Geodan.

Figure 6. Catastrophic landslide tragedy of Bukit Antarabangsa, near Kuala Lumpur (2002) showing severely destroyed houses which were designed incorporating the traditional characters. Source: Utusan Malaysia.

REMODELLING OF FORM THROUGH DIGITAL ALGORITHM

There were many extensive researches to overcome landslide tragedy and loss from the geological and engineering aspects, unfortunately there is an absence from the architectural aspect towards enhancing the building technology to remodel the type of housing in Malaysia to make it landslide-resistant.

In principle, a curved form is far resilient than an angular form when being subjected to an equal amount of force as shown in Figure 5, due to its ability to distribute an imposed force equally along its structure to the ground due to the reduction of stress concentration points[7].

In a precedent research by the authors in collaboration with I-GEO, a structural test was done and it is evident that a curve building structure – such as walls - with computational algorithmic manipulation in response to the slope contour could resist the force in a longer duration than a 90 degrees block before reaching its failing point when being subjected to an equal amount of force on its exposed surface.

It is now known that the rectangular arrangement in the traditional house design in landslide-prone area needs to be replaced by a curved design for higher resilience, most importantly on the structural planes which are facing the hazardous slope where the predictive displaced soil will take place in the event of landslide. The intensity of the curve algorithm could be vary and manipulated based on the contour of the slope through computational plotting.

Using the basis of $F_L = ma$, where m = predictive mass of displaced soil and existing structures on soil, and a = predictive acceleration of moving soil on slope to ground, the range of sudden imposed force in the event of landslide on building structure, or F_L, is known.

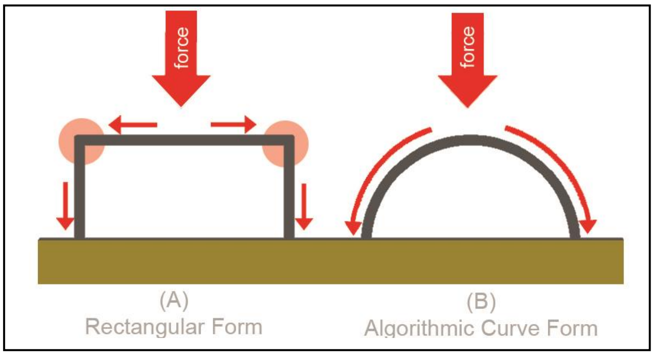

Figure 7. Comparison of reactions to an equal subjected force between a rectangular form (A) and an algorithmic curve form (B). (A) consists of multiple stress concentration points (circled in red) and (B) has no stress concentration point enabling it to distribute the imposed force equally along the arc to ground. Source: Aimee Roslan Atelier.

Introduction to Antiballistic Material

Aside from the remodeling of form, a different building material shall be introduced to replace the current. A suitable resilient material is of a high-tensile and antiballistic; the 2 properties which enable a structure to resist a large force such as landslide and earthquake. Today most houses in Malaysia are built with brick and concrete with high-compression strength. Concrete is known to be dense, heavy and has a very low tensile strength making it incompatible to be used.

Material with a good tensile strength as steel is proven to be able to resist an external force longer than concrete before failing. Steel is also lighter in weight, able to withstand weathering and affordable within the country in the long run, making it the most suitable material to replace concrete for now. The downside of steel is it is lack of antiballistic reaction to a concentrated high-velocity impact. Therefore there is a need to combine steel with an antiballistic property to create a stronger composite material to resist landslide force.

A new material called 'graphene' was found from the chemical separation of graphite in 2004. As an antiballistic material claimed as 'the new Kevlar', a single atomic later of graphene is able to absorb a high-velocity impact up to 6700 mph or 3 times of bullet speed[8]. Unlike Kevlar, graphene is unable to act as a stand-alone material for being too brittle. A breakthrough research at the Korean Advanced Institute of Science and Technology (KAIST) used chemical vapour deposition to by marrying graphene to metals creating strong composite materials by hundredfold[9].

Lomiko Metals stated a coating of graphene just a few atoms thick has the potential to increase the strength of metals, including steel, by 100 times or more and economical to use to strengthen steel is as it could coat a surface area of steel the size of a football field using only about a kilogram of graphene[10]. With the increased strength, it could also reduce the amount of actual steel used in construction. Polymer coatings containing graphene oxide could also be used to add strength and corrosion resistance to steel and other metals.

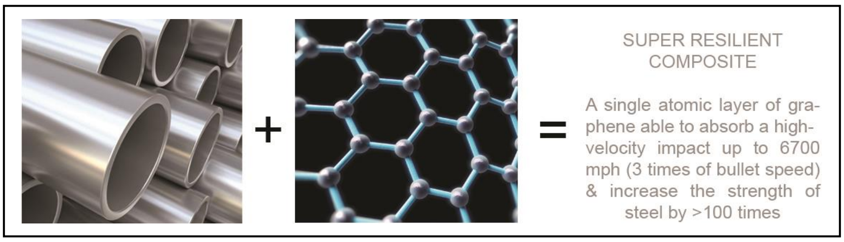

Figure 8. Combination of an antiballistic material of graphene is claimed by experts to increase the strength of steel up to hundreds times or more, creating a super resilient composite. Source: Aimee Roslan Atelier.

(Re)formation Prototype

In the variable aspects of geology, the prediction of landslide momentum, its scale, types of soil, slope locations, and hazardous month calendar have been issued by local authorities and research organisations like I-GEO, Malaysian Department of Works and the International Research Centre of Disaster Prevention Malaysia (IRCDIP) [11]. Since these data are known, a formula of the combination of algorithmic curve form and steel-graphene composite strength could be remodelled into a prototype of a landslide-resistant. The remodeling is necessary on the section facing the hazardous slope as the structure will face the highest amount of force during the event of landslide.

The proposed prototype would consist of 3 main components; the external shell (main structure), internal shell and sway foundation. The main structure that faces the hazardous slope is to be built using algorithmic curve structure of cold-formed tubular steel with graphene coating.

The steel's ultimate tensile strength (UTS) of the external shell is to vary, depending on the predictive landslide force of the area as determined in the geological data available. The replacement with algorithmic curved steel structure shall provide a higher resistance than the current material due to its high tensile property.

The proposed internal shell is made of a layer of Kevlar fabric, with its thickness and tensile strength to vary as the main structure. Kevlar's strength is 5-10 times of steel and able to support the steel structure and high-velocity displaced soil and rocks from hitting the occupants from the inside due to its flexibility, durability, low cost and bendable. Kevlar will act as the internal member to protect inhabitants from ballistic soil particles.

While the foundation is remodelled from the typical concrete footing to steel, equipped with an impact absorbent footing with gauge track to allow structural sway in response to the predictive landslide force from the surface facing the slope. The sway technology is rooted from the earthquake-resistant buildings being built around the world where the Young's Modulus theory of elasticity is applied. Plastic deformation enables the structure to respond to force and resists damages, which the current concrete footing in the conventional houses is failing to react to. A computer simulation of both scenarios being made as shown in Figure 9.

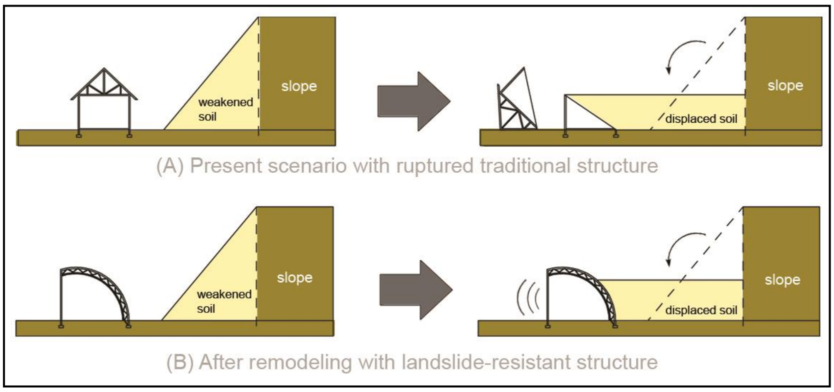

Figure 9. The diagram shows the present scenario of a landslide event in Malaysia where the traditional designed house suffers structural failure after being hit by the displaced soil (A); and the reaction of remodeled house using the combination of algorithmic form and steel-graphene structure shows structural resilient and sway (B). Source: Aimee Roslan Atelier.

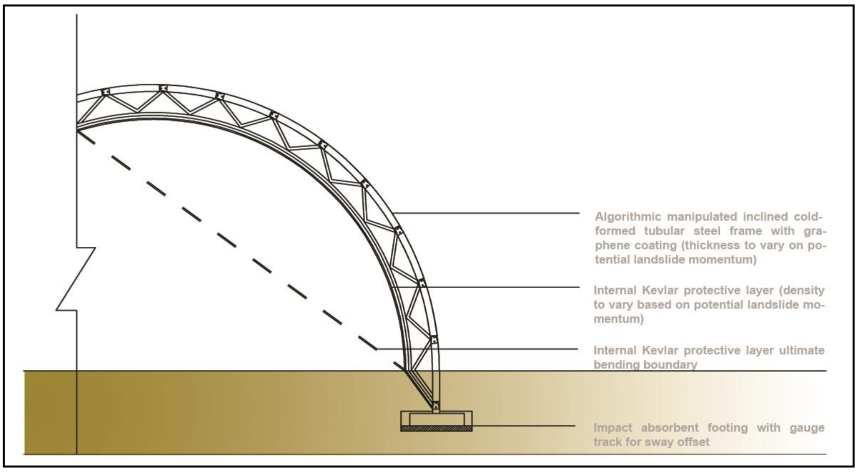

Figure 10. Sectional detail of the proposed prototype of landslide-resistant house in Malaysia's disaster prone area through algorithmic remodeling of traditional structure via steel-graphene composite. The section shows the 3 components; the main structure (external shell), internal shell and foundation. Source: Aimee Roslan Atelier.

CONCLUDING REMARKS

Architectural identity needs to evolve in parallel to the current urgency and circumstances. Though traditional identity in architecture is a living proof of a nation's ethno-cultural development, preservation of techniques and style of the past is seen irrelevant in scenarios where research, innovation, and new emerging technology could provide solutions to problems of today. It is evident through analysis and experiments done in this research that the design characteristics of the conventional building design are unsuitable to be made a safe dwelling in landslide-prone areas in Malaysia.

The typical traditional rectangular arrangements with sharp and pointy edges on structural members are more inclined to suffer building fractures during the event of landslide harming the occupants within. This is being exacerbated by the usage of compressive materials which are unable to respond and withstand sudden large force as landslide's.

The current digital tooling is able to be made of full use to remodel the building through algorithmic design, when non-angular form is proven to be of higher resilience and able to withstand larger force, giving protection to building occupants to take shelter in the event of emergency. The protection is to be enhanced by high-tensile material as steel. Latest research has also shown the application of graphene could increase the strength of steel to hundredfold, making the invention of a landslide resistant structure to be plausible.

The main purpose of a home is to provide shelter and protect human from danger. In this case, the 'traditional' design has failed to comply to this purpose when it comes to combat the number one natural disaster in the country. Architecture has to play its role, therefore there is a need for the reformation of the current building design towards creating a responsive, landslide-proof building in hazardous areas where catastrophic damages and loss of lives could be prevented in the future.

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CHANGING CYCLING BEHAVIOUR: SYNTHESIS OF A THEORETICAL FRAMEWORK AND A CROSS-DISCIPLINARY CRITIQUE OF URBAN DESIGN

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1. INTRODUCTION: CYCLING, URBAN DESIGN AND BEHAVIOUR CHANGE

This paper examines how behaviour change theory can help to understand how behaviour is or can be changed and how that relates to urban design. It does so by focusing on a specific behaviour, namely cycling, which is currently promoted by various cities, urban planners, urban designers and other professions as a sustainable mode of non-motorised transport.

Behaviour can generally be understood as actions or inactions taken by an individual person or a group of individuals in response to "cues", e.g. internal or external stimuli.[1] Both the physical context and societal context can serve as such a cue, and behaviour is therefore regarded as highly (but not only) context dependent. Urban design, by its very nature, interacts and transforms the physical and sometimes even the social context[2]: Urban designers are hence (both intended and not intended) likely to alter, add or remove the cues that trigger actions or inactions and therefore change behaviour. The key problem addressed in this paper is that that due to the complexity of both human behaviour and the amount of environmental and non-environmental variables that influence behaviour, it is challenging to identify how (changes in) the built environment influence behaviour. And it is additionally difficult to change behaviour through environmental "interventions" ("coordinated sets of activities designed to change specified behaviour patterns”[3]).

Researchers from various disciplines are carrying out studies on interventions to promote cycling. But several systematic literature reviews of such studies[4] concluded nevertheless that the evidence for relevant interventions/variables is still "largely inconclusive"[5] and that the "lack of conceptualization … has been identified as a hindrance to research progress"[6]. With such insufficient evidence, there is also no solid theoretical foundation research, policy making and (urban design) practice. And without a solid theoretical foundation and evidence, most approaches, policies and interventions are likely to be ineffective. The reviews also argue that that effective interventions should instead be (1) based on a behavioural analysis as well as possibly focused on specific target groups, (2) deliberately chosen from the wide range of possible interventions, and (3) combined and coordinated[7].

In urban design, but also in general, there is a lack of theory as a systematic and comprehensive basis for understanding and changing behaviour[8], which leads to what behaviour change literature calls “ISLAGIATT-approaches” [It-Seems-Like-A-Good-Idea-At-That-Time][9]: Policy making, practice and

even research selectively relies on paradigms, model solutions, best practice studies or intuition instead of theory or evidence. Sometimes, such ISLAGIATT-approaches might lead to good results, but they are also likely to fail.
But what is missing is an inclusive theoretical framework of analysis to research and understand cycling behaviour beyond ISLAGIATT-approaches. This paper argues that psychology and behaviour change theory has the potential to link research, evidence, practice and policy making from different disciplines by focusing on their common denominator, the targeted behaviour: cycling. It therefore proposes a synthesised framework that could help to structure both research and practice related to cycling by identifying and addressing its particular aspects more systematically. The framework builds on already existing models and hence provides a platform to link an established model of behaviour and existing studies in other disciplines. It was used to structure (1) a literature review on variables that are proven to influence cycling, and (1) a policy content analysis of London-related cycling/transport policy documents. Both helped to further develop and extend the framework, which as a result provides a comprehensive overview of ways in which urban design can/could, but also can/could not contribute to an uptake in cycling in London, but also beyond.

2. METHODOLOGY

The literature review (Fig. 1, left) reflected the cross-disciplinary approach of this paper by covering existing literature in urban design and related disciplines as well as sources on cycling and behaviour change. The key objective was to identify frameworks on behaviour change/cycling/physical activity, which are linked to model of behaviour. The findings of the literature review were synthesised in a "preliminary framework" and as the guidance for the subsequent policy content analysis [PCA].

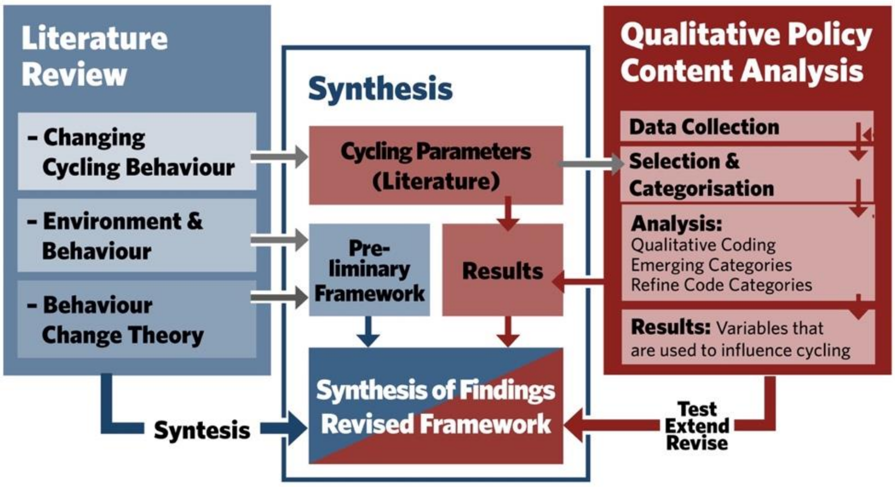

Fig. 1: Overview of the methodology

The PCA (Fig. 1, right) analysed policies that aimed at promoting cycling in London, to identify how different actors (try to) promote cycling and what interventions they propose. This served two purposes: Firstly, it provided an opportunity to test the applicability of the framework. Secondly, it revealed possible variables/interventions/aspects that were not covered by the (reviewed) literature.
Overall, 71 cycling policies were identified as in directly significance to London. They were screened, categorised and a set of 28 policies were systematically selected to represent (1) the most significant policies and (2) each involved actor at least once. This ensured that the PCA would lead to a wide and diverse range of proposed interventions, as urban design as a profession and a task is in general difficult to narrow down or attribute to a particular group of actors or activities[10].

All proposed interventions or variables found in the remaining policy documents were coded. Similar codes were grouped either in categories derived from the literature or in emerging, new categories. Only the main categories will be presented and discussed here, but the complete results were documented in the MRes-dissertation, which formed the basis of this paper[11]. The results of the PCA were compared with and integrated into the final framework. Even though the results helped to further develop the framework, it is important to highlight that (1) the results of the PCA cannot be compared with or be interpreted as scientifically tested variables and that (2) the frequencies of the codes be used for a quantitative analysis.

3. BACKGROUND

Urban designers are frequently intending or proposing behaviour change, for example in relation to safety, to traffic patterns, to uses of public spaces, anti-social behaviour etc. Such intends are not always clearly articulated, but hidden behind moderate terminology: Jan Gehl, for example, famously demanded: "And most important of all, we [i.e. Urban Designers/Urban Planners] must work wholeheartedly to invite people to walk and bicycle in cities as part of their everyday routine."[12]. In order to do so, he proposes a range of guidelines to (re-)design how our cities look and function. He advocates in this sense the use of urban design to make ("invite") people walk and cycle more[13]: he intends to change behaviour.

Basis for such thinking is, that: "Urban designers have long understood that built form influences human behavior, not by way of environmental determinism but rather through environmental possibilism. The design qualities of places make some activities possible and easy to undertake and other activities impossible or difficult. Spatial design can invite, welcome, and encourage certain behaviors and discourage others."[14].

Such approaches draw their justification from (1) their intend to make cities more liveable/sustainable/equitable/healthy/safe/etc. and (2) the argument that the context of behaviour is rarely neutral or in its natural state, but already manipulated by various different interests. Crocker, for example, uses the case of suburbanisation, traffic planning and infrastructure provision to explain how behavioural patterns are regularly subject to specific political and economic interest. Crocker argues, that those interests influence how cities are shaped and thereby tend to deliberately configure specific contexts to manipulate behaviour – but unfortunately not always in favour of the public good[15]. Sustainable design, as proposed by Crocker, consequently seeks the careful re-configuration of contexts[16]. Design interventions that aim as such a re-configuration are essentially what psychologists would call a "behaviour change interventions" [BCI][17].

In the case of cycling in the UK, there is a growing number of researchers that argue that policies and interventions continuously failed to deliver a significant change, and they substantiate such claims with references to the comparably low and slowly growing modal share of cycling.[18] There is an on-going debate on which interventions are most effective and it is difficult to understand why some policies and interventions failed. But three aspects arose during the literature review for this paper:

First, it is well understood that both the socio-economic / socio-cultural context and "the structure and organisation of physical environments" together influence mobility patterns[19]. At the same time, "the provision of infrastructure alone appears insufficient to engender higher levels of cycling."[20] However, infrastructure and other measures are typically treated as distinct layers in separate disciplines and literature, and it remains unclear how both interact and relate to each other. In the literature, this separation becomes apparent when various types of (typically policy related) measures are called "behaviour change interventions" or "soft measures", but physical interventions are typically called "infrastructure". This paper argues that both should be understood as behaviour change interventions, as both intend to change cycling behaviour.

Second, there is inconclusive evidence for variables and interventions to promote cycling[21]. There is a plethora of proposed cycling interventions, ranging from provisions of cycle lanes and infrastructure,

to image campaigns, nudging, incentives or even restrictive measures. But the lack of a common theoretical foundation and terminology makes it difficult to compare, and evaluate all the different approaches. Urban design is by its very nature predominantly focused on the urban form and structure, land use patterns, networks, design and transport systems[22]. An consequently, there is a strong advocacy by urban designers for physical interventions, such as cycle lanes and other physical infrastructure[23], possibly leading to ISLAGIATT-approaches.

Finally, there is the widespread belief – particularly within the built environment professions – that observing, mapping and understanding human movement provides insights on how to change it. In this sense, there are many studies that investigated particular (environmental) "parameters" or "variables" of a specific behaviour and provide reliable insights into specific aspects and "variables" of cycling, (cf. Table 1).

Table. 1: Overview of individual, social and environmental variables

Individual and social variables[24], such as:	**Environmental variables, such as:**
Gender, age, experience, skills, speed, trip distance, trip type, trip origin and destination, car ownership, desired lines, rational reasoning, habits, motivation, perceived risk, policy and legislation, institutional capabilities of cities, cycling cultures, nudging, social marketing, etc.	Rainfall, temperature, hilliness, residential density, public transport density, street connectivity, land use patterns, choice and integration (Space Syntax), high quality/well maintained infrastructure, attractive/appealing infrastructure, segregated lines, on street lines, “good urban design”, “cycle scale” etc.

Most reviewed studies aim at understanding only one specific (type of) variable in detail and reviews were typically restricted to either environmental, social or individual based interventions. Only Pucher et al.[25] and Yang et al.[26] were found to provide a general overview on a wide range of variables, and very few studies indicated which theoretical frameworks or models were employed for particular interventions[27]. If studies concluded policy or design recommendations, they were mostly based on a direct 'translation' of the correlate into a determinant of an intervention[28], even though many of the analysed variables (for example "urban density"[29], "typography"[30], "weather"[31], "betweenness centrality"[32]) are in practice difficult to influence.[33].

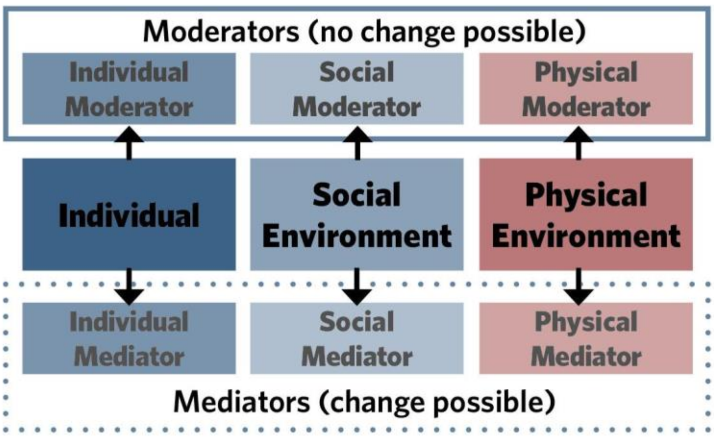

Fig. 2: Overview of types of variables, incl. their moderators and mediators

In general, it can be concluded that there are individual, social and physical/environmental variables, which can be further distinguished as "moderators" (variables which cannot be changed) and "mediators" (variables which can be changed and hence become the focus of intervention strategies)[34]. Particularly mediators can be used to design interventions, and urban design would typically be associated with mediators in the physical environment. But some mediators at the urban morphology level, such as residential density, hilliness, street connectivity etc., could theoretically be changed, but are in reality almost impossible to change. Interestingly, the review also revealed some examples, where design or interventions can help to reduce the impact of moderators, such as for example e-bikes (can compensate lack of physical ability as a moderator) or rain-sensitive traffic lights, which prioritise cyclists (compensate the impact of rainfall as a moderator).

4. SYNTHESISING THE FRAMEWORK

A second type of literature was found in the well-established field of Environment-Behaviour-Studies[35], which typically draw from detailed observations and provide insights into the mutual relationship of the built environment and behaviour by conceptualising the scale and origin of internal or external stimuli and variables[36] (psychological, social, environmental, policy/legislative influences [37]). While they certainly help to analyse the behaviour, they are still lacking an underlying general model of behaviour.

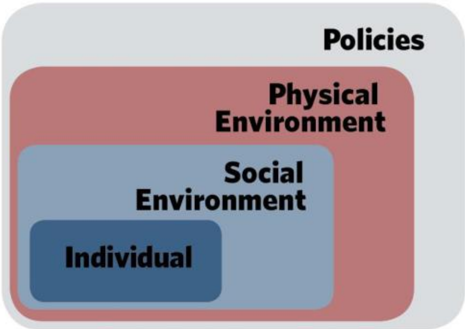

Fig. 3: Ecological model, derived from Biddle et al.[38]

A similar framework was found in the field of policy research: "The Model for Physical Activity Policy Research" by Schmid et al.[39] describes how policies impact physical activity and health. Schmid et al. refer to the Richmond-Kotelchuck's model of health policy[40] which distinguishes three interdependent 'policy determinants' that "influence the development, implementation and outcomes of policy"[41]: (1) "the knowledge base" (research/evidence/data informing decisions), (2) "political will" (society's desires and commitments) and (3) "social strategy" (plans for implementations/solutions).

Fig. 4 The Richmond-Kotelchuck model of health policy (Own diagram, derived from Richmond and Kotelchuck 1991 in Atwood 1997)

They argue, that in case of low political will, it is consequently important to clearly understand and communicate the (monetary) benefits of cycling and to demonstrate effective implementation-strategies.

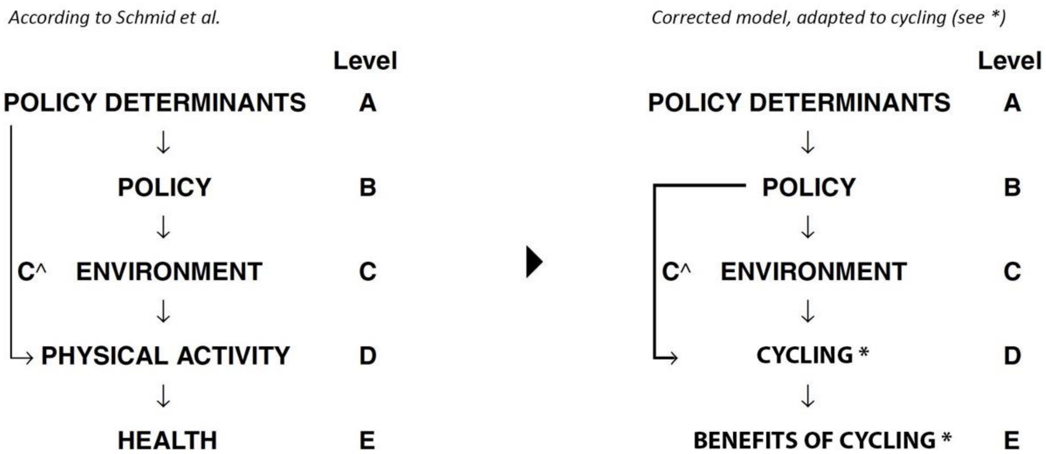

Fig. 4: left: The Model of Physical Activity Policy Research as published by Schmid et al.,
right: The same model, [C^] corrected in correspondence with the authors and adapted to cycling.

Schmid et al.'s model describes the causal relationship from policy determinants [A], via policies [B] to physical activity/cycling. Policies [B] either influence the target behaviour [D] directly via [C^] or indirectly via the (physical or social) environment [C]. The resulting uptake of physical activity/cycling [D] leads to the resulting benefits [E]. The literature review revealed (and later also the PCA) revealed that the (potential) benefits of cycling were regularly mentioned as a key driver of the political will and the development of social strategies. This allowed a first addition to Schmid et al.'s model: a "feedback loop" from the benefits [E] to the policy determinants [A], that functions as a positive reinforcement. The following model emerged as a result:

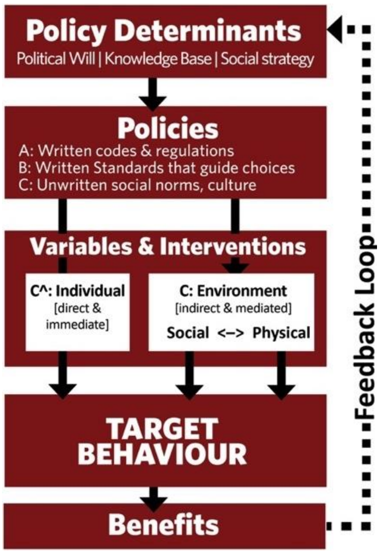

Fig. 5: The first stage of the proposed framework, partly derived from Schmid et al. 2006

The last part of the literature review focused on behaviour change frameworks within psychology, namely the MRC model[42], the Behaviour Change Wheel (BCW)[43], Intervention Mapping[44], the RE-AIM framework[45] and the Individual, Social and Material Model (ISM)[46]. Amongst them, the BCW stood out for several reasons: its coherence, its links to existing theory, its integrated model of behaviour, and its comprehensive range of intervention- and policy types. An additional advantage of the BCW is, that it was developed by a comprehensive review of 83 (often very specific) theories and provides links to many of them[47]. The BCW was deliberately designed to be applied in various disciplines and as a platform for communication between them. Therefore, the BCW is also accompanied by a Taxonomy[48] that provides a clear terminology and enables the direct comparison and evaluation of scientific studies. There are short[49] and comprehensive descriptions[50] of it already, and this paper will therefore only give a short description of the BCW.

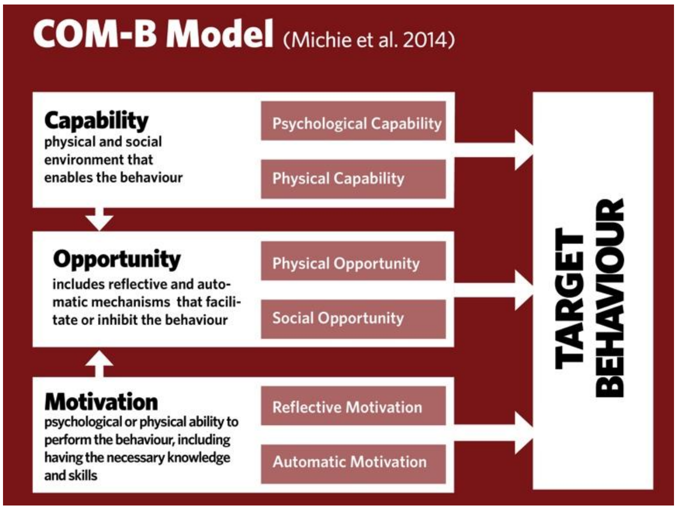

Fig. 7 (right): The COM-B model, derived from Michie et al. 2014

The COM-B forms the foundation of the BCW by arguing, that "behaviour occurs as an interaction among three necessary ‘COM’ conditions – capability, opportunity, motivation – leading to the behaviour"[51]. The COM-conditions are further divided into psychological and physical capability,

social and physical opportunity, and automatic and reflective motivation. Amongst them, urban design would typically be associated with physical opportunity. The BCW conceptualises different policy categories, and intervention functions, defines them (Fig. 8).

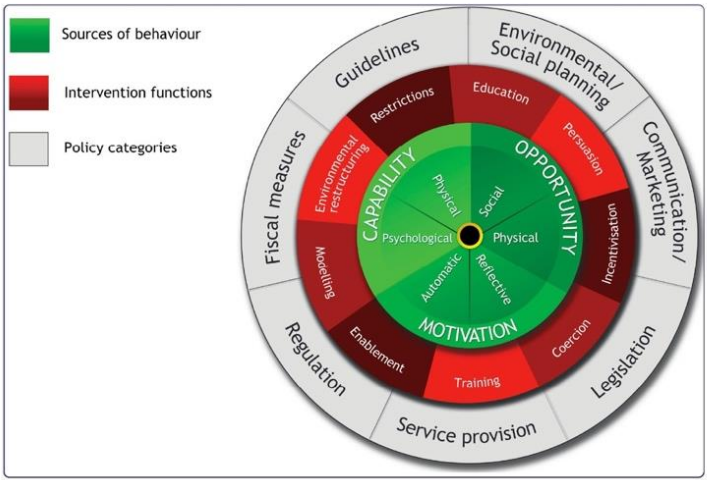

Fig. 6 (left):Overview of the Behaviour Change Wheel, from Michie et al. 2011

It provides additionally contains a very detailed catalogue of suitable interventions for each condition and a methodology to develop them. But, most importantly, it also links the interventions directly to a widely applicable and universal model of behaviour. This helps researchers and practitioners to avoid ISLAGATT-approaches: The idea behind the Behaviour Change Wheel is to enable "behavioural analysis" that evaluates capability, opportunity or motivation and then informs a theory and evidence based selection of policies and intervention functions in order to maximise a specific COM-B-component. (Fig. 9)

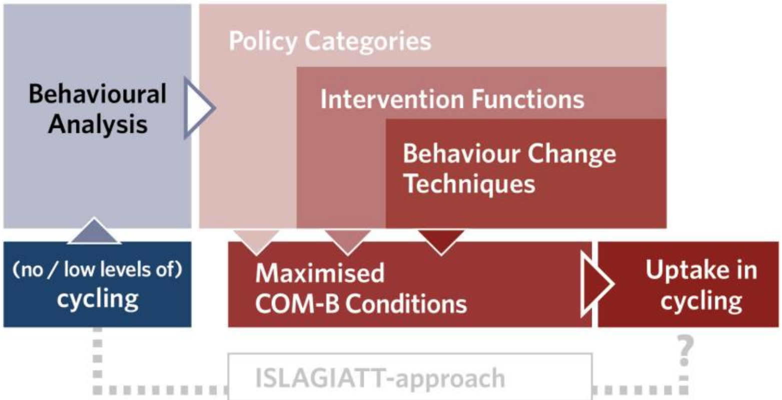

Fig. 7: Elements of the Behaviour Change Wheel and how they affect cycling.

Thereby, the BCW provides a link from theory to analysis and helps to choose suitable interventions by indicating which strategies would – according to the theory – miss to achieve the aspired change. The structure of the BCW links easily to the other models described above and thereby provides the missing theoretical foundation for the other models (Fig. 10).

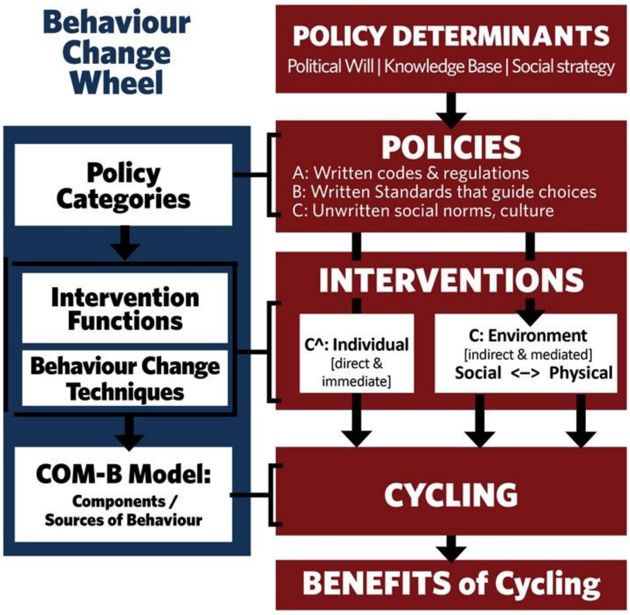

Fig. 8: The proposed framework and how it links to the BCW

At this stage, the findings of the PCA were added by locating the resulting main categories within the framework. While some of the categories corresponded well with the synthesised framework, there were also new categories which were not specifically mentioned in the reviewed literature. The PCA particularly revealed that "training", "knowledge transfer", "strategic visions", but also "design principles", "monitoring/evaluation" appear to be seen as important for policy makers and decision makers. These results indicate where urban designers can contribute to promote cycling: Knowledge transfer and training through best case studies and expertise, as well as the development of visions, policies, plans, and strategies all lie well within the skill set, responsibility and the day-to-day activities of urban designers. And as most policies appeared to be (deliberately) vague in advising specific interventions, the decision and design by the individual planner becomes increasingly important, as they translates the policy into an actual intervention. It is in this link between policy and implementation, where design principles, design guidelines, and substantial training can massively influence how cycling is/could be promoted. The PCA also revealed, that in practice, non-physical/social/individual interventions and physical interventions are in practice often combined. Examples would here be cycle to school campaigns, with both training and specific infrastructure (cycle lanes and bike parking), or campaigns where companies provide incentives, promotion, bike parking and changing rooms with showers all together. And at least according to the policies, such combined measures that go beyond plain infrastructure seem to be very successful.

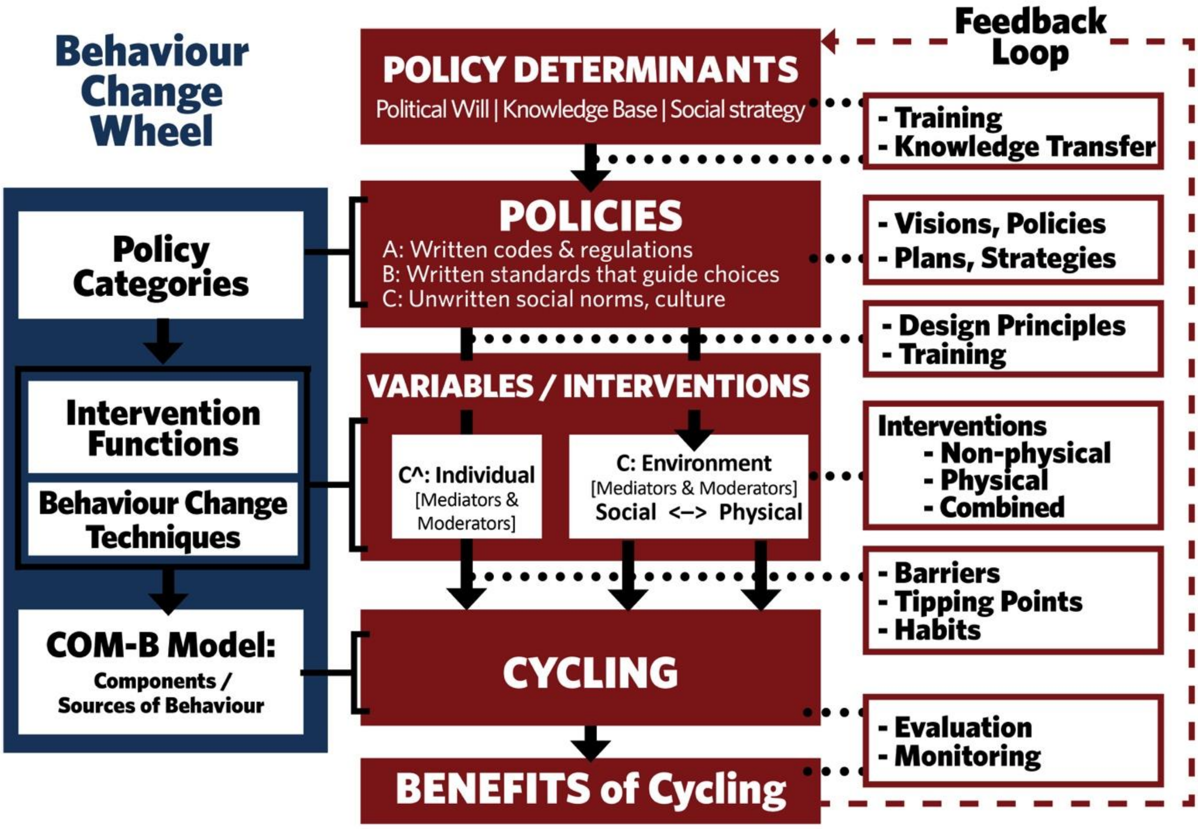

Fig. 9: The complete proposed framework, with links to the BCW and the results from the PCA.

Another emerged aspect was the concept of tipping points, the counterpart to barriers. Tipping points describe the cues that make non(-regular)-cyclist a cyclist. And some sources indicate, that this is a process often related to changes in the life style, a new job, moving into a new town or peer pressure. This highlights that removing/bridging (physical) barriers is of course necessary, but effective behaviour change needs to go further than that.

5. DISCUSSION AND CONCLUDING REMARKS

This paper could only briefly cover the field of behaviour change, but the final framework indicates how various measures to promote cycling relate to each other and could provide a basis for structuring research on cycling. And the link to the existing BCW provides both researchers and practitioners with a solid theoretical foundation. This opens up a wider perspective on urban design that could help to multiply the potential impact of design solutions:

The re-configuration or the re-design of urban space and physical features (i.e. urban design) is certainly a powerful tool to deliver change by providing or denying "opportunity" (possibilism or determinism) – particularly in cities with contested space such as London. But urban designers can do much more: increasing the quality of the space, addressing capability and motivation, but also knowledge transfer, and engaging in influencing policy determinants. And it became equally clear that important psychological aspects (habits, motivations or "tipping-points") are rarely adequately addressed, and Urban Design is hence likely to not unlock the full potential that its interventions could have. Here, the framework provides guidance and a platform for research, evaluation and exchange that could help to deliver systematically designed and hence effective interventions instead of ISLAGIATT-"solutions".

This leads to the recommendation for further studies: The importance of habits and "tipping-points" was hardly covered by the reviewed literature, nor specifically addressed in the research design of studies on cycling. Further studies would be also necessary on (1) the relevance of training and knowledge transfer amongst decision makers and practitioners, and (2) the relation between costly infrastructural changes, and their actual effect on cycling – particularly taking into account the role of habits, tipping-points.
The field of Behaviour Change is still constantly evolving and the framework proposed in this paper needs further development too. However, it can be concluded, that there is little need to develop completely new methods or theories to research and understand how urban design impacts behaviour; very necessary and helpful theories and methods are already at hand, just in neighbouring fields. In this sense, this paper understands itself as a kind of signpost directing urban designer towards this neighbouring fields and their existing knowledge, methods and theories.

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THE USE AND IMPACT OF MANUAL AND MOTORISED BLINDS AS AIDS TO THERMAL AND VISUAL COMFORT IN DOMESTIC BUILDINGS IN THE UK

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INTRODUCTION

There is significant evidence that the combustion of fossil fuels for energy has contributed to an increase in CO_2 and other greenhouse gases in the atmosphere since the Industrial Revolution; there is also evidence of a parallel increase in global temperatures, all of which have contributed to climate change and detrimental environmental impacts. The built environment has made a notable contribution to these issues and in 2011 for example it accounted for 62% of global energy consumption. Up to 85% of this energy was operational (as opposed to embodied)[1] and in the EU 50% was used to operate heating and cooling systems in buildings[2]. Consequently, several strategies have been developed to reduce energy consumption and associated environmental impact from the built environment including improved insulation. Although this has proved environmentally beneficial by reducing energy demand for heating, in conjunction with changing climate and weather patterns however, it has also contributed to a rise in the overheating incidents in buildings. This in turn has increased the demand for electro-mechanical cooling (e.g. air-conditioning and fans), the use of which negates some of the benefits of reducing energy for heating.

There are many examples of contemporary buildings that have been designed to minimise thermal gain in summer and/or warm locations; this can be achieved through appropriate building orientation and/or technical design features such as those in Jean Nouvel’s Arab World Institute in Paris, France (which includes an intelligent shading system on the south façade to manage light and solar gain)[3] and Alejandro Aravena’s Siamese Towers in Santiago, Chile (which incorporate a double skin to remove heat from the building)[4]. Many buildings do not include this type of feature or good insulation however as a result of which interior temperatures are high in summer and low in winter, and although appropriate design and correct orientation of new buildings could mitigate these issues, there is a considerable quantity of new and old building stock in the UK that does not address one or both factors successfully.

Blinds, shutters and other shading products can be both retrofitted in existing buildings and

incorporated into new building designs. In addition to creating privacy and security for building occupants, they can address some of the above problems in that, if correctly used, they attenuate daylight and help to reduce energy use and associated impact by limiting thermal gain in the summer and thermal loss in the winter. In the UK use of motorised and automated shading systems is increasingly popular in commercial buildings with shading systems. However the emphasis of this study is domestic buildings, where interior space, user behaviour and levels of energy consumption often dramatically differ from that in commercial buildings; for example, air conditioning is installed in very few domestic buildings and manual shading products are the most widely used. This could change as use of motorised blinds has been shown to encourage user interaction and thus improve thermal comfort, well-being and energy savings. While component materials and manufacturing processes for this type of blind system differ from those in manual blinds, they also consume electrical energy for operation and therefore overall environmental impact is higher than that of manual blinds.

This paper briefly considers thermal and visual comfort, health and well-being of building occupants; it then compares the embodied and operational environmental impact of motorised blinds and associated energy savings to determine their overall environmental impact and concludes by discussing a major challenge to the construction industry that is also limiting the potential benefits of blind use.

CONTEXT AND BENEFITS OF BLIND USE

Blinds and shutters have been used around the world for hundreds of years to cover unglazed and glazed window openings although the precise origin and date of invention is unknown. Early examples of blinds and shutters made from natural materials such as bamboo and reeds were developed in the Far and Middle East. Slatted wooden 'venetian' type blinds were also developed in Persia prior to widespread use across Europe and America while patents dating from the middle of the 18th century illustrate the development of blind mechanisms. Today various types of interior and exterior blind (such as roller, slatted, pleated, vertical, panel) made from both natural and synthetic materials (including wood, textiles, aluminium, and polymers) are available.

Both blinds and shutters are used for privacy and contribute to building aesthetics, while shutters (which are usually made from wood or metal) also enhance security. Furthermore the 'correct' use of blinds helps to keep buildings warm in the winter and cool in the summer although what is 'correct' varies according to geographical location[5] and type of blind (opaque, semi-opaque, roller, slatted, fit-to-window / cassette etc.). Nevertheless incidences of overheating in buildings are increasing; this is due in part to changes in weather and climate, rising numbers of heat waves in the UK[6], as well as changes in, performance of and inappropriate specification of building products such as glazing and insulation. These factors further highlight the importance of correct blind use[7] which also contributes to human wellbeing by controlling glare, natural light levels, access to view and interior temperature. This is particularly important for the very young and the elderly who are more susceptible to ill health (and even death) as a result of exposure to high[8] or low[9] temperatures, which is not only unpleasant for them but can lead to additional health service costs; there are also indications that the previously described environmental factors can enhance productivity in the workplace[10] and various related real time research projects are on-going (for example at LSBU).

As aids to temperature control and thermal comfort blinds and shutters reduce energy consumption, and a wide range of impacts including associated CO_2, and other greenhouse gas emissions. In fact the 'correct' use of blinds can reduce energy consumption by up to 15% for double glazed windows[11] and 25% for single glazed windows[12] in both residential and non-residential settings. Consequently blind use has the potential to reduce heating costs during the winter and cooling costs during the summer.

THE ENVIRONMENTAL IMPACT OF MANUAL BLINDS

It must be remembered however that, like all products, blinds have embodied impacts and a research project was undertaken in 2015 in order to ascertain the extent to which this affects their overall environmental profile[13]. Life Cycle Assessment was used to quantify the average impact of different types of manual blind (namely wooden and metal venetian, polyester vertical and roller) in a typical UK house. This study differs from 'carbon footprint' studies, which, as the name suggests, only consider the impacts of carbon and its equivalents. Life Cycle Assessments includes hundreds of material, gas and liquid inputs and outputs including emissions to land, air and water, the impact on ecosystems, resource supply and human health[14]. LCAs are therefore more holistic and accurate than carbon assessments as illustrated in the study of a refrigerated display cabinet that compares the results of an LCA and a carbon study of the same product. The results highlight the shortcomings of carbon assessments and show that the ratio of embodied to operational impact is proportionally higher than in that in the carbon assessment[15].
The LCA results of the manual blinds were positive and showed that, even if energy savings were very low (5%) and life short (3 years) providing that the blinds were recycled at end-of-life, their use has a lower environmental impact than not using blinds. Furthermore if energy savings are similarly low (5%) and the blinds are sent to landfill at end-of-life they are also environmentally beneficial as long as they are used for at least 5 years.

USER INTERACTION AND MOTORISED BLINDS

Despite their potential contribution to human well-being and energy saving in the UK in non-residential premises in particular the installation and use of air conditioning (and associated energy and emissions) is increasing because the various properties and benefits of blind use is not recognised[16]. There are a number of reasons why this is so including inaccurate specification of blinds and inadequate fitness for purpose, poor understanding of correct use and associated user behaviour. In their longitudinal study in Switzerland Paule et al[17] found that users do not move (i.e. raise and lower) blinds regularly or frequently and therefore potential reductions in thermal loss and/or gain are unfulfilled. This same study identified an interesting change in user behaviour when different control strategies were implemented: building occupants with motorised blinds moved their blinds far more frequently than occupants with manual blinds and the researchers concluded that this was because the motorised blinds were easier to use than manual blinds.
Therefore it is fair to conclude that motorised blinds could be a positive means of encouraging more effective and proactive blind use. This type of blind has higher embodied and operational environmental impacts than manual equivalents however because they require electrical energy,

additional mechanical and electronic mechanisms, electrical and operational components to function. This in turn raises a question as to what overall environmental benefits derive from use of this type of blind: i.e. whether the environmental impact of energy savings exceeds the combined embodied and operational environmental impacts of the products.

THE ENVIRONMENTAL IMPACT OF MOTORISED BLINDS

This paper now describes comparative Life Cycle Assessments of the overall environmental impact of two types of motorised blind, namely mains (hard wired) and battery operated. By considering the impact of blinds in a domestic context both the earlier study and this study differ from many others, which have measured performance and impacts in commercial premises[18], [19]. This study employs the same methods and many of the same parameters as the study of manual blinds as follows:

- the blinds were all reverse engineered and quantified in a screening LCA created with SimaPro software and the Ecoinvent database and hierarchical (average) weighting set
- the functional unit in the model is one average house with seven blinds that cover a total of $14.5m^2$ double-glazed windows
- annual average annual energy consumption for space heating is 60% of the total of domestic energy use (although it varies according to external temperature), which is calculated as 11,160 kWh per household[20], [21].

The manual blinds study included a 100% polyester dimout roller, a wooden venetian, an aluminium venetian and a vertical blind with polyester vanes to reflect the fact that different types of blind are commonly installed in individual houses. This current study only includes motorised roller blinds however because they are the most popular choice of interior domestic blind. The models include different fabrics, namely dimout fabrics (which reduce thermal loss during the winter and night) and a screen fabric (which reduces thermal gain and improves visual comfort during the day). The list of parameters in the model are as follows:

- 3 typical fabrics:
  - 100% polyester multilayer dimout
  - 72% PVC / 28% glass fibre composite dimout
  - 64% PVC / 36% glass fibre composite screen
- 2 types of motorised system:
  - 1 x mains powered / hard wired system
    - standard electrical and electronic components, metal and polymer housings, 2-core wire to mains, 13 amp plug
    - operational energy input is based on raising and lowering blinds for 30 seconds per day
    - blinds are controlled by handheld remote with rechargeable Li-ion battery (details of recharge and product life below)
  - 2 x battery operated systems
    - controlled by
      - a ‘wand’ control attached to the blind mechanism

- a separate remote control
- Electrical / electronic components: size and specifications vary according to whether they are part of the 'wand' or the 'remote control' based system. The inputs, outputs and results for these two complete systems are averaged

- Batteries in blind mechanisms and controllers use Li-ion rechargeable batteries. Battery charge lasts for 6-12 months depending on level of use and so the model includes electricity input for 1.5 charges per year.
- Battery life is limited and they are replaced once every 5 years

The following parameters are the same as those in the models for the manual blinds:

- Energy savings of 5%, 10%, 15% and 20% are modelled. However it is expected that average energy savings will be higher than those for manual blinds because user interaction with and levels of movement of motorised blinds is higher than that of manual blinds.
- Product life is set as 3, 5, 10, 15, 20 years; this is dependent on customer preference and quality and durability of the blinds themselves.

The overall environmental benefits of recycling manual blinds at end-of-life have already been described above; however many blinds are disposed of before components reach the end of their functional life and so the new study also includes reuse / replacement of some components. The models are based on the following parameters:

- End-of-life scenarios represent best and worst cases namely all parts recycled and all parts sent to landfill.
- Reuse and replacement: some components deteriorate as a result of direct exposure to sunlight and fabrics can fade and/or discolour and as the most visible part of the blind, customers are most likely to want to replace fabric when they redecorate, typically every five years[22]. A fabric 'refresh' (replacement) every 5 years is therefore modelled (Good quality blinds that are not misused or abused can last for more than 20 years; all components other than fabric and batteries are therefore reused once (at 5 years), twice (at 10 years), 3 times (at 15 years), and 4 times (at 20 years) over product life.

Results for the reuse models are compared with results for complete product replacement.

LCA RESULTS AND DISCUSSION

The dimout and screen blinds fulfil different functions and while the dimout blinds will generally be used at night they could also be used during the day if the property is unoccupied or with artificial light. The screen blinds will be used during the day to improve visual and thermal comfort. Once again in order to reflect a typical mix of blinds in a domestic interior, the impact of the blind fabrics was averaged. Predictably the environmental impact of the motorised blinds was higher than that of the manual blinds because of the additional components, the impact of which was determined by both the mass and type of materials and manufacturing processes associated with the various electrical and electronic components, product casings, batteries, energy input for charging and transport. The benefits of reuse and recycling were apparent despite the fact that the batteries had to be recharged at least once a year and were replaced every five years.

	product life	5 years				10 years				15 years				20 years			
energy saving	end-of-life scenario	landfill		recycle		landfill		recycle		landfill		recycle		landfill		recycle	
	operating system	mains	battery	mains	battery	mains	battery	mains	battery	mains	battery	mains	battery	mains	battery	mains	battery
5%	A	X	X	✓	✓	X	X	✓	✓	X	X	✓	✓	X	X	✓	✓
	B	X	✓	✓	✓	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10%	A	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	B	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
15%	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	B	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
20%	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	B	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Figure 1. The environmental benefits of hard wired and battery operated motorised roller blind use in a typical house in the UK
Key: A = complete product replacement
B = replace fabric and batteries; reuse all other components
✓= impact of blinds + operational energy is lower than not using blinds;
X = impact of blinds+ operational energy is higher than not using blinds

The results clearly show that use of motorised blinds is environmentally beneficial providing that they are recycled at end-of-life. This is not the case if they are sent to landfill and the impact of mains powered blinds is higher than not using blinds (as shown by X in Table 1 and confirmed through analysis of the complete numerical results). Use of mains-powered blinds also has a higher impact than that of battery-operated blinds when:

- energy savings are 5% and under
- complete products are replaced after 5 or 10 years rather than being 'refreshed' (i.e. only batteries and fabric are replaced)
- when the product life is only 5 years and energy savings are 10% and below

It is expected that use of motorised blinds will create greater energy saving for heating and cooling as consumers interact with and move these blinds more frequently than manual blinds. Although mains-powered blinds have a higher impact than battery-operated blinds in some respects they may be more attractive to consumers because they are easier to maintain: in the case of mains-powered blinds only the batteries in the remote control have to be recharged and replaced whereas batteries for both the roller mechanism and the remote control have to be recharged and replaced in battery-operated blinds. Mains-powered blinds would probably need an electrician to install them which could limit their application in the DIY market and increase overall cost.

Nevertheless, like manual blinds whichever system is installed use of motorised blinds has the

potential to reduce environmental impacts and overall direct energy costs, to improve occupants' well-being and subsequently to produce further indirect economic benefits by reducing medical and health issues.

LIMITATIONS TO THE POTENTIAL BENEFITS OF BLIND AND SHUTTER USE

At present, even though research shows that blinds could reduce energy use up to 15% for double glazed windows and 25% for single glazed windows in domestic and non-domestic settings it is almost impossible to accurately quantify the impact and benefits of particular blinds and shutters on specific buildings. This is partly due to unpredictable and/or misinformed user behaviour but also due to the lack of accurate data about the performance of blinds and shutters in industry standard software.

The models generated as part of this research include variables of 5%, 10%, 15% and 20% to account for the lack of precise data about energy saving and although appropriate for the methodology in the LCA studies, such imprecision is not appropriate for building modelling. Currently the performance of blinds and shutters is under-estimated by many programs as a result of which their value as passive and/or low energy and sustainable aids to temperature control, energy saving and well-being are not fully recognised. The reasons for this are various and complex but are summarised in a National Energy Foundation report to which some of the authors also contributed:

> "In general mainstream software appears outdated with regard to assessing the performance of solar shading as it does not conform to the latest international standards" [23].

The various developments in materials composition, lamination technology, blinds design and structure (e.g. concertina and cassette) are being measured however and results added to an international database managed by the European Solar Shading Association.[24] . The intention is to incorporate this higher calibre data into industry software so that architects, designers and engineers can properly understand the benefits and use of blinds and shutters. This in turn will help to change perception of blinds and shutters as décor alone to important parts of building fabric.

CONCLUDING REMARKS

This paper began by briefly describing the history of blinds and the contribution of shading devices to occupants' health and wellbeing. Current designs, materials and manufacturing processes, potential energy savings from heating and cooling and associated environmental impact resulting from correct blind use in the domestic context were also discussed. Non-domestic buildings will also benefit from use of shading products although user behaviour, the size and layout of spaces and levels energy consumption differ from those in domestic buildings. Furthermore, motorised and automated shading systems are increasingly common in non-domestic buildings that include shading products as a result of which 'correct' use of blinds is more likely; these combined factors mean that levels of energy saving, associated environmental and health benefits therefore differ from those in the domestic environment where the majority of shading products are still manually operated.

Research indicates that motorisation of domestic blinds will positively impact on user interaction and encourage more correct use. However, the embodied impact of motorised blinds is higher than that of manual blinds. A study shows that the environmental benefits of manual blind use significantly

outweigh their embodied impacts; this paper builds on that study and includes comparative Life Cycle Assessments of motorised blinds. The results also showed that their use is also environmentally beneficial because the benefits of potential energy savings also outweigh embodied impact although the point in time when this occurs is later than that of manual blinds and longer product life should therefore be encouraged.
This paper describes the diverse benefits arising from use of shading products like blinds and shutters. Their importance in the built environment was also advocated in a CIBSE technical report and journal article that urges construction professionals to include shading products in building models and property developers to install them[25]. As discussed above however there is a need to update and improve the quality of data available to professionals in the construction industry to enable them to create accurate models based on current and changing weather and climatic conditions. Only then will the full potential of blinds and shutters as aids to sustainable construction be properly realised.

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FROM SUSTAINABILITY TO RESILIENCE: AN EXPLORATION OF THE DEVELOPMENT OF SUSTAINABLE ARCHITECTURE TERMINOLOGY.

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INTRODUCTION

In the last 50-years, architecture has navigated new territories towards a ‘green sensitivity’ and is developing new fields – sustainable architecture. Accompanying this new field of sustainable architecture is the creation and adaptation of the architectural lexicon and language. The architect’s lexicon has transformed from ecological (or eco), environmental, green, sustainable, and now resilience. The importance of terminology can be highlighted by this excerpt from Thomas explaining that “[…] terminology provides definition, clarity, and boundaries which may be fought or celebrated”.[1] However, this is not often the case within sustainable architecture. The terms mentioned above are used with growing frequency and often substituted for one another and employed as tautologies, losing their nuances. Consequently, this frequent misuse often results in an increase of ‘greenwashing’ and confusion by laymen; rather than the progression of the field of sustainable architecture. The ambiguity of these terms are commonly discussed within literature, which the following quotes illustrate along with the common inference is that these terms are now so overused that they hold little to no meaning and in some cases add more confusion than clarity.

> Theoretically, no one can take a stand against sustainability because there is no definition of it. […] The S-word seems to point to a universal idea, valid anywhere, at any time.[2]
>
> What does the term ‘sustainability’ mean? There seem to be as many definitions as the number of people one asks. […] confusion has been caused by the fact that there are such very widely divergent views on how to achieve it.[3]
>
> This is epitomised primarily by the ambiguous nomenclature of terms such as ‘sustainable’, ‘bioclimatic’, ‘ecological’, ‘green’, ‘eco-friendly’ or ‘environmental’, which are recurring labels that, although rarely ascribed a precise meaning, are repeatedly and undistinguishably attached to buildings in architectural competitions, magazines and debates, increasing confusion and misconceptions.[4]

These three short excerpts offer one side of the debate, in contrast, few argue that the openness of these terms allows designers to interpret and respond to these complex issue with some freedom.[5] However, terminology impacts the way architecture is explained, discussed and explicated; and as these key terms (or buzzwords) become vaguer, there is a seemingly inherent need to define or understand the meaning

of them. Raising the question; are these terms relating to a ‘green sensitivity’ hindering rather than helping the development of sustainable architecture? This paper focuses on the period following the 1960s, while recognising that sustainable architecture can be referenced as far back as vernacular building. Therefore, it firstly aims to understand the development of the sustainable architecture lexicon, exploring the different meanings and their role in contemporary architecture. Secondly, the context and background of sustainability is presented, outlining the development. Following this, the associated lexicon and a short history of the interrelationships between eco-, green-, sustainable- and resilient architecture is outlined. The latter of this paper analyses the definitions of the above terms in three stages. The general definitions of the previous mentioned terms are systematically analysed to understand their context and development. Secondly, analysis of secondary data from a questionnaire conducted by ‘Architectural Design’ journal with five prominent architects is explored to set a baseline for the development of these notions. Lastly, empirical data from a survey of 115 experts in the field of sustainable architecture is analysed and echoes what literature suggests; that there is a plethora of definitions and understandings of what sustainable architecture means and it is a common debate what impact this ambiguity has on the field of sustainable architecture.

CONTEXTUAL HISTORY OF SUSTAINABILTY

Sustainability has grown in popularity over the last decades. However, the concept can be traced much further back in history. While this paper focuses on the period after the 1960s, understanding how the core concepts have developed in a wider sense is important in understanding the context in which this field occurs. Around 700 years later, the first comprehensively formulated concept of sustainability developed in Germany within the forestry industry in 1713.[6] The notion of not cutting down more trees than that could be replanted was established and is the most direct reference to contemporary definitions of sustainability. Skipping forward around 270 years to 1987, the ‘Brundtland Report: Our Common Future’ was created and is responsible for forming what is now the most commonly used definition for sustainable development. The Brundtland Report defines sustainable development as "development which meets the needs of current generations without compromising the ability of future generations to meet their own needs".[7] The formulation of this definition is a key moment in contemporary history and is seen as the foundation for many other sustainability definitions and models. In 2005, the World Summit on Social Development identified three sustainable development goals; economic, social and environmental which are referred to as the three-pillars, triple-bottom-line or are visually represented as three overlapping circles.[8] This development has served as a foundation for many standards and certifications globally, especially within architecture. The implications of these developed definitions and associated models are discussed and explored later in this paper with the investigations of how experts in the field define sustainable architecture.

The development of sustainable architecture

Many eras, events and movements in history can be post-rationalised as being sustainable in one form or another and this is often a common occurrence within sustainable architecture. Retrospectively, Vitruvius along with vernacular architecture can be seen as the vanguard of sustainable architecture. Both of which responded to the societal conditions of their time, they built with local considerations and addressed environmental concerns out of necessity. In contrast, the industrial revolution is responsible for many of the issues, such as; pollution and scarcity of materials which sustainability addresses today. However, it is evident that these issues have been considered within architecture as far back as the 1840s. Yet, the vocabulary for this period did not yet include sustainability or sustainable architecture, still, these notions addressed are still very similar to what is discussed today. For example, John Ruskin, in his book ‘The Seven Lamps of Architecture’ writes:

> [God] has lent us the earth for our life, it is a great entail. It belongs as much to those who are to come after us, and whose names are already written in the book of creation, as to us, and we have

> no right, by anything that we do or neglect, to involve them in unnecessary penalties, or deprive them of benefits which it was in our power to bequeath.[9]

This quote in many respects can be compared to the Brundtland Report definition mentioned earlier, even though they were written in different context. Similarly, both emphasise the importance of maintaining our natural environment and resources for future generations.

SUSTAINABLE MOVEMENTS FROM THE 1960S

Eco-architecture gained momentum with the counterculture movements of the 1960s. It came about in response to high-rise congestion and suburban sprawl, with people wanting to live independently from authority. Parallel to this, new publications emerged which addressed the negative state of the natural environment, the most famous being ‘Silent Spring’ by Rachel Carson in 1962. In response, a radical architecture developed. One example of this was, Drop City, an ‘off-grid-geodesic-dome’ artist community in Colorado, USA established in 1965. This community utilised recycled materials, especially metal from cars to create an array of colourful homes influenced by Buckminster Fuller’s principals of material optimisation in the form of geodesic domes. Following this, in the 1960s and 70s, influential pioneers developed more integrated approaches to ecological architecture which proceeded these unconventional and radical beginnings. Some examples of these pioneers are; Lewis Mumford, Ian McHarg and James Lovelock who led the way in making their environmental principals popular. Continuing in the 1990s, Sim van Der Ryn and Stuart Cowen developed an approach to ecological design which they explained as: "Any form of design that minimizes environmentally destructive impacts by integrating itself with living processes".[10]

Trailing but also interrelated with eco-architecture came green architecture which dominated the late 1970s, 1980s and early 1990s. Revitalisation for environmental concern emanated with the 1970s oil embargo and the creation of the societal groups and events such as; Greenpeace, ‘Friend of the Earth’ and Earth Day, which influenced the context that green architecture emerged within. This new surge of interest gave rise to a more socially responsive and philosophically oriented group of architects. Specifically, in response to the oil crisis, for the first time energy was a major issue for the built environment and subsequently, the expansion of technological solutions for energy savings had a major impact on green architecture. Dean discusses the implications of applied technology from the 1980s as the devolution of architecture which he argues has led to a techno-science he attributes to the influence from Buckminster Fuller and Reyner Banham and terms ‘green building’.[11] The allure of technological solutions has been overwhelming and within green architecture, this has led to a split between technology-based approaches and other more holistic approaches which has created a subcategory of green-high-tech-performance buildings which are goal-based with measurable parameters for resources and energy conservation.[12]

During the late 1980s and early 1990s, sustainable architecture emerged with growing concerns connected to the publication of documents such as; the Brundtland Report and Agenda21. Sustainable architecture is often considered an expansive term which may include green and eco architecture. It can be seen to address problems in a more trans-disciplinary way and respond to multiple complex problems. During this period LEED and BREEAM also formed and subsequently refined their measurable criteria and certifications, encouraging a growing focus on energy, resources and materials. This focus on the measurable has been supported by the ever growing advancement of technological-add-ons. Bill Reed’s description that “sustainability is just dying slower” supports this bipolar approach to sustainable architecture.[13]

Some speculate that our efforts to remedy our impact on the environment have come to little, too late and we now need to design for consequent disasters. Resilient design and architecture is an advancing approach to solving current and crucial problems with a future scenario perspective. The reasons why there is this current transition towards resilience from sustainability is not clear. However, some of the arguments include: resilience has an associated flexibility and a lack of focus on the measurable.

Secondly, our built environment has past the point of sustaining and there is now a need to address future crises and disaster scenarios which resilience does. Thirdly, resilience encompasses a positive approach which offers opportunities for designers and lastly, there is a fatigue towards the vague and emptiness of the word sustainability and its subsequent greenwashing. Minnery uses the following metaphor for the difference between sustainability and resilience: "If the sustainability movement taught all of us to reduce, reuse and recycle—to tighten our belts, as it were—then resilience calls for a belt-and-suspenders approach".[14]

EXPLORING DEFINITIONS

Language and meanings evolve and transform; the sustainable architecture lexicon is a key example of this. Until recently eco, green, sustainable and resilience have been adjectives used to describe architecture, however, now combined with the word architecture these adjectives have transformed into nouns – eco architecture, green architecture, sustainable architecture and resilient architecture. The most basic definitions of these terms have been taken from the Online Oxford and Cambridge Dictionary, they have been analysed to understand not only the different language used to define them but also to understand the nuances in their conceptions as these new nouns are often used interchangeably as synonyms for each other. For each definition, key nouns, verb and adjectives are highlighted to understand the main focus, the attitude associated with the verb and how the nouns are described.
Chronologically, starting with eco-architecture (Figure 1), the key nouns are *principles*, *architecture*, *conservation* and *surroundings*, which are described with the adjectives *ecological*, *environmental* and *natural*, showing a key focus on the natural environment. Subtle verbs like *application*, *design* and *harmonise* are used. The use of *application* is noteworthy; application can be defined as the action of putting something into operation or putting something on a surface. This denotes a shallow rather than holistic approach to the integration of ecological principles in the design process.

Definition of *eco-architecture* in English:

eco-architecture

NOUN

The application of ecological principles to architecture, typically in the design of buildings which promote environmental conservation and harmonize with their natural surroundings.
Related green architecture

Figure 1. Eco-architecture definition from the English Oxford Dictionaries.[15]

Green architecture (Figure 2) has a similar focus on buildings and the natural environment but denotes designing as an *activity* - rather than an application - of other principles or strategies like in eco-architecture. *Protect* is also employed rather than a more affable verb such as the previously used harmonise.

Definition of *green architecture* in English:

green architecture

NOUN

The activity of designing buildings in a way that protects the natural environment.

Figure 2. Green architecture definition from the Cambridge Business English Dictionaries.[16]

In contradiction to the origin of this term, this definition of sustainable architecture has little reference to either the Brundtland or three-pillar definitions of sustainability. Resources, future generations, social or economic factors are not included in this definition illustrated in Figure 3. The verb *manage* is utilised, which can be defined as 'administer and regulate,' not terms often associated with creative endeavors such as design or architecture. It could be speculated that this influence arises from the introduction of restrictive certifications to the design process. Other unenthusiastic and constraining words used are the verb *minimize* and the noun *[environmental] degradation* rather than natural environment or environmental conservation which were employed in previous definitions.

Definition of *sustainable architecture* in English:

sustainable architecture

NOUN

Architecture managed in such a way as to employ design techniques which minimize environmental degradation and make use of low-impact materials and energy sources.

Figure 3. Sustainable architecture definition from the English Oxford Dictionaries.[17]

This resilient architecture definition (Figure 4) was not taken from the online Oxford or Cambridge dictionaries as it is a term still in its infancy and not included in their collection. However, this version defines the term with the same rudimentary detail as the previous definitons. Aside from the noun *structures*; *disaster* and *life* are used which show an association to future thinking. The adjective *adaptable* and verb *learn* demonstrate an emphasis on the concept of change for the unforeseen.

Definition of *resilient architecture* in English:

resilient architecture

NOUN

Resilience means designing adaptable structures that can "learn" from their environments and sustain life, even in the face of disaster.

Figure 4. Resilient architecture definition.[18]

These definitions overlap but are not identical. The above analysis has illustrated how these terms transformed and differentiated over time. Variances can be seen with the use of nouns, firstly, two of the four definitions utilise secondary principles or techniques to achieve their design goals and secondly, the environment or context is discussed with a variety of attitudes. There is a clear development with the verbs used which reflect the societal context in which each concept was established. The progression from harmonise, protect and minimise, to learn, is representative of architectures attitude or relationship towards the natural environment. These definitions come from very standard sources, however, they offer a clear simplicity of the distinction of each term, provide vocabulary clarity and set a contextual frame for the following definitions which appeared from within the architecture profession.

Definitions from the architecture profession

The previous analysis was conducted as a precursor to understand the context and compare how the profession understands and defines sustainable architecture. In 2001, Architectural Design conducted a 'green questionnaire' with five prominent architects.[19] This questionnaire was conducted over fifteen years ago and is utilised as a baseline to understand how these definitions have transitioned. Four questions were asked, however, this paper will focus on only one of the questions; *"What is your, or*

your practices definition of sustainable design?" All responses were compared (see Table 1) by keyword analysis to comprehend if there were commonalities between the answers to understand if a general focus could be concluded.

Table 1. Keywords used to define sustainable design by five prominent architects.

	Lord Rogers	**Lord Foster**	**Thomas Herzog**	**Jan Kaplicky**	**Ken Yeang**
Brundtland	X				
Ecology					X
Economic	X				
Efficiency		X		X	
Energy	X	X	X	X	X
Environment	X				X
Longevity		X		X	
Loose fit	X				
Martials		X		X	X
Method			X		
Passive		X			
Preservation			X		
Quality		X			
Resources	X		X	X	
Self sufficient				X	
Social	x				
Systems					X
Waste		X			

As Table 1 illustrates, energy appeared in all responses and was the one common focus for all definitions. Secondary to this, was resources and materials with three out of five having this response. This illustrates that energy, resources and materials are the key focus and this correlates with the previous Oxford definition which highlighted an emphasis on materials and energy sources with the addition of the environment which in this case was only included by two of the respondents. These findings demonstrate that there is some continuity with how this term is defined but that they are not universal and are is adapting and changing with each person.

Expert survey definitions

A primary survey was conducted with 113 experts in the field of sustainable architecture from the United Kingdom, Denmark, Sweden, Germany, Australia, New Zealand and the USA. Around half of the respondents were from academia and half from practice. For this paper, the open-ended question *'How do you define sustainable architecture?'* is the focus. Keyword and thematic analysis of the participant's answers illustrated that not one of the answers were worded exactly like another and many varied significantly. Figure 5 shows a graph of the keywords used, displayed separately for academic and practice. Six of the top keyword responses have been highlighted and include; social, environment, economic, resources, human needs and ecological. It is evident that both the triple-bottom-line or three-pillar model and Brundtland definitions are present in these expert definitions. These two definitions can be speculated to affect both sides of the profession with differences between practice and academia being evident. The three main keywords for practice are social, environment and economic and in academia more responses were different. However, the highest responses were social, environmental and ecological. It is also interesting to note there were a higher number of responses indicating future-

thinking for academia than for practice which resonates more with the Brundtland understanding of sustainability.

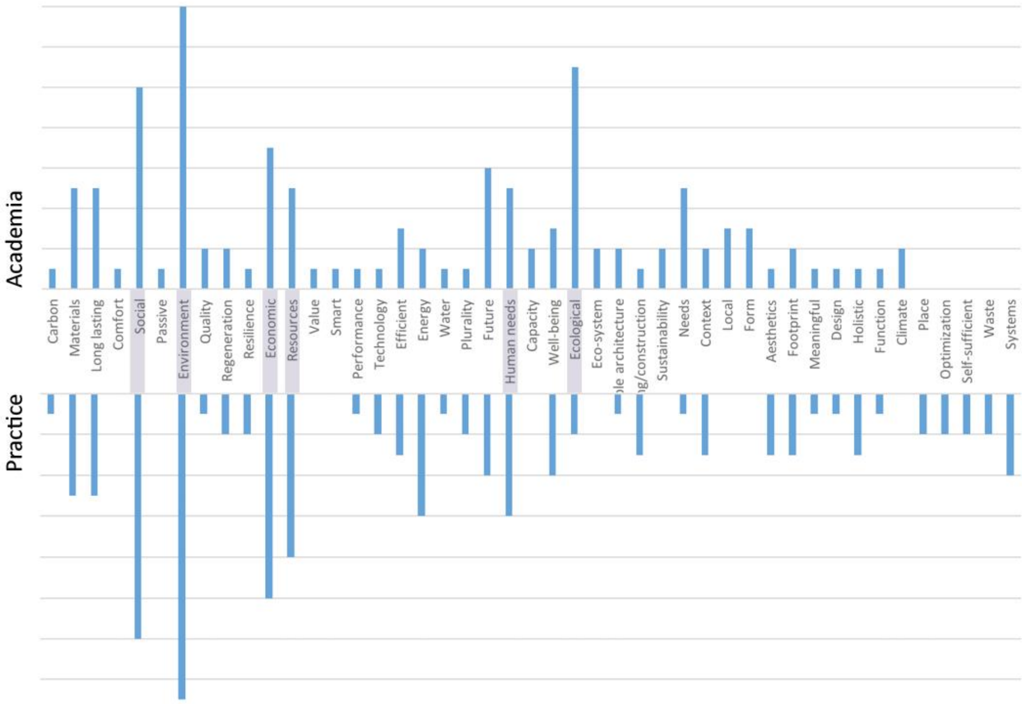

Figure 5. Graph of keywords from the survey responses to the question 'How do you define sustainable architecture?'

DISCUSSION

There is an evident shift that has occurred within the architect's lexicon and it can be posited that this is influenced by the societal issues through history as well as from the wider definitions from the Brundtland report and Agenda21. It is apparent that from 2001 there has been a transition towards a focus on materials and energy which is associated with the triple-bottom-line model. This has developed from the oil crisis, for the first time in contemporary history the profession was forced to consider the energy use in buildings and the subsequent creation of technologies to reduce demand. As well as the formation of certifications such as LEED and BREEAM which promoted a focus on the measurable hard issues of energy, materials and resources. One key focus which has remained throughout all of the variations of definitions has been the importance of the environment. However, the attitude or approach to the environment has altered through time from conserve, protect, minimise and learn from. The implications from these different approached can be seen in built examples from each period. It is apparent that contemporary discourse and practice struggles in understanding the nuances between each definition and their impact on the design decisions which are made.

CONCLUSION

This paper has set out not to attempt to standardise the architect's lexicon but rather to provide a starting point for a larger discussion about the implications of using terms in which to discuss architecture. The development of sustainability has framed the discussion and indicated how wider definitions effect those which are used within architecture. Outlining the evolution of sustainable architecture has suggested that many of the issues architects address today have been present for many years with altering focuses. The historical overview illustrates how terms develop from societal issues and its relationship with

nature. Three variations of definitions from different sources and time periods showed not only the progression of the field but also indicates how these may be developed for future scenarios.
There is a plurality of definitions which address how architects approach designing with the natural environment and finite natural resources. Each definition offers slight nuances in how this is achieved. Understanding this is crucial in adding precision to interpreting 'sustainable' architecture in the built environment. Rather than using eco, green and sustainable as synonyms for each other, using these terms correctly may add clarity to the profession and consequently reduce the current explosion of greenwashing.

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SUSTAINABLE DESIGN INTERVENTIONS FOR THE BUILT ENVIRONMENT: A SYNERGISTIC STUDY OF COMPUTATIONAL FLUID DYNAMICS AND ART

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A PRELUDE TO INDO-FRENCH ARCHITECTURE IN PONDICHERRY

Just one block away from the Fish House, one finds the iconic ‘Golconde’ (Designed by Antonin Raymond and completed in 1945). It is India’s first modern ‘green building’ and has a world stature architecturally –its bio-climatic response is outstanding and is arguably the most comfortable building in Pondicherry without an HVAC (Heating Ventilation and Air-conditioning) system. Raymond Antonin aligned the building cleverly to capture the land and sea breezes with adjustable prefabricated asbestos cement louvers. It showcased all the fundamental principles of architecture- simplicity, directness and closeness to nature -the latter accentuated through gardens and water bodies fostering a kind microclimate [1,2].

Although Golconde undoubtedly set the scene for a new genre of architecture, it remained a building isolated from the rest of the buildings in *Ville Blanche*. These ‘White town’ buildings (a mostly European Locale in Pondicherry during the colonial times) typically have one or two floors in brick and lime masonry with large arched windows and high ceilings- a time tested feature to separate two layers of stratified air within a room enabling *displacement ventilation* – very essential for comfort in warm and humid climes. The light, hot air remains above the *neutral layer* – positioned several feet above an occupant’s head- whilst cool, fresh air blows in through the large doors and windows - the high ceilings of “Madras Roofing” (timer joists with burnt bricks and lime finish) facilitate this pattern of air flow [3].

The advent of modernism arrived when the international township of Auroville was conceived in the late 60s by Mme. Mirra Alfassa. Indeed this synthesized building styles and forms that were utterly *avant garde*. Buildings in nearby Pondicherry’s Ville Blanche were a mere replication of the French style of architecture appropriated from the French Riviera with its boulevards, promenades and mansions[4,5].

Pondicherry’s idyllic charm attracted people from all over the world. Real estate started booming, and, in its wake unplanned and unregulated growth led to an increase in vehicular traffic, congestion and other related problems. Environmentalists opined that Pondicherry’s famed promenade reinforced with coastal defences was not only unsightly, it was also an environmental blunder, eating away into the natural, sandy beaches caused by the cascading effect of many concerns including the problems of salt water intrusions and displacement of livelihoods of fishermen. Pondicherrians have been peculiarly

resistant to fluctuations in weather patterns year after year – in the forms of freakish hurricanes, interspersed with bouts of extremely high temperatures (exacerbated by the urban heat island effect [6]), periods of extreme precipitation events causing widespread flooding from choked storm water drains. Within this grim spectre, Pondicherrians liaised with Indian National Trust for Art and Cultural Heritage (INTACH) to begin a dialogue between citizens and architects to confront the most urgent task of the time - a new exploration of the built up spaces within the city. Starting with a handful of architects mainly based in the Auroville -Pondicherry region, building activity took a turn towards the better within the last decade- nearly sixty years after Golconde. The building landscape became dynamic and green housing became popular[7,8].

The space crunch and better awareness prompted experimentation – in some cases, creating a contemporized, yet traditional language suited to the clime and lifestyle of its citizens. Clearly, having large water-guzzling gardens was impractical. The emphasis instead was on the use of manmade building fabrics-the use of compressed earth instead of traditional bricks, use of green facades and organic drapes, a reinvention of ancient Tamil houses built around a central courtyard and a host of other building features. It was clear that this challenge of new architecture arose partly from the complexities of building engineering serving as a window on climate change.

However, until recently these buildings did not consciously combine advancements in building physics and architecture, nor did they confront culture. Changing weather patterns is a crisis of a culture and thus of the imagination –culture generated desires for certain kinds of dwellings because the built environment can also be the principle driver of the carbon economy.

This motivated us to undertake the "Fish House" project which combines a green ethos within a practical residential setting in the heart of the city, opposite a bustling Fish Market (see Figure 1a).

Figure 1 a. A Tamil fisherwoman selling fresh fish just opposite the 'Fish House' in Pondicherry.

Figure 1 b. Scaffolding around the 'Fish House' under construction.

THE FISH HOUSE PROJECT

The Fish House – the name – came into being because of its proximity to the local fish market in Pondicherry. The house is being built on a small plot of land (7.5m x 12.5m) adjacent to a bustling street, Ambour Salai (commonly referred to as Canal Street). Having its two sides abutting the road (East and South), it presented a perfect challenge to the architect –the house had to be inward looking in order to combat the daily smell of fish, noise and dust from the busy streets[9]. A study of existing settlement patterns in the surrounding area, with mostly narrow row-houses, some of them dating back to 200 years, showed that an internal courtyard, often on one side of the house, could solve many problems of insufficient light, ventilation and unwanted sound. This has been accomplished in the Fish House adjoining an existing two storey house. Fortunately, the bye-laws in place are not a hindrance here as in many other cities[10,11]. The courtyard also takes care of the entire infrastructure like fresh water pipelines and waste water from toilets with a direct access to the court. A water body on the east will lend serenity and coolth with a small fountain.

Fortunately, the clients were very open to the concept of a green wall and an internal courtyard with a pond, making it a unique building in Pondicherry. The south west corner will have a stairwell with a hydraulic lift facing the courtyard. The material palette of the whole building will be very minimal to allow a creative play of light and shadows. The RCC frame structure with an RCC slab will have an infill of aerated cement concrete blocks (light-weight to minimize the load) for sound-proofing and thermal insulation. All the internal walls will be plastered with a unique mixture combining lime and a local seed extract - kadukkai (haritaki) – terminalia chebula – for its time tested strength and water proofing properties. All fenestrations will be mosquito-proofed with wire-meshing. The doors will be of local wood with an infill of plywood or bison board (a cement-based board with wood shavings). The flooring of local black cuddapah (rough cut) will be cool to the feet and easy to maintain[12].

The green wall draped around the east and south façade of the building is a low-tech solution. But importantly, it serves as a home for the smaller birds that are almost disappearing. It will have specially made local terracotta pots affixed at different levels, allowing easy nesting for them.

We show a photo-realistic render of the Fish House using Lumion in Figure 2. In the next section, we shall illustrate how the transference of outdoor heat/coolth is retarded – we shall first experimentally estimate the U value of an organic drape and then use it in state of the art CFD software to project indoor thermal comfort.

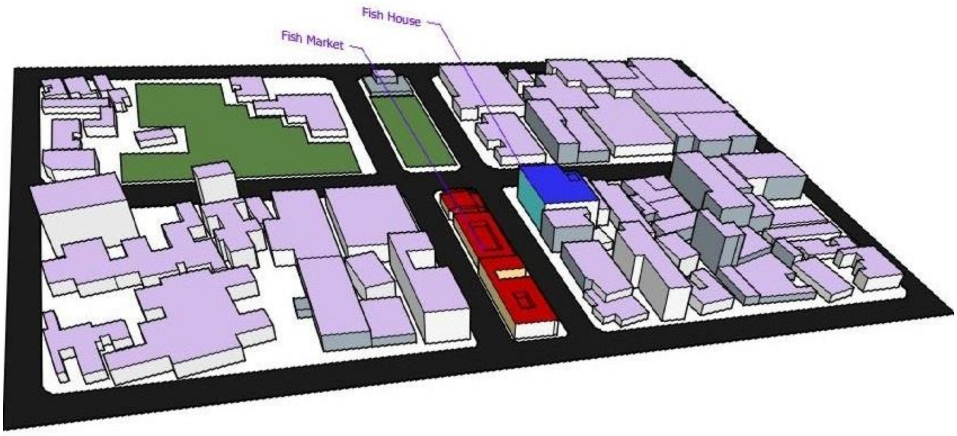

Figure 2. Fish House shown in city grid. The bottom image indicates how it will look upon completion. Parda bel (Vernonia elangofolia) can cascade down from a metal frame structure with netting[13]. The green wall covering parts of the East and South façade will not only shelter birds but will also lend a cooling and cleansing effect [14,15]. A similar effect is also achieved with the use of a time tested organic drape – khus, for which we have shown tailor-made experimental results.

THE THERMAL PROPERTIES OF ORGANIC DRAPES

We start with Wood Wool -a product manufactured by shaving off wood into thin, long slivers. It is widely used in desert coolers for its unique thermal properties. We have used this for our experimentation because it closely proxies *Khus* (*Chrysopogon zizanioides*), which can replace the green drape on the Fish House or can be alternatively placed between adjacent balconies. With this arrangement, a major fraction of the incident solar radiation is not absorbed by the Wood wool mesh owing to the presence of air gaps. The presence of the air gaps leads to new pathways for the entry of heat as is illustrated in figure 3 b.

Figure 3 a. Experimental setup showing khus embedded in a wire mesh coupled with a thermocouple and a pyranometer [16]. Note that the air pockets within the mesh serve as insulators and the thermal properties can be attenuated by increasing the air spaces with and without added moisture.

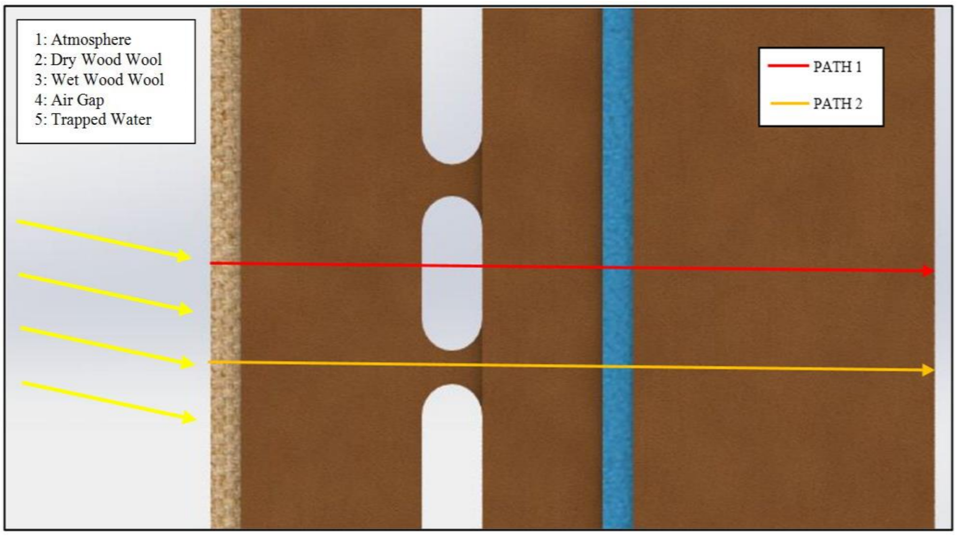

Figure 3 b. Schematic diagram of Wood Wool Mesh showing air gaps. The resultant mesh is analogous to a thermal circuit with two paths in parallel and multiple thermal resistances for each path in series.

Table 1 shows the representative pathway through multiple layers chosen for this study to mimic all possible cases of heat transfer routes [17].

Table 1. Measured thermal conductivities for a possible organic drape to be used in the Fish House. It may be placed on a different balcony replacing a green drape.

	Layer	Air %	Thickness Fraction	Conductivity k (W/mK)
A	Dry Wool	90	0.05	0.054
B	Wet Wool	80	0.30	0.012
C	Thermal Bridge	-	0.20	-
D	Wet Wool	80	0.20	0.012
E	Trapped Water	20	0.05	0.650
F	Wet Wool	80	0.20	0.012

As anticipated, the U-values (thermal transmittivity values) derived from the thermal conductivity Table shown above, decreases exponentially with increasing thickness. For the subsequent indoor thermal comfort analysis, we have chosen a U value of 0.2 W/m²K.

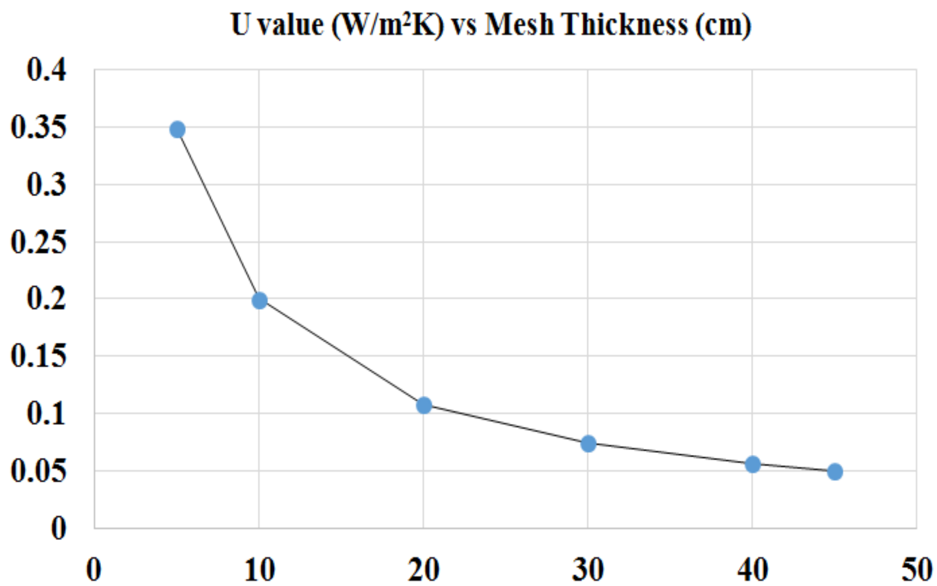

Figure 3 c: U-values for varying thickness of wood wool

Our CFD computations using Autodesk Ectoect shall help ascertain the right dimensions of the floor to ceiling height, wall thickness, depth of the veranda and the thickness of the organic façade[18]. We have done CFD runs where we can foretell the expected drop in temperature with the use of a Wood wool façade that is hung just outside a balcony facing a wall made of mortar and plaster. Figure 4 b. shows the diurnal temperature variations of such an arrangement for a very warm month in April. From the figure, we find that up until 12 noon we have salubrious conditions in the interiors and indeed the indoor temperatures are substantially lower. A high incidence of solar energy on the Fish House increases the thermal mass– and the interior temperatures exceed the exterior temperatures. In contrast, in Figure 4a, the organic façade (200 mm thick) in place-there is a drop in temperature of 4-5 °C over a period of 5 hours. In energy terms, it translates to a saving of 33% monthly. In human comfort index terms, the façade lowers the PMV inside a typical room of the Fish House by 24%.

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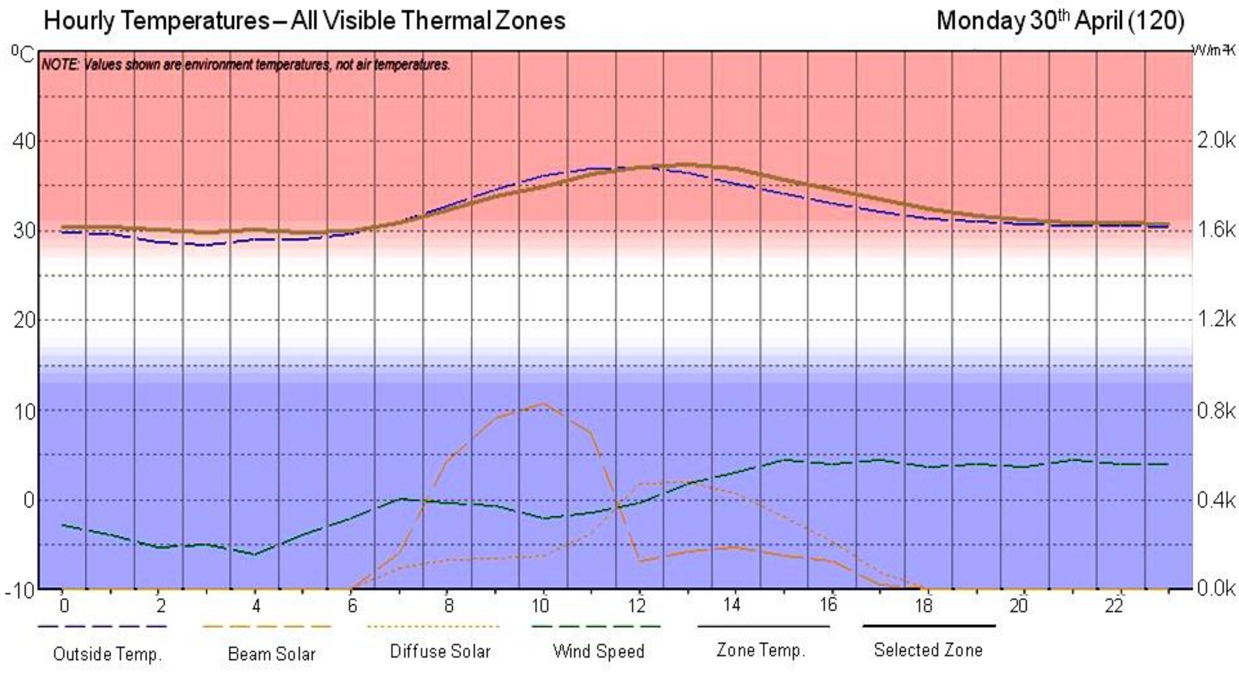

Figure 4a: Diurnal variation of internal temperatures during April using a wood wool drape on the exterior of the Fish House. We have used a U-value of 0.1 W/m²K corresponding to 20 cm thickness covering an area of 3.48mx9.3 m² on the second floor balcony facing the main street.

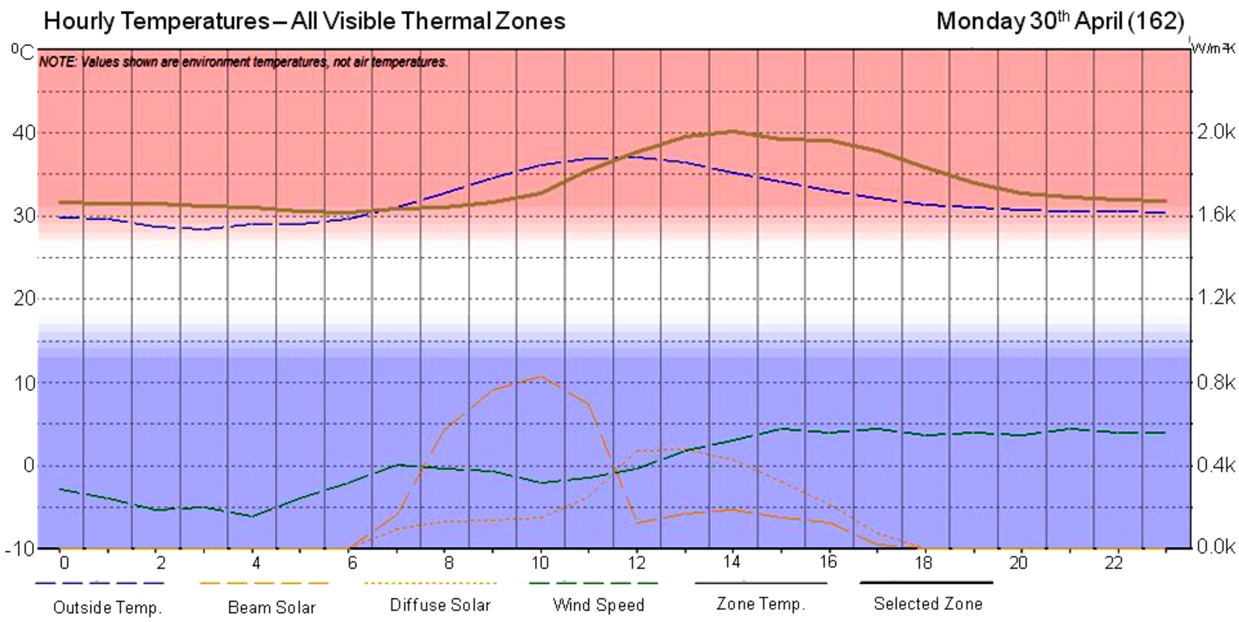

Figure 4 b. As in Figure 4a, but with the organic drape removed.

THE REDEMPTIVE ROLE OF ARTWORK ON THE FISH HOUSE

From the foregoing analysis, it is clear that the Fish House Project will appeal to mechanical engineers, fluid dynamists, structural engineers, green architects and importantly, to any sensitive citizen concerned with green habitation. It is a design project connecting its residents to believing in sensitive livability, fostered not just by green technology but also by the redemptive role of art – this is what we are trying to illustrate in this section.

The diffusion of modernity across Auroville and Tamil Nadu happened in stages - the first stage comprised of erecting structures that bore the unmistakable stamp of French architecture in a tropical setting. This was followed by radical experimentation in building forms and styles within the framework of the unique "Galaxy" master plan of Auroville – first conceived by the architect Roger Anger and thence developed by Indian and other architects worldwide. These strands of architectural development serve as a pointer towards the vision in which the visual arts are seen to be moving rapidly forward in and around Pondicherry, infusing new strands of thought in the draping of facades where space is at a premium- this brings us to the genre of eco house paintings invented by the famous fine artist and illustrator Tanya Ling. We give below an example of how this might proceed.

In a departure from the other Pondicherry and Auroville buildings, the Fish House will combine the force and fluidity of simple line drawings to lend a stunning visual appeal not just for its residents but also to the hundreds and thousands of international tourists who walk past the main street where it is being built (see Fig 1b. showing the scaffolding and the adjoining street). When completed, the Fish House will stand as an exemplar- it shall showcase not just the key ingredients of sustainability and greenness but also how it can lift up the feel for an entire neighborhood in a seaside tourist resort. Two images of an artistically enhanced drawing by Ling are shown; one in bright and the other in muted light.

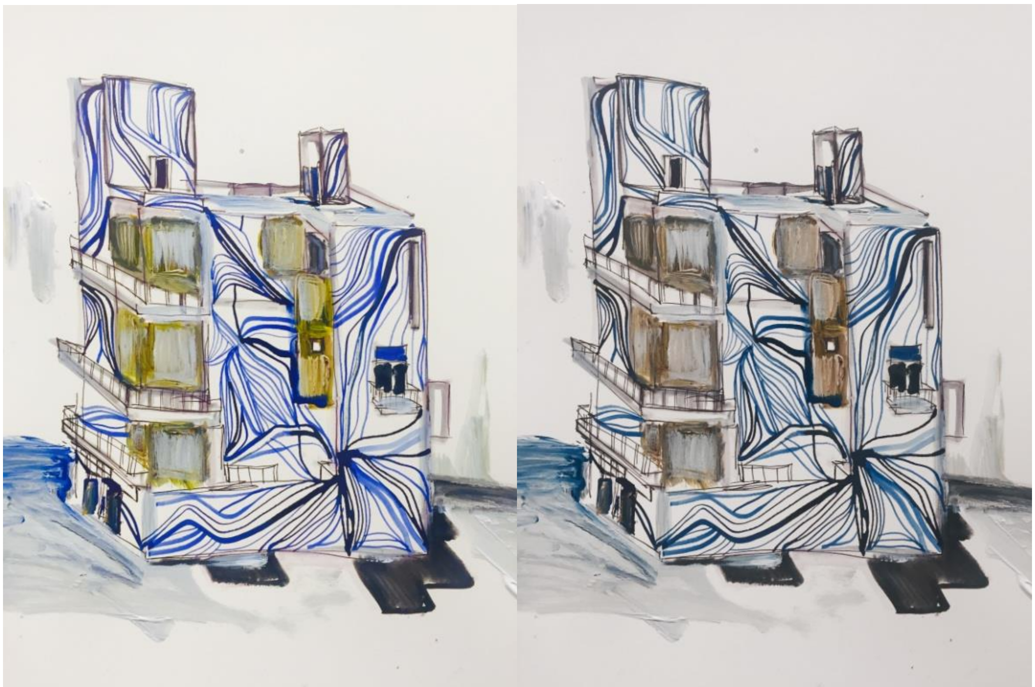

Figure 5: Tanya Ling's Line drawings embellishing the facades of the Fish House. This is just an illustration how it might look when all or some of the concreted walls are painted.

The Tanya Ling paintings have been referred to as 'wave paintings'. In part because of the colour of the ultramarine ink but also because the individual lines although static, describe movement and form that unpredictably contrasts and expands in three dimensions. The form organically dips, weaves and rolls-in this respect the paintings could be an attempt to describe moving water or perhaps the movement of wind so essential to the Fish House Project.

The decorative motif would reflect the adjoining ocean the building faces and signify conceptually much of the building's eco concerns and Ling's edifying and uplifting artwork. They will bring an energy and force to the environment.

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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally

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FROM THE BODY TO THE CITY. DESIGN AS A GROUNDING PROCESS FOR A BLOCK AS A COMMONS IN BRUSSELS.

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AN URBAN BLOCK AS COMMONS

Established in Brussels in 2012, Commons Josaphat (CJ) defines itself as a *collectif à géometrie variable*[1]. It contributed to the discourse on the Commons as a catalyser of other civic initiatives: on the one hand attracting on a conceptual level those explicitly referring to that philosophy. On the other hand, because of its modus operandi, by providing more generally a platform for civic activation, grown by co-optation, as a way to consolidate a core group of engaged individuals; but also by organising moments of public debate such as general assemblies and workshops. As a result, some of the initiatives involved within the framework of CJ, although resonating with it, are not originally motivated by the concept of Commons, as it will be shown.

To intervene in the planning process of *la friche Josaphat*[2] has been since the beginning the purpose of CJ, in order to answer to the needs of a city characterised by a strong demographic growth, unaffordable housing and forms of socio-spatial segregation. The proposed alternative would be based on non-speculative ownership formulations, on the *mise en commun* of land and the resources of the site at the advantage of the entire city, not only of the concerned neighbourhood.

Through the time activities articulated around two parallel strategies. In the short term, activities of temporary occupation of the site allowed to establish relations with other local initiatives and to meet the inhabitants, thus contributing to the debate on the commons on multiple fronts. While looking in the long term, the future of the site has been the object of several ateliers, of a call for ideas and finally, of a *cahier de recommandations* as a result of those processes. In the course of both short term and long term processes, the administrative institutions have been involved on the one hand to negotiate the forms of accessibility and use of the site; on the other hand, to open a dialogue concerning its future.

As part of the latter, since the end of 2015 the *Groupe Modelisation*[3] has been formed with purpose of conceiving the pilot project of an urban block, thus proving the feasibility of an *îlot pilote*[4] as a commons. In order to be as realistic as possible, the block has been chosen on the basis of the Regional Masterplan for the area[5], for a total of 12.000 square metres and approximately 120 dwelling units. Additionally, the exercise involves real civic initiatives and specific actors, pre-existing the initiative of Commons Josaphat, previously engaged in the quest of concrete solutions to the living needs and desires of specific groups of inhabitants. The initiative of Pass-Ages –with Cogeneris- addresses intergenerational forms of cohabitation, including a centre for death and birth. Sacopar is a no profit organisation promoting a holistic concept of health and wellbeing where the living environment would play a fundamental role. The Community Land Trust Brussels (CLTB) is a no profit organisation operating for property accessibility to low income inhabitants[6]. Comensia and Samenhuizen –at present interested in the project, but not yet fully engaged in the design process- are respectively a regional agency for the construction and management of social housing and a no profit organisation for cohabitation projects. Îlot is a no profit organisation dealing with homelessness.

Having been engaged in the activity of the *GM,* I had the possibility to observe at a close distance and for a sustained period of time[7] the design process of the *îlot pilote*. The paragraphs that will follow are a synthesis of those observations, collected during the meetings and activities organised to develop the

project, in which I was involved as an architect. The operational condition of the design exercise allows to seize -almost by definition- the emancipatory claims, the values and desires at the origin of the involved civic initiatives, emerged independently from the discourse on the Commons. On the other hand, it allows to recognise the specific spatiality required for their actualisation.

WHAT BODIES DO

The framework of CJ and the exercise of *GM* in particular, in a moment characterised by an increasing proliferation of civic initiatives[8], provide a privileged window on the emergent forms of urbanity. In particular, though the discourse on the Commons is easily appropriable in the present conjuncture[9], the civic initiatives involved in the project for an *îlot pilote* pre-existed that discourse. Actually, together with many others, they probably contributed to its emergence. They have been triggered by obsolete dwelling structures, policies and procedures -or perceived as such- by an inefficient welfare[10], by the scarcity of resources. But those circumstances provide in fact the conditions to potentially enact radical social and spatial changes: there is no emancipation without oppression[11]. It is in the infrastructural void of a shrinking welfare state -somehow represented in the materiality of the vacant site of Josaphat- that the mentioned initiatives operate thus having the possibility to redefine the role of those infrastructures and *modus operandi*.
Behind the re-writing of cohabitation forms, age based patterns of living and social categories –in the past consolidated by redistributive welfare state technologies[12]- are being questioned and new ones are being experimented. The body is the means for these subjectivities to emerge, to explore a new relationship with the world. So for example, the inhabitants of Cogeneris and Passages, while provided with the resources to access private property, they are interested in a form of cohabitation mixing different generations and different familiar compositions. Among them, aged individuals are concerned by the development of the *ilot pilote* as an occasion to express new attitudes towards aging, which require the definition of a new spatial grammar.
Less a matter of exploring new ways of dealing with biological conditions and more a matter of affiliation, of belonging, for some of the families of the Community Land Trust home ownership is perceived as a condition for what Castel would define individuation[13]. Permanence, a long term

Figure 1. A walk on the site of Josaphat with inhabitants and members of Commons Josaphat. Photograph by the author

permanence, is what allows to transform the world - and the self- by appropriating it. Citizenship is meant as the possibility to contribute to the urban transformations, to make one's own neighbourhood[14]: it hence requires a bodily presence, as a condition to transform the world, to have an impact on reality, thus escaping the condition of a continuous mobility caused by the inaccessibility or irregularities of the rental market and which impedes to organise, *de tisser des liens*[15].

Unfortunately only these brief glimpses could be offered in this paper. In synthesis, the reclamation of the self seems to unfold through the reclamation of the body, explored as a bundle of relations, through which the individual redefines himself: relations with one's own living environment, relations with other individuals. In this sense the emergence of subjectivity is an inherently spatial-spatializing process. On the background of current circumstances, characterised by growing precarity I argue this return to the space of the body can be read as an emancipatory process. With the word precarity here I refer to the condition of fragility and destabilisation produced as the result of a number of processes, described by many scholars from different points of view[16]: migration, unrecognised citizenship, flexibilization of work, housing conditions, health and gender related issues.

These dynamics in fact characterise the socio-demographic condition of Brussels, where for example the family, basic cog of the reproductive machine is transforming, increasingly dysfunctional[17], disrupted by precarity as a destabilising life condition. The number of sole-parent families[18] is increasing, as well of single individuals, because divorced or because unable or uninterested to build a family. Which in fact has stopped to represent the main life organising structure, replaced by an explicit -less a niche phenomenon than in the past- exploration of different ways of living[19]. To the crisis of the traditional family structure, the effects of the phenomenon of young old[20], of the increasing number of unemployed individuals, experiencing what Castel[21] would call disaffiliation, as well as stateless people, need to be added[22].

Precarity means insecurity, dispossession of labour capacities, of the body, of its biological rhythms[23]and reproductive capacities. But, out of both choice and necessity, it could lead individuals to explore a whole world of possibilities, beyond those which were supposed to be sources of safety and security. The case of the *ilot pilote* shows how, as a result of a multifaceted precarity, a growing number of individuals is exploring alternative living paths and forms of dwelling encouraged and empowered by the growing numbers of peers, bearers of new rights, willing to be recognised, to claim back *la propriété de soi*[24].

A GROUND OF POSSIBILITIES

Although many of these alternatives are not new in themselves, it is interesting to observe how they converge: the strategies and the assemblages experimented in order to realise them. And in this process, to observe the re-articulation of the role and of the relationship with the infrastructure whose latency allows the mentioned civic initiatives to emerge and operate. Emancipation is less in the specific condition being claimed than in the process that allowed to reach that condition: it is less in the simple ownership of the house than in the process -individual and collective- which led many individuals to re-define their idea of ownership within a larger project, making it accessible, as in the case of the CLTB.

A demand for recognition is implicit in the specific spatial articulations proposed and negotiated by the involved citizens, performing subjectivities during the very phase of the design. Recognition of the young old, of the monoparental families, of low income individuals as citizens contributing to the making of the city, of individuals with mental disorders or other disabilities. Recognition of the exceptionality of the time and space required at the beginning or at the end of an individual's life. Each one of them performs through space the relationship with the self and with the other.

This does not mean that redistributive claims are solved or irrelevant, as the involvement of actors such as Comensia or the Community Land Trust proves. But what is interesting to observe is in fact

the reciprocal empowerment of the recognition and the redistributive oriented initiatives. In fact, the diversity of projects and complementarity of resources is what allows to intersect both dimensions, thus supporting their realisation. In the name of the sovereignty of the self, the very distinction between recognition and redistribution is actually blurred. Individuals are triggered to re-invent themselves and the social protection based on their will and availability to commit, to exchange, to contribute; as elemental gestures not only oriented to the care of the other, but also performed for the emergence of one's own subjectivity.

Hence, looking at the gathering of the mentioned projects, it difficult to say if redistribution supports recognition; or the desire of recognition allows to reach redistribution. The situation configured around the *îlot pilote* in fact seems to confirm what Fraser and Honneth pointed out[25]: the two dimensions are strictly interrelated and it would be a falsification to presume that one could be reached without any implication of the other. It is perhaps in the direction of such a hybridisation that the shift towards more emancipatory conceptions of welfare could be imagined.

Hybridisation, in this specific case, is made possible by the federating capacity of CJ: on the one hand related to its *modus operandi*, horizontally organised, aiming at increasing the critical mass of experiments around the concept of commons. But at a more pragmatic level, the intersection of redistributive and recognition claims happens because of the possibility of pooling resources – land, to start with- and several, concerned groups of citizens: in fact, a process of commoning, according to the definition of De Angelis and Stavrides[26]. As a result of all the activities and of the commoning process, CJ and more concretely, the exercise of the *îlot pilote*, they engender what I would define grounds of possibilities: not a land or a field, but ground, as a lived, inhabited dimension. Because of a number of practices and discourses that concerned it, a connective and radicating dimension, implying limitations as well as potentialities, embedding cultural construction and negotiations, juridical agreements and spatial decisions, compatibilities and incompatibilities[27]. And for each single project involved, the state of possibility is produced precisely by the articulation of those conditions, the limiting and the empowering ones. The emancipatory value is in fact increased by the constellation of supra-individual conditions which would make possible each single project at the same allowing the realisation of the others[28].

In this sense, although as said the civic initiatives engaged in the *GM* existed independently from the discourse on the Commons, the overarching paradigm of the commons is not uninfluential[29]. In the name of the commons, relying on the same piece of land cannot be just about the coexistence of different subjects in the framework of a juridical agreement. It is matter of shared governance, of regulated accessibility, of care, of rituals and attitudes – of commoning- through which that piece of land will be protected and made accessible beyond the small group of citizens involved in the design process of an *îlot pilote*. It is a matter of uses, which by making possible the cohabitation of the different projects produce the conditions for their realisation.

Nevertheless, what needs to be stressed, is that the emancipatory value is not only about the concept of sharing or co-producing or taking care –at the core of the concept of Commons-, though these might be in themselves emancipatory, given the current conjuncture of limited resources and disappearing welfare. *A priori*, it is also about a horizon within which the claims being made by the various initiatives are pondered and re-signified at a collective level, embedded in the larger social construction. It is about the ground - as previously mentioned- where those initiatives, in order to enact emancipation, need to establish multiple dialogues and synergies, thus reframing their claims without losing specificity. In order to be radical, to benefit the society as a whole, without creating oppressive conditions for the groups non-directly or not immediately concerned, emancipation needs to be grounded.

In the next paragraph I will try to recognise and to qualify the spatiality – and the embedded relational dimension- emerging out of the design process for an *îlot pilote.* The purpose is to seize the precise spatial conditions which would allow the realisation of the specific projects of these groups of inhabitants in Brussels. As shown, this is matter of space. Not only because we are dealing with a

process of urban transformation and land- as a scarce resource- is implied. Not only because what I have named grounds of possibilities are inherently spatial: space being required for the encounter of needs and intentions, for the reciprocal confrontation and the alignment of the different projects, for the emergence of the social, beyond the individualisms of the isolated projects. Or because the materiality of space could operate as a federating framework, against the isolation precarity and disaffiliation are supposed to engender. But also because, as previously explained, in times of precarity, individuation –the emergence of subjectivity, the re-appropriation of the self- is performed through the body, through a relational appropriation of space, physically or symbolically[30].

THE SEMIOTICS OF AN OPEN COURTYARD

According to the original intentions of Passages and Cogeneris, before their engagement in the design exercise of the ilot pilote, the exchanges among the different generations, the lifestyles and life moments at the core of their projects were imagined to happen within the fluidity of a continuous open space, where the different building typologies would have been distributed. Instead, the configuration of the block chosen by the *GM*, among those proposed by the Masterplan, reduces the possibilities of articulation. Four or five storey volumes oblige to shift from of a low density configuration to a higher density, while the internal, open courtyard – if not properly articulated- risks to create more obligations then complicities (figure 2). The original purposes and values however persisted through the design process and they explain the tendency to transcend the rigidity of the volumes, with terraces, gangways and corridors meant to multiply the options for accessibility. Anyhow, despite its limitations, it is the courtyard -instead of a family or individual centred, single housing unit- which in this moment seems to better signify the concept of emancipation: in between the re-appropriation of the self and emerging forms of reciprocity. On the background, the dismantlement of the concept and the infrastructure of welfare state –in French, meaningfully called *securité sociale*- as established after the second world war.

The spatial performance of the subjectivities here observed starts from the domestic realm, second skin and basic dimension through which individuals relate to the rest of the world. Consolidated forms of domesticity are disrupted, diluted in a spatiality which opens

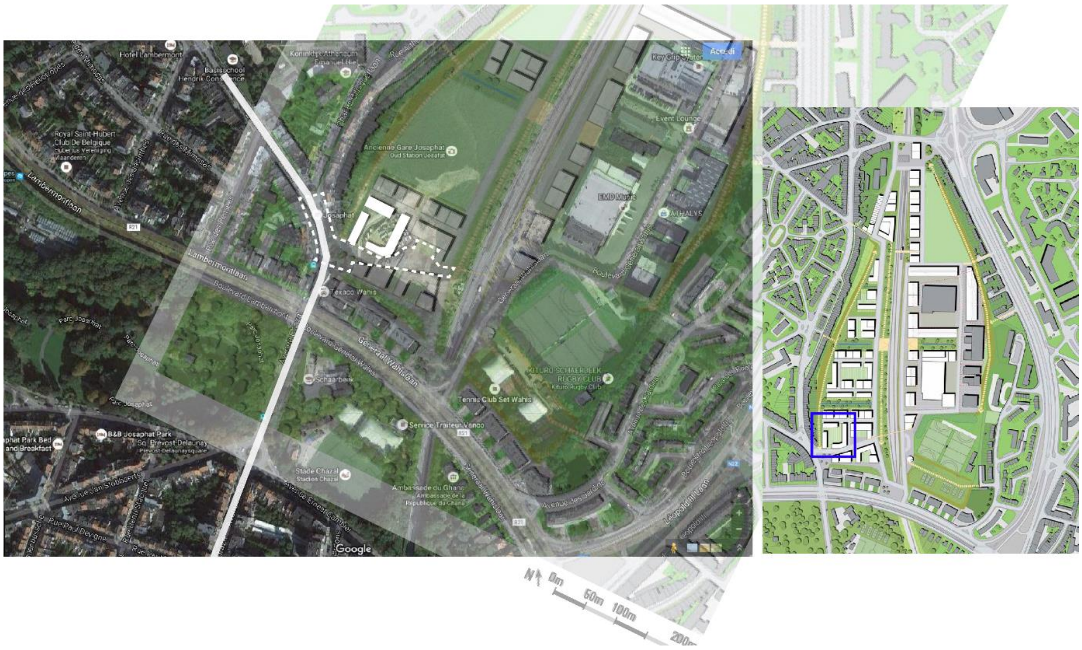

Figure 2. A slide for a design session of the group modélisation, showing the position of the îlot pilote in relation to the site and to the Masterplan. Graphics by the author.

to new possibilities for the self and for the social construction. So for example, in order to fuel the contact between different generations, corridors become large and inhabitable, challenging the rigidity of the volumes calculated by the Masterplan. The apartments of the students are combined with small units for elderly people. Common spaces are designed to share time or a meal. Far from the constrictions of planned activities and common agendas, it is the "fortuitous encounter" - the *en* of the Japanese Pavilion at the latest architecture exhibition at the Venice Biennale[31]- to nourish a different domesticity, made of spontaneous sharing and an invisible support, of reciprocities made possible in the everyday life.
As part of this porous solidarity, the proposed facilities and activities are conceived to be accessible also to the rest of the neighbourhood. So for example the access to the *salle polivalente* is possible both from the interior corridors of the building which contain it, then from a public terrace.
For an actor such as the CLTB, in the name of redistributive needs, the hybrid accessibility and spatiality of the courtyard is what allows to build and to support the intersection of public, collective and private resources, making possible the realisation of their projects. As in one of their first projects, in Rue Verheyden, the courtyard is not an optional tribute to public accessibility or a compromise with the spirit of community. It is in fact at the core of the project feasibility, by building the compatibility of different needs and expectations – those of the inhabitants, of the neighbourhood, of any other citizen- *on the ground* of the unavoidable spatial coexistence[32]. It shows how collective, private and public could coexist at very small scale of an urban block, without necessarily merging.
Overall, different degrees of privateness emerge: the porous privateness of individuals experimenting new reciprocities could coexist with the intimate privateness of individuals making space-and-time for the beginning and the end of life.
A different domesticity however does not exhaust the cultural and spatial realms articulated around the courtyard. Which is not just about the prolongation of the porous and transcalar dynamics of cohabitation installed in the interior of the buildings and permeating the whole *îlot pilote* –from the kitchen to the garden, in between recognition and redistribution. Is this courtyard a pure sum of privates? Or a collectivisation of privates? What about publicness and the accessibility of the observed

reciprocity patterns? Is publicness reduced to the physical possibility to walk through the courtyard, simply allowed by the morphology of the block?
In fact the forms of welfare and the reciprocities explored though the design exercise of an *ilot pilote* are so specific –determined by a unique combination of inhabitants with their needs and desires- to question some consolidated –or stereotypical- emancipatory dimensions of the (public) welfare state, such as redistribution, open accessibility, universality. Dimensions which are in fact questioned and re-articulated by the exercise of the *îlot pilote*, as part of the mentioned encounter between redistributive and recognition claims. A deeper analysis could not be developed here. But what seems to be suggested, looking at the intersection of different practices and needs, is that emancipation –in the present conjuncture- is not only the possibility of a (homogeneous) group of people to shape their lives, but is in the possibility to make this happen together with and through the actualisation of other thousand different claims. Emancipation cannot be reduced to universal formulas, neither it is possible in isolation. Emancipation is possible and is radical through the simultaneous, actualization of specificities, recognised and enacted *through* their coexistence, not because of exclusion. The *îlot pilote* shows how this is made possible by unique combinations of needs and resources: grounds of possibilities generated by their specificities, which emerge by being enacted, by exploring unknown forms of living together. But most importantly the *îlot pilote* shows the crucial role played by space: as the irreducible dimension where projects need to articulate, to establish a social dimension and to coexist in order to be realised[33].
The public dimension of the *îlot pilote*, what is "re-distributed" to the rest of the city is first of all the urbanity created at the scale of a block: the same courtyard introverted by the routines of the inhabitants is extroverted by facilities such as kindergarten, a *maison medicale*, a publicly accessible terrace, a social restaurant, a library, a praying room. Secondly, it is a sense of possibility which relies more on engagement and reinvention of the self, on acts of appropriation and care, than on a paternalistic distribution of resources.

INFRAPUBLIC

By converging within the framework of the *îlot pilote*, because of the spatial constraints and of the will to realise the projects, because of the bundles of uses, emancipatory discourses contaminate and the purposes of the single initiatives, where possible, slightly transform, embedded in the larger multi-coloured frame of appropriations defined by the project. As a result, in an extreme synthesis of my observations, hybridity, transcalarity, transversality, a concerned and regulated accessibility, an appropriable publicness seem to be the spatial conditions for the mentioned emancipatory processes to unfold. These are the main spatial attitudes emerging out of the exercise of the *îlot pilote*, between pragmatism and the utopic horizon of the commons[34].
The way in which the coexistence of public, private and collective is made possible and accessibility is addressed by the *îlot pilote* reveals a peculiar connective dimension, instituted by the convergence of the different initiatives, where in fact pre-existing collectives could be empowered within a larger framework of action. With the purpose of regulating the circulation of resources and their protection, of balancing the sovereignty of the self, care and the responsibilities towards the other, in this courtyard the distances between private, public and collective are shortened by blending and overlapping their boundaries. What is embodied in the space of the courtyard, according to Dardot and Laval for example, could actually be the real public– in opposition to the State public: according to them in fact, no public is possible without the engagement of the community to which it refers[35]: without appropriation. The gestures of care imagined through the design exercise for the *îlot pilote* in fact imply appropriation. It certainly is a different public, generated by spontaneous, experimental and not institutionalised practices. As an analogon of the concept of infrapolitical[36], the concept of

infrapublic could be useful to describe the dimension where hybrid assemblages of civic initiatives are organised, according to non-centralising modalities; not institutionalised although looking for an institutional engagement; not directly criticising the institutional attitudes though disguising a strategy to contest and transform their role. The infrapublic precedes the public: not to be replaced by it, but as an unstable, non-institutionalised dimension within which new inhabiting experiments are enacted, creating the premises for new institutional infrastructures.

Less a matter of exceptional protests and more a massive pattern of evasion[37]: this could be in fact a good description of the dimension where contemporary forms of civic activation situate, reacting to a state of precarity. Gestures and practices which force institutional protocols by continuously asking for exceptions, gradually transforming their vocabulary, their modus operandi.

Whether to call it infrapublic or differently[38], the matter is to acknowledge the emergence of a different spatial, cultural and social dimension, where the variety of current civic activations challenges and blurs the boundaries of public, private and collective. Appropriable, accessible, hybrid, non-institutional: the infrapublic is the dimension where grounds of possibilities could crystallize, allowing emerging subjectivities to regain the *propriété de soi* as part of larger socio-spatial constructions.

DESIGN AS A GROUNDING PROCESS

The hybrid and transversal socio-spatial condition allowing emancipatory paths to interweave and hence to happen, would have never emerged without the exercise of design: firstly, revealing the needs and desires of the concerned actors; secondly, leading the different initiatives to discuss the concrete conditions and the spatial requirements for their realisation.

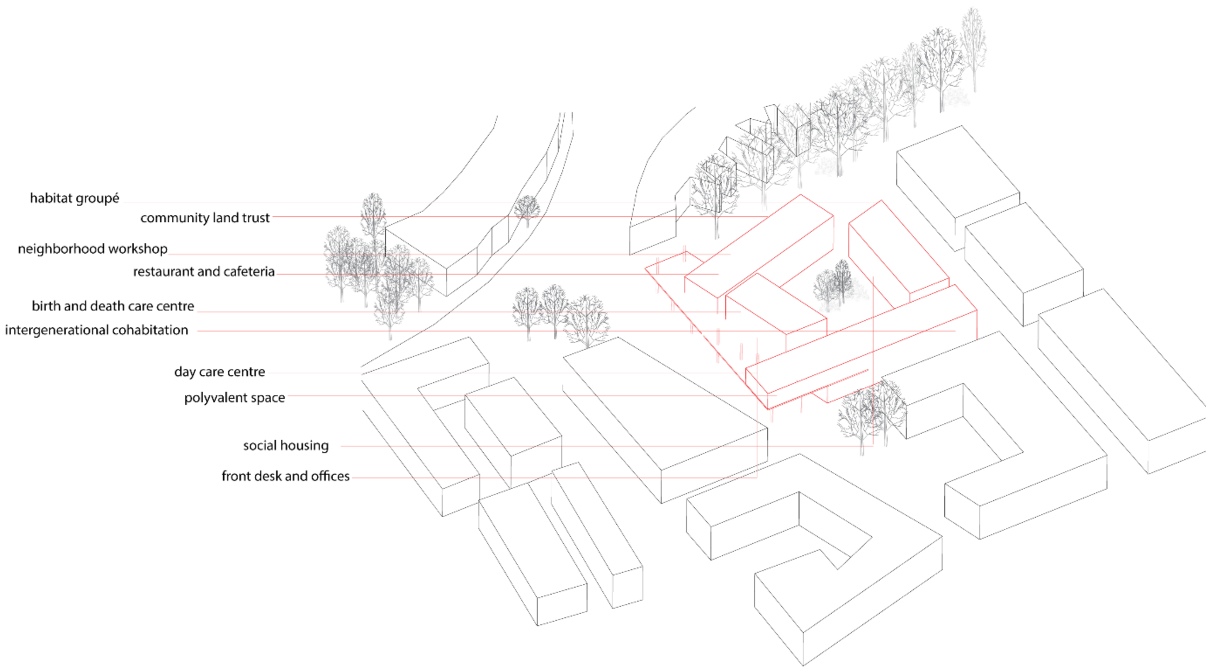

Figure 3. In red the volumes of the îlot pilote. Drawing by the author.

It is relevant to point out that the design exercise developed by the *GM* in fact concerned and intersected multiple levels: not only the spatial, but also the financial and the governance aspects have been considered and where possible, treated into detail.
In particular, approximating as much as possible the realisation of the block, the design exercise allowed to seize the relevance of property, as the institution traditionally crystallising in space the juridical conditions of any artefact or project: in terms of domains of sovereignty and hence, of responsibilities and possibilities of governance. But property is also crucially operating at the core of emancipation, in between redistribution and recognition[39].
In the case of Josaphat, each of the involved initiatives encompasses not only different spatial needs, but also different expectations as far as ownership options are concerned, determined by different income thresholds and different emancipatory paths. The families of the CLTB need an affordable home ownership. On the other hand, many families of Passages have no special requests in terms of affordability, but are in fact more interested in a different way of living.
Looking at governance, if on the one hand, for example, it would be easier to assign a specific building to each involved juridical subject; on the other hand, this could engender rigidities in the behaviours of the inhabitants and in the organisation of activities supposed to be accessible to the rest of the neighbourhood. Consequently, traditional property formulations will have to be challenged, suggesting an interesting, unprecedented role of the design process: as a laboratory where consolidated property formulations could be disassembled and re-assembled, each time according to the specific needs of the concerned communities[40].
Under these conditions, design has to orchestrate spatial configurations and the adequate juridical architectures, allowing to distinguish or to combine responsibilities and rights, but also resources and desires, of the different involved juridical subjects.
In other circumstances, inhabitants would adapt to the conditions of an existing block or of the proposed project -from property to the organisation of space-, their agency being possibly determined by the allowed forms of participation. In the case of the *îlot pilote*, the project is originated by the gathering of its inhabitants and it will exist only because responding to their specific needs and resources. Design as a process and its envisioning capacity–challenged beyond the spatial domain- is what allows not only the encounter of the inhabitants, but also the configuration of the unique, multilayered architecture, which would make the project feasible, by responding to the specific conditions which generated the project.
Additionally, coming to terms with the spatial conditions of the site, the design process leads the different expectations and claims to confront, to define the strategies for their coexistence given the spatial limitations of the given urban block. This spatial constraint brings to adjustments, alignments, coordination: in other words it allows to embed isolated projects into a larger emancipatory scheme Hence, the design process creates the conditions for emancipation not only by prefiguring of the required assemblages, but also inducing a socio-spatial redefinition of the original claims: it thus shifts the emancipatory process at a more radical level, as the different strategies of emancipation would be realised simultaneously and *thanks* to the others instead than excluding the others (echoing Laclau's understanding of the grounded dimension of emancipation).
As previously mentioned, the word "ground" captures the thick deposit on land of values and rights, discourses and negotiations, spatial and juridical architectures which allow emancipation to articulate, in between the individual and the social, the body and the city. It is by grounding that emancipatory projects could be realised. Then I argue design could support emancipatory projects as a grounding process: by identifying and shaping the constellation of conditions, spatial and non spatial, required for the concerned projects to be realised.

CONCLUSION

A final note on the relevance of the case study. The case observed is a very specific window on the current forms of production of urbanity. The point in focusing on such a micro situation in Brussels is more about rising questions than about abstracting synthesis.
The observations made concerning the needs and desires of the concerned inhabitants are not meant to be generalised, although they could easily be referred to larger pictures provided by scholars concerning precarity, for example. This does not imply that their spatial attitude is defined only by precarity; or that other reactions to precarity would not be possible. Any case would be unique, especially when looking at the spatial and design practices as practices of becoming.
It is undeniable that if there is any common denominator for the multiplicity of urban experiments mushrooming everywhere in these days, it is their non-representativeness. Any attempt to reduce their characteristics to more general terms would automatically fail to seize their essence and their originating values. This is a challenge for research. But also for urban policies: how to connect the irreducible plurality of this form of emancipation to the transformation of the city? If emancipation is a matter of space, as the case of the *îlot pilote* suggested, then the role of design as a process to deal with it will have to be questioned. The case of *îlot pilote* showed the capacity of design to operate at a micro-scale, creating the conditions for a bundle of different civic initiatives to complement each other, to coordinate and to be realised. The challenge will be to embed this level of micro-initiatives, at which emancipatory possibilities are generated, into the adequate policies, operating at larger urban scales, without losing their emancipatory momentum, without breaking the continuity between the practices of bodies and the required infrastructures.

My deepest gratitude to the members of Commons Josaphat and the citizens of Brussels, for allowing me to learn from and to be part of such a unique process of social, personal and urban change.

[1] This definition has been formulated by CJ in the absence of a juridical structure. At present the collective constitutes an asbl, no profit organisation.

[2] A vacant site of twenty-four ha classified as ZIR (Zone d'Interet Regional) and belonging to the Region (SAU is specifically the agency in charge of its management). From the 1950s to the 1990s the area was a freight station.

[3] From the beginning, the different activities of Commons Josaphat were developed through the organization of ad hoc groupes de travail. *Groupe Modélisation* is one of them.

[4] In French, an urban block pilot project.

[5] Publicly presented in 2015.

[6] Verena Lenna, "Scenes from the Right Not to Be Excluded." In *Territories in Crisis*, edited by Cristina Bianchetti, Elena Cogato Lanza, Agim Kerçuku, Angelo Sampieri, and Angioletta Voghera. Berlin: Jovis, 2015.

[7] As co-founder of Commons Josaphat, I had the chance to follow the activities and to observe the variety of practices and discourses articulating around this platform for civic activation from the very beginning. Not being originary from Belgium, CJ provided me with an exceptional occasion to learn about the context of Brussels and its varied landscape of urban activations, to observe at a close distance a number of ongoing urban dynamics, in the post-crisis conjuncture of a global city.

[8] From the point of view of Urbanism, I refer in particular to the research of Bianchetti, which looks at European territories and at the varied landscape of practices and initiatives reacting to the last economic crisis. The books Territories in crisis and Territori della Condivisione are the result of this research.

[9] Accessibility of land and of affordable housing, the co-production of the city, the opportunity of engaging in the making of one's own *cadre de vie*, to install more sustainable practices and forms of living, to protect resources and their accessibility– especially scarce resources such as land, water, green environment. Not last the opportunity of reducing real estate based speculative dynamics: all these purposes, at the core of the discourse on the Commons certainly represent a shared horizon of meaning and of action for many initiatives gathering in the name of the Commons. Unfortunately, they can only be mentioned in the framework of this paper.

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[10] The housing question and in particular the inaccessibility oh housing market to low income households is a major issue in Brussels Capital Region, largely documented by literature

[11] Ernesto Laclau, Emancipation(s).London: Verso 1996.

[12] Gøsta Esping-Andersen, The Three Worlds of Welfare Capitalism, Princeton University Press 1990.

[13] « Exister comme individu c'est, me semble-t-il avoir la capacité de développer des stratégies personnelles, disposer d'une certaine liberté de choix dans la conduit de sa vie perce que l'on n'est pas dans la dépendance d'autrui » (Castel & Haroche 2001)

[14] As stated by one of the future inhabitants of the CLTB, during one of their General Assemblies.

[15] Martine De Gerlache, founder of Cogeneris and member of Commons Josaphat, in an interview released to the initiative The Art of Organising Hope, June 2017.

[16] Berardi, Butler, Federici, Lazzarato,Tsianos just to mention a few and those that I have more frequently read when dealing with precarity. According to the philosopher Roberto Esposito, the italian school of thinking has focused on these fenomena much more then others as a result of a tradition centered on the material conditions of life. Additionally, it has to be noticed how radical media platforms and journals increasingly stress the impact of precarity on individuals living conditions.

[17] If flexibility –which produced precarisation- engendered a greater availability of labour force, at the advantage of neoliberal logics of production (Berardi, but also Boltansky and Chiapello), at the same time it jeopardised the reproductive function of the family. Additionally, it also liberated time. The combination of these two factors is allowing –or obliging- individuals to explore alternative paths of life, experimenting different forms of solidarity as part of their spatial performance, as it will be shown.

[18] Lorella Pazienza, architect at the CLTB reports this factor at the origin of the design of new housing typologies (interview June 2014). Concerning Brussels, the phenomenon is confirmed by Marie Laurence De Keersmaecker. in her recent presentation « Qui a besoin de quel type de logement ? Analyse du profil des ménages bruxellois et de la demande de logements », at the conference « L'acquisitif social : comment outiller les ménages à revenus modestes dans l'accession à la propriété ? », organised by ARAU, March 2017, Brussels.

[19] As shown by intergenerational cohabitation, LGBT housing projects.and other less specific cohabitation projects.

[20] Well exemplified by the inhabitants of Cogeneris

[21] Robert Castel and Claudine Haroche. *Propriété Privée, Propriété Sociale, Propriété de Soi: Entretiens Sur La Construction de L'individu Moderne*. Paris: Fayard, 2001.

[22] Précarité is reported in Brussels as in increasing phenomenon, related to unemployment, but not only. Health, housing, citizenship, gender, lack of education and other forms of imparities related issues can be other factors determining a precarious life.

[23] Franco Berardi, *Lavoro, Sapere, Precarietà*. http://eipcp.net/transversal/0704/bifo/it. 2004.

[24] These few lines are necessarily a synthesis of interviews and fieldwork, of my engagement in the activities of the GM, of the reading of primary and of secondary sources on the phenomenon of precarity in Brussels.

[25] Nancy Fraser and Axel Honneth, *Redistribution or Recognition?* London: Verso, 2003.

[26] Massimo De Angelis and Stavros Stavrides interviewed by An Architektur,"On the Commons: a public interview with Massimo De Angelis and Stavros Stavrides", and published by e-flux, june 2010.

[27] Some elements of this definition of ground refer to the Italian concept of *suolo* (the Italian translation for ground) as treated in Monica Bianchettin Del Grano, *Suolo. Letture E Responsabilità Del Progetto*. Roma: Officina Edizioni, 2016.

[28] The ground is one of the six dimension of emancipation identified by Laclau. "If the act of emancipation is truly radical, if it is really going to leave behind everything preceding it, it has to take place at the level of the 'ground', of the social. If there is no ground, if the revolutionary act leaves a residue which Is beyond the transforming abilities of the emancipatory praxis, the very idea of a radical emancipation would become contradictory." Ernesto Laclau, *Emancipation(s).* (London: Verso 1996) pg 2.

[29] More constraining perhaps than other discourses which in this moment could eventually produce similar gathering effects: as for example those on systemic governance, on smart cities or on urban resilience.

[30] The implied reference is to Deleuze and Guattari concept of *territorialisation*, as a process of semantic and/or physical appropriation of the environment, as a process for the becoming of the subject. This emerges not only form the discourses of the initiatives involved in the project for an îlot pilote, where space allows to perform new forms of living or citizenship. It is also evident by looking at the practices of temporary occupation of the whole site, which it is not possible to analyse in the framework of this paper. The concept of territorialisation is useful to highlight the emergence of the subject – singular or collective – by means of the inhabiting process.
[31] *en: art of nexus* is the title of the exhibition of the Japanese Pavillion at Venice Architecture Biennale (edition 2016), which dealt with the living troubles of contemporary Japanese society
[32] Verena Lenna. 2015. "Scenes from the Right Not to Be Excluded." In *Territories in Crisis*, edited by Cristina Bianchetti, Elena Cogato Lanza, Agim Kerçuku, Angelo Sampieri, and Angioletta Voghera. Jovis.
[33] The space of this paper does not allow to deal with the role of public institutions in the development of the project, at present informed about the proposal of the *GM* but not yet ready to include it in the Masterplan.
[34] This imbrication of scales and discourses, though not deeply treated in this paper, has been observed through the lens of a very limited spatial exercise, at the scale of an urban block. Looking at the larger scale of the *friche* and at the long term capacity of the collective Commons Josaphat to work on multiple fronts, with temporary occupations and involving existing neighbouring initiatives, it is inevitable to notice transcalar spatial dynamics embedding that specific exercise in an even wider discourse, at the scale of the whole city.
[35] What it is normally meant as public should actually be defined as state related, *étatique*. Amador Fernandez-Savater, "Laval & Dardot: 'El Desafío de La Política de Lo Común Es Pasar de La Representación a La Participación.'" *El Diario*, 2015.
[36] The concept of infrapolitical introduced by the anthropologist Scott describes a level of informal resistance and political activation, comprising different forms of action, enacted independently from the institutional political system. The infrapolitical is practiced in the everyday and does not require any form of membership or adhesion to formal protocols. In Scott, C. James, *Domination and the Arts of Resistance. Hidden Transcripts.* Yale University Press.1990.
[37] Paraphrasing Scott, pg 195.
[38] Concerning neologisms, that a hybrid realm of action and of civic construction is emerging, where public, collective and private overlap and redefine, is anyhow proved – among other things- by the recent proliferation of labels trying to seize a collaborative, necessarily transversal attitude of citizens' initiatives: co-creation, co-production, co-design, and so on. These labels are increasingly multiplied and appropriated by the administrative discourse. While on the one hand this linguistic appropriation is certainly part of the neoliberal voracity concerning alternative, non-institutional practices and discourses (as shown by Boltansky and Chiappello), with the effect of institutionalising any implied critique; on the other side it also provides civic initiatives with a margin to empower their action, thus exploiting the "opening" they created through their everyday actions.
[39] I refer to the main hypothesis of my PhD dissertation. The relationship between property and *individuation* (in French) is in particular at the core of Robert Castel works. The role of private property in supporting emancipation is historically established at the times of the French revolution, as largely confirmed by the juridical literature. With the installation of welfare state, *la propriété sociale* is established, allowing accessibility of resources to *le plus grand nombre* (not necessarily always leading to emancipation). At present, while both the role of private and of the public property are object of debates, the possibility of alternative forms of ownership are being elaborated, more or less directly related to the discourse of the Commons.
[40] Only to be mentioned in the space of this paper, this would imply a radical turn in the conception of property, from an institution a priori protecting the subjects (as explained in Stefano Rodotà, Il Terribile Diritto. Studi Sulla Proprietà Privata. Bologna: Il Mulino,1981) to an institution allowing the attribution of responsibilities and the convergence of multiple forms of accessibility.

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THE HOME OF MAN - A MANIFESTO COMMEMORATING THE SEVENTY-FIFTH ANNIVERSARY OF THE FIRST EDITION OF LE CORBUSIER AND FRANÇOIS DE PIERREFEU, *LA MAISON D'HOMMES*.

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INTRODUCTION

Accordingly, Le Corbusier in "Towards a New Architecture", 1922, the question was: "Architecture or revolution"[1] – also stated in "The Home of Man", 1942: "… people live in poor conditions, this is the real, the most profound reason for the battles and upheavals of our time."[2]

The nineteenth- and twentieth-century Metropolis encompasses the major social changes towards twenty-first-century capitalism, following the slipstream of people's migration from rural areas to still bigger urban agglomerations. Currently, this goes on with even bigger pace in Africa, Asia and Latin America. In these emergent regions people still live in poor conditions, while in the US and EU the enhanced living/housing standard throughout the post-war economic growth is deteriorating under the rising inequality of recent crisis.

Today Le Corbusier's concerns are met by new concerns for the local and global milieu, as a conflict between fulfilling people's social requirements and their long-term impact on the environment. A conflict, which can only be solved politically addressing said inequality.[3] That is our century's challenge obtaining social and natural sustainability, let alone preventing further hazards caused by depletion of resources and liability to climate change.

The manifesto

The manifesto at hand – assuming a relation between the Modern Movement, MM, and sustainable urbanization – obviously has to question the relevance of MM's urban models, programmes and ideas, vis-à-vis the crucial agenda of architecture and sustainability.[4]

This retrospective questioning is about unfolding MM's inner potentiality and outer actuality concerning todays housing and urban development; it's about revealing its constitutive ideology and in the same process – ref said assumption – relate to the overwhelming global agenda on resources and climate change.

The present manifesto does not fully meet those tasks, it is primarily a sketch around some key elements of the stated retrospective questioning, which – under the terms "potentiality and actuality" – intends to relay

the projects of MM at the realm of urbanism both in the sense of the academic discipline and in the sense of the "real" urban culture.

MM'S URBAN MODELS

Taken as a programme the modern house and the modern city were elaborated by more architects, a few of which explicitly contributed to a wider vision of the modern city, e.g. Le Corbusier, Ludwig Hilbersheimer or Raymond Hood, whose radical urbanism signified the opposed tendency of their fellow contemporaries, e.g. Ebenezer Howard, Bruno Taut or Frank Lloyd Wright, representing the suburbanization of the city. Far from being a consensual programme – as implied in the terms: modernism, functionalism, rationalism or the later American invention "international style" – MM was "in statu nascendi" split between conflicting positions on urban density or suburban dispersal, on Urbs or Suburbs.

The modern city did not, do not, develop towards a mutual vision, let alone the conflicting aspirations of MM; it has no equilibrium – be it good or bad – but is composed of initiations and terminations of various urban models carried out during time and space. It's not a model of the laboratory, the proverbial melting pot, rather it is a laboratory of the models.

So, retrospectively reviewing MM, particularly Le Corbusier and the circle of CIAM[5], is not about revitalising its overall vision. Rather, it's about confronting the urban models of Le Corbusier: "Ville Radieuse"[6], Ludwig Hilbersheimer: "High-rise City"[7] and Raymond Hood: "The City of Towers"[8], or Ebenezer Howard: "Garden City"[9], Bruno Taut: "Auflösung der Städte"[10] and Frank Lloyd Wright: "Broad Acre City"[11], against their actual outcome within the urban laboratory of models e.g. the New Towns of London and Stockholm, or the Linear Cities of Copenhagen, i.e. reconsidering intentions against outcomes, focussing on the features, which can actually be sustained as sustainable – so to speak.

Those urban models are sampled under the terms: The High-rise, The Garden and The Linear City, the latter through its distinct urban structure embedding the features of the former as embodied entities. The structures of which are overlapping The Linear City, comprising the elements, "the equipment", of both, as it is intentionally demonstrated by Ivan Leonidov's superior project for Magnitogorsk[12] or resultantly by Peter Bredsdorff's Finger Plan[13] for Copenhagen.

The Linear City

Linear cities, as urban models, were elaborated in the late nineteenth-century by Arturo Soria y Mata for an area outside Madrid,[14] and by Tony Garnier, La Cité Industrielle, for a region of the south-eastern France.[15] At the late 1920s and 1930s more linear cities were proposed by the Russian architects N.A. Milyutin, I. Leonidov and M. Ginzburg.[16]

Later plans and proposals for linear cities or urban structures based on linear growth were Ludwig Hilbersheimer's structure plan for eastern USA[17], Lucio Costa's Brasilia[18], Kenzo Tange's Tokyo Bay[19], and Metabolic urban visions, such as Constant Nieuwenhuys' New Babylon[20] or Kisho Kurokawa's Helix City[21] from 1961. Recent proposal is The Arch[22] for a Palestinian linear city connecting the West Bank and the Gaza Strip, linking together the mayor cities in the area.

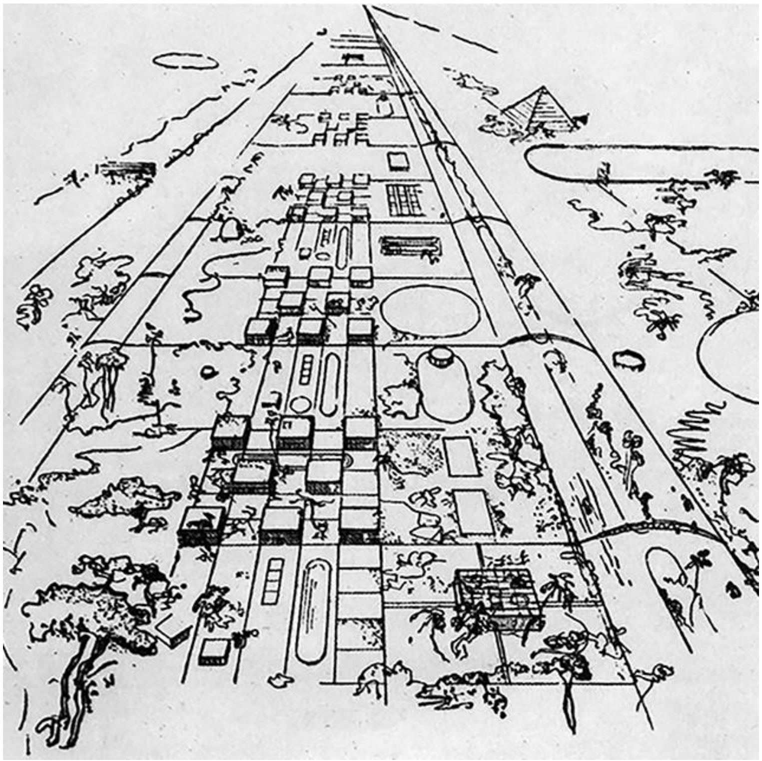
Parallel hereto, reports by UN and The World Bank[23] conclude, that the largest impacts on urban development is achieved by controlling the urban growth along public transit routes, establishing more efficient transport corridors.

Magnitogorsk

In the aftermath of the Russian Revolution about 1930 several proposals on social rebuilding were presented by city planners, among which were protagonists of both centralisation, alleged "urbanists", and of decentralisation, alleged "de-urbanists". The former proposed gigantic blocks "cornbinats" with

thousand or more inhabitants equipped with facilities such as nursery, gymnasia, sport hall, and collective cafeteria, while the latter proposed linear cities of homes alongside zones of similar social amenities, but evenly facilitating sparsely populated areas and isolated communities.[24]

Ivan Leonidov's "project for a socialist resettlement" at the Magnitogorsk chemical-metallurgical plant was based on the criteria that the prime aim was: "first, a new social concept, and second, its translation into architecture."[25] The project merged the urbanists' and the de-urbanists' ideas of new social concepts, translating these into an architecture that comprised housing of both low-rise two storey and high-rise thirteen storey: the low-rises inhabiting groups of sixteen people occupying a house in a group of eight, and so forming a neighbourhood of 128 inhabitants, while the high-rises formed pairs of twin towers each inhabiting 96 people, and forming a neighbourhood of 192 people.

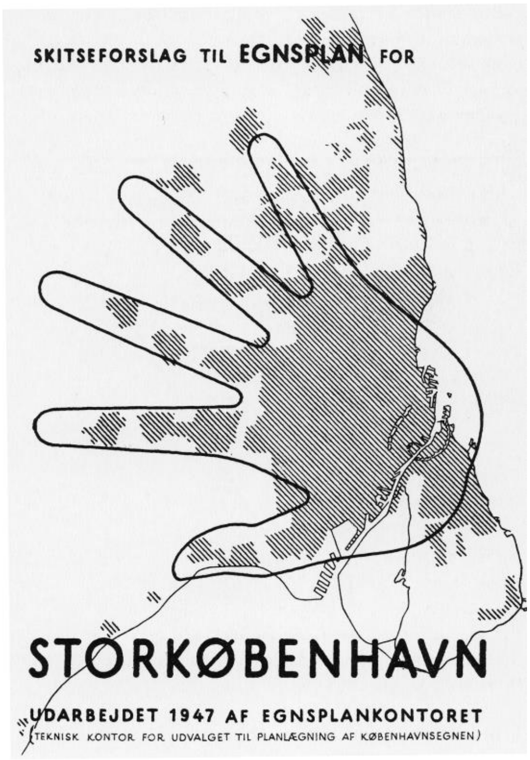


The overall plan was a linear city of three bands as a continuous overlapping nine square grid, distributing the contraposed housing sectors of high-rise towers and low-rise houses with interposed sectors of social and recreational facilities including sectors left over to horticulture.

Leonidov's basic idea of the new social concept and its translation into architecture were expressed as "1.: The arrangement of a group living in such a way as to avoid enforced socialization and excessive densities, which would inhibit the spontaneity of daily life; 2.: To establish a close relationship between architecture and nature thereby abolishing private lots and gardens; 3.: To provide a maximum freedom for living arrangements and for interpersonal relationships; 3.: To create a state of resilience (*élan de vie*) through the planned organization of a given territory."[26]

The Finger Plan

The ideas of linear cities were implemented in Denmark by a group of architects led by Peter Bredsdorff, who in 1947 designed the Finger Plan as a linear city for the regional urban growth around Copenhagen. The plan was an alternative to the most recognized post-war answer to the problem of urban sprawl, The Greater London Plan,[27] by Patrick Abercrombie, who designed The London Green Belt of autonomous satellite cities, guiding growth towards 8 New Towns, e.g. Stevenage 1946, Basildon 1949, Milton Keynes 1967. Opposed to the unregulated growth of major cities, where layer upon layer were added to the city perimeter, "new towns" like satellites around the central city became the preferred regional strategy for major cities after WWII.

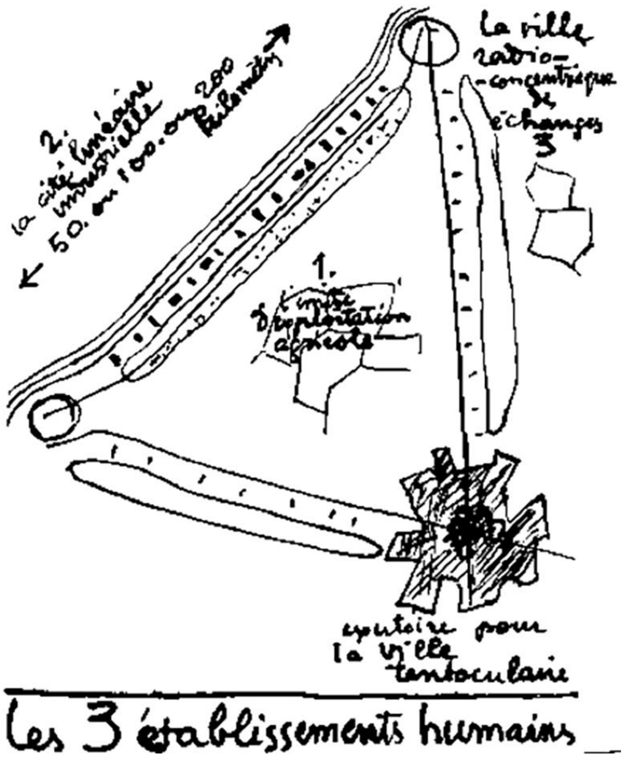


The Finger Plan, like The Greater London Plan, proposed new centres and laid out areas for housing, institutions and industries around the central city, only the Finger Plan linked more gradual the suburbs and the central city, guided the regional growth along the radial infrastructure of roads and railroads, and along the concentric perimeter of the central city. The plan attempted to limit commuting, balancing residence and work at each of the fingers and localizing zones of industries at the central city perimeter, where the fingers met the palm of the hand. The plan protected, as one of its basic ideas, a landscape with greens, forests and agriculture between its fingers.

Compared to the widespread "new town" satellite plans, the Finger Plan is one of few realized linear cities. As model for urban growth it is simple: based on existing conditions, economically sensible and technically

facile; it presuppose no major changes to the central city area, and protect easy access to parks and greens for as well the existing city as its extensions.

The Finger Plan is still guiding the regional planning around Copenhagen, even if the landscape between some fingers is visibly "webbed" by urban sprawl, and the density has remained low. The housing is dominantly single-family homes, which makes the public transportation less efficient and the borderline between city and landscape less clear and less necessary. There is a striking graduation of density and balanced zoning between housing, institutions and industries from northeast to west and southwest, following the dispersal of social classes: the north-eastern finger along the coast of Øresund being the most affluent and less dense, while the south-western finger along the coast to Køge is denser and less affluent. The newly planned finger, Ørestad,[28] close to the central city is the more consistent linear city: the density is high and the urban layout connected to the Metro; housing, institutions and industries are located lengthwise with the open landscape closely crosswise.

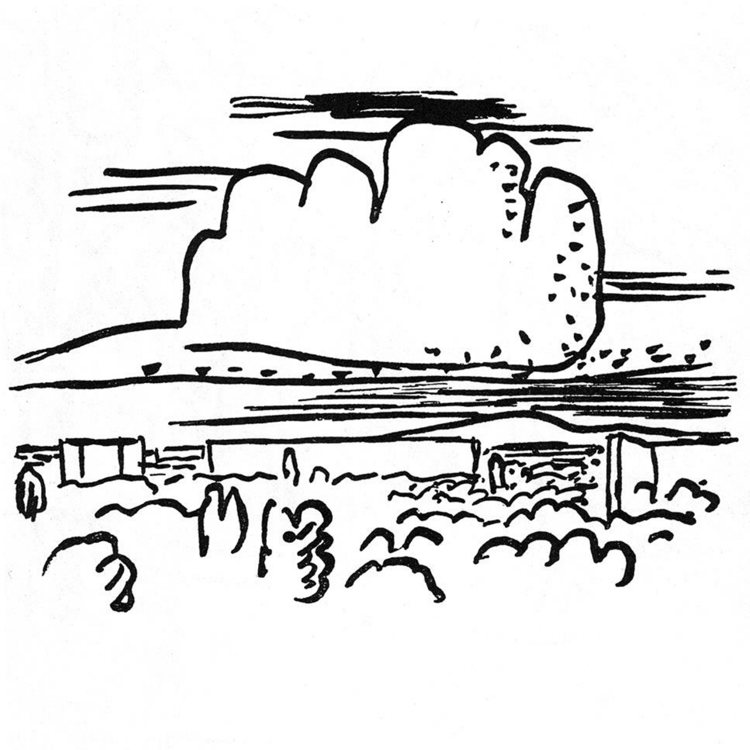


Le Corbusier and the linear city

Through CIAM[29] Le Corbusier became involved in the Russian discussion on the side of the "urbanists", but was at the same time conscious of the ideas on The Linear City. The Russian "de-urbanists" criticised his La Ville Contemporaine for being a traditional concentric city, and as a reply he wrote "Réponse à Moscou"[30], in which he modified the project to La Ville Radieuse. The urban design was still centred on high density, but now the concentric part was merged with an extensible linear city.

In the 1950s under the auspices of ASCORAL[31] LC revived the idea of linear cities, recognizing the question of proper localization as the key question, la clef, of urban design. Later in his testament, Mise au point, July 1965, he wrote: “the Linear Industrial City, was a necessary and redeeming form for solution of problems that had preoccupied reformers of good will, of all points of view, … We must localize industry and discover the meaning of the term to localize.”[32] The term emerges from a critique of the industrial world cities and his array of alternatives in e.g. The Three Human Settlements[33], where he sketched the relations between centred cities, the rural settlements and the proposed linear industrial city.

As is clear in the above brief exemplification, the ideas and proposals for linear cities were closely related to MM’s generation of architects and city planners as their solution towards a social and natural balanced urbanization. Nonetheless, linear cities were never a wide-ranging alternative to the concentric central cities of the former Metropolis or the recent meshwork of the Mega City, but at most an alternative for certain addendums, and then never more than an assemblage of suburban garden cities and spread fragments of urban density, let alone sections of high-rise cities.



A SOCIAL PACT AS A PACT WITH NATURE

Throughout history, architects have mostly been dealing with the institutions and residences of the rich and mighty, while the dwelling of the people were at the mercy of property speculation or left to auto organization. In late nineteenth-century there were –beside the early linear city proposals of Arturo Mata and Tony Garnier – certain attempts towards social housing connected to the upcoming labour movement. But it was finally the programmes and projects of MM that put social housing on architecture’s agenda,

bearing in mind the shortage of housing under the 1920s crises in the aftermath of WWI and the Russian revolution.

The programmes and projects of MM, and in particular those of LC, have been crucial to modern architecture's approach to culture and nature, and subsequently to cities and landscapes. Controversial at times regarding its impact on urban planning MM's potentials have often been ignored as relevant to current concerns and discussions on sustainable urbanization. The restoration of lost urbanity included in late modern criticism joint with the gentrification processes of the central cities have dismissed the modern programme from architecture's agenda on urban planning, and more or less succumbed earlier ideas of master plans for housing, institutions and industries.

Nevertheless, the above propagated agenda of MM on housing with greens, light, air and view – unifying home, city and nature around the modern apartment block of dwellings – might be valued not only for its proximity to greens but also for its high-density potential. Being a key issue of sustainability in urban contexts this potentiality puts MM's projects and programmes back on architecture's agenda, still holding actuality, as for incorporating "The Home of Man" in a sustainable setting.

With reference to late modern criticism, the objectives of our manifesto cannot be a new universal vision – another *tabula rasa* against existent urbanity. It got to be an inquiry into the diversity of the prevailing global urbanism, taking into account the conflicting aspirations of past and current architectural conduct and knowledge, as stated above. Far from unravelling these urban conflicts, we adopt the view on architectural practice and theory embedded in the nineteenth- and twentieth-century's urban history, which we claim still provides a paradigmatic discourse for researchers, educators and practitioners.

Hence, our objective is – on the basis of the inherited material urban history – to affirm the crevices within the likewise inherited dichotomies embedded in modern architecture's views on art, culture and nature as openings into the acknowledgement of the complexity and entanglement of architecture and sustainability. It is in the realm of the urban laboratory of applied models by the self-same MM that we are identifying a territory to question and investigate.

As stated introductory Le Corbusier's concern for the home of man is met by new conflicting concerns between the social demands of people and their long-term impact on the environment – "between the needs of man and the need of Mankind". Hence, commemorating that people still live in poor conditions, we adopt the policy of an urbanism equally balancing today's social and natural challenges, opposing late century incorporated socioeconomic changes towards present-day neoliberal capitalism. Needless to say, this is the twenty-first-century's challenge concerning global and local regulations of the endlessly shifting allocation and reallocation of production, of the social and natural damages in the slipstream of people's migration to still bigger urban agglomerations, and of the transformation of past century Metropolis to recent Mega City regions.

Resilient strategies

Globally, the discourse on sustainability is an apocalyptic political agenda influencing all major issues of urbanization and architecture. Locally, however, might subsist a resilient pragmatic approach to the apocalyptic scenarios of present and future urbanization: given the dispersal of previous urbanization resiliency, extensibility and density are locally the major pragmatic task of architecture towards a sustainable urban environment. Which pragmatism questions the constitutively inherited and still favoured solitary built object of MM versus the possibility of an architecture reconsidering MM's entire impact on contemporary urbanization, which as just as many fragments are merged with the former Metropolis and the meshwork of the Mega City.

The rationale of our manifesto is that re-thinking, re-writing, re-modelling and re-sampling MM's projects and programmes – eloquently questioning the formative influence of MM – might uncover a more sensitive path towards sustainable urbanisation, in so far as it implies not only critical but also affirmative strategies. Said concept of the city as a "laboratory of the models" might offer a resilient conduct in line with the above heading, "as for a social pact as a pact with nature".

Postscript, Re-:

In his essay, "Rewriting Modernity"[34], Lyotard states "the pointlessness of any periodization of cultural history in terms of 'pre-' and 'post-', before and after, for the single reason that it leaves unquestioned the position of the 'now', of the present from which one is supposed to be able to achieve a legitimate perspective on a chronological succession."[35] From the point of view of this position the heretical 'now' dissolves modernity as a clearly circumscribed entity fixed chronological between 'pre-'and 'post-', let alone a modernity out-dated by the alleged postmodernity.

Henceforth, being well aware that the term "modernity" might be confined successively to earlier events in history: enlightenment, renaissance, christianity or antiquity, we recognize that a retrospective review is only justified in so far as we are consulting history simultaneously, memorizing and elaborating in order to re-inscribe "MM" into the present.

Rewriting as well as rethinking and all these other 're-s' are not about striving for a new beginning to be found in some forgotten authenticity. In the wording of Lyotard: "the, 're- ', in no way signifies a return to the beginning but rather what Freud called a 'working through', *Durcharbeitung*,"[36] which is essentially linked to thinking, writing or modelling as far as these processes initiate, what we do not know yet.

So, memorizing and elaborating in order to re-inscribe MM into the present is this 'working through', as an open minded imaginative process, simultaneous memorizing, what's 'no longer', elaborating, what's 'not yet' and thus inscribing, what's 'now'.

It's not about the closures of periodization, revitalisation or reconstruction. It's about unsealing what is constitutively hidden in the event of a thought breaking through, MM's, resisting the prejudices of the -ism's, of the modern-ism and its pre-, late and post-; it's about elaborating its *pro-grammes, pro-jects and pro-posals* constituted between 'not yet, 'no longer' and 'now', opposite the impossible succession of before, now and after, which succumb the present as "a legitimate perspective on a chronological succession."

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DESIGNING SUSTAINABLE SEA DEFENCES: DEVELOPING PRINCIPLES FOR PROCEDURES, PROCESSES AND PRACTICE

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Figure 1. Portsmouth Elephant Cage Logo

INTRODUCTION

Two stages of The Portsmouth Elephant Cage, an international design research programme, were held over 2016-2017 with the purpose of advancing study into more sustainable, effective, efficient and better future spatial design responses to climate change induced rises in sea level in urban locations; through an archetypical investigation of Portsmouth, UK (Figure 1).

In the first stage, launched through an open Anglo-Dutch design contest procedure, eighteen emergent young design professionals from architecture, landscape architecture, engineering and planning were selected. They were coalesced into three balanced competitive teams, mentored by six international coastal design experts from across the disciplines, and supported by sixteen masters of architecture students along with five promoters from Project Compass CIC, Architectuur Lokaal and the Portsmouth School of Architecture. This stage over two and a half days included eight seminars, generated collaborative design outputs from the three teams and included in a final public consultation key authority stakeholders.

Prior to the programme's commencement outline engineering proposals for Portsmouth's southern sea front defences had been published. These raised significant questions regarding potentially adverse impacts on the city's sustainability and its tourist economy. The three teams therefore developed alternative design polemics capable of addressing sea level rises along this frontage and were encouraged to innovate.

The programme's ostensive aim was to evaluate, hypothesize, consult and shift the understanding of potential design opportunities for coastal defences and their resilience[1]. It also aimed to further inform design practice, advance professional knowledge, expertise and understanding to build capacity for achieving better and more sustainable global solutions for urban and regional resilience in comparable coastal cities. This co-creation process was founded on collaborative cross-disciplinary professional working practices, consultation and the opportunity these offer for contributing to the advancement of knowledge, its exchange, networks of expertise along with public understanding and expectations.

This paper outlines the context, objectives, process, adopted procedure and collaborations underpinning the programme with initial reporting and reflections on the principles emerging from the first stage, along with preliminary outputs.

This design research was supported by Project Compass CIC (UK), Architectuur Lokaal (NL), and the Stimerings Fonds Creatieve Industrie (NL), was hosted within the Portsmouth School of Architecture in collaboration with the Eastern Solent Coastal Partnership and extends the author's ongoing design research inquiry on sustainability and resilience in Portsmouth and the Solent region[2].

CONTEXT

Climate change induced rises in sea level pose significant recognised risks for sustainable development in urban agglomerations globally[3]. A known problem arises therefore as to how best to address these risks efficiently, appropriately and sustainably; along with how investment on mitigation might be most effectively allocated, prioritised and designed to maximise resilience and cost benefits[4].

At a conservative estimate 147 to 216 million people globally live on land at risk of being submerged below sea level, or at regular flood levels, by the end of this century assuming emissions of heat-trapping gases continue on their current trend, but the figure may be as large as 650million. The largest populations by numbers of those most exposed are in countries in Asia; China, Vietnam, Japan and India, with the UK and four other European countries also making the list (Figure. 2)[5].

Top 20 Most At-Risk Countries

By Total

Country	Population Exposed (thousands)	Percent of National Population Exposed
1. China	50,465	4%
2. Vietnam	23,407	26%
3. Japan	12,751	10%
4. India	12,643	1%
5. Bangladesh	10,230	7%
6. Indonesia	10,157	4%
7. Thailand	8,176	12%
8. Netherlands	7,793	47%
9. Philippines	6,205	7%
10. Myanmar	4,742	9%
11. United States	3,087	1%
12. United Kingdom	2,574	4%
13. Brazil	1,737	1%
14. Germany	1,665	2%
15. France	1,256	2%
16. Malaysia	1,171	4%
17. Taiwan	1,032	4%
18. Korea, Republic of	1,028	2%
19. Nigeria	848	1%
20. Italy	842	1%

By Percent

Country	Population Exposed (thousands)	Percent of National Population Exposed
1. Netherlands	7,793	47%
2. Vietnam	23,407	26%
3. Thailand	8,176	12%
4. Japan	12,751	10%
5. Myanmar	4,742	9%
6. Bangladesh	10,230	7%
7. United Arab Emirates	570	7%
8. Philippines	6,205	7%
9. Bahrain	80	6%
10. Belgium	619	6%
11. Oman	148	5%
12. Taiwan	1,302	4%
13. Indonesia	10,157	4%
14. Denmark	232	4%
15. United Kingdom	2,574	4%
16. Malaysia	1,171	4%
17. China	50,465	4%
18. Hong Kong	241	3%
19. Cambodia	449	3%
20. Ireland	133	3%

Figure 2. People living on land that will be below sea level or chronic flood levels by 2100, assuming current emission trends continue, and medium sensitivity to sea level warming. For the list ranked by percentage exposure, we consider only countries with total populations over 1million.

Coastal cities of twenty seven European Union states exposed to the risk of inundation, up until 2100 from 100 year event storm surges, indicates a high preponderance are located around the North Sea, the English Channel and the Atlantic. States such as the Netherlands and UK are particularly exposed (Figure. 3)[6].

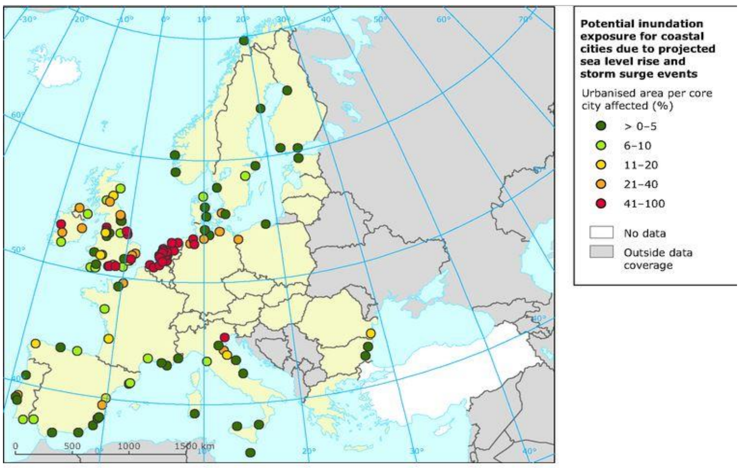

Figure 3. Map shows the proportion of the city area (UMZ inside the core city) that would be affected by potential inundation caused by a sea level rise of 1m.

With a long highly indented coastline the UK's coastal exposure is also high. The UKs' coastline at around 12,429km is high for a land mass of 243,610 km^2 and has a coast/area ratio of 51.4 m/km^2, whilst relative to the length of its coastline the UK has a low population at 5.2 people/m*(a)*[7]. However Ordnance survey calculates UK's main island at 17,820 km[8] and when the larger islands are added, this rises to 31,368 km from which may be derived an upper coast/area ratio of 129.6 m/km^2 [9].
This illustrates the significant and unique challenges the UK faces with a coastline that is proportionately high relative to its land area and with a comparatively low density of people relative to coastal length. UK therefore needs to ensure its coastal management and mitigation strategies for sea level change deliver optimum cost benefit, so that investment, which is currently prioritised to protecting life and property, may also be more critically considered in areas of higher population densities in terms of whole life and social value sustainability, for overall efficiency and effectiveness.
Whilst the analysis of empirical data relating to climate change induced flood management and wider strategic responses has developed rapidly, direction on the necessary detailed design resolutions particularly in urban coastal areas remains more skeletal. In responsive design ongoing questions arise as to how urban agglomerations and their societies may best react to the risk, so that the most appropriate and sustainable solutions achieving best value and environmental quality are delivered. An intent of this research programme has been to explore and expand this knowledge.

England

In England and Wales the Environment Agency estimated that "around 10m people, in 5.5m properties, live in flood risk areas, with 2.6m of those properties at direct risk of flooding from rivers or sea" and that there is "a recurring theme is of inadequate consultation, co-operation and unity between public authorities".
A probable scenario of a 2m rise in sea levels would threaten significant UK population concentrations, with regionally the highest anticipated numbers, 111,356 located in South East England (Figure 4)[10].

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[a] Compared to the lengths of the Dutch coastline 451km, Italy 7,600km, Spain 4,964km, or France 3,427km, compared to the coast/area ratio of Netherlands 13.3 m/km^2, Italy 25.8 m/km^2, Spain 9.95 m/km^2, Ireland 21.0 m/km^2 and France 7.58 m/km^2 and Compared to the ratio of population to length of coastline for The Netherlands 37.78 p/m , Italy 8.00 p/m, Spain 9.36 p/m, and France 19.46 p/m

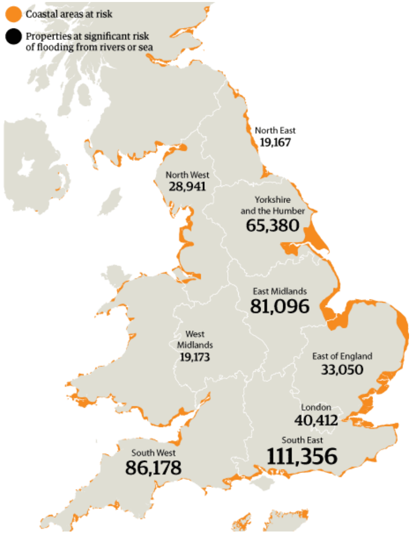

Figure 4. Probable scenario: A 2m rise in sea level (Guardian 2010. Source: The Environment Agency)

In February 2017 nearly £6 billion of investment was consented for England for both coastal and fluvial projects to address flooding issues,[11] (or roughly 11% of High Speed Rail 2).

Portsmouth

South Hampshire is the largest built up region at risk in the South East, with Portsmouth in the low lying East Solent coastal area having a population density of 5,100 people/km^2, which exceeds that of London, being pre-eminent. Portsmouth is one of only two island cities in Europe and like Venice also has an imperial maritime history, with its open spaces provided largely by the sea or along the seafront.

The Portsmouth Southsea southern frontage is particularly vulnerable to rises in sea level. There are 8,077 residential properties within this areas primary food cell, with 4,114 residential properties and 704 commercial properties at direct risk of inundation[12]. This popular southern frontage, has extensive beaches, promenades and leisure activities; is rich in historic assets, with five scheduled monuments and thirty four listed buildings; and has a range of other unique functions such as the world's only commercial hovercraft service, the large annual Victorious Festival and the grandstanding for yacht racing events which occur immediately off this coast. The city derives a significant 12% of income from tourism.

In 2015 the Eastern Solent Coastal Partnership (ESCP) a local authority consortium with a remit to manage the regions coastline, sought to consult the public on their approx. £62m proposals to improve sea defences to the Portsmouth Southsea frontage[13]. Existing defences have, in places, passed the end of their life expectancy so replacement is urgently required. The ESCP proposals based on a policy of 'holding the line' entailed constructing a terraced concrete sea defence structure on the beach and raised a number of challenges, including whether or not better value might be achievable, and what future lessons might be learnt[14].

Summary review of existing Coastal Management Strategy

There are three strategic options commonly adopted when evaluating coastal management; attack, defend or retreat[15].

In an attack strategy the usable land/space is extended into, on or over the sea (example: the Dutch Polders). Defend seeks to secure existing waterfront lines (example: a sea wall), while a retreat strategy accepts the invasion of the sea as part of the natural processes, which may also be used to help dissipating the sea's energy (example: salt marshes).

In areas having a high population density coastlines are most commonly defended and typically two forms of approaches may be adopted; hard or soft engineered defences. Hard engineered solutions cover for example sea walls, groynes and rock armour; while soft engineering may cover beach nourishment, replenishment and managed coastal realignment [16].

A range of developed coastal defence typologies may then be deployed according to factors such as; the sectional profile of the coast/sea front, the character and level of coastal exposure, alignment and configuration of the coast, the angle of wave energy and the strength and direction of longshore drift. Additionally the anticipated extent of climate change induced rises in sea level, the base evaluation data and the designed scenarios, the risk factors applied to tidal, surge and overtopping episodes; the cost of interventions, along with social, cultural and environmental factors and impacts for the specific location, may then be evaluated.

Notably the sectional profile significantly affects how rapidly wave energy and overtopping maybe deflected or dissipated on impact; with a more vertiginous and severe hard engineered coastal perimeter taking greater energy impacting on its smaller surface area.

In the UK the risk factors adopted are typically established to withstand a 1:200 year flood event. This may be lower than the Netherlands for example, where designs might provide for above a 1:4000 year event, and are therefore more robust and offer greater long term resilience and sustainability[17].

RESEARCH OBJECTIVES, METHOD AND ANALYSIS

Objectives

A unique research proposal was instigated to further interrogate the issues along the Portsmouth Southsea frontage (Figure 6). Key objectives included exploring, unencumbered, options to enhance the potential for more creative and better quality design solutions and guidance, and developing this through collaborative practice engaging expertise across the disciplines of architecture, landscape architecture and coastal engineering.

Figure 6. Site, outlined in yellow, designated for the Portsmouth Elephant Cage

The intentions were also to develop wider professional knowledge and practices in the field of coastal management design, along with their dissemination and seek to influence commissioning authorities and stakeholders, in urban coastal areas most at risk, by developing contributions to effectiveness and efficiency that inform better design quality and value in future outputs.

Process, procedures, organisation and implementation.

As both countries share a high exposure to risks from rising sea levels, an Anglo-Dutch international collaborative framework was instigated to advance the programme, through the agencies of an architectural procurement intelligence service, Project Compass CIC with Dutch collaborators Architectuur Lokaal, an Architecture Foundation. A purpose being to 'highlight the many advantages and flexibilities some alternative approaches to procurement can offer to increase understanding of the potential'[18]. The Dutch 'Stimulerings Fonds Creative Industrie' provided funding enabling its implementation.

To elicit wide ranging options, collaborative cross-disciplinary design research, expertise from suitable design professionals and mentors, a unique innovative process was developed and structured, aligned with recommendations for collaborative 'parallel commissioning' within Project Compass's Design Contest Guidance[19], and to Architectuur Lokaal's experiences of four previous Elephant Cage competitive exercises. The name encompasses varied procedures for collaborative design practice, having a competitive selection stage, which puts 'big young beasts together with mentors'. Inspired by the writings of the Architectural critic Geert Bekaert[20] it has similarities with a design charrette but access is open and a collaborative inter-generational and inter-disciplinary co-creation process is engaged. The process, programme and participatory composition was then uniquely constructed for the research enquiry remit.

In September 2016 open competitive calls for Anglo-Dutch participants (of forty years of age or under) were issued with a Competition Brief, Project Brief and terms and conditions. Following their submission deadline UK participants were selected by an architectural jury*(b)* and notified on 3 November 2016.

Over 23th - 25th November 2016, the Elephant Cage then brought together seventeen young Dutch and British experts in Architecture, Landscape, Engineering and Planning in Portsmouth to work together on this design research collaboration supported by Masters students from Portsmouth School

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[b] Russell Curtis (RCKa architects), Sasha Bhavan (Knox Bhavan Architects), Merlin Fulcher (The Architects Journal) and Walter Menteth (Project Compass)

of Architecture. Mentoring was provided by seven experts from the various design disciplines and hosted in the Portsmouth School of Architecture.
For full analysis a site visit, provision of the outline design drawings along with seven seminar presentations delivered by the internationally eminent mentors and organisers*(c)*, further briefing*(d)* and models of the current proposals, prepared specially and emphasising some impacts at human scale were provided. Participants were formed into three professionally balanced teams and over two and a half days, prepared three design strategies that responded to the climate change and coastal defence brief; exploring propositions for both local and global application. The teams were encouraged to consider divergent theoretical design viewpoints based on their synergies.
This first stage of the Elephant Cage concluded with a public presentation and debate of the three proposed schemes, at which key stakeholders and the public were present.

Analysis

The analysis contributed a valuable context for the design research and the following critiques were raised.

Figure 5. 1:1 scale model (with inset sections) of existing ESCP proposals showing the height of the proposed sea defences in 5 locations indicating the impact on existing landside views and access towards the sea along the Portsmouth Southsea frontage. (© Russell Gould & Walter Menteth)

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[c] Martin Knuijt (Director OKRA, Landscape Architects), Matthijs Bouw (Director One Architecture), Nick Clarke (Director Ramboll), Sophie Thompson (Director LDA, Landscape Architects), Julia Barfield (Director Marks Barfield Architects), Indira van t'Klooster (Architectuur Lokaal) and Walter Menteth with Anna Berkman. Frank de Graaf and Alexander Lee (Royal Haskoning DHV) provided additional mentoring

[d] Including a presentation covering the public authorities existing engineering led proposal, by Zane Gunton (Eastern Solent Coastal Partnership) the participating representative of the commissioner's

The separation of the promenade, beach and sea from Southsea common and the city to the north were considered detrimental. In most parts a wall, with limited access over it, would be apparent from the landside severing the city from connecting fluidly with the coast. This wall was found to rise up to a height of 3.8m, was not well integrated to the landscape character or urban context on its landside and blocked views of the sea (Figure 5).

Various implications arise from the extensive use of concrete hard-wall engineering solutions. As opposed to alternative coastal defence typologies concrete constructions using terraced sea walls, may incur higher CO2 emissions and whole life costs, whilst delivering a coastal frontage that can be less hospitable and poorly accessible for all, especially children and the elderly. To maintain them they can require extensive water jet and biocide cleaning.

Small listed structures such as wind shelters, seats and monuments despite their relative ease of re-location were being treated as fixed edifices establishing immovable points of reference in the proposed plans. Similarly roads running parallel and immediately adjacent to the coast line and serving the beach were impacting the available sea defence options because it appeared they were also being addressed as unchangeable elements.

Rather than giving consideration to any more nuanced contextual approaches including coastal realignment, the ESCP design was pre-determined by an early policy decision to ‘hold the line’, which notably was impacting the strategic designs, the sustainability and whole life cycle costing.

The outline proposals were prepared within strict Governments budgetary constraints, with little extension of the scope of works through leverage, and had advanced to HM Treasury Green Book stage two (The Outline Business case). In part these funding limitations, the remit, its outputs and programme could also be seen to have had an impact.

Southsea common is 0.5km wide between the sea front and the city and is a unique area of largely open land which when considered conjunctively with the sea defences appeared to offer further and better opportunities.

Given the extensive investment to be committed there appeared opportunity and capacity for leveraging more enhancement from the proposals including the potential for improving the waterfront environment, amenity and promenade by better integrating landside architectural and landscape projects with the proposed engineering requirements.

INITIAL OUTPUTS

In responding to the programme the three teams entitled 'Awake, Asleep and Dreaming', 'The New Common' and 'Dancing Coastline' prepared their outputs which reflected their distinct approaches. Their detailed presentations are as described in summary below[21].

'Awake, Asleep and Dreaming'

Rather than having a single line of defence, three separate lines of defence are proposed, referred to as Awake, asleep & dreaming, and reflecting their degree of active protection. Unique scenarios develop in adaptive relationships in the interplay and spaces between these three lines of defence as their relative positions vary along the coast (Figure 7).

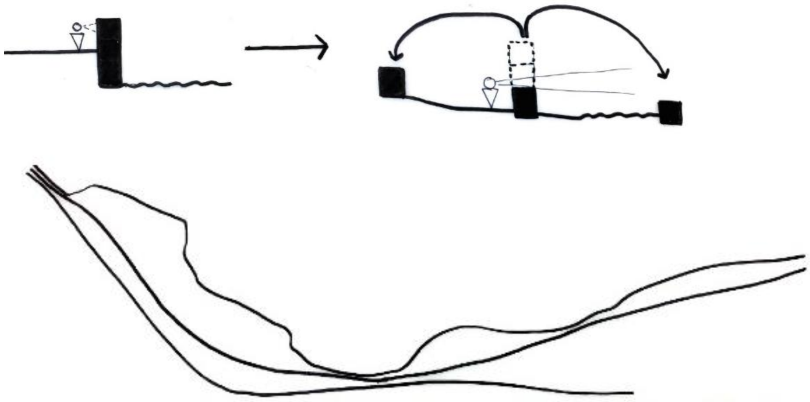

Figure 7. Awake, asleep and dreaming. Schematic section (top) and plan (below).

The asleep line comprises the outer most defence line, locating off shore elements in the form of reefs and barriers designed to absorb and dissipate the most severe wave energy. Over time this is sustained by natural processes of deposition, strengthening and enlargement (Figure 8).

Figure 8. The outer defences, the 'asleep' line.

The second 'awake' line of defence comprises interventions creating inhabited barriers and functional infrastructure sustaining economic activity on the sea front; which might for example include beach huts, lidos, kiosks, stadia seating on levees, water capture cisterns and tunnels.

The third defence line 'dreaming' proposes linear landscaped berms and levees as the final defence line so that this may enhance wider social and community activity; which might for example include performance bowls, skate board parks and undulations providing amenity landscape offering increased environmental value.

'The New Common'

In their sea front character assessment and analysis of the coastal conditions this team identified three varied conditions along the frontage and responded with three strategic approaches one for each of the identified conditions (Figure 9).

At Southsea common it was proposed to raise the common upwards to create an undulating naturalised coastal landscape; creating opportunity to re-profile the coast so that a usable beach front would, once again, be achieved. Easy access to the beach is provided over a re-landscaped common now located at a higher level; with additional amenity both above and below it and potentially rich environmental benefits. The space beneath this 'new common' offered opportunity for a wide range of black box activities, conference centres, cinema, leisure, service circulation and parking functions delivering economic sustainability and contributing towards the city's regeneration. The successful scheme at Katwijk in the Netherlands recently completed by OKRA Landscape architects, provided a reference for this design, landscape and economic modelling (Figure 10). This new defence line then continued with a hard engineered levy around Southsea Castle.

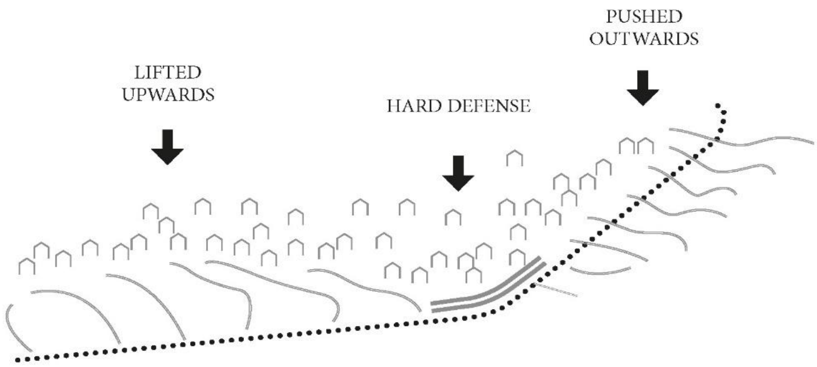

Figure 9. The whole common is lifted, the Southsea castle area reinforced and the Eastney beach widened towards the sea

To suitably enhance the existing Eastney beach to the east, beach replenishment and enlargement was

Figure 10. Lifting Southsea Common creates a new landscape & regenerated beach front whilst providing many new opportunities for commercial development & social use located in the space beneath.

proposed, extending the shoreline outwards. Shingle dredge excavated to keep the existing ports mouth navigation channel clear for shipping was found suitable; but this is currently transported overland for beach replenishment to the UK east coast (at great expense and environmental costs). In the ESCP designs rock armour was proposed, for example for new groynes, and this was to be quarried and imported from Norway. This replenishment strategy, while significantly contributing towards defence and sustaining the potential ecological, social amenity and economic benefits, might also develop a more efficient circular economy.

'Dancing Coastline'

This team perceived it to be crucial to develop realistic expectations from coastal management over the long term in response to the inevitability of change. Their proposition for appropriate and incremental interventions, postulated a dynamic 'dancing' coastline which would change over time, requiring delivery of salient 'precision work', utilising multiple modes and approaches, involving stakeholders and engaging with both defend and retreat strategies.

A landscape scenario for a 100 years hence was proposed, embodying for example the identification of protected and higher ground, based on enhancing the uniqueness of places and character over the projected timescale along with the principles of re-flooding (Figure 11).

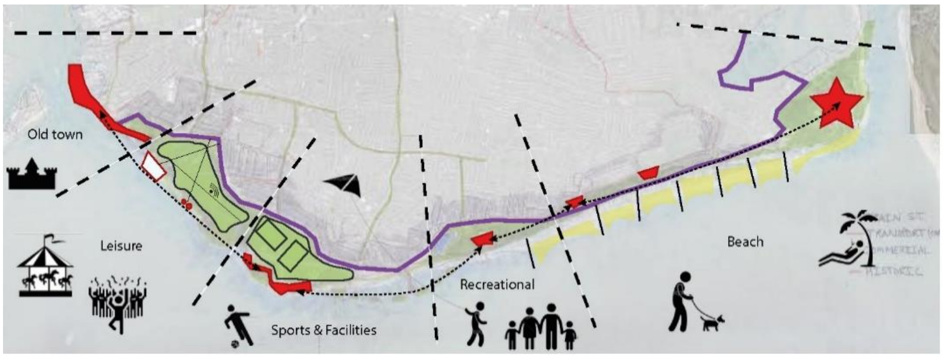

Figure 11. Schematic frontage plan. With precision works identified areas having unique characteristics change to enhances their unique features

In proposing that land could be lost to the sea, whether over 100 years or during particular storm events, it was considered that public education, expectations and landscape management might be better unlocked; on the premise that a defence strategy demarking a singular line of public safety offered reduced flexibility, and that greater benefit might derive from some permanent or temporary loss of land. Those areas would then over time contribute more effectively to mitigating storm and surge energy. It was considered that two such proposals that might deliver more appropriate and effective solutions were allowing flooding into Canoe Lake and also parts of Southsea common. These illustrated how circulation and amenity might then be addressed across the public realm in this retreat strategy (Figure 12).

Figure 12. View of Southsea common year 2117, in an extreme scenario

Interim findings

This research has identified initial sea defence design and policy parameters having potential application both for guiding wider city coastal resilience and sustainability globally, whilst informing improvement in Portsmouth. From the first stage the following summarises some parameters for coastal design strategies in urbanised locations that lead beyond simple hydrological and engineering led solutions.

Strategic design parameters for coastal strategies

Instigating more contextually specific investigations by wide ranging early inter-disciplinary collaborative practice to reframe progressive discourse can permit conceptual innovation and co-creation that better informs sustainable design, practice and implementation.

The character and context of the sea should be well understood and evaluated from all available data and projections. For example this should include wave energy, predicted sea level changes, longshore drift, surge probabilities, sediment availability, coastal dynamics, alignments and processes, ecology, maritime traffic, geology and movements, seasons, temperature and salinity, and anticipate the long term energies and changes impacting coastal locations. Hinterland analysis of the wider landside character and topography, and its environmental, social and economic context is necessary to fully optimise coastal response strategies allowing interventions to be better tailored to their context (not simply along a narrow sea front margin). In dense urban areas particularly it must be recognised that waterfronts provide multiple social benefits for all ages for example for amenity, health, well-being and leisure, sustaining considerable economic benefits. These should be valued both qualitatively and quantitatively.

CO2 emissions are evidentially impacting sea levels rises and should be given greater consideration in coastal design strategies. CO2 production, mitigation, and whole life embodied energy should be particular considerations when designing coastal defence structures accounting for all factors

including: materials, the supply chain and ecological values. Designs creating lower CO2 emissions and having lower embodied energy should be better valued.

To ensure designs are robust in the long term when evaluating risks in urbanised areas it is advisable to allow for sufficient contingencies based on a broader range in the progressing trends of data forecasts underpinning anticipated sea level rises. Some forecasts now being applied might be considered conservative, particularly in the UK. Reviewing these upwards in areas of high population could be advisable[22].

In the management and expectations of sea level change it is possible to implement more appropriate and more incremental interventions through improved governance, education, consultation, engagement and programming for having, over time, more resilient and adaptive coastlines. Frontage margins that may permit re-profiling the coastline section or allow some partial or full future inundation, should be considered and where-ever possible sufficient margins should be allowed and/or planned. When dissipated over a wider surface area the sea's energy maybe reduced proportionally and more sustainable benefit may also derive.

Rather than adopting a single line of defence thought should be given to staggered defence lines, considering the opportunities and benefits which might accrue in the intervening spaces and/or sacrificial areas, and the possibilities that the lower heights of defence structures can offer more complimentary alternate functions. When building a reef, levee or wall fully consider what further opportunities may arise. For example can energy be productively captured and used, and what additional benefit may derive above, within or beside the element.

Raising and lowering land levels, and extending sea fronts might be considered, with more nuanced deployment of all potential attack, defend and retreat strategies in synergy. When well designed, raising land levels in dense urban areas can provide significant opportunities with areas below grade suited to 'black box' functions.

Existing environmental, social and cultural assets should be reviewed holistically over the whole life of an anticipated project, with substance given to adaptive re purposing of such assets within sea defence strategies. Adaptive repurposing of the existing foreshore topography might also be considered.

Existing infrastructure might be better reviewed with greater flexibility and consideration given to their mobility and/or relocation. Fixing coastal defence lines for the next 100 plus years on the basis of existing roads, promenades or small civic monuments clearly may not be most effective. Coastal access, circulation and its porosity should therefore be considered and reviewed holistically. For example vehicular circulation organised radially to the line of the coast may offer more sustainable future solutions than roadways aligned parallel and in close proximity to the coast, because radial routes can then be foreshortened.

Coastal pedestrian, bicycle and service routes need not be conjunctive or adjacent, and segregation may benefit landscape, ecological, environmental, health and safety concerns. Access to the waterfront should seek to offer maximum landside connectivity with safe, unencumbered and step free access for all ages, wherever possible. However where safe alternative routes can also be provided during times of inundation coastal promenades do not always need to be above high water level. This might be considered similar for example to the way people can choose to freely walk anywhere on a beach.

Proposed coastal strategies should be economically modelled over their whole life cycle and where investment is more widely integrated in a sustainably contextual long term spatial design strategy, sea defences infrastructure may deliver broader benefits. With public investment better value resolutions may be sustained where there is opportunity for levering forward additional private funds. For example when building a wall, levee or reef - for providing additional benefit make it attractive for forward investment.

CONCLUSION

The Portsmouth Elephant Cage scope, process, programme, design briefing and seminars significantly contributed to enhancing knowledge exchange, skills transfer, the development of cross disciplinary professional expertise and co-creation. The collaborating professionals, mentoring and support by masters students, brought forward a wide range of creative propositions providing valuable new insights having global and local relevance, with the international engagement expected to extend capacity and the reach of the programmes outputs.

The first stage outputs having been reviewed and continue to be disseminated alongside the web resource that has been developed, to inform better design practice elsewhere[23]. These may also contribute to enhancing the opportunities for a strategic design vision for Portsmouth's frontage.

By considering a wider conceptual field within a competitive co-creation process engaging multi-disciplinary teams and drawing upon best practice and exemplars, provided fresh and enriching insights. Through embodying innovations that better inform social, environmental and economically contextual resolution, the outputs underlined the infrastructure's potential, extended research inquiry and informs practice. By pursuing polemically different strategic propositions creatively the three alternatives have highlighted more resilient and sustainable designs principles.

The divergent but complimentary outputs generated at the Elephant Cage, while offering hypothetical shifts, can be seen as having a wider strategic relevance extending beyond application to a specific context. Yet the individual lack of specificity was a contextually pragmatic weakness. With the participants having more time and immersion to consolidate their outputs a more direct Portsmouth specific practical applications might have been delivered on programme completion.

Comparative studies of two different recent coastal management scheme designs at Katwijk and Schreveningen (NL) and blue-green strategies within Rotterdam along with further seminars delivered by local experts and stakeholders were undertaken in the second programmed stage. The stagings might have been better reversed but for functional necessities. Finally the process and outputs were further appraised against real and theoretical situations and feedback[24].

Nonetheless key principles derived from The Elephant Cage's strategic outputs have subsequently informed an alternative more detailed sea defence alternative design proposition on Portsmouth's Southsea front, radically different to that of ESCP. Launched in June 2017, this was publically presented and exhibition in July 2017 at the Portsmouth Grassroots Festival and is reported separately[25]. After publication interest from the community, the public authorities and their representatives, in response, had generated a paradigm shift in the perception of opportunities and benefits that may be derived from Portsmouth's sea defences[26]. To inform Portsmouth's design practices it would also clearly have been better for the clients to have resourced and have had

implement this Elephant Cage process of 'parallel commissioning' at commencement of their own design investigations.

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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally

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SIMULATION ON THE ENVIRONMENTAL PERFORMANCE OF TRADITIONAL & CONTEMPORARY DWELLINGS IN GHADAMES, LIBYA

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BACKGROUND

The study of traditional and contemporary settlements may have been addressed in a number of publications worldwide whilst still not widely reflected in a Libyan context (Chojnacki, 2003). These topics usually were discussed in narrow sections or carried out by individuals who so often enchanted by and interested in to document the beauty of old solutions. Discussing the discord between old and new solutions needs deeper understanding of their form, elements, functions and the role of context considering the social customs and microclimatic conditions. In Cairo where simple and inexpensive design strategies were used in residential buildings such as vaulted and domed roofs showed 32% less in cooling loads than using conventional flat roofs (Dabaieh et al., 2015). The simulation carried in Dabaieh et al. (2015) study also showed 53% reduction in cooling hours when vaulted roof coated with high albedo ratio and rim angle of 70 is used. Similarly, in the Middle East the climatic features of the courtyard house was investigated by Bekleyen and Dalk (2012) to understand the seasonal movement of residents to better achieve indoor comfort conditions. It can be said that sun-path plays a key role in defining space functionality and other related architectural aspects in traditional architecture. The contemporary movement of sustainable development seems to rather concern with low energy buildings in which so often associated with cost whilst less attention paid to the environmental performance of those buildings (Taylor et al., 2009).

Energy resources and environmental pollution are the main challenges of new constructions as the first accounts for 45% worldwide and 30% for gas emissions in buildings alone (Zhai and Previtali, 2010). 36.18% of primary energy in Libya is consumed in domestic buildings whilst 75.36% of this energy is used for space cooling mainly in summer (GECOL, 2012). Thus, buildings produce more CO_2, generate more pollution, consume more energy and waste more natural resources than any other industrialized sector (Sozer, 2010). However, these global figures encourage this research to investigate the issues related to the building form, energy use and the possibility to apply passive means to reduce or to generate energy from alternative sustainable sources. Computer simulation programs became important tools for evaluating not only energy performance of existing and newly building designs but rather assessing the whole process of the design, operating system and lifecycle maintenance of the building. According to Fasi and Budaiwi (2015) there are many building programme softwares (BPS) used worldwide to simulate the energy and thermal performance of a building including EnergyPlus. The EnergyPlus engine tool which was developed by the American Department of Energy helped DesignBuilder to pass three major tests (the analytical, comparative and executable tests) to comply with today’s industry needs (Dabaieh et al., 2015). This article discusses the environmental performance of both traditional and contemporary dwellings of Ghadames through the use of simulation program that would enable the researcher to virtually understand issues related to thermal comfort and building behavior in such context.

RESEARCH METHODOLOGY

The study carried out methods of field surveys including temperature records and observations of both traditional and contemporary built environment of Ghadames as well as evaluating householders’

behavior and building design preference. In addition, simulation was carried out to assess the building compliance with minimum acceptable indoor conditions for human comfort and equally energy required to condition the space to that minimum requirements. Typical traditional and contemporary houses were selected in order to compare the environmental performance of each type.

GEOGRAPHICAL AND CLIMATE FEATURES

Ghadames town is located in the north east of the Sahara Desert. The town was built over 400 years ago on an Oasis that lies approximately 630 km to the south-west of Tripoli close to the junction between Libya, Tunisia and Algeria (Chojnacki, 2003). The climate is characterized with high temperature records, high and dense solar radiation, low relative humidity rates and zero rainfall in summer whilst relatively cold winters especially at night. In addition, the daily diurnal temperature is high particularly in summer time and the sky condition is sunny and clear almost throughout the year.

TYPICAL MODEL OF TRADITIONAL HOUSE

Ghadames consists of two types of settlements, one representing the traditional type of architecture found in the old town, and the second is modern urban settlements expressing the contemporary architectural forms in the new town. Dan Amazagra is the name of the traditional house was surveyed during field visit to Ghadames city. The house consists of three storeys with one storage room on ground floor, three bedrooms and one central living room, the toilet on the first floor and kitchen and loggia on the roof level. However, this typical traditional house is compact in form and has similar spatial organization arranged in a vertical layout as most of houses in the old town of Ghadames Figure 1). Also these houses are oriented towards the covered alleyways as main entrance and having roofs attached to each other offering a pathway for women to move from building to another.

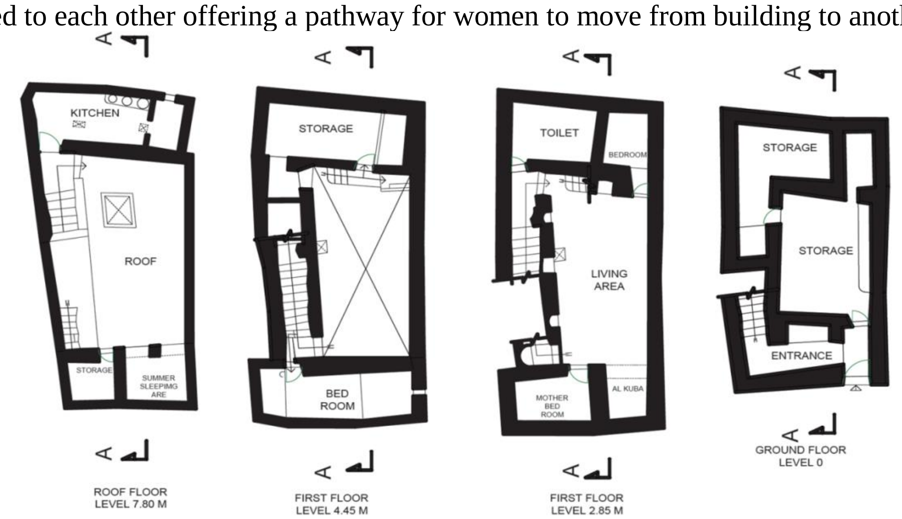


Figure 1. Plans of typical traditional house

Construction materials

Building material is one of the key aspects that define the desert architecture which is so often called adobe architecture in literature. The selection of specific materials and methods of construction was less of a choice by inhabitant and rather was influenced by many factors. Among these factors is the ecological land cover especially the abiotic elements such as soil, climate and other geological conditions. Equally important, the economic structure of society and inherited experience and knowledge of construction methods and techniques have an impact on the way local dwellings were built. Technically, walls are made out of sun-dried mud bricks with approximate digestions of 12×40×(75, 60, 50)cm as the thickness of the wall varies starting at 75cm on ground level to change at height of 3m to 60cm and then to 50cm at height of 5 to 6 m (Al-Zubaidi 2002 and Allafi 2012). According

to Gabril (2014) the roof materials of the traditional house indicated high thermal performance with a heat transfer value of 0.402 W/m^{2}k as shown in Table 1. Al-Zubaidi (2002) stated that rocks and mud are the most common building materials in the old town of Ghadames due to the nature of the desert land.

Table 1. Roof construction materials of traditional house

Ext	Material description	Thickness	Conductivity	Density	Specific heat
1	Sand stone mixture	150	1.83	2200	712
2	Palm tree leaves (mat)	30	0.083	1800	180
3	Palm tree wood	150	0.08	600	2000
In	U-value		0.402 W/ m^2.K		

TYPICAL MODEL OF CONTEMPORARY HOUSE

The model shown in Figure 2 is a typical two storey house in Tukash neighborhood located in the new part of Ghadames city. It represents one of the first housing project schemes launched in early 1980s by Libyan government in Ghadames consisted of over 600 housing units designed by Polish architects Mika Ratshiva and Andrzej Zukowaski and constructed by Turkish company (Ben-Swessi1993). The house consists of one living room, kitchen, two bathrooms and three bedrooms.

Figure 2. Plans of typical contemporary house

Construction materials

It can be said that construction materials used in contemporary houses in Ghadames are the same as those used in other Libyan cities characterized with the use of cement, concrete, tiles and ceramic in light weight constructions with high heat transfer values (U-value). Building walls in Ghadames are constructed from concrete cavity blocks and can be found in different thickness and size ranges from 150-250mm with conductivity 0.55-1.2W/m deg. ˚C, Density 1800-2240 Kg/m^3 and specific heat capacity 650- 880 J (Kg deg. ˚C) as shown in Table 2.

Table 2. Wall construction materials of contemporary house

Ext	Material description	Thickness mm	Conductivity W/m	Density	Resistance
1	Cement & sand light	12	1.0	1000	0.012
2	Concrete cavity block	200	0.7	1900	0.357
3	Cement & sand light	12	1.0	1000	0.012
In	U-value	**2.083 W/ m²K**			

According to Gabril (2014) the U-value of walls in Ghadames dwellings were found to be slightly higher than what have been found in this study at 2.648 W/m^{2}K whereas roof U-value was at 2.016 W/m^{2}K due to using insulation materials as she claimed. These input data were carefully studied as it has great impact on the simulation outcomes. Table 3 shows the contemporary roof construction materials and its thermal properties.

Table 3. Roof construction materials of contemporary house

Ext	Material description	Thickness mm	Conductivity W/m	Density	Resistance
1	Floor tiles	10	0.8	550	0.013
2	Cement mortar	20	0.94	2000	0.021
4	Concrete slab	200	0.57	2200	0.175
6	Cement mortar	20	0.88	2100	0.015
In	U-value	**2.791 W/ m2K**			

SIMULATION AND FINDINGS

EnergyPlus alongside with some other tools such as Radiance and SBEM were chosen to carry out a thermodynamic and energy simulation for existing typical traditional and modern houses to compare their energy and environmental performance. The tools are integrated in an interface program (DB) provides one of the greatest confidence in results and capable to test the annual cooling/heating loads and various control strategies with the ability of assessing overheating risk in buildings (BRE, 2009).

Analysis of traditional house

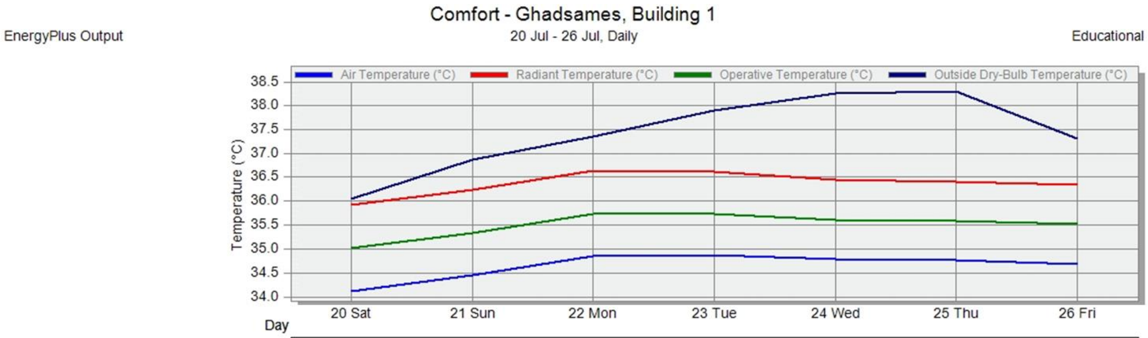
The model was simulated based on the following building information input data shown in Table 4. The window-to-floor ratio (WFR) has been calculated for this typical house and found to be 0.018 whilst the window-to-wall ratio was approximately 2.6% which is far less than the recommended ratio for hot climate buildings by for example Mandilawi (2012) which is 15%.

Table 4. Traditional house base input data

Category	Input data
Climate	Desert Climate
Building orientation	0-0
Constructional materials	Traditional building materials
Building height	9.7m
Total ground floor area	24.142 m^2
Total first floor area	31.95 m^2
Total mezzanine floor area	11.55 m^2
Total roof area	29.86 m^2
Glazed area	0.0 m^2
Surface-to-volume ratio	43.82/234.79 = 0.186
Occupancy density (people/area)	8/67.84 = 0.118 p/ m^2
Building systems	Natural ventilation

Indoor thermal conditions

Simulation was run during a typical summer week in July, and also for the whole year to compare results with actual temperature readings. Figure 3 demonstrates that air temperature (T_a) estimated around 34.5˚C throughout typical summer week due to high radiant temperature and low humidity rates. The figure also shows that PMV model predicted the indoor comfort conditions to be out of the recommended zone.



	20 Sat	21 Sun	22 Mon	23 Tue	24 Wed	25 Thu	26 Fri
Air Temperature (°C)	34.14	34.46	34.85	34.87	34.80	34.78	34.70
Radiant Temperature (°C)	35.92	36.24	36.63	36.61	36.44	36.40	36.34
Operative Temperature (°C)	35.03	35.35	35.74	35.74	35.62	35.59	35.52
Outside Dry-Bulb Temperature (°C)	36.05	36.86	37.34	37.89	38.24	38.28	37.31
Relative Humidity (%)	8.14	10.02	10.39	8.01	10.67	15.47	19.24
Fanger PMV ()	2.85	2.99	3.13	3.09	3.08	3.14	3.16

Figure 3. Indoor thermal conditions in typical traditional house

In fact, field surveys carried out inside this house found that residents were comfortable at high temperature records (29˚C to 32˚C). Noticeably, the microclimate of the old town has great effect on mitigating indoor and outdoor conditions due to the green belt surrounding the town as well as the water source and streams passing through the urban settlements.

Heat gains and total energy consumption

Internal and external heat gains highly associated with the energy consumed inside buildings especially in extreme climate conditions. In Ghadames solar radiation is relatively high and old town settlements are built to receive as less solar direct heat gains as possible where buildings stand wall to wall by all sides as can be seen in Figure 4. The figure also shows that lighting is the main consumer inside the house and water pumps were installed later as part of the house modification to meet locals' needs. The total annual energy use inside the traditional house estimated at 28.87kWh/m^2. According to Noguera and Cervera (2012) PassiveHaus specified that the annual total energy demand for space requirements should be limited to 20-30kWh/m^2.

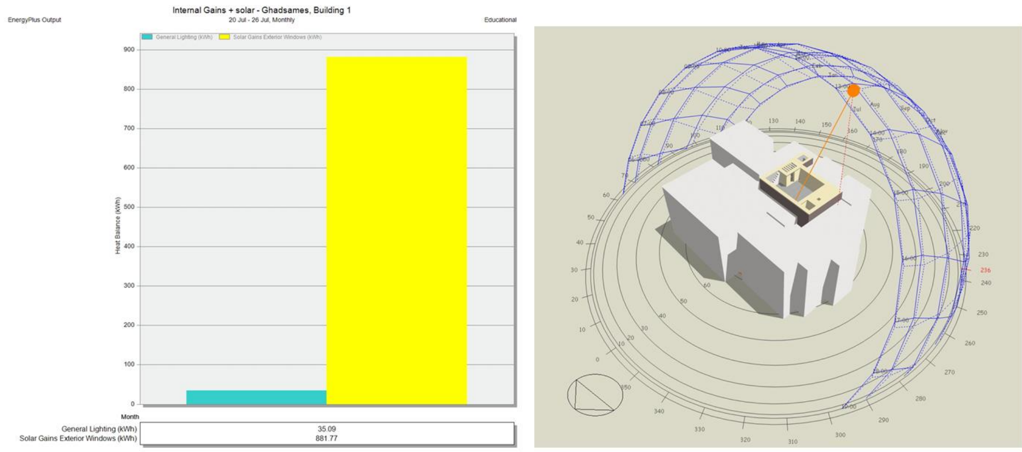


Figure 4. Total energy consumption and solar heat gains in typical traditional house

Daylighting

Radiance has been considered as one of the best tools to test the sufficiency of daylighting which is integrated into CIBSE and LEED calculations. in practice daylight factor of 2% to 5% showed to have great balance between achieving good daylighting and thermal aspects (CSH, 2010). BREEAM Credit HEA1 aims to encourage and recognize designs that provide appropriate levels of daylight for building users.

A pass requires that both the following conditions are met:

- At least 80% of net lettable floor area in occupied spaces is adequately day-lit, having an average daylight factor of at least 2% at the working plane height of 0.7m under a uniform CIE overcast design sky;
- A uniformity ratio of at least 0.4 or a minimum point daylight factor of 0.8% (spaces with glazed roofs, such as atria, must achieve a uniformity ratio of at least 0.7 or a minimum point daylight factor of at least 1.4%).

Results indicated no compliance with minimum standards set in BREEAM calculations and the house fails to be adequately lit naturally. However, by looking at the most used space inside the house (the central hall) results indicate that an average daylight factor of 3.21% has been achieved despite the poor daylighting distribution as shown in Table 5.

Table 5. Daylighting performance in typical traditional house

Summary Results	
Total area (m2)	67.010
Total area above threshold (m2)	15.190
% Area above illuminance threshold	14.52
Criterion a) 80% of area adequately day-lit	FAIL
Criterion b) Uniformity ratio >= 0.4, min DF = 0.8%	FAIL
BREEAM Health and Wellbeing Credit HEA1 Status	FAIL

Zone	Block	Floor area	Min DF (%)	Uniformity ratio	Area adequately	Average
Toilet	first floor	6.320	0.00	0.00	1.82	1.6
Living-	first floor	17.68	0.00	0.00	5.67	3.21
Cesspit	ground	4.75	0.00	0.00	0.00	0.0
Total		**28.750**				

Analysis of contemporary house

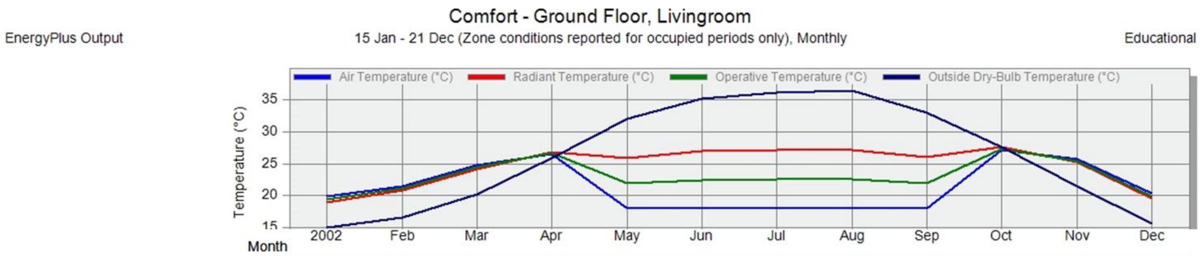
The main input data for the simulation is based on the model information which is shown in Table 6.

Table 6. Contemporary house base input data

Category	Input data
Climate	Desert Climate
Building orientation	0-North
Constructional materials	Contemporary building materials
Building height	6 m
Total floor area	108.290 m2
Total roof area	61.40 m2
Glazed area	16.520 m2
Surface-to-volume ratio	260.8/333.9 = 0.781
Occupancy density (people/area)	4/108.29 = 0.037 p/ m2
Building systems	Air conditioning systems (HVAC)

Indoor thermal conditions

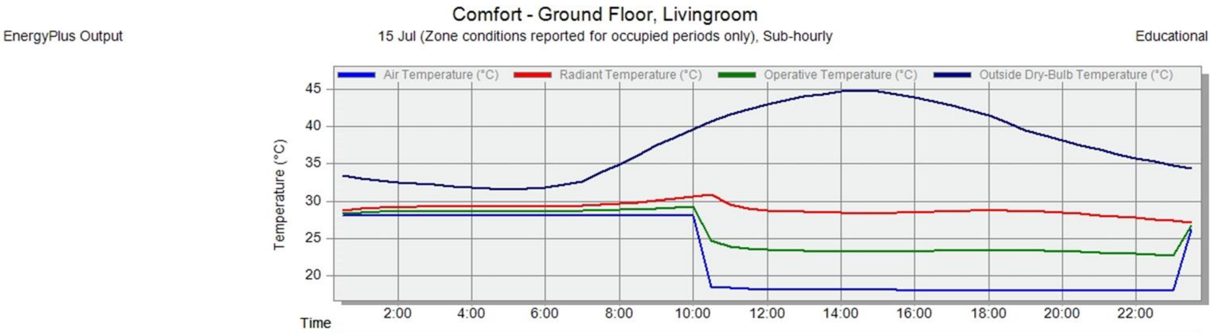
Surveys indicated that contemporary dwellings in Ghadames use mechanical cooling and heating systems to achieve indoor comfort conditions. Householders and professionals confirmed that AC is used around April to October every year. Figure 5 explains why householders start using AC at that time of the year as the average outdoor air temperature started to rise above 25˚C in April and drops back to similar degree around October. The system clearly achieved comfort conditions as operative temperature is maintained within the comfort zone between 19˚C to 27˚C.



	2002	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Air Temperature (°C)	19.88	21.55	24.74	26.62	18.00	18.01	18.00	18.00	18.00	27.16	25.70	20.36
Radiant Temperature (°C)	19.04	20.81	24.13	26.83	25.94	26.95	27.11	27.15	26.03	27.64	25.21	19.56
Operative Temperature (°C)	19.46	21.18	24.44	26.72	21.97	22.48	22.56	22.57	22.01	27.40	25.46	19.96
Outside Dry-Bulb Temperature (°C)	15.07	16.67	20.28	25.86	32.05	35.24	36.21	36.44	33.05	27.59	21.57	15.71
Relative Humidity (%)	27.69	26.04	24.07	23.04	38.09	36.91	27.58	35.18	41.90	22.52	20.24	37.03
Discomfort hrs (all clothing) (hrs)	98.25	98.00	27.00	83.50	9.75	4.75	0.00	0.00	0.75	112.00	20.50	96.50
Fanger PMV ()	-1.54	-1.06	-0.15	-0.36	-2.22	-2.04	-2.07	-2.02	-2.19	0.64	0.11	-1.33

Figure 5. Indoor thermal conditions in contemporary house in annual base

These findings relatively agree with field temperature measurements where indoor air temperature was recorded between 24˚C to 26.5˚C inside the contemporary houses. On a daily base the majority of householders during field surveys and investigations stated that AC is switched on at around 10:00 am to 23:00pm for approximately 12 to 14 hours a day in summer. Outside temperature drops down late evening until early morning as the Figure 6 shows. This reveals that those occupants started using AC at the right time when indoor radiant temperature begin to rise until clearly outdoor temperature begin to have downtrend course.

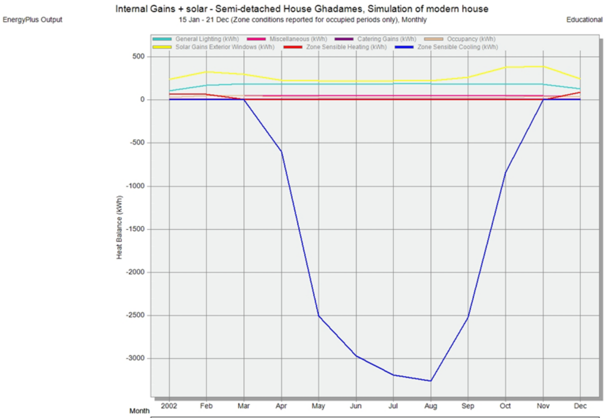


Time	2:00	4:00	6:00	8:00	10:00	12:00	14:00	16:00	18:00	20:00	22:00
Air Temperature (°C)	28.00	28.00	28.00	28.00	28.00	18.15	18.04	18.01	18.00	18.00	18.00
Radiant Temperature (°C)	29.19	29.26	29.24	29.65	30.59	28.79	28.39	28.46	28.73	28.44	27.74
Operative Temperature (°C)	28.59	28.63	28.62	28.83	29.29	23.47	23.22	23.24	23.37	23.22	22.87
Outside Dry-Bulb Temperature (°C)	32.56	31.76	31.76	34.93	39.68	42.98	44.70	43.91	41.53	38.10	35.72
Relative Humidity (%)	18.29	18.26	18.25	18.25	18.24	33.12	33.35	33.41	33.46	33.56	33.66
Mech Vent + Nat Vent + Infiltration (ac/h)	0.69	0.69	0.69	0.68	0.67	0.65	0.64	0.64	0.65	0.65	0.66

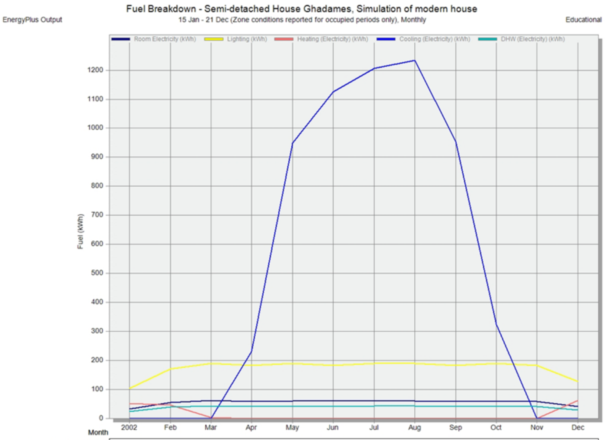
Figure 6. Indoor thermal conditions in typical contemporary house in daily base

Heat gains and total energy consumption

In regions where cooling is in high demand the design for minimum internal heat gains is a key of importance for efficient energy building designs. Figure 7 reveals that solar heat gains is less during summer as the sun-angle being higher on vertical surfaces and lower in winter which increases the internal heat gains. Simulation results also showed that space cooling brings the highest energy bills to the house at an annual rate of 9201.57kWh/108m2 = 85.19kWh/m2. According to Carmody et al. (2009) the total energy usage in a residential building should not exceed 20-30kWh/ m2 per year in total primary energy for space cooling base on European Standards.



Month	2002	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
General Lighting (kWh)	103.44	170.28	188.45	182.48	188.58	182.35	188.58	188.94	182.00	188.58	182.84	127.71
Miscellaneous (kWh)	27.49	45.72	50.99	48.81	50.35	49.45	50.35	50.67	49.13	50.35	49.13	34.29
Catering Gains (kWh)	5.29	8.72	9.65	9.34	9.65	9.34	9.65	9.65	9.34	9.65	9.34	6.54
Occupancy (kWh)	29.70	47.32	45.84	33.63	28.50	22.63	22.73	22.01	24.57	28.43	39.48	36.51
Solar Gains Exterior Windows (kWh)	241.21	327.72	295.16	229.73	222.20	213.21	219.79	224.31	264.80	376.28	390.23	246.52
Zone Sensible Heating (kWh)	70.32	62.54	5.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	86.72
Zone Sensible Cooling (kWh)	0.00	0.00	0.00	-599.65	-2506.91	-2972.12	-3187.42	-3260.06	-2521.57	-842.16	0.00	0.00



Month	2002	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Room Electricity (kWh)	32.78	54.44	60.64	58.15	60.00	58.79	60.00	60.32	58.47	60.00	58.47	40.83
Lighting (kWh)	103.44	170.28	188.45	182.48	188.58	182.35	188.58	188.94	182.00	188.58	182.84	127.71
Heating (Electricity) (kWh)	51.44	45.34	3.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.48
Cooling (Electricity) (kWh)	0.00	0.00	0.00	231.43	948.97	1125.34	1206.25	1233.64	954.65	324.11	0.00	0.00
DHW (Electricity) (kWh)	23.37	38.49	42.62	41.24	42.62	41.24	42.62	42.62	41.24	42.62	41.24	28.87

Figure 7. Internal heat gains and total energy use in typical contemporary house

Daylighting

The window to wall ratio WWR in this semi-detached house is found to be 10.4%, which is far less than what is specified by BREEAM. Inside the living room average daylight factor is assumed to be at 1.9% with the use clear glass and no window blinds installed. Table 7 shows the daylighting simulation using BREEAM calculations in DesignBuilder. The overall daylight performance of the house shows no compliance with internal standards with approximately 23% of internal zones adequately lit through natural lighting. This figure indicates how poor the window design in

contemporary housings which results in a consequence impact on human visual discomfort and energy compensated by artificial lighting. Two main reasons were found during the surveys for using artificial lighting most of the day in contemporary housing; privacy and absence of solar shadings for windows.

Table 7. Daylighting performance in typical contemporary house based on BREEAM calculation

Summary Results	
Total area (m2)	108.290
Total area above threshold (m2)	24.930
% Area above illuminance threshold	23.0
Criterion a) 80% of area adequately day-lit	FAIL
Criterion b) Uniformity ratio >= 0.4, min DF = 0.8%	FAIL
BREEAM Health and Wellbeing Credit HEA1 Status	FAIL

CONCLUSION

This research introduced the simulation analysis of the two models representing typical traditional and modern housing of Ghadames. EnergyPlus has been chosen in this study due to its flexibility, accuracy and capability of using high performance engine tools. This analysis process is to compare the old and new settlements' energy and environmental performance and also to infer the positive aspects of both dwellings in terms of achieving comfort design conditions. However, results showed that neither traditional nor modern dwellings have achieved comfortable indoor conditions according to ASHRAE and CIBSE standards in terms of thermal and visual comfort and indoor housing conditions requirements.

To conclude there is a need to develop the existing housing designs to meet local community aspiration and respond to local climate. This can be only achieved by considering the local conditions in design, construction and operation phases meaning that right material, layout design, passive climatic strategies should be considered and utilizing the right technology for environmentally and energy efficient housing. The design of future housing in Ghadames and hot arid regions in general requires great attention as existing models are highly dependent on mechanical systems and nonlocal building styles that noticeably reflect foreign culture and way of life.

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MODERNIST ARCHITECTURE AND ITS IMPLICATION ON ENERGY CONSUMPTION IN PUBLIC AND PRIVATE RESIDENTIAL APARTMENTS IN ACCRA, GHANA

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INTRODUCTION

According to design principles, there is a close relationship between architecture and the climate of a region. However, this design principle is becoming less relevant due globalization. Globalization has made the world more liberalized in the use of building material (Gill, 1995). It has introduced modernism and post-modernist architecture and this has led to profound changes and new technologies which are relentlessly shaping architecture's relationship with society and culture. Eldemery (2009) asserts that rapid urbanization and technological advances have resulted in standardization of built environments, depriving human habitats of cultural and regional identity and thus becoming an international malaise as the same building methods, materials and styles are applied globally.

In Ghana, the effect of globalization is evident in commercial and residential buildings. Designs from other parts of the world are replicated with less concern for the weather condition. Architectural designs are transferred from temperate climate into tropical Ghana. These changes have created a new face of contemporary architecture of glass irrespective of the prevailing environmental and climatic conditions. The obvious is that these contemporary buildings use up more energy for lighting and ventilation contrary to the climate-friendly traditional architecture.

According to the International Energy Agency (IEA), the rationale for building codes to address energy efficiency in buildings is because the building sector is the largest energy-consuming sector accounting for over one-third of final energy consumed globally (OECD/IEA, 2013). In Ghana, residential buildings consume about 47% of all electricity generated and it is estimated to be increasing by 10% to 15% per annum due to demand from growing population and the steady growth in commercial sector activities (Ministry of Energy, 2010; ISSER, 2005). The demand for electricity in 2016 was estimated to be 16,798-18,737 GWh as compared to 2015 requirement of 14,150-16,398 GWh (Energy Commission, 2016).

The IEA further suggest that it is easier and cheaper to achieve energy efficient buildings at the planning stage than after construction. Setting energy standards for new buildings are therefore among the most important single measures for achieving energy efficient buildings. However, in Ghana, the building regulation and energy policies do not explicitly spell out the standards or codes for energy consumption in residential buildings. It is recently that a new legislative instrument on Zoning Guidelines and Planning Standards (Town and Country Planning, 2011) makes reference to planning standards for electricity supply in three categories of houses in Table 1.

Table 1: Relationship of House type to Electricity Consumption per Household

	House types and Amenities	**Electricity Consumption per month (watts)/hhld**
a.	Low Income Housing	
	Lighting	480
	Power for small cookers, electric iron and radio	5,000
	Total Consumption	**5,800**
b.	Medium Income Housing	
	Lighting	800
	Power for small cookers, electric iron, refrigerator and TV and radio	8500
	Total Consumption	**9,300**
c.	High Income Housing	
	Lighting	1000
	Power for small cookers, electric iron, radio, hifi and TV, refrigerator and air conditioner Unit	14000
	Total Consumption	**15,000**

When the Akosombo Hydroelectric Power Plant in Ghana was built in 1965 the total transmission system peak was 1020 megawatts for a population of about 6 million. Now the population of Ghana is to over 25 million. Although additional power generation plants have increased Ghana's total transmission system peak to between 2,325 and 2,477 MW, increased population and corresponding development continues to exert much pressure on Ghana's energy supply. Inadequate gas and fuel supply to some of the electricity generation plants have rendered some of the power stations redundant (Energy Commission, 2016).

Between 2014 and 2016, Ghana experienced a regular 'dumsor', power cut in electricity supply. Power cuts were on daily basis and the Electricity Company of Ghana (ECG) released an emergency load shedding timetable indicating when there will be power supply and power cut in various parts of the country. The National Load Shedding Guide, published in the national newspapers, indicated the days and times when households will not have electricity supply. The general arrangement was that households will go off for 12 hours and have power stability for 48 hours. Figure 1 gives an example of the National Load Shedding Guide from 6th February to 5th March 2015.

LOAD-SHEDDING GUIDE

The Electricity Company of Ghana wishes to inform its cherished customers that due to generation shortfall it has become necessary to publish this load shedding guide.

All Communities in the bracket are on loadshedding, but all or some may not go off depending on the quantum of power to be shed.

	FRIDAY 06/02/2015	SATURDAY 07/02/2015	SUNDAY 08/02/2015	MONDAY 09/02/2015	TUESDAY 10/02/2015	WEDNESDAY 11/01/2015	THURSDAY 12/02/2015
DAY 6AM TO 7PM	B; (A)	C; (B)	A; (C)	B; (A)	C; (B)	A; (C)	B; (A)
NIGHT 6PM TO 6AM	A; (C)	B; (A)	C; (B)	A; (C)	B; (A)	C; (B)	A; (C)
	FRIDAY 13/02/2015	SATURDAY 14/02/2015	SUNDAY 15/02/2015	MONDAY 16/02/2015	TUESDAY 17/02/2015	WEDNESDAY 18/01/2015	THURSDAY 19/02/2015
DAY 6AM TO 7PM	C; (B)	A; (C)	B; (A)	C; (B)	A; (C)	B; (A)	C; (B)
NIGHT 6PM TO 6AM	B; (A)	C; (B)	A; (C)	B; (A)	C; (B)	A; (C)	B; (A)
	FRIDAY 20/02/2015	SATURDAY 21/02/2015	SUNDAY 22/02/2015	MONDAY 23/02/2015	TUESDAY 24/02/2015	WEDNESDAY 25/01/2015	THURSDAY 26/02/2015
DAY 6AM TO 7PM	A; (C)	B; (A)	C; (B)	A; (C)	B; (A)	C; (B)	A; (C)
NIGHT 6PM TO 6AM	C; (B)	A; (C)	B; (A)	C; (B)	A; (C)	B; (A)	C; (B)
	FRIDAY 27/02/2015	SATURDAY 28/02/2015	SUNDAY 01/03/2015	MONDAY 02/03/2015	TUESDAY 03/03/2015	WEDNESDAY 04/03/2015	THURSDAY 05/03/2015
DAY 6AM TO 7PM	B; (A)	C; (B)	A; (C)	B; (A)	C; (B)	A; (C)	B; (A)
NIGHT 6PM TO 6AM	A; (C)	B; (A)	C; (B)	A; (C)	B; (A)	C; (B)	A; (C)
	FRIDAY 06/03/2015						
DAY 6AM TO 7PM	C; (B)						
NIGHT 6PM TO 6AM	B; (A)						

Below is the list of Affected Areas. Customers should please identify their areas and consult the time table. Customers can also access the load shedding guide at our website: www.ecggh.com. For further enquiries, please call our Contact Centre on 0302-611611.

Figure 1: The National Load Shedding Guide indicating when ther will be electricity supply. The alphabets represent various groupings in the regions
(Source: Graphic http://www.graphic.com.gh/images/pdfs/ecg_load_shedding-table.pdf)

Another recent development in Ghana's residential housing is the use of glazed sliding windows for fenestration. This sort of fenestration reduces the volume of natural air introduced into rooms thus making natural ventilation ineffective. Hence, air conditioners are used to maintain thermal comfort in the rooms while the traditional buildings promoted passive cooling techniques by using openable jalousie, batten or louvre blades for windows. In some cases, earth or mud used for wall construction and thatch for roofing combined to create a desirable thermal comfort in rooms.
However, with the current challenges in Ghana's energy supply it is imperative to re-examine architectural designs of residential buildings since residential buildings in Ghana consume about 45% of all electricity generated. This study seeks to examine household electricity consumption levels in private-built and government-built residential apartments. The objectives are:

1. To study the design and fenestration of some private-built and government-built residential apartments in different suburbs in Accra.
2. To investigate occupants' strategy to achieve thermal comfort in the apartments.
3. To compare electricity consumption in private-built and government-built apartments.
4. To investigate resident's preferences and taste and reasons in the choice of fenestration.

ENERGY AND BUILDING POLICIES IN GHANA

There are several organisations involved in the Ghanaian electric power industry. They include,

i. The energy policy formulation and implementation institutions including Ministry of Energy, Ministry of Power, The Public Utilities Regulatory Commission (PURC), The Energy Commission,
ii. The Electricity generation, transmission and distribution utilities including The Electricity Company of Ghana (ECG), The Northern Electrification Department (NED), Northern Electricity Distribution Company (NEDCo)
iii. The Independent Power Producers (IPPs)including Volta River Authority (VRA) and Bui Power Authority (BPA)

Each of these organisations have specific roles to play in Ghana's energy sector. See ISSER (2005) for further discussion on the various roles. There have been several policies to guide the energy sector over the years. Currently, the PURC is the economic regulator while Energy Commission is the technical regulator and licensing authority with regards to energy management in Ghana.

The Energy Commission of Ghana in collaboration with the African Climate Technology Centre developed the National Energy Policy framework 2010 to improve energy efficiency in commercial and public buildings in the country. The energy policy is the key policy that guides the development and management of Ghana's energy sector. One of the focus of the Energy Sector Strategy and Development Plan 2010 is to support indigenous research and development aimed at reducing the cost of renewable energy technologies. Closely related to the energy policy is the Science, Technology and Innovation Policy (STIP) formulated in 2009 and with the goal "to achieve national development goals for poverty reduction, competitiveness of enterprises, sustainable environmental management and industrial growth". One of the objectives on energy under the STIP is "to ensure the supply of sustainable, affordable, safe and reliable energy for domestic and industrial use". No mention has been made on promotion of energy-conscious buildings in the country.

Although architectural practice in Ghana is regulated by the Architects' Registration Council (ARC), this regulating body has not been very strong on the ground until recently when the council was empowered by a legislative instrument. According to the council "the ARC is a government regulatory body for the architectural profession established through the Architects Decree 1969, NLCD 357. The Council, an Agency of the Ministry of Water Resources, Works and Housing (MWRWH), is responsible for the registration of persons within the Architectural Profession, guiding the profession and promoting the standards of education, training and practice towards a sustainable built Environment".

Yet the promotion of sustainable energy buildings is left to the discretion of the architect, developer and the preference of the client. The national regulating bodies have very little influence over building designs. Building permits are granted to clients by the metropolitan, municipal or district planning authority after all architectural and engineering technical drawings have been thoroughly inspected. The National Building Regulations, L.I. 1630, regulations 86-89, states that "Every habitable room ….. or space shall be provided with facilities for the entry from and natural ventilation to the open air provided that the rooms and spaces may be considered to satisfy this provision if they are mechanically ventilated except that electric fans (air conditions) shall not be permitted in lieu of the requirement of this provision". Unfortunately, not all the planning authorities have the necessary expertise to ensure that this requirement is fulfilled in submitted building plans.

OVERVIEW OF RESIDENTIAL HOUSING SUPPLY IN ACCRA

Residential housing supply in Accra is mainly from five sources; namely government sector, corporate sector, not-for-profit sector, individual supply and informal sector. The corporate sector and individuals including Ghana Real Estate Developers Association (GREDA) supplies about 90% of the national housing stock. Non-profit organisations and others supply just a minimal fraction of the housing stock. However, low income housing supply is mainly achieved through middle and low income individual petty landlords who build incrementally and rent out rooms (Addo, 2013; Addo, 2016; Karley, 2008). According to the 2010 population and housing census, only 7.2% of all the house types supplied in Accra were owned by the government (GSS, 2012). Incremental housing supply in Accra is estimated to be 80% of all houses built (Intsiful, 2004).

Until the structural adjustment policies in the 1980s, residential housing supply was mainly from government for public workers. In the early 20th century, public housing was developed around health and sanitation issues. A bubonic plaque in 1907 in Kumasi and an earthquake in 1939 in Accra sparked governments' involvement in public housing supply (Addo, 2014). This led to the

construction of colonial houses in elevated parts of Accra. These houses were enclosed with wide verandahs and wide windows to allow for natural ventilation through the rooms as seen in Figure 2.

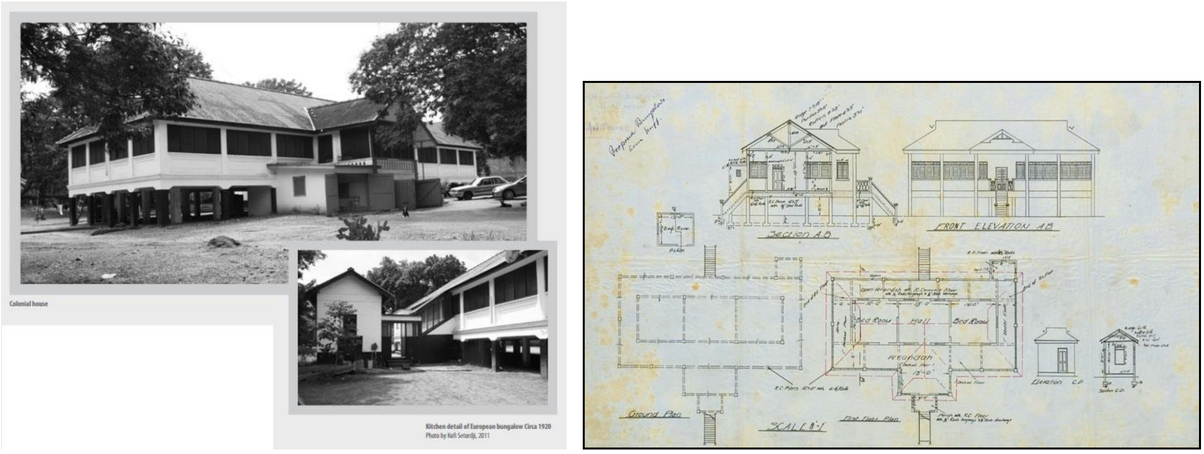

Figure 2: A photograph and plan of a colonial housing located in Ridge, Accra. These houses are now being demolished and replaced with multilevel residential apartments and commercial buildings Source: Ghana Institute of Architects and Ola Uduku.

Public apartments in Ghana are commonly funded by the government and other para-statal organisations. State funded residential buildings became part of Ghana's housing supply around 1970s. Several of these apartments were built all over the country. The construction of large-scale state-funded residential buildings was mainly led by two state institutions; the State Housing Construction (SHC) and the Social Security and National Insurance Trust (SSNIT). While SHC built mostly single storey bungalows, SSNIT ventured into multi-level apartments.

With neo liberal policies following the Structural Adjustment Programme (SAP), policies were put in place for the government to play the role of a facilitator instead of a provider of housing (Yeboah, 2000). This policy allowed many foreign businesses to enter the housing market. These foreign based real estate developers introduced their own architects and house designs which have been described as "spectacular architecture and high-rise towers" and dotted in parts of the capital city, Accra (King, 2004). Such architecture depicts signs of African urban modernism and African urban fantasy (Watson, 2013). Gated housing estates became a phenomenon and a preserve for diaspora living (Grant, 2005, 2009). Accra today displays westernized architecture with designs from Europe, United States of America and the Middle East transferring design ideas from the temperate regions to the tropical climate of Ghana. Unfortunately, most of these architectural designs are not appropriate for the tropical climate of Ghana.

On the other hand, some of the public apartments built by SSNIT or SHC are often designed by Architectural and Engineering Services Limited (AESL), a parastatal organization. The prevailing climatic conditions are taken into consideration during the design of the apartments, meanwhile, some of the private-built residential buildings are designed with less consideration for the prevailing climatic conditions. These buildings are often guided by international standards and they are required to make a statement, have an identity and some uniqueness rather than just being functional. The designs of the high-end buildings are such that mechanical ventilation is often required to maintain thermal comfort indoors and which increase energy consumption.

ARCHITECTURE, RESIDENTS' BEHAVIOUR AND ENERGY CONSUMPTION

Intergovernmental Panel on Climate Change (IPCC) 2007 report indicate that building form, orientation, self-shading, height-to-floor-area ratio and decisions affecting the opportunities for and effectiveness of passive ventilation and cooling can greatly influence the subsequent opportunities to reduce building energy use (Levine et al., 2007). According to the report, many elements of traditional building designs in both developed and developing countries have been effective in reducing heating and cooling load at the early design stages where key decisions are usually made by the architect.

Generally, the climate of a particular region determines the architectural design in that region. Temperate climate building designs may strive to contain warmth indoors while tropical climate may require warm air to be expelled from buildings. In the temperate climate double glazed windows provide better protection against cold while openable wide windows allow cross ventilation in the tropics (Fry and Drew, 1964). According to Fathy (1986), the proportion of window area to wall area becomes less as one moves toward the equator and that in warm areas people shun the glare and heat of the sun by decreasing the size of the windows. Parasonis et al. (2012a and b) have suggested that architectural solutions can be employed to achieve greater energy efficiency for the entire lifecycle of the building.

The room temperature in buildings is a combination of several factors including outdoor temperatures, construction material and the kind of equipment used (Amos-Abanyie et al., 2009). The Institute of Statistical, Social and Economic Research (ISSER, 2005) report observed that residential consumers in Ghana, comprising of middle and high-income urban consumers, typically use a number of high energy consuming household appliances and items such as air conditioners, fridges, water heaters, electric cookers, a substantial amount of lighting equipment and bulbs for the houses and this has led to substantial use of energy in residential buildings. According to Lam et al. (2006), using passive and low energy cooling techniques could greatly reduce the reliance on air conditioner for space cooling.

To achieve energy-conscious buildings and thermal comfort, Santamouris and Allard (1998) propose a balance between the thermal performance of the building envelope and the appropriate selection of techniques for heating or cooling. Al-Assar (2017) also identified the relationship between fenestration and thermal comfort in sustainable energy buildings. Sustainable energy buildings can be achieved by improving the building envelope, modernising heat sources and ventilation, introducing automation and heat metering and improving other installed equipment (Chwieduk, 2003). Using standards and mortgage rules and implementing innovative renewable technologies may ensure lower energy consumption thus, making buildings sustainable over its life cycle.

The energy use of a building depends on the behaviour and decisions of occupants and owners (Levine et al., 2007). According to Swan and Ugursal (2009), occupant behaviour varies widely and can impact energy consumption by as much as 100% for a given dwelling. This assertion was earlier proposed by Mann (1979) who stated that despite all the architectural standards there lies at the centre of architectural design the issue of taste and the question of standards. Hence, Mann (1979), in citing Herbert Gans, mentioned that there are different taste requirements for high, middle, lower-middle and low classes of people. Although there is a direct correlation between the architectural design and energy efficiency in buildings, residents' preference and taste for a particular design feature can greatly impact on building designs. The issue of wealth, lifestyle and class influence fenestration design and eventually energy use in buildings. While residents may want to achieve sustainable energy buildings, their architectural taste and preference as well as ownership status may or may not support that objective although, in a study by Yang et al. (2014), thermal comfort was ranked high by building occupants compared to visual and acoustic comfort and indoor air quality.

From the discussions, correlation between architectural design, residents' behavior and energy consumption in buildings is established. The architectural design, in terms of the arrangement of rooms, the fenestration, building material all tend to reflect clients' taste. It these features in

architectural design are not correctly combined, thermal comfort in the buildings may be compromised and only achieved through mechanical means.

STUDY AREA

Ghana is a tropical country found in West Africa and lying between latitude 4.3^0 and 11^0 North and longitude 1^0 12’ and 3^0 15’ West, 8^0 North of the equator. Temperatures range from 27^0C to 38^0C. The mean annual temperature for Accra is about 26.5^0 Celsius and relative humidity ranges from 75% to 85%. Accra is the capital city of Ghana with a regional population of about 4 million. It is located in the coastal part of the country as represented in Figure 3. It serves as the political and economic hub of the country and host a number of multinational organisations attracting several international visitors.

Many residential areas in the central areas of Accra such as the Cantonments, Ridge, Roman Ridge, Airport Residential Area, Ringway Estate, Osu and other places are all undergoing redevelopment as construction of multilevel offices and apartments are taking place. Most of these developments are being implemented under the Greater Accra Metropolitan Area Strategic Plan published in 1995 in accordance with Town and Country Planning Ordinance of 1945. Under the redevelopment and investment plan, the central area of Accra is to be transformed into a ‘modern’ Central Business District with the facilities being of highest international standards. Government bungalows occupying about 1.2 acres of land are being demolished and replaced with multistorey mixed use buildings.

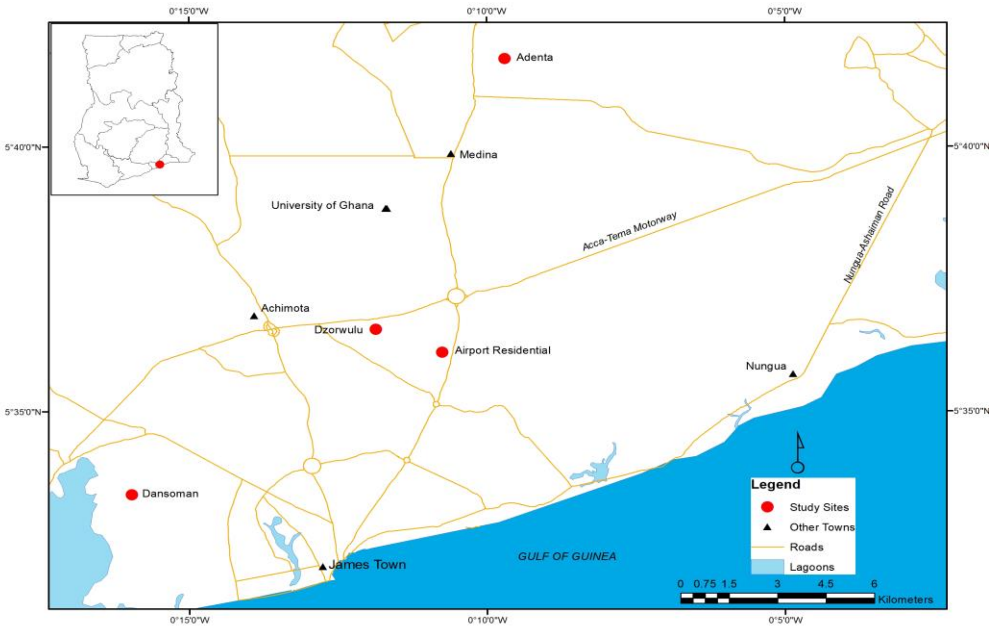

Figure 3: The location map showing part of Greater Accra Region and the red dots representing the four study areas.

Dansoman is one of the suburbs in Accra. It is located in the western part of the city. Dzorwulu and Airport residential areas are located within the central part of Accra while Adenta is also another suburb located in the eastern part of the city. Dansoman and Adenta are generally classified as middle-income communities while Dzorwulu and Airport residential areas are predominantly classified as high-income residential areas. Notwithstanding, part of the high-income communities are still regarded as low-income communities with squatter settlements. In all four study communities were sampled.

METHODOLOGY

A field survey was conducted between January and February 2017. The warm season in Ghana begins from October and usually ends in March with the two warmest months being December and January. Conducting this research in January afforded us the opportunity to determine the thermal comfort of buildings during the warmest months. Again, the surveys were done during the daytime between 1 pm and 4 pm over the weekends when the sun was high. It was anticipated that most of the households would be available over the weekend.

Both quantitative and qualitative research approaches were adopted in the data collection. Since the research was comparing public built apartments with private built apartments, the study communities selected needed to reflect the samples. Social Security and National Insurance Trust (SSNIT) apartments were selected in Dansoman and Adenta communities to represent public built apartment. SSNIT is a Ghana government agency and is the highest provider of public apartments. They have large scale development of apartments in all the ten regions of Ghana. The Dansoman SSNIT development is one of the earliest housing estates by SSNIT. Construction began in 1988 in Dansoman. The Adenta SSNIT development is one of the recent housing estates by SSNIT in Accra. Construction began in 1999 and recent additions were made in 2015. Dansoman and Adenta communities were purposively sampled because they have large SSNIT estate developments that are primarily classified as middle-income communities. Selecting these two categories of public built apartments reflects the early beginnings of public social housing after the structural adjustment liberalization policies. It is also during this era when postmodernist architecture was in vogue and architectural design of buildings depended much on the environment and technology present in the tropics.

Apartments from four different estate developments, Turquaz, Royal Airport Plaza, Alema Court and Kuku’s Court in Airport and Dzorwulu residential areas were selected to represent private built apartments. The Airport and Dzorwulu residential areas are primarily classified as high-income communities and the scale of real estate development was small as compared to the SSNIT flats. Several of the apartments in these high-income communities were built by private developers after the structural adjustment era when liberalized policies were introduced into the housing market. The oldest development selected was the Alema court built in 2001 while the most recent was the Turquaz developed in 2012. The apartments in the high-income communities were randomly sampled, based on the willingness of a respondent. Several of the apartments were in gated communities with security at the entrances and it was only when a household allowed the research assistants access into their premise that they could interview the household. In the case of the SSNIT flats, they were accessible to the research assistants. They knocked on doors, sought permission for an interview. If granted, the interview is conducted, if not they moved on to the next household.

In all 42 households were interviewed. The first part of the research instrument was designed for respondents to select from possible options and to add to the options provided. At the same time, the instrument also gave the respondents room to express their opinions at the end of the interview. From the Adenta and Dansoman SSNIT flats 22 households were randomly sampled. Ten of the respondents were selected from 10 different blocks in Dansoman SSNIT flats because of the prototype nature of the three-bedroom apartments. A similar approach was adopted for selecting respondents in the Adenta SSNIT flats. The remaining 20 respondents were also randomly sampled from the Airport and Dzorwulu residential areas in Accra. The questions were designed to collect information on the type of windows used, the method of cooling during the day and night, the indoor climate during day and night, for respondents to estimate the thermal comfort in the rooms, the effectiveness of natural ventilation used as a passive cooling technique in the rooms, the amount of money spent every month on electricity bills, what influenced respondents’ decision to live in such a house and lastly whether respondents would like to change their fenestration to take advantage of natural ventilation if they had

the opportunity. Architectural floor plans of a three-bedroom Adenta SSNIT flat and a three-bedroom Turquaz apartment were presented.
All the responses were entered into the SPSS statistical tool. Results were cross tabulated and presented in tabular form. The analysis focused on fenestration, means of cooling, residents' assessment of thermal comfort and electricity cost and consumption.

CASE STUDIES

Dansoman and Adenta SSNIT flats

SSNIT was established in 1972 under National Redemption Council Decree (NRCD) 127 to administer the National Social Security Scheme. One of the core functions of SSNIT was to invest. The contributions were invested in massive real estate development from 1988 in all the ten regions of Ghana. Dansoman and Adenta SNNIT flats are all part of the real estate development in Accra. They comprise of bedsits, one-bedroom apartments, two-bedroom apartments and three-bedroom apartments. Figure 3 shows a picture of one of the block of flats in Adenta. Figure 4 shows a typical plan of one of the three-bedroom apartments in the Adenta SNNIT flats. The open plan encourages natural ventilation of the rooms. Figure 5 also shows a cross section of some of the flats in Dansoman. The building designs are different in the two communities.

Figure 4: A view of part of a block of SSNIT flats at Adenta.

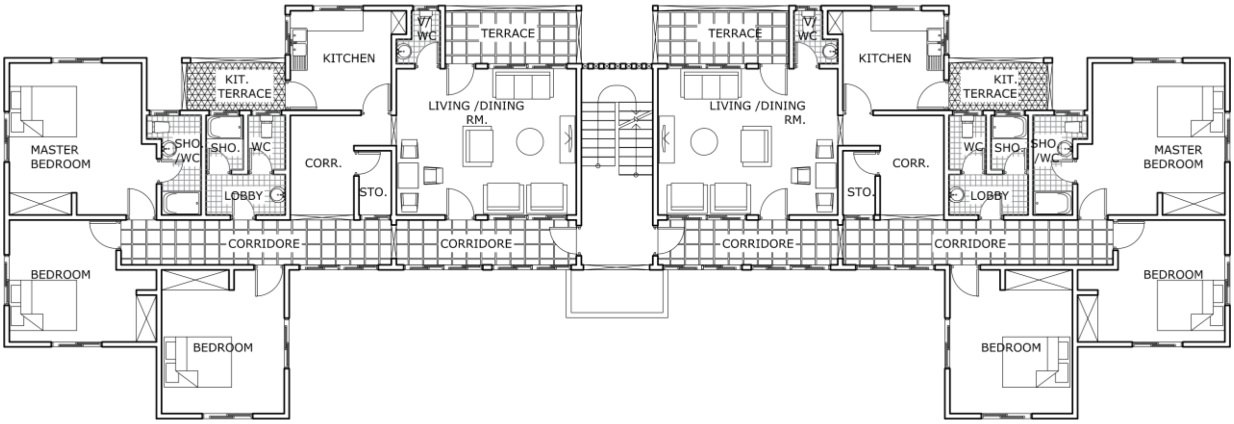

Figure 5: A typical floor plan of a 3-bedroom SSNIT Flat in Adenta

Figure 6: A picture of one of the SSNIT Flats in Dansoman

Dzorwulu and Airport residential areas

A total of four different apartments were selected in the Airport and Dzorwulu residential areas. Alema Court is a 24 number two and three-bedroom luxurious apartments built by Taysec, a Ghanaian owned construction company in Ghana, in 2001. According to Taysec, the company is noted for high quality property development in prestigious residential areas and they maintain international standards in the quality and style of buildings for clients and at the same time build to clients' taste. The Alema Court apartment is located in the Airport Residential area in Accra. Different apartments are built around a courtyard, part of which is a swimming pool as shown in Figure 7. The apartments are two and three-bedroom units with glazed sliding windows.

Figure 7: Picture shows the courtyard of the Alema Court in Airport residential area. Source: Taysec Construction Limited

The Royal Airport Plaza is a gated community within the Airport residential area. The luxurious apartments are laid out around a courtyard with a swimming pool. Each apartment has three-bedrooms. Kuku's court is an apartment complex in the Airport residential area. Turquaz residence is a luxurious block of flats converted from a commercial building in 2012. The apartment is located in the Airport residential area. It is a nine storey building with four apartments on each floor and each apartment has three bedrooms as shown in Figure 8. The Turquaz building has developers from Turkey and is designed with expatriates and international clientele in mind. Apartments are priced at GH₵ 2,000,000.00. The Turquaz building has a closed design with internally located corridors. The plan prevents efficient use of natural ventilation in the rooms.

Figure 8: A picture of the Turquaz residence in Airport residential area

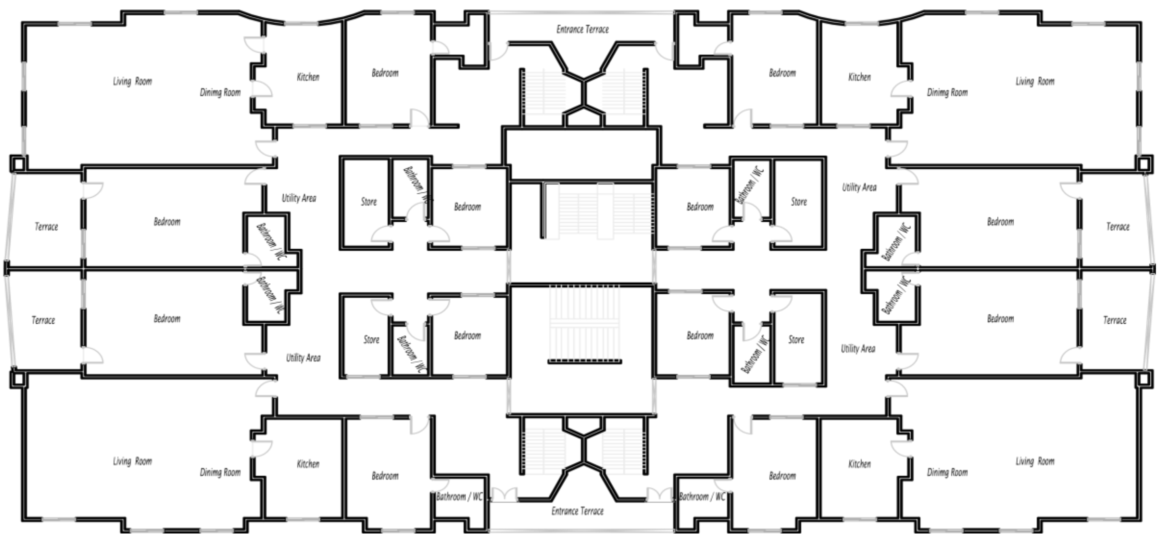

Figure 9: Ground floor plan of the Turquaz building

RESULTS AND DISCUSSION

In comparing the two floor plans, there were vast differences in the floor plan of the Adenta SSNIT flat and the floor plan of the Turquaz apartment. The Adenta SSNIT flat had an open plan while the Turquaz apartment plan was closed. The differences in design explains why the Turquaz building uses air conditioners to cool the rooms. Without air conditioners, room temperatures will be high and even when windows on external walls are opened, there will not be any cross ventilation and the warm air will circulate in the rooms. On the other hand, the open plan of the SSNIT flat enable passive cooling of the rooms using cross ventilation. The design of the SSNIT flat is quite similar to the earlier designs of government buildings where verandahs with windows were introduced on the periphery of buildings to allow the rooms to have good cross ventilation of natural air. The Turquaz building exemplifies a temperate climate design where the intention is to retain heat in the buildings. There is a disconnection between the design and the climate. In this case, mechanical means of cooling will need to be employed to achieve a good thermal comfort. It is not surprising that the Tuquaz apartments have such a plan because the developers are from Turkey and the design was carried over and implemented in the tropical region without much modification. The liberalization of the housing sector has enabled foreign developers to enter into the housing market and introducing designs and technologies foreign to the climate. The regulating bodies, such as the municipal planning authorities need to assess and approve designs that are appropriate for the tropical climate.

Out of the 42 houses that were sampled 19 had sliding windows and 23 had louvre blades. The glazed sliding window is a combination of a slider and a metal framed glazed sash windows. The sliding windows may reduce natural ventilation by about a half or a third depending on whether it has two or three adjacent parallel tracks for sliding. The fixed glass prevents air infiltration into the houses thus making it necessary for occupants to use air condition. On the other hand, louvre blades, which is an arrangement of adjustable parallel, horizontal glass blades is designed to regulate airflow or light penetration (Al-Assar, 2017). The presence of a mosquito mesh behind the window allows for continuous opening of the windows throughout the day. Thus, almost 100 percent natural ventilation is achieved in the rooms and this makes the louvre blade system act as a passive cooling strategy.

In Table 1 almost all the apartments from the Adenta and Dansoman residential areas, which were also public built apartments, had louvre blades. On the other hand, almost all the apartments in Airport and

Dzorwulu residential areas had glazed sliding windows except two units. The two apartments with louvre blades were government apartments.

Table 1: Type of window openings in the four residential areas

Developer	Residential area	Glazed Sliding/ fixed windows	Louvre blades
Public built	Adenta	0	12
	Dansoman	1	9
Private built	Airport	9	2
	Dzorwulu	9	0
Total		19	23

Air conditioners and fans were used for mechanical cooling during day time and night time. Table 2 presents the summary of apartments using air conditioners and fans during day time and night time. While occupants in SSNIT flats use fans in maintaining a reasonable cool temperature both in the day and at night, residents in the private-built apartments in Airport and Dzorwulu used mainly air conditioners to maintain a cool atmosphere. Few residents in the high income residential areas combined the use of fans and air conditions. The observation made was that the apartments using air conditioners in the high class residential areas were mainly occupied by expatriates, business persons, and high-income earners. Residents could pay for the energy consumed. However, the energy crisis of the country will not make it prudent for unregulated use of energy without any controls.

Table 2: Mechanical means of cooling the rooms during day time and night time in the four residential areas

	Day time			Night time		
Residential area	Air conditioner	Fans	Combination (aircon+fan)	Air conditioner	Fans	Combination (aircon+fan)
Adenta	0	11	1	0	10	1
Dansoman	0	10	0	0	10	0
Airport	7	1	3	4	3	4
Dzorwulu	9	0	0	4	2	3
Total	16	22	4	8	25	8

It was interesting to observe from Table 3 that about two-thirds of the respondents using glazed sliding or fixed windows described the thermal comfort of their rooms to be satisfactory while one third responded that the thermal comfort in the room is poor. Similarly, the thermal comfort of respondents using louvre blades followed a similar trend except that about 3 persons described the thermal comfort in their rooms as good. None of the respondents using glazed windows described the thermal comfort in the room as good. Almost an equal number of respondents staying in apartments using glazed sliding windows and louvre blades described the thermal comfort of the rooms to be poor. Some of the residents in the high class residential areas explained that they would have liked to open their windows to allow natural ventilation into their rooms but the design of the fenestration prevented them from doing so. On the other hand, some of the respondents in the SSNIT flats wished they could change the fenestration from louvres to glazed sliding windows to make the building more attractive. Again, some of the respondents in the SSNIT flats rated the thermal comfort in their rooms to be poor because they explained that the rooms become hot during the day time and there is less breeze during the night time. The orientation of the buildings may explain the observation.

Table 3: Respondents estimation of thermal comfort compared to the type of fenestration

Type of window	Poor	Satisfactory	Good
Glazed window	6	12	0
Louvres	5	14	3
Total	11	26	3

In a tropical climate the thermal comfort in buildings with glazed sliding windows is normally poor without mechanical ventilation (Simons et al., 2014). Following Al-Assar (2017) explanation, about 90% of natural ventilation is prevented into rooms using glazed sliding windows as compared to rooms using louvre blades for fenestration. Thus, respondents using glazed sliding windows tend to use air conditioners to achieve thermal comfort as can be found in the high income residential areas. The research however, recognises that thermal sensations, satisfaction, and acceptability of an individual are all influenced by the match between one's expectations about the indoor climate in a particular context, and what actually exists (De Dear, & Brager. 2002).

Interestingly some respondents choose security over thermal comfort and so preferred to have secured and fixed glazed windows. This practice was common in the high class residential areas. The observation is synonymous to Grant's (2005) finding where residents considered security as one of the reasons for choosing to stay in a gated community. Others preferred the aesthetic appearance of buildings with the glazed sliding or fixed windows. According to the respondents, it makes the building look 'modern' and 'beautiful' and using glazed windows give an impression of 'affluence'. Some middle-class households in the SSNIT flats were prepared to sacrifice the cost savings made on electricity consumption over the introduction of glazed windows. Levine et al. (2007) observed that the energy use of a building also depends on the behaviour and decisions of occupants and owners. Most of these anomalies may be corrected through public education by the professional bodies such as the Ghana Institute of Architects and the Ghana Institution of Engineers.

From Table 4, electricity bills paid in Dansoman and Adenta SSNIT flats were about three or four times less than what was paid in Airport and Dzorwulu apartments. One respondent paid about 2000 Ghana Cedis for the monthly bills but explained that the meter was faulty and that previously he was paying about 600 Ghana Cedis every month. Other respondents staying in the same block of flat were paying averagely 600 Ghana Cedis. The results show that respondents who were paying less for electricity bills were either using fans or natural ventilation while those paying high amounts were mainly using air conditioners to attain thermal comfort in the rooms during day and night times. Although ownership of air conditioners may not be the only way to assess electricity consumption, air conditioners are known to be important sources of energy demand with an average energy use of 1000 KWH per year. This forms about 11.6 percent of total household electricity use (Hausman, 1979).

Table 4: Comparing the monthly electricity bill paid with the various mechanical means of cooling the rooms during day and night times.

	Day time			Night time		
Amount (GHS)	Air condition	Fans	Combination (aircon+fan)	Air condition	Fans	Combination (aircon+fan)
25	0	1	0	0	1	0
70	0	2	0	0	2	0
80	0	1	0	0	1	0
100	0	10	0	0	10	0
120	0	3	0	0	3	0
150	0	3	1	0	2	1
160	0	1	0	0	1	0
200	0	1	0	0	1	0
400	4	0	1	2	0	2
450	3	0	0	3	0	0
500	1	0	1	0	1	1
550	1	0	0	0	0	1
600	4	0	1	2	1	2
650	1	0	0	1	0	0
2000	1	0	0	0	1	0
Total	15	22	3	8	24	7

The electricity tariffs are calculated based on units consumption, street light levy and national electrification levy and a service charge. Referring to the Electricity Company of Ghana (2017) electricity tariff reckoner effective 7th April 2017, a household paying 650 Cedis per month consumes about 750 kwh electricity per month while a household paying 25 Cedis consumes about 60 kwh per month. The consumption levels from the middle and high income residential areas are far in excess of what has been proposed by the Town and Country Planning Department in Table 1. The proposed consumption level for middle income residential areas is about 9600 watts per household per month as compared to the least consumption of 60,000 watts per household per month. Similarly, the proposed consumption is 15,000 watts per household per month but the indication is that high income communities consume about 750,000 watts per household per month. There is a disconnect between policy and real electricity consumption levels in residential buildings. A true reflection of how much electricity is consumed by households in different residential areas will be required for effective planning and management.

CONCLUSION

The research set out to investigate the relationship between electricity consumption in residential buildings and the type of fenestration used as well as the means of maintaining thermal comfort in the buildings. The results showed that the arrangement of rooms in an apartment, the type of window used, the means of cooling and creating thermal comfort in rooms together impact on the electricity consumption in residential apartments. Apartments with fixed or sliding glazed windows tend to use air conditioners to achieve thermal comfort and this increases the electricity consumed. However, houses with louvre blades make use of natural cross ventilation and this leads to less consumption of electricity. According to Al-Assar (2017), the louvre blades act as passive cooling system for the buildings. The study also found out that residents' desire for security and aesthetically appealing buildings sometimes dictate the kind of fenestration used in residential apartments.
The study recommends that;

1. Developers and households will need to be educated on efficient electricity use in buildings to achieve sustainable energy buildings. Energy-conscious designs should be the preoccupation of architects and engineers in Ghana. Following the suggestions of Lam et al. (2006), architects and building designers should assess the appropriate passive design strategies especially during the initial conceptual design stage.
2. The design and fenestration of buildings should be suitable for the tropical climate so that less energy is needed to cool the interior spaces and create a reasonable thermal comfort. Wide openeable windows will allow natural ventilation through the rooms and this will act as a passive cooling mechanism for the buildings. Less energy will then be required to maintain thermal comfort in the interior thus making the buildings energy efficient.
3. Policy makers such as the Energy Commission, the Town and Country Planning Authority, Volta River Authority, Electricity Company of Ghana, Architect's Registration Council and the Ghana Institution of Engineers should develop a standardized code on energy consumption in residential buildings. This will guide future planning, design, and construction of residential apartments in Ghana.
4. Other design principles can be used to enhance thermal comfort in buildings such as good arrangement of rooms, use of external shading devices and landscaping.

It is anticipated that if the buildings become energy efficient and new technologies are used, then substantial reductions in Ghana's electricity consumption levels will be achievable and the power outages faced in the country will minimize given the anticipated increase in residential development in future.

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ISSUES AND PERSPECTIVES OF HOUSING FOR OLDER PERSONS IN NIGERIA- IN SEARCH OF A TIPPING POINT

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INTRODUCTION

Planning for the housing situation of an ageing population is one of the challenges of many countries today. In Nigeria, housing provision is majorly a matter at the family level where the individuals take on the responsibility for their housing plans. Though, there is increasing involvement of the private sector, governments and mutual aid groups in housing provision, the government takes more on the responsibility for facilitating for the different actors to realize their housing plans and for influencing the situation in the housing market. In order to do this successfully, knowledge about the housing preferences of the different actors is crucial. In Nigeria today, most people remain in ordinary housing all through life, while an infinitesimal proportion of the population age 65 years and above move to assisted living or other forms of housing (e.g. living with children or family members). As the Nigeria population continues to age and the near absence of aging in its policy discourse, this paper portends on the need to ascertain that suitable housing is provided for the Nigerian elderly. With the country's current housing deficit of about 17 million and the fact that most individuals remain in ordinary housing through life, lack of adequate policy intervention may culminate in a very specific housing crisis. For example, many houses in the city centres are becoming dilapidated because of the inability of their aging owners to maintain or repair them. This situation is even worse in the rural areas. This exacerbates an already ingrained set of problems about housing quality and suitability in Nigeria. The research underlying this paper asked the following questions: what issues are developing regarding elders living with their family as the population ages? What housing options exist for elders with varied degrees of disability? What is needed to address housing issues for older Nigerians? By drawing on previous work and published data to consider age-related household trends and housing needs in Nigeria, this paper intends to stimulate dialogue and future research on housing needs of older adults in Africa in a bid to avert a potential housing crisis for this demographic category in the coming decades.

POPULATION AGING AND HOUSING

Population aging is described as the rise in the median age of a population resulting in a shift in the age structure of that population. While this ageing trend started in the developed world, it is now a global phenomenon, and it is accelerating, especially in the developing world. In industrial countries, the share of those 60-plus has risen from 12% in 1950 to 22% today and is expected to reach 32% (418 million) by 2050. In developing countries, the share of those 60-plus has risen from 6% in 1950 to 9% today and is expected to reach 20% (1.6 billion) by 2050. The pace of this change means that developing countries will have much briefer periods to adjust and establish the infrastructure and policies necessary to meet the needs of their rapidly shifting demographics. It also means that unlike developed countries, they will need to cope with getting old before they get rich[1]. The problem of global aging is going to be more

seriously felt in the developing countries than in the developed countries as there will be higher absolute numbers of elderly people, a larger share of elderly, longer healthy life expectancies, and relatively fewer numbers of working-age people.

Like every other region in the world, Africa's population is ageing, but this is happening much more quickly. By 2050, the number of people over 60 living in Africa will increase from just under 50 million to just under 200 million[2]. This unprecedented demographic shift portends profound implications for society, influencing people's social, economic and political lives. Nigeria, Africa's most populous country, has a young population with only 5 percent of its population aged 60 years and above, accounts for nearly 7 million of its entire population[3]. Estimates by the United Nations (2012) shows that the elderly population in Nigeria will increase from 6.4 million in 2005 to 11.5 million in 2025, and then 25.5 million by 2050. This implies that the elderly population will constitute about 10 per cent of the total Nigeria population by year 2050[4].

The discussion of the potentially serious implications of these changes for the provision and funding of public services, and for housing, are evolving in academic and policy arenas in Nigeria. Studies on the living arrangements and housing circumstances of older people is yet to receive adequate attention in many African countries, including Nigeria, except for few studies making general comments on the issue within studies on challenges of aging. Couple with this is the near absence of reliable data on housing in the country.

DEFINITION OF AN OLDER PERSON

There is no universal agreement on when old age begins. Our perception depends largely on context and our own age. Most countries of the developed world have accepted the chronological age of 65 years as a definition of the elderly or aged person. The age of retirement is often used as the marker of old age (which in Nigeria is currently age 60). In Africa and Nigeria in particular, the ageing process is a biological reality which has its own dynamics, usually beyond human control. The definition of the elderly or aged person correlates with the chronological age of 50 to 65 years depending on the setting, region, and the country[5]. Apart from this chronological definition, most societies have a set of social markers which determine who is old. Glascock and Feinman's 1980 definition of old age in developing countries in which a number of African countries were included, reported that the definitions of old age fell into three categories: chronological age, change in social roles, and change in capabilities[6]. Some have opined that the concept of who is old depends on how long people are expected to live in a particular community. This has led the World Health Organization to suggest that if a definition of old age in Africa is to be developed, it should either be 50 years or 55 years in light of the fact that life expectancy in Africa is lower than those of the western countries[7]. Complicating the issue of definition of old age is that in much of Africa, in view of the level of development and illiteracy, actual dates of birth are often unknown. Specifically, in Nigeria, many individuals do not have official records of their birth. As of 2012, Nigeria had not implemented the compulsory registration of births and deaths as legislated since 1979[8]. The current UNICEF report estimated that 70 per cent of the children born annually in the country are not registered at birth[9]. It is therefore reasonable to surmise that the situation would have been worse for the older generation, particularly those born in rural communities. Thus, effort to define old age by reference to chronology alone may be fraught with inexactitudes. In a study of age identification among the Yoruba of south western Nigeria, it was found that there was a strong relationship between chronological definition of old age and some social markers, particularly for women. Women were more likely to be defined as old if they have attained menopause and have grandchildren, and men, as old, if they are advance in age and experience limitations in their physical capabilities[10]. In addition, the Welsh Government's Strategy for Older People in Wales defines older people as aged 50 and over, although this has been the subject of much discussion[11]. However,

given unprecedented improvements in life expectancies, the increasing complexity and heterogeneity of populations in terms of their age structure is also reflected in the distinction now often made between the Third and Fourth ages, or "young-old", "old-old" and "oldest old" groups[11]. For the purpose of this paper, old age, unless otherwise stated, is defined as aged 60 and above.

OLDER PEOPLE'S HOUSING OPTIONS

Shelter has been universally accepted as the second most important essential human need after food. A home is much more than physical shelter since it gives those who dwell in it a sense of security, privacy, comfort, and independence. it also plays a major role in facilitating social interaction with family and friends[12]. Over 60 per cents of Nigerians who are 60 and above are home owners[13]. The high incidence of home ownership among this age category can be linked to the value attached to house ownership among the Nigerians. To many people house ownership is personally and socially desirable and represents a measure of well-being especially in old age. Reasons for this include the generally held belief that house is not only a mere shelter; it a source of financial asset for owners who let them out to tenants for a fee. Home ownership is a popular retirement component by individual worker while in active service. It has proved to be highly rewarding for those who build for rent especially in cities. However, the rate of substandard homes among the elderly exceeds those for other age groups. Many houses are becoming dilapidated over the years, (especially in the city centres), and in later life, the ability of older adults to maintain or repair them is often limited by low incomes. In addition, many older people have had to contend with the reality of living alone as adult children leave their parents to set up their own families in different geographical locations.

Majority of older individuals perceive their home as one of their most prized possessions. However, the quality and type of dwellings in which older adults live depend on many things such as their income, age, marital status, gender, and race, as well as their health and functional status[14]. In spite of these factors, the standard and suitability of older people's accommodation is vital to their health and quality of life and a key factor in their capacity to take care of themselves or to be cared for should they become dependent[15]. Hence, good quality housing is a critical factor in the promotion of independence and the attainment of a good quality of life for older people.

Apart from the physical structure, critical to the issue of quality housing for older people is its social components or what constitutes a household. According to the Nigeria population and housing census 2006[16], a household "consists of a person or a group of persons living together usually under the same roof or in the same building/compound, who share the same source of food and recognize themselves as a social unit with a head of household". There are two major types of households recognized: regular and institutional. The criteria used to categorize regular and institutional households were 'presence of a recognized head of household', 'sharing of catering arrangement' and 'feeling of belonging together as a social unit'. There were other types of household classification/identification used during the census: Homeless households, Homeless persons, and Nomadic households, Transient persons, Fishing and Hunting population and Institutional/Census functionaries. In all, a total of 28.9 million households were enumerated out of which 95.2 percent belonged to regular households, 3.6 per cent were in the institutional category, while homeless, nomadic transient, fishing and hunting households were 1.3 percent.

However, the data on the residential patterns for age 60 plus in Nigeria indicate that over 65 per cent of older adults stay alone, 14 percent reside with their spouses. 2.6 per cent live with their children, 11.1 percent stayed with parents, 1.3 percent lived with siblings, 3.0 and 0.7 lived with other blood and non-blood relations respectively while 1.6 per cent lived in institutional households. Most older households are characterized by couples or single people living alone in general needs housing, as many of them prefer to stay in their current homes. A good number of older home owners typically have at least two spare bedrooms. The data indicate that majority of older persons reside in general needs housing without

consideration for peculiar old age needs both in term of the physical structures, location and social supports.

Housing options for elders with varied degrees of disability

In spite of the strong desire of many older adults to continue to stay in the houses they used to be when they are younger, certain conditions such as varied degree of disability may make the home environment unsuitable for daily living. In some cases, they move in with family members in order to be close to people who can assist with daily living activities and needs[17]. Many of them live with children, relatives and few in institutional housing. In Nigeria, institutional residential options are not yet integrated into the Nigerian housing system though there are about ten residential care homes for an elderly population of over 5million[18]. Many of these which can barely pass as nursing homes are operated by religious organizations, NGOs, States and Local Governments' welfare department. In some instances, the elderly is kept in the same facilities with destitute and delinquents. This is quite worrisome and emotional degrading for the concerned elders and their family members.

EMERGING ISSUES ON ELDERS LIVING WITH THEIR FAMILY

The traditional African housing unit is a compound. It is a group of compartments, with no clear cut divisions, built in the form of a rectangle enclosing and facing an open courtyard. Though there may be slight variations in architectural design by ethnic groupings, a compound is the unit of common residence of patrilineal descent groups. This design promoted intergenerational support which served as safety net in old age. In the face of modernity and gradual depletion of the extended family system, the compound housing pattern is gradually fading out giving way to a new style of architecture that encourages dispersal and promotes the nuclear family model. In essence, the modern architecture design and family system may be responsible for a high proportion of older persons staying alone. In the absence of institutional housing for older persons and the need to ensure sufficient care in old age, the older person may have to live with younger relative or adult children. This practice is in line with the age long pattern of sequential responsibility in which parents look after their children, and the children look after their parents when they are old people are too feeble to work. Apart from this, a high incidence of global migration and rural-urban drift is making it impossible to sustain the age long practice of family members staying together throughout life.

In addition, Nigeria's high unemployment rate is constituting a threat to the age-long pattern of sequential responsibility. Unemployment rate in Nigeria increased to 10.40 percent in the fourth quarter of 2015 from 9.90 percent in the previous period. The number of unemployed persons went up by 518 thousand to 8 million and labour force population rose by 1 million to 76.95 million. The underemployment rate grew to 18.7 percent (14.4 million), compared to 17.4 percent (13.2 million). Unemployment rate in Nigeria averaged 8.85 percent from 2006 until 2015, reaching an all-time high of 19.70 percent in the fourth quarter of 2009 and a record low of 5.10 percent in the fourth quarter of 2010[19]. Many grown up children who should be saddled with the responsibility of providing care for their aged parents, in the absence of state administered old age pension, still depend on their parents for economic support.

In many instances today when an older person has to stay with family member, it is within the nuclear family and not the extended family as the former is gradually replacing the latter. And when this occurs, a critical issue is that the older person stays alone for most hours of the day because the nature of economic activities in urban centres requires that adult children stay away from home most hours of the day. Hence an older adult living with them may experience loneliness during the period. In some instances, older adults who live in their adult children's homes, relay the lesson of reciprocity as they cook, do housework and babysit their grandchildren. They make it possible for both parents to go to work without the fear of entrusting childcare to the maid, or high bear the high cost of day-care centre.

Just as older adults in other parts of the world prefer to age in place, the Nigerian elderly prefers to age-in-place. Maintaining one's independence has been described as a crucial component of successful ageing. One way to achieve this for older adults is to age in place which is the ability to stay in one's home as a person ages[20]. The current trend in Nigeria is for the elderly to live alone many of who found their living arrangements difficult. See Table one below.

Table 1: Distribution of Population by Age Groups and Relationship to the Head of Household

Age Groups	Total	Head of Household	Spouse	Child	Parent	Brother/Sister	Other Blood Relation	Non-Blood Relation	Institutional Household
60-64	2,450,286	1,605,867	443,019	58,743	195,686	30,235	60,137	16,772	39,827
65-69	1,151,048	752,363	194,390	30,593	103,741	14,068	29,659	8,124	18,110
70-74	1,330,597	899,151	147,579	32,176	166,095	16,514	40,986	8,018	20,078
75-79	579,838	382,139	65,971	19,135	73,937	7,414	18,127	3,902	9,213
80-84	760,053	484,533	73,887	28,844	116,170	10,439	28,890	5,130	12,160
85+	715,225	469,802	52,300	14,762	123,227	8,975	28,703	4,557	12,899
Total	6,987,047	4,593,855	977,146	184,253	778,856	87,645	206,502	46,503	112,287
%	100.0	65.7	14.0	2.6	11.1	1.3	3.0	0.7	1.6

WHAT IS NEEDED TO ADDRESS HOUSING ISSUES FOR OLDER NIGERIANS

As the nation's demographic profile tilts towards the elderly in the coming decades, it becomes expedient to commence a dialogue toward the development of a housing policy that will specifically address housing needs of older persons. Past efforts at addressing the housing problems in Nigeria have erroneously equated the housing needs of young adults with that of older adults. Compared to the younger population, the needs of older people are not always the same as the latter are exposed to higher risks of increasingly poor health, disability and frailty. Loneliness is also sometimes a challenge for those who have been widowed or whose family and friends have died or moved away. These factors can have a significant impact on health and wellbeing of older persons. All in all, as we age, the likelihood of needing more help with health, social care and social requirements will increase.

We must begin to think about building age friendly cities, towns and villages. Older people live in both rural and urban settings and each of these locations have their peculiar attributes and implication for this category of people. Older persons who in many instances migrate to rural areas at retirement are confronted with untold hardships in the course of everyday living. While the urban area grapples with inadequate housing, unplanned development, improper maintenance of existing structures, aging, absence of social infrastructure, insecurity and pollution., rural housing is deficient in social services such as electricity, water supply, as well as transportation facilities. Additionally, the houses in the urban core areas are characterized by inadequate infrastructural facilities, poor ventilation, non-availability of in-built toilet and kitchen, as well as poor refuse disposal system. Other problems that are associated with urban housing are lack of effective planning, development of shanty towns, and availability of dilapidated houses. Older people's housing needs can be twofold: the need for repairs and adaptations to existing accommodation; and the need for alternative accommodation when necessary or when preferred. In this light, financial support can be provided by government for repairs and adaptation to existing accommodation to encourage aging in place for those who are physically active to sustain activities of daily living. However, for those whose independent living may be hampered as they advance in age, provision of home care services may be encouraged. While it may be practically impossible to bring back the compound housing system that ensured intergenerational interaction and

safety net in old age, there is the need new housing models that would ensure social inclusiveness, age friendliness, safety and comfortability for the elderly. Some of these models are already in place especially in the western world. There is also the need to promote citizens' education for "lifetime-smart" homes so that housing stock can be built to become age-sustainable rather than catering to age-specific needs.

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THE ROLE OF CO-BUILDING GROUPS IN CREATING SUSTAINABLE BUILDINGS AND NEIGHBOURHOODS: LESSONS FROM FREIBURG IN GERMANY

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INTRODUCTION

Co-building groups (Baugemeinschaften in German) is not a new phenomenon. Ruins of houses built by socially organized groups have been found in Basta in South Jordan, which dates back to 9,000 years ago. The early peasants from the Stone Age chose the endogamous and kinship way of life to ensure access to valuable resources such as food, and as a means to ensure social cohesion and to manage conflict within the group.[1] Co-building groups in the major cities in Germany (such as Berlin, Hamburg, Freiburg and Tubingen) have been increasingly growing.

Here, there is a need to distinguish co-building groups from housing co-operatives (Baugenossenschaften in German). Both, as non-commercial housing associations, have played an important role in delivering alternative solutions for affordable housing. While co-building groups provide the members home ownership, housing co-operatives grant the tenants "the right to use a residential apartment for an unlimited period under the condition that they are members of a housing cooperative and fulfil their duties. The tenants do not own the property, but rather holds a stake in the association". [2] Housing co-operatives are the third pillar of housing, alongside renting and home ownership. As argued by Haffner and Brunner "Being a cooperative occupier of a dwelling should allow for more secure occupancy rights than ordinarily available to renters and less secure occupancy rights than ordinarily available to owner-occupiers".[3]

However, co-building groups require a more active role and personal commitments from the members to design and construct their own houses. A co-building group is consisted of different people (families, single, young, elderly people) who collectively buy land plots to design and build their own houses together. The group diversity provides access to a wide range of resources, experiences and networks for creative thinking and innovation.[4]

The social and economic aspects of co-building groups have been examined elsewhere.[5] Nevertheless, the contribution of co-building groups to ecological aspects of urban sustainability has not been researched systematically. This paper aims to examine the role of co-building groups in enhancing sustainable buildings practices, as a key step towards low-carbon urban transition. Drawing on the experiences of two internationally recognized sustainable city districts in Freiburg (Vauban and Rieselfeld), it will explain if and how co-building groups mobilize resources for urban sustainability. The research objectives are:1) to analyse the potentials and limitations of co-building groups (as institutional entrepreneurs) in contributing to sustainable neighbourhoods including social, ecological and economic dimensions; and 2) to discuss the role of planning policy framework in creating and maintaining socio-political space for co-building groups.

RATIONALE

There is no single definition of the term co-building groups. They are shaped in different ways, depending on their constellation, aims, and the context in which they are emerged and developed.
However, as argued by Ornetzeder and Rohracher [6], the members of co-building groups are usually organised and "bound together by contracts, acquires a building ground, assigns an architect, plans the building in cooperation with the architect and other planners, and finally commissions a construction company to realise the project". The core group (usually a group of friends) delegate management tasks to an external facilitator. The extended network is usually well-placed to provide additional skills essential to achieve the aims of the group by arranging different tasks e.g., purchasing the land, applying for funding, and building working groups for design and construction.[7] However, a key success factor is the ability of members "to work through differences, hold the group together and ensure that individual aspirations align (to a significant extent) with those of the group".[8]
Co-building groups can in many ways contribute to urban sustainability e.g., by generating a cost-effective construction, colourful architectural design, open space and community infrastructure. They can facilitate collective action between future neighbours at an early stage and enable a healthy community.[9,10]
The organisational structure of co-building groups is of special importance for studying how 'institutional entrepreneurship' is appeared and shaped to transform the existing housing industry structure, including norms and values. Co-building groups act as 'institutional entrepreneurs' defined as individuals, organizations or groups of organizations who try to mobilize resources to create "new or transform existing institutions" for sustainable housing.[11] The introduction of the notion of institutional entrepreneurship by DiMaggio has helped to convey the mainstream neo-institutional analysis aimed at studying the role of actors in reproducing or transforming institutions.[12] In this paper, the notion of institutional entrepreneurship, which conjoins the two words 'institutions' and 'entrepreneurship', is used to shed lights on the institutionalization process of co-building groups. While the former defines the mainstream developers, the latter advocates the discourses for the entrance of new niches in the existing housing market.

METHODS

In this study, a qualitative case study methodology is applied. The co-building groups have played a key role in realising the sustainable city districts of Vauban and Rieselfeld, which have been planned and developed in Freiburg in the last decades (Table 1). In particular, the co-building groups in Vauban have been targeted for an in-depth analysis of the emergence and institutionalisation process of co-building groups, which is defined as the 'main unit of analysis'. However, this study discusses the emergence of co-building groups in a broader context of the planning policy framework of the City of Freiburg, which is defined as the 'embedded unit of analysis'. The both units are studied within the historical and socio-political context of Freiburg.

Table 1: Summary descriptions of the case study districts

City district	Previously-developed land	Planning and construction	Constructio n area (hectare)	Population	Housin g units	Number of co-building groups
Rieselfeld	Site of a sewage works	1992--2016	70	12000	4200	120
Vauban	Site of a French army barracks	1994--2009	40	5500	2000	60

The information finding methods have been desk study and direct observation. A diverse source of information has been used such as research articles, local newspapers (Amtsblatt, Badische Zeitung, Immobilien Zeitung Freiburg, and Freiburger Wochenbericht) and the official documents of the Freiburg City.

FINDINGS

In the first sub-section, the characteristics of housing market in Freiburg and then the role of City of Freiburg in creating an enabling environment for co-building groups is discussed. Then, in the second sub-section, some insights into the role of co-building groups in urban sustainability, in particular in Vauban, are provided. In the last sub-section, the case study results are summarised.

Planning policy framework for the housing market in Freiburg

The housing market in Freiburg is very diverse and dynamic, which is dominated by municipal housing company (Freiburger Stadtbau) and three housing co-operatives (Bauverein Breisgau, Familienheim Freiburg, and Heimbau Breisgau). Co-building groups have been described as a new version of housing co-operatives to provide affordable housing in Germany.[13] However, co-building groups besides cost savings, as a result of the economies of scale[14], contribute to enhanced social interaction and high participation of future occupants in architectural design of buildings and neighbourhoods.[15] How the City of Freiburg has supported co-building groups, as a relevant policy instrument to achieve sustainable housing and neighbourhoods? In Germany, usually the municipalities take control over the land supply as they are responsible for the costs of all new infrastructures demanded by new housing development. The City of Freiburg through the process of building application has promoted co-building practices to achieve housing diversity and to create a stronger commitment to the construction of housing in the lower price segments.[16] The successful implementation of the notion of co-building groups depends to a large extent on the favourable preconditions provided by the City of Freiburg, for instance, by providing the co-building groups with land plots; and by setting up central project groups in the new construction areas such as the Rieselfeld Project Group in Rieselfeld and Forum Vauban in Vauban, as a legal bodies of the extended political process and the social work.[17]
In 1992, the City of Freiburg and the municipal service provider from Stuttgart (Kommunalentwicklung LEG) appointed a joint management team (the Rieselfeld Project Group) as the coordination unit for the Rieselfeld project, which acted beyond the regular administrative hierarchy. They established 'Quartiersarbeit von K.I.O.S.K'[1], which included the representatives of future citizens to evaluate the outcomes of the Rieselfeld project on a regular basis.[18,19]
The Forum Vauban was financially supported by the Federal German Environment Foundation. It acted as a link between future residents and the City of Freiburg and played a key role in supporting co-building groups in Vauban, where the residents took their own initiative in the planning and construction of their own houses. Forum Vauban supported co-building groups by setting up different working groups to deal with possible conflicts arising among members including legal and financial issues. It provided the co-building groups with consulting services throughout the whole planning and construction process and helped them to actively lobby for resources.[20,21]

How co-building groups took form in Vauban?

In Vauban, to allow for individual designs and vibrant residential area, municipal land plots were distributed among co-building groups to plan and build their own multi-family houses together. Some co-building groups consisted of members with adequate skills in architecture, building regulations and real estate finance. They were quite aware about the environmental requirements and acted accordingly. For instance, they imposed strict regulation and requirement on those who moved into the district and searched for information about the amount of embodied energy used to produce building materials.[22,23,24,25]
The co-building groups in Vauban took the responsibility for building design of their common property, combining their individual and collective needs in a common plan. The members of co-building groups were directly involved in the internal design of their own houses.[26] The aim was to achieve an architectural diversity and sense of ownership in the neighbourhood design in order to "build a robust and conflict-tested community along with the buildings".[27] Among other, the co-building group 'Keehäuser' has been considered as a model for eco-friendly social housing in Vauban.

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[1] The acronym K.I.O.S.K stands for Contact, Information, Organisation, Self-help and Culture.

Co-building group 'Keehäuser'

In the first stage interested people got together, and then they found the architect Michael Gies, who acted also as a project manager to facilitate the group building; identify funding; arrange contacts with authorities; and to make sure that the group fulfil the necessary requirements to apply for a municipal building plot. Small groups of members were established to deal with different issues e.g., to facilitate architectural plan and communication; and to bring together the social and ecological aspects of housing.[28]

In summer 2006, the members of the group after three years planning and construction work moved into their own homes, one-third to rental houses and two-thirds to owner-occupied houses. Also, later after moving into the houses people helped each other in childcare, and elderly care. Obviously, it emerged conflict of interests between the members, e.g., among those who wanted to paint roofs with flowers and those who wanted to install solar photovoltaic on the roof. A compromise was made by agreeing that small roofs should be only used for flowers and the large roofs for solar photovoltaic.[29]

The Keehäuser group is considered ecologically-oriented co-building group because of many reasons: 1) using eco-friendly building materials (e.g. untreated steel plates and untreated Douglas) in the construction of passive houses; 2) saving resources and energy by sharing common spaces and equipment for energy-consuming practices e.g., washing and cooking; 3) relying on solar thermal heating and solar photovoltaic and participating in a regional wind turbine; 4) building good thermal insulation, big windows to the south and ventilation towers; and 5) installing a micro CHP in the house to meet a possible high demand for heating in winter. Then, after moving into the houses the members were committed to reduce residential energy consumption related to different practices (e.g., water heating, space heating and cooling and electricity used for electrical appliances and lightning). In 2008, the co-building group Keehäuser was awarded important prizes for bringing together the social and ecological aspects of housing such as the ZDF prize for energy saving in new buildings and the prize from the Association of German Architects BDA in Baden-Württemberg for building zero emission homes.[30,31,32]

Summary of the case study results

In Freiburg there are almost 200 co-building groups, of which 120 in Rieselfeld and 60 in Vauban[33], which have played a vital role in achieving urban transition. Members of a co-building group are often well-educated and possess adequate professional skills and motivation for innovation. They focus more on the process of planning and construction (e.g., self-determination, responsibility) and the sustainability aspects of buildings.[34]

The co-building groups played a major role in initiating and implementing sustainable building practices and in increasing the sense of ownership and social sustainability in both Rieselfeld and Vauban. In particular, in Vauban, they have contributed to an early involvement of the users in the design and building process of their own houses, affordable home ownership, and user-oriented architectural design, which generated identity and a sense of place.[35,36,37] As the Table 2 shows, the co-building groups can be driven by different reasons.

Table 2: Most frequented reasons to build co-building groups.[38]

Economic reasons
- To save costs up to 20% compared to conventional construction
- To reduce operational costs by excellent thermal insulation
- To distribute administrative costs over many members

Social reasons
- To get know the neighbours before moving into the house
- To support each other both under the contraction and occupancy
- To shape the neighbourhood as a social network and to increase social stability
- To involve the future occupants in the individual design of their home

Ecological reasons
- To avoid urban sprawl and the intensive use of cars
- To protect the environment and human health through the use of appropriate construction materials and technologies
- To conserve energy resources by creating onsite energy supply

The co-building groups usually introduce and implement innovative ideas not existing in the mainstream construction &housing market. According to Hubert Burdenski, chairman of the co-building association in Germany, the co-building groups in Vauban and Rieselfeld think always a step ahead than the city planners and commercial developers by introducing and implementing innovative ideas for low-energy housing. When people build their own houses together they are personally motivated or socially obliged to use eco-materials and to save more resources.[39]

DISCUSSION: CO-BUILDING GROUPS AS INSTITUTIONAL ENTREPRENEURS

Drawing on the results of empirical work, the key research questions are addressed in the following sub-sections.

The potentials and limitations of co-building groups

The co-building groups have played a major role in initiating and implementing sustainable building practices and in increasing the sense of ownership and social sustainability in the city districts of Rieselfeld and Vauban. They have contributed to the diversity of housing market in Freiburg, and have played a multi-functional role in increasing the home ownership, affordable housing and ecological housing, as main pillars of urban sustainability. Some co-building groups, besides the incitement to save effort and money, could bring social and environmental aspects of sustainability together. Thus, the German model of co-building groups could be a roadmap to a socially-sustainable built environment and as an emerging pathway towards sustainable urban transition. Nevertheless, two limitations to upscaling and institutionalising the concept of co-building groups are addressed here.

First, applying the concept of co-building groups requires a bottom-up approach to planning and construction, and a strong social movement organization capable to convert bonding social capital (initial informal relationship) into bridging social capital (the ability to link with external bodies and expertise). Therefore, the concept could only work in those contexts highly supported by planning policy framework. For instance, in the last years many Swedish groups have visited Freiburg to look at this housing model but have not been able to apply it, because the Swedish housing market, which is dominated by a few commercial housing companies, hasn't allow it. Also, Little concludes that Freiburg is characterised by "sustainable urban communities" supported by a constellation of different actors (city councils, planners, architects, grassroots activists and citizens), which are highly lacking in the Irish housing market.[40]

Second, the co-building groups might cause social exclusion. Members of co-building groups are usually well-educated people with main motivation to save on housing costs. It is therefore not very relevant for low income households. Co-building groups "as practised in Germany - would not be appropriate for less well-off households. This is because of the initial collateral required alongside the necessary budgetary flexibility and the potential for project over-spend".[41] As the initial network of a co-building group is growing, many conflicts can arise among members. For instance, individual design preferences can be confronted with collective needs and interest, which usually requires professional mediation. The initial core group members may accept external members in order to create a more professionally-led group and to institutionalise the objectives of the group. However, the privilege of the core group in selecting relevant members might imply social exclusion of less financially able community members.[42] The core group is usually characterized by people from similar socio-economic backgrounds, who come together based on previous experiences and relationships. About 56% of the group members in Freiburg find each other through personal contact. Therefore, they might imply exclusion policies, for instance, by rejecting less financially capable applicants, disabling social mix in the neighbourhood.[43]

The role of planning policy framework in supporting co-building groups

The planning policy framework in Freiburg supported the formation and development of innovative niches of co-building groups, as alternatives to existing housing. They provided an enabling context in which the power of speculative developers was reduced in favour of co-building groups. On the basis of the contribution of co-building groups to sustainable urbanism, the City of Freiburg provided a lower price of land for co-building groups in a competitive bidding process. In return, it required that in the buildings, constructed on municipal land, the annual heating (space & water heating) should not exceed 65kWh/m2, which is significantly above Baden-Württemberg standards.[44]
However, certain norms and values are highly embedded in the strategies, interests and preferences of mainstream developers. Therefore, the long-term survival of the existing players in the housing market, especially commercial developers, will dependent on their capacity to adapt their business strategies, which they have successfully pursued in the past decades, to the new environmental policy. It has been possible up to now for many mainstream developers to survive by relying on the existing core competencies of construction. Nevertheless, the requirement of the new regulatory framework to enhance sustainable buildings and neighbourhoods, is likely to convert (or enforce) such competencies into new knowledge and values.

CONCLUSIONS

Co-building groups as an innovative niche to the existing housing market can act as a key trajectory to facilitate sustainable urbanism. They are able to contribute to new forms of the community planning and co-living, whether as passive houses or as multi-storey wooden houses. They could provide new pathways for the climate-neutral and resource-conserving neighbourhoods. Furthermore, they can contribute to achieving many urban sustainability agendas: affordable housing, high quality and liveable places, the alignment between individual and collective desires, and enhanced community identity and social cohesion. However, they remain a niche in the mainstream housing market and will meet a wide range of challenges in transforming the existing housing system towards more sustainability. The entrance of co-building group (as a growing segment) into the mainstream housing market depends largely on their success in dealing with a variety of contested debates around sustainable buildings (e.g. energy efficiency, comfort, and cost savings). Therefore, the future work about co-building groups can focus on the questions about potentials and obstacles to upscale co-building groups, including their knowledge and skills, technical systems, managerial systems, and values and norms.

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SOLID WASTE MANAGEMENT IN DEVELOPING NATIONS: AN ASSESSMENT OF RESIDENTIAL APARTMENTS IN IKEJA, LAGOS STATE

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INTRODUCTION

Waste management is an efficient method of handling generated wastes, which involve processes and conscious efforts at minimizing it[1]. Increase in waste in recent times has been due to a rise in population and consumer spending, which is as a result of growth in wealth, and the major source of solid waste generation has been attributed to households. The types of solid waste amongst others are, paper, nylon, wood, dust, cloth, metal, scraps, bottles, electronic gadgets, food remnants, rubber and plastics. The massive generation of these wastes in Nigeria, have made the capacity to naturally absorb them become a challenge[2]. It is believed[3] also that, these environmental problems grew out of human impact on the natural system, and that the growth of solid wastes is an environmental problem in different localities in Nigeria. He also sees the prevalent idea of throwing away wastes at every available space in every settlement in Nigeria as a noticeable menace. This has led to heaps of refuse dumps along streets, motor parks, schools, markets and people's immediate environment. It constitutes a nuisance with an unpleasant odours, thereby breeding pests, and diseases[4].

Figure 1. Wastes indiscriminately dumped in a neighbourhood at Ikeja

It is established already that waste generation increases due to urbanization, as it is the case in developing countries like Nigeria and in mega cities like Lagos state. This calls for the need to manage wastes adequately towards the achievement of sustainable development, with the consciousness that, the volume of wastes generated is a reflection of human activities[5].

Lagos state has a population of about 20 million, with an annual growth rate of 3-6%. The city generates about 10,000 metre tons of waste per day, which results into 0.5kg per person per day. According to figure 2, the amount of waste generated follows the same trend as the population[6].

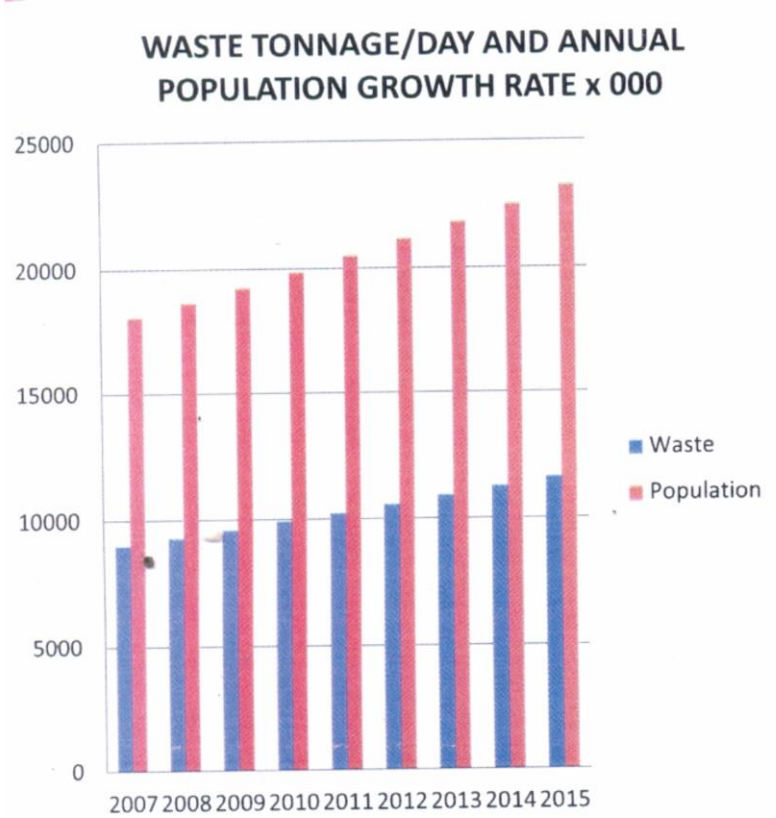

Figure 2: Waste generation and annual population growth rate x 000 (Olubori, 2013).

Research Focus

This research is aimed at finding out, how waste is managed in residential apartments of Ikeja, with a view to finding solutions to identified lapses.
This aim will be achieved by making findings on residents' assessment of waste management in their apartments and their attitudes to it.

Overview of Solid Waste, Assessment and Residential Buildings

According to New York Department of Environmental Conservation[7] solid wastes are abandoned or discarded, they listed to be waste tyres, scrap metal, latex paints, furniture and toys, garbage, appliances and vehicles, oil and anti-freeze, empty aerosol cans, paint cans and compressed gas cylinders, construction and demolition debris. Mason community services[8] in similarities to New York department of conservation definition considers solid wastes to be items like household garbage, food wastes, yard wastes, demolition and construction debris, household appliances, furniture, scrap metal, machinery, car parts and abandoned and truck vehicles. But for United States Environmental Protection Agency[9], solid waste is any garbage or refuses, sludge from waste water treatment plant, water supply treatment plant, air pollution control facility and other un-needed materials that emanates from community activities. However, Encyclopedic.com[10] simply defines solid waste as a "broad array of materials discarded by households, businesses, industries, and agriculture".
Assessment on its own is viewed as an appraisal or evaluation[11]. It is also regarded as an act of deciding the value or importance of a phenomenon[12]. But, according to University of Connecticut[13], It is a process of gathering and evaluating information from various sources towards developing a deep understanding is equally an assessment.
However, for a building or an apartment to be regarded or perceived as residential, Glossary of Statistical Terms[14] concludes that, more than 50% of the floor area must be used for dwelling. Statistics Finland[15]

goes further to classify residential apartments into categories, which are: detached houses, semi-detached houses, terraced houses, row-houses and blocks of flats.

Figure 3. Typical views of residential apartments in Ikeja. Source: Field work

STUDY AREA

The case study approach was adopted for the study. The specific case selected was Ikeja. Lagos State, where Ikeja is situated, was created on the 27th of May, 1967, through States Creation and Transitional Provision Decree No 14 of 1967. Before this time, Lagos municipality was administered as a Federal Territory by the Federal Government. The State took off fully as an administrative entity on the 11th of April, 1968. It is the 6th largest city in the world, with the smallest landmass in Africa. It is West Africa's most resourceful single trading market with highest concentration of people, and it is projected to be the 3rd largest urban conurbation in the world in the year 2015. It has an area of 358,861 hectares or 3,577sq.km[16].

Figure 4. Map of Nigerian, showing the location of Lagos State. Source: http://www.google.com.ng (2013)

Lagos is located on the Atlantic coast in southern Nigeria (figure 4); it became the capital of southern Nigeria in year 1906, and later became the capital of Nigeria after the combined protectorate of Nigeria was formed in 1914. It became a melting pot, through its being the terminus of roads and rail lines leading to all parts of the country and it is the site of Nigeria's main international airport. The political and economic situation in recent years attracts more Nigerians to metropolitan Lagos to seek employment, a situation which has led to a constant increase in its population.

Although Lagos state, in terms of area, is the smallest state in Nigeria, of which 75,755 hectares of its area are wetlands, yet it has the highest population, which is over five per cent of the national estimate. Of this population, Metropolitan Lagos, an area covering 37% of the land area is home to over 85% of the State population.

The rate of population growth is about 600,000 per annum with a population density of about 4,193 persons per sq. km. In the built-up areas of Metropolitan Lagos, the average density is over 20,000 persons per square km. Current demographic trend analysis revealed that the State population is growing ten times faster than New York and Los Angeles[17]. Ikeja, the study area is the administrative capital of Lagos state.

The choice of Ikeja for the purpose of this research is due to its significance in Lagos state and its importance to Nigeria. Its economic and social activities make it a place of good representation (Meenan, 2004).

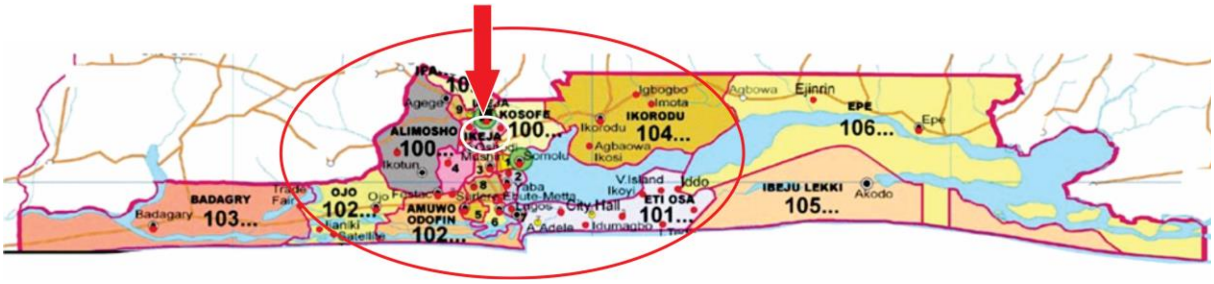

Figure 5. Map of Lagos State, showing Metropolitan Lagos in red highlight, and the red arrow pointing to the location of Ikeja. Source: www.google.com

SAMPLING TECHNIQUE

The study area has all the classified areas in it; low density, medium density and high density income.

Table 1: Wards within Ikeja Local Government

		HIGH DENSITY WARD	MEDIUM DENSITY WARD	LOW DENSITY WARD
Ikeja	1		Anifowose/Ikeja	
	2		Agidingbi/Omole/Ojodu	
	3		Alausa/Oregun/Olusosun	
	4		Onilekere/Onipetesi	
	5	Ipodo/Seriki Aro		
	6		Adeniyi Jones/Ogba	
	7		Okeira/Aguda Titun	
	8			Onigbongbo
	9			GRA
	10		Wasinmi/Opebi/Allen	

Ipodo/Seriki Aro, the only high density ward in Ikeja was selected, Wasinmi/Opebi/Allen was randomly selected from the medium density wards, while GRA was equally selected, from the low density wards. These wards are randomly selected, in reference to table 2.
Questionnaires were administered in selected residential buildings within these wards. Stratified sampling procedure employed in this research was to ensure adequate representative of the study population across all types of residential neighbourhoods.
Number of questionnaires distributed and retrieved, are as stated in table 2

Table 2: Distributed Questionnaires and retrieval rate

Density Area	No distributed	No returned (%)	No properly filled (%)
High Density	262	180(68.7%)	160(89.0%)
Medium Density	253	200(79.1%)	177(88.7%)
Low Density	235	215(91.5%)	208(86.7%)
Total	750	595(79.3%)	545(72.7%)

FINDINGS

Across the density zones, most respondents are males at 64.4%, while 36.6% of the respondents are females (Table 3). Majority of them are married (59.7%), while 27.5% are just single (Table 4).

Table 3: Respondents' Gender

		High Density	Medium Density	Low Density	Total
Respondents' Gender	Female	53(33.1%)	62(35.0%)	79(38.0%)	194(35.6%)
	Male	107(66.9%)	115(65.0%)	129(62.0%)	351(64.4%)
	Total	160 (100%)	177 (100%)	208 (100%)	545 (100%)

Table 4: Marital status of respondents

		High Density	Medium Density	Low Density	Total
Marital Status of Respondents	Married	96(60.0%)	111(62.7%)	115(55.3%)	322(59.1%)
	Divorced/Separated	4(2.5%)	4(2.3%)	12(5.8%)	20(3.7%)
	Widowed	5(3.1%)	5(2.8%)	6(2.9%)	16(2.9%)
	Single Mother	4(2.5%)	4(2.3%)	6(2.9%)	14(2.6%)
	Single father	3(1.9%)	9(5.1%)	8(3.8%)	20(3.7%)
	Never Married	47(29.4%)	44(24.9%)	59(28.4%)	150(27.5%)
	Others	1(0.6%)	0(0.0%)	2(0.6%)	3(0.6%)
	Total	160 (100%)	177 (100%)	208 (100%)	545 (100%)

According to the highlights of table 5, most respondents (84.3%) rely on the government agency to dispose their wastes off their apartments and compounds. These wastes are kept for 4-10 days in their apartments before disposal; this is practiced by a total of 67.2% of respondents. Most of them adopt the use of waste bins (covered and open) to store their wastes. The wastes are mostly kept within the compounds (50.5%), though a number of them store wastes in their kitchens and balconies (46.3%). 76.6% of respondents admit that they do not sort their wastes before storage. Most of the respondents are however of the opinion that, waste management was not envisaged at the point at which their apartmnets were conceptualised.

Table 5: Respondents' attitude and perception concerning waste management

		High Density	Medium Density	Low Density	Total
Mode of waste disposal	Government agency	134(83.8%)	153(86.5%)	173(83.2)	460(84.3%)
	Dump Site	8(5.0%)	10(5.6%)	15(7.2%)	33(6.1%)
	Any available space	8(5.0%)	3(1.7%)	8(3.8%)	19(3.5%)
	Paid Community waste disposal	10(6.2)	11(6.2)	12(5.8%)	33(6.1%)
Frequency of waste disposal	1-3 days	44(27.5%)	43(24.3%)	48(35.6%)	135((24.8%)
	4-6 days	51(31.9%)	60(33.9%)	72(39.3%)	183(33.6%)
	7-10 days	55(34.4%)	59(33.3%)	69(37.7%)	183(33.6)
	Above 10 days	10(6.2%)	15(8.5%)	19(12.6%)	44(8.1%)
Waste Storage	Open waste bins	43(26.9%)	46(20.0%)	48(23.1%)	137(25.1%)
	Covered bins	70(43.8%)	82(46.3%)	113(54.3%)	265(48.6%)
	Waste bags	41(25.6%)	44(24.9%)	34(16.3%)	119(21.8%)
	Bare-floor	1(0.6%)	4(2.3%)	3(1.4%)	8(1.5%)
	Others	5(3.1%)	1(0.6%)	10(4.8%)	16(2.9%)
Where waste is kept	Kitchen	31(9.4%)	34(19.2%)	69(33.2%)	134(24.6%)
	Balcony	43(26.9%)	39(22.0%)	36(17.3%)	118(21.7%)
	Outside apartment Within compound	78(48.8%)	97(54.8%)	100(48.1%)	275(50.5%)
	Others	8(5.0%)	7(4.0%)	3(1.4%)	18(3.3%)
Waste sorting	Yes	22(13.8%)	18(10.2%)	38(18.3%)	78(14.3%)
	No	114(71.2%)	141(79.7%)	162(77.9%)	417(76.5%)
	No idea about sorting	24(15.0%)	18(10.2%)	8(3.8%)	50(9.2%)
Provision for waste management in Building Design	Yes	66(41.2%)	58(32.8%)	74(35.6&)	198(36.3%)
	No	94(58.8%)	119(67.2%)	134(64.4%)	347(63.7%)
	Total	160 (100%)	177 (100%)	208 (100%)	545 (100%)

RECOMMENDATIONS

As highlighted, the first four recommendations are based on British Standard's Waste management in Buildings – Code of practice.

1. Regulations that will require local authorities and private sector organisations to increase recycling targets, to be put in place. This will have a positive effect on residential apartments.
2. Designers should give attention to safe access to collectors and collection vehicles (Figure 6).

3. Waste points should be located, without resulting into injury or becoming a nuisance, and should be protected from scavenging.
4. Storage areas should be well ventilated.
5. Government and private organisations should draw up plans to educate the residents, including putting it into the schools curricula, in order to get them more involved on waste management issues.
6. There should be legislations to take care of environmental sanitation offences.

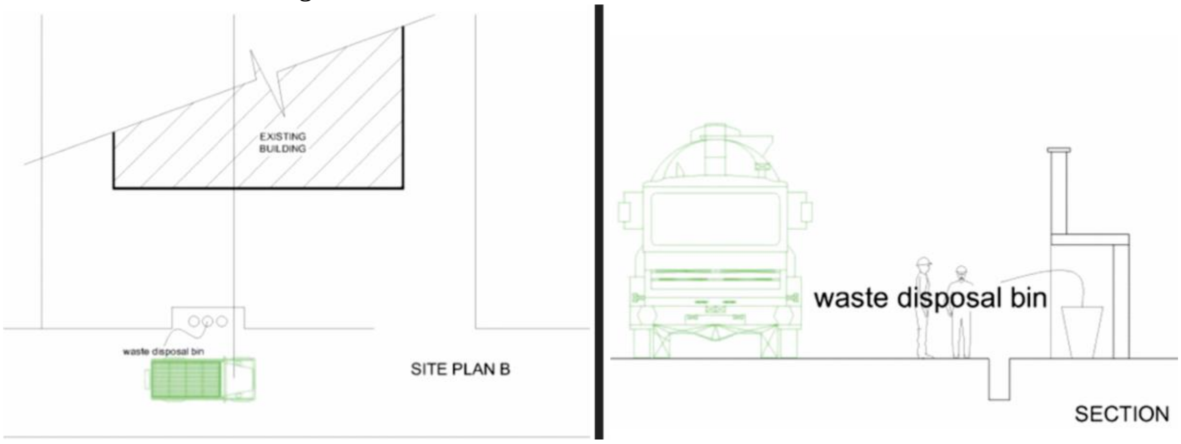

Figure6: Recommended wasted storage before disposal (plan & section)

CONCLUSION

Findings in this research are based majorly on the perspective of residents. If properly annexed, it will lead to policies that will bear positive influence on neighbourhoods and the people.

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RETROFITTING THE ARCHITECT: DESIGNING WITH (SUSTAINABLE) STAKEHOLDERS' PRACTICES IN MIND

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INTRODUCTION

When it was made public that the RCR Architects studio had been awarded the Pritzker Prize, a widely circulated congratulatory email stated in three languages that "sustainability, social, mobility…everything is important and helps, but *what really matters* is space, light, material, time…" (our emphasis). We find over and over again this same opposition between aesthetic categories and other dimensions and criteria that could, or should, guide architectural design and the assessment of its worth. Again, now in the words of Steven Holl, and in a slightly more balanced way: "The space, the geometry, the light of an architecture in great proportions must remain *the core aim*, while engineering aims for zero carbon, ultra-green architecture"[1] (our emphasis).

But design needs to be *integrated* in order to achieve truly sustainable levels. Even among those architects that do not reject it outright as some fashionable and soon-to-be-forgotten strand, we find a counterproductive tension between the axes of sustainability (experienced by many as yet another set of technical constraints) and aesthetics (understood generally as the core of the creative enterprise of the architect). This tension may be explicit or, worst of all, tacit, a taken-for-granted part of the professional ethos and outlook of architecture. How architects *do* architecture defines the limits to how they will work existing opportunities for greater sustainability into their projects, but also whether they will *discover* new opportunities for it.

This is, to start with, a question of *when* decisions are taken. As Lance Hosey puts it, "up to 90% of the impact of a building or product is determined by the earliest design decisions: location, orientation, massing, form, fenestration, etcetera". But if *creative* decisions that shape those parameters take place empirically before those oriented by *calculations* (and this is another way to rephrase the tension we pointed at above), the result may be closer to lipstick-on-a-pig, or to put it more mildly, a massive loss of opportunities for well-oriented design decisions at the point in the design process when they most matter.

But we need to go a step further, or, as it were, take one back. Even before the architect defines shape, location or massing, some decisions might have severely curtailed the ecological potential of the construction. A building that is not connected with the public transport networks, a building that introduces a program that is redundant in an area, and, fundamentally, any new building in a neighbourhood where underused equipment exists, are all ways to miss the most relevant sustainable aspirations. If the decision on sustainable elements comes at the end of the design process, we are probably never going to reach the highest standard in any eco rating scheme. But if a new building

is done when we could have refurbished existing ones, we would be wasting resources unnecessarily, probably to an even greater extent. Questions facing ecological challenges need to appear before the pencil touches any more or less white surface (since building "generative" ideas are often, and famously, traced on napkins).

Discussions around architectural sustainability often take for granted that the process of building itself is not in question. That is, they accept that building is the best solution for the problem at hand: sheltering, connecting, isolating, etcetera. But we would like to take a page from the analysis of power, as in the classic Bachrach and Baratz contribution[2], and bring to the fore the relevance of non-decisions (to build), or more precisely, keeping as open as possible the range of best options in order to solve the problem at hand. Bachrach and Baratz pointed out that deciding the scope of what is to be decided is itself the first, and often the most significant, locus of power. We think this is very much also the case for sustainable architecture: building towards a good solution may not involve what is conventionally understood as building. Transforming an existing building, offering the population better access for facilities, providing services (perhaps not place-based) are sometimes much better solutions that a brand new building in terms of reducing impact and creating benefits. What this also entails is that these solutions may not be achieved by conventional architects.

The scale of changes

We do not think it is necessary to diagnose yet again the role of the built environment in achieving greater degrees of sustainability. It may be useful, however, so as to gauge the proportions of the challenge to the profession, to look at strategies towards climate stabilization, such as the "climate wedges" approach proposed by Princeton researchers[3]. They indicate that building energy use should decrease 25 per cent from current (2004) levels by 2054, as one of the main 'wedges' that would take us down from 'business-as-usual' scenarios of runaway climate change. This should be accomplished through a combination of retrofitting the extant stock, and by pursuing "known and established approaches", as the 1996 IPCC put it (more than twenty years ago) to energy use reduction in new designs.

This goal, we think, calls for a radical rethinking of the role of architects and of the building sector in general; for example, they may have to think of themselves not as (primarily) builders of new stock, but as large-scale retrofitters. Of course, new and old buildings need to be designed to fulfil demanding goals. But also, and crucially, the architectural profession needs to reinvent itself.

A way to visualize this is to see the changing role of architects as part of the transition from an 'empty world' paradigm to that of a 'full world', a formulation we borrow from the ecological economist Herman Daly[4]. He applied it to neoclassical economics, but it is equally relevant to architecture, as part and parcel of the professional and economic system that "filled in" the world. This means the tools, references, habits, and criteria of excellence they used must be completely overhauled. In particular, we would like to draw attention to the creative impulse, an important motivator and shared value for the designer community.

THE PROBLEM AT THE HEART OF ARCHITECTURAL PRACTICE

We posit that how architects (empirically) do architecture is a crucial dimension of the wicked problem of giving people a built environment that helps them to live within their ecological means. Within the cultural values, norms and patterns that we find in the architectural community, we emphasize, because of how it impacts sustainability, the very diverse meaning and enactments of *creativity*. We could call this "the fountainhead problem", alluding to how the classic Ayn Rand novel and King Vidor film codify in popular culture a certain image and understanding of the relationship of the architect, her work and the ownership-authorship nexus between them.

If architects are taught and come to identify themselves as creative professionals, what do we mean by that? Creativity can be enacted in very diverse practices, with widely differing impacts on

sustainability. Some of them actually run counter to it. We have found among prestigious architects a certain understanding of creativity, which we could define as the ability to translate inner preoccupations and intuitions, even personal obsessions, into built matter: self-expression or self-referentiality are, in this domain, often mistaken for creativity. From this understanding, technical parameters (where sustainability is subsumed, in this point of view) are but constraints that must be solved (often by third parties, such as structural engineers) for the aesthetic language of architecture (and its particular declension in the individual architect-author) to emerge.
In order to understand how this severely hinders sustainable solutions (and even more so non-solutions), we need to understand the sources of “inspiration” that architects use at the core of their projecting practices. Although usually mixed, we can distinguish at least the following:

a) The imitation of disciplinary prestigious forms.

b) Unlikely solutions (seemingly unstable cantilevers, immensely terse façades without any protruding elements, spaces were all elements are part of a continuous surface) that tell them apart from what non-professionals would do.

c) Elements that show in their final shape the origin of design ideas, or the process of development and materialization process (first “napkin” sketches, later to be revered, for instance).

d) Allusions to other parallel artistic disciplines, that are valued as prestigious within architectural cultural references: certain films, photographers’ works, writings.

e) Purely self-referential items, related to the architect’s personality, tastes, personal history or memories.

We find it hard to ascribe true creativity to these self-expressive and self-referential reflexes, most of all when they get in the way of truly creative solutions to the immensely more wicked, and certainly more relevant, problem of achieving sustainability. We suggest a way to destabilize this neat opposition that has the potential to redefine a good part of architects’ professional identity and practices.

ADDING A THIRD (USER) DIMENSION

The core of this strategy is a deep engament with all stakeholders in the process of carrying out architectural projects, particularly (but not only) users. The consequences of this engagement are multiple, but they include new forms of communication, reflection and learning, a different way to conceptualize the life span of the project, and a multidimensional set of evaluation criteria.
These features have in fact been an underexamined dimension of the best architectural work that we have examined, which is not often the one referenced and paraded in the glossy magazines of this professional world. Take the work of Jan Kattein, whose actions towards enlivening commercial street involve building… social relationships, like introducing neighbourhood kids to shop owners and workers. This is (obviously) a very low-emissions strategy (more on this below).
However, standard visual depictions of architectural projects and works constitute a paradoxically invisible barrier to this type of architecture. Depicting architecture as a life-scale model has become a cottage industry by itself, and the hegemonic language to represent, discuss and criticize it. But very little information of the dynamic, multiple point-of-view practices we see as crucial can be inserted onto the slick pages of buildings where all signs of real life is carefully excised. The insertion of pseudopoetic text comments few people read is another layer of non-information as to how the people in those spaces lived, spent energy, changed materials or solved daily problems, thanks to or against their built environment.

So, the first stage in a three-dimensional architecture is to understand *all* stakeholders involved in a given situation, devise ways to represent their points of view and practices, and design on those grounds. Again, this calls for more tools (including ethnographic observation, discussion groups or interviews) than the ones traditionally deployed by architects; more diverse work teams, and new criteria for their decisions.

To enable architects to operate in the space defined by this third dimension, we will address now only two of the many possibilities we have identified as candidates for deep changes in architecture design teaching, research and professional practice.

First and perhaps foremost, architects must both build and make explicit[5] their design agenda. In all their endeavours, they need to spell out clearly (and beforehand) what their goals are: "I am trying my building to incorporate a communal space in the terrace that is accessible 24/7, I am trying to reduce the weight of and average construction by 25 per cent, I am trying my building to introduce a beneficial shadow in the adjacent plot". Making the design agenda explicit help architects, and all stakeholders involved, realize what the real scope of their intervention is, and engage in an informed, productive, continuous and symmetrical dialogue.

This design agenda must be, therefore, inclusive of all people that could benefit or otherwise be affected by this architecture. In this list we recommend to include not just immediate users but renters, promoters… but also non-humans, to use a Latourian term: air, waterways, soil, and living beings they support.

In practical terms, architects should acknowledge and incorporate into their design those objects and processes that are immediately useful to stakeholders. Rather than the sources of inspirations deemed "artistic" or "creative" (ultimately, self-referential), they may derive their first ideas from those elements, usually a varied bunch of details, which are more likely to engage their stakeholders. Doors, gates, furniture, windows… elements they interact directly with.

Architecture has been thought of as the aesthetically engraved hardware to human interaction and social software. In order to reach the degree of sustainability that the ecological crisis demands, it needs an upgrade, and it needs to learn to use those very soft tools in opposition to which it once defined itself. This will come to redefine what architecture is, how it is done, and what good architecture is valued. And, hardest of all, the first element we need to retrofit is the profession itself.

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ENDNOTE

[1] '7 Questions with Architect Steven Holl'.

[2] Bachrach and Baratz, 'Power and Poverty'

[3] Pacala and Socolow, 'Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies'.

[4] Daly, 'Economics in a Full World'

[5] We would like to underline, although we cannot dwell at length upon this point here, the relevance of the writing form itself, and how it should embody this imperative towards design openness.

ASSESSING SUSTAINABILITY IN HOUSING LED URBAN REGENERATION: INSIGHTS FROM A HOUSING ASSOCIATION IN NORTHERN ENGLAND

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Assessing investment in housing

Following the economic crash of 2008, it is becoming increasingly difficult for housing associations to comply with their mission[1]. Due to the financial shortage, prioritising investment in the right way is more important than in the past. The current decision making processes on investment in housing are often undertaken without having full understanding of all the benefits related to such an investment, leading to an underestimation of the overall value of the investment itself. Part of the issue is related to the lack of a robust evaluation methodology which uses an evidence based and quantitative approach to gauge the hidden benefits of a scheme. This paper aims at filling this gap, by exploring how far a more comprehensive assessment methodology, namely SUstainable Return On Investment (henceforth: SuROI), can be useful in uncovering those hidden benefits in the specific case of the social housing sector. The existing methodology has been developed up to the stage of providing stakeholders with a robust and evidence-based overall assessment of the value of an investment as a whole. This paper discusses the specific application of SuROI to the housing sector and additionally suggests the potential applicability of SuROI in mapping benefits and costs across the stakeholders' community, allowing decision makers in the housing sector to negotiate a potential financial contribution from positively impacted beneficiaries.

The paper firstly discusses limitations in the most applied assessment methods and then introduces SuROI in order to pave the way for the calculation of the overall benefits of two case studies, both approached with two alternative methods, showing how SuROI allows the unveiling of benefits which are hidden in the traditional approach. To achieve this goal, a case study research strategy has been chosen.

Critical review of the current assessment methodology

This section will set the context for understanding how the assessment of urban regeneration strategies has been typically performed so far. The aim is to appreciate the innovation behind SuROI, in comparison to recent and/ or current assessment methods, commonly used to assess the impacts of investment in housing in different programs or initiatives. The following methods, mainly related to governmental schemes, will be reviewed: (1) EGRUP Guidance, (2) City Challenge, (3) Single

Regeneration Budget, (4) New Deal for Communities, (5) Urban Development Corporations, (6) Enterprise Zones, complemented by the following methods: (7) Hemphill framework and (8) Sustainable Urban Renewal Project Assessment Model.

The EGRUP guidance uses a framework for the ex-post evaluation of expenditure and regeneration schemes[2]. The guidance concedes that although all costs can be quantified, some "important" or intangible benefits cannot be. Such benefits, for example social benefits, are simply listed, rather than being assigned a monetary and quantifiable value. In addition, attention is drawn to issues with "outputs that are essentially unquantifiable"[3]. Environmental benefits were measured quantitatively, but by using a Likert Scale. The guidance itself states that there is "clearly a need for a more rigorous approach, which would involve assigning monetary values to the environmental improvements"[4].

City Challenge Programmes had an integrated nature - traditional housing improvements were complemented by other aspects, for example, with job creation, training and crime and community safety. However no method was set up to capture any of this information in numerical and quantifiable format. Both City Challenge reports focus on outputs (rather than outcomes/ impact) and focus on expenditure and outputs in relation to annual targets[5]. Further to this, some indicators although appearing to be covering outcomes, are actually measurements of outputs[6]. Within the qualitative/ intangible areas, such as the *quality of life* category, it is stated that there is no standard indicator. In addition, within the unit cost per output statistics, values pertaining to *health* and *community and social* are simply listed, without any figures, as "not applicable" and impacts are not measured within the summary cost benefit account [7]. It is admitted within the official final evaluation that "more emphasis should be given to assessing outcomes"[8].

The Single Regeneration Budget (SRB) used indicators to gauge economic benefits, housing benefits, social benefits, environmental benefits and community benefits[9]. Social surveys and structured interviews were used to gauge opinions of key stakeholders within the SRB partnerships, together with an in depth case study approach[10]. The methodology looks to cite overall net additional achievements, however it is not able to numerically quantify the holistic sustainable impact of the programme in terms of all three aspects of the triple bottom line. In addition, it is stated that there are problems of comparability in the way the SRB is evaluated[11]. Perceptions about physical and environmental quality and amenity were assessed through resident and visitor surveys according to the methodology of Glennerster and Turner where scores were derived from direct observation[12]. In addition, in terms of the measurement of social aspects such as quality of life, quantified outputs in this area simply enumerate the numbers of new health, sports and cultural facilities and the numbers of local people given access to them. It is also stated that it is not thought generally possible to quantify all social effects[13].

A number of data collation and analysis tasks were central to the national evaluation of New Deal for Communities (NDC), the most important of which was the biennial household survey. In 2002 a baseline was established across all thirty nine NDC areas using a survey questionnaire. This addressed socio-demographic, status, and attitudinal considerations across all outcome areas. It was based on a random-sample survey design and used 3,4, or 5 point Likert scales to quantify the responses[14]. Any change in NDC areas was benchmarked against other deprived, comparator areas. No previous evaluation of any English ABI at that time had been able to explore questions of net change across all relevant regeneration areas and their residents, for all outcomes, from a common baseline[15]. NDC used shadow pricing methods to determine value for money, the first time that this had ever been carried out[16].

Urban Development Corporation (UDC) evaluations are performance related with a limited range of criteria, such as "jobs created and safe-guarded, hectares reclaimed and quantities of constructed roadway"[17]. The emphasis in UDC evaluations is on value for money with many commentators asserting that a greater range of non quantifiable variables should have been accounted for within the scope of the evaluation[18] and performance indicators [were] mainly input and output measures and "did not provide a complete basis for assessment of how effectively the corporations have achieved

their regeneration objective"[19]. A list of such indicators can be seen in Oatley (p.10) showing that social and environmental outcomes are not taken into account via a quantified methodology[20].

The final evaluation of the original Enterprise Zones (EZs) assessed the extent to which EZs had generated additional economic activity and physical regeneration[21]. The evaluation methodology covered an analysis of data, which included annual monitoring data provided by the Department of the Environment, in combination with further data collected by consultants to quantify the additional economic activity generated. Main factors analysed included employment characteristics, the number of firms established, industrial compositions of the firms within the zones, environmental improvements and impact on the local property markets[22]. The amount of jobs and costs per job created were highlighted, but the evaluation made a limited assessment of any inward investment to the zones[23]. Face to face and postal surveys were sent out to local companies to gauge company perceptions of EZ benefits. Studies were carried out to assess the effects of EZ policy on local property markets, the creation of new economic activity and impact on the physical environment. There is no mention at all within archived governmental documentation on Enterprise Zones of social and environmental impacts being quantified.

Hemphill et al. measure sustainability by allocating a points score to indicators within five areas - economy and work, resource use, buildings and land use, transport and mobility and community benefits. Residents and other users within a regeneration area are consulted through questionnaires and structured interviews where results contribute directly to a points scoring system. Points are allocated to each involved indicator and to each indicator set. Indicators are used to measure the performance of the regeneration scheme against sustainability criteria. However the authors add that "although it is possible to set indicator parameters for certain regeneration outputs (number of jobs created; amount of private sector investment levered), it is difficult to extend the same rationale to more specific and intangible sustainability criteria"[24].

The Sustainable Urban Renewal Project Assessment Model (SURPAM) model uses weighted indicators resulting from surveys and questionnaires. Subsequent factor analysis and analytic hierarchy process was carried out. All indicators fall under the triple bottom line. The model requires input from stakeholders and can be used to properly plan a prospective urban regeneration scheme. Citizens are able to express opinion on the design of a particular proposal before it becomes a reality with scores being expressed through multiplication of the weight of a design criterion by the score indicating the performance of a scheme with respect to an individual criterion. However, it is cited by the authors that the model struggles to measure subjective topics such 'sense of community' as it "was impossible to develop relevant quantitative indicators" for this[25].

Towards a more comprehensive appraisal of the impacts from housing investments: implementing the Sustainable Return on Investment (SuROI) approach

The review of assessment methods and tools discussed in the previous section allows the assertion that, despite there being previous tools which have evaluated urban regeneration schemes, there appear to be none which take into consideration the hidden social and environmental benefits of a scheme. No tool then goes on to quantitatively measure such hidden benefits by the usage of SuROI [26] which incorporates such frameworks as Social Return on Investment (SROI) or Ecosystem Services Analysis (ESA) and places a numerical value on social and environmental components of the triple bottom line; aspects which are normally difficult to compare against more easily measured economic impacts[27]. Recent guidance from the Royal Institute of Chartered Surveyors (2014) recognises the need to include a wider range of factors that can influence the value of built environment projects and asserts that sustainability considerations are now considered as important when undertaking

valuations[28]. In addition, the Social Value Act (2012) requires that economic, environmental and social benefits are taken into consideration as part of any procurement processes, showing that the focus on sustainability is starting to become more important at national level.

SuROI aims to allow the environmental and social value of a project, programme or policy in the built environment to be made explicit through evidence, and be added to capital costs to give an overall sustainable value [29]. SROI compares the prospective social benefits of a particular scheme against its costs and ESA takes the costs and benefits of the environment into consideration. ESA covers both the natural and built environment, including architectural aspects within its definition[30].

Table 1: Criteria for assessment for SuROI as against other more traditional approaches (Authors' elaboration)

Evaluation method	Holistic (focus on economy, environment, social issues)	Measures inputs of a project	Measures outputs of a project	Measures outcomes of a project	Measures outcomes quantitatively	Measures social impact quantitatively	Measures environmental impact quantitatively
SuROI	✓	✓	✓	✓	✓	✓	✓
SROI	✗	✓	✓	✓	✓	✓	✗
EGRUP	✗	✓	✓	✓	✗	✗	✗
CC	✓	✓	✓	✗	✗	✗	✗
SRB	✓	✓	✓	✓	✗	✗	✗
NDFC	✓	✓	✓	✓	✓	✓	✗
UDCs	✓	✓	✓	✗	✗	✗	✗
EZs	✗	✓	✓	✗	✗	✗	✗
Hemphill et al	✓	✗	✓	✓	✓	✗	✗
SURPAM	✓	✗	✓	✓	✓	✗	✗

SuROI is heavily influenced by SROI and incorporates the Social Value UK impact map (Figure 1) as its framework[31]. For more information on how SuROI differs from SROI, please see Bichard (2015) and Higham et al. (2017)[32].

The impact map requires the inputting of details and figures into its spreadsheet format to ultimately arrive at a final quantitative impact ratio of a project. Such details include the establishment of stakeholders (those who influence the project), inputs (costs of the project), outputs (number of units of delivery) and outcomes (predicted/ stakeholder change)[33].

There are five stages involved in a SuROI calculation. Four stages can be seen within the parameter of the impact map, in spreadsheet format, with the final stage 5 involving the final ratio centred calculations. For further detail on the stages of the calculation process see Higham et al., (2017) or Bichard (2015)[34].

Stage 1		Stage 2			Stage 3								Stage 4					
Stakeholders	**Intended/unintended changes**	**Inputs**		**Outputs**	**The Outcomes (what changes)**								**Deadweight %**	**Displacement %**	**Attribution %**	**Drop Off %**	**Impact**	**Action Plan**
Who do we have an effect on? Who has an effect on us?	What do you think will change for them?	What do they invest?	Value £	Summary of activity in numbers	Description	Indicator	Source	Quantity	Duration	Financial proxy	Value £	Source	What would have happened without the activity?	What activity did you displace?	Who else contributed to the change?	Does the outcome drop off in future years?	Quantity times financial proxy, less deadweight, displacement, and attribution.	What needs to be done?
					How would you describe the change?	How would you measure it?	Where did you get the information from?	How much change was there?	How long does it last?	What proxy would you use to value the change?	What is the value of the change?	Where did you get the information from?						

Figure 1. SuROI impact map, which uses the Social Value UK SROI impact map as its framework

Research Methodology

To demonstrate how far SuROI can support a more comprehensive evaluation of the benefits deriving from investment in housing schemes, two extant case studies have been selected, drawing from a housing association based in North West England. City West Housing Trust (CWHT) is a not-for-profit housing association, based in West Salford. The two case studies covered were chosen due to the range of housing types on offer, the amount of community engagement carried out with stakeholders by CWHT and the potential for future research. Both cases have been investigated by analysing internal reports and documents and by interviewing selected key informants from CWHT. The case studies were chosen from other projects within the company due to them being the only two schemes that had reliable recorded stakeholder feedback on them.

The first case study is a high rise scheme. CWHT has invested £43.2M to improve 666 high rise flats across 9 blocks in Eccles, Salford. Improvements include thermal cladding, enclosed conservatory balconies, self-cleaning windows and new lifts, whilst internal improvements include remodelling to provide an open plan living space as well as new kitchens, bathrooms, security doors and heating and ventilation systems. The figures below show before and after photos of the high rise blocks.

Figure 2. City West Housing Trust high rise blocks before works

Figure 3. City West Housing Trust high rise blocks after works

The second case study is an environmental scheme. During 2014/15 CWHT delivered high specification environmental improvements to 476 customer homes. These improved the physical appearance of neighbourhoods, enhanced property security and provided off street parking. The figures below show photos of before and after the works:

Figure 4. City West Housing Trust "environmental" scheme before works

Figure 5. City West Housing Trust "environmental" scheme after works

In order to appreciate the contribution of SuROI to a better understanding of the benefits achievable, both case studies have been assessed twice, by adopting both a "traditional" approach and the SuROI approach, allowing a comparison of the numerical values from the two methods. As the "traditional" method, the authors decided to select the Single Regeneration Budget (SRB), because SRB projects were subject to a considerable amount of monitoring and evaluation[35]. It had also been responsible for a huge amount of expenditure across the UK(£26 billion in the 1990s)[36], it is holistic in approach[37] and the review of the SRB conducted from the Department of Land Economy at Cambridge University[38] had been referred to as the most extensive piece of evaluation work on the impact of urban regeneration interventions[39] and as a "substantial evaluation framework"[40].

Discussion and Conclusions

The evaluation of both the environmental and high rise schemes cited, using both evaluation approaches, highlights how, simply by using two different evaluation approaches, different conclusions on respective impacts of schemes can be gleaned.

Where items such as "intended beneficiaries" or "activities" are listed within the SRB evaluation, they are left out and not compared to the SuROI approach. The central argument and defence of this stance centres on the notion that if you cannot quantify something, you cannot measure it. This is the very stance we have taken elsewhere within the paper. Because SuROI is an evaluation method that by its very essence quantifies, subsequently enabling comparisons between previously difficult to compare items, it was felt that to ensure consistency in approach, the same stance should be used to gauge the difference in impact between the two evaluation approaches. Consequently, any aspect of the SRB approach that could not be quantified was left out and this resulted in the direct and quantifiable comparisons between the two evaluation approaches on each scheme.

In terms of the quantifiable outputs, it has been calculated that the difference in value recorded for the environmental scheme was £6.06 for every £1 invested and that for the high rise scheme the ratio was £0.23 for every £1 invested.

In terms of the types of data analysed; scheme expenditure and details of quantities of works carried out were recorded, staff salaries and officer time were factored in in terms of scheme inputs, customer surveys were used for primary data which assessed impact, the detail of which could be used within both the SRB and SuROI approaches, monetary values were used based on a suitable financial proxy[41] from a variety of respected statistical sources including the Global Value Exchange (GVE), the HACT database and in addition, a wide variety of City West Housing Trust company statistics. Such statistics included investment scheme costs, fuel bill amounts saved by tenants and the amount of rent received as income by City West Housing Trust[42].

Some observations can be gleaned from the comparison between the SRB evaluation and the SuROI approach. Within the SRB, there would appear to be a lot less information to hand from which to make strategic decisions or conclusions on the level of impact of a given scheme. In comparison, because the SuROI method "makes the invisible visible", previously intangible areas become tangible, meaning that more information is readily available to decision makers which can increase the accuracy of decision making in the field of housing led urban regeneration. Additionally, not all impacts of a scheme are going to be quantitative. The SRB led methodology quantifies qualitative values in terms of the change in numbers of respondents or percentage change of response. This provides accurate information from directly involved stakeholders, but this does not bring into play enough supporting data. By utilising the SuROI method, further indicator sets and proxies, brought

about by tapping into sometimes thousands of responses, provide much more information, which can increase the accuracy of the impact and the accuracy of any subsequent strategic decision making.

It can be difficult via a traditional method of evaluation, to come to a conclusive decision on what the clear cut, holistic and sustainable impact of a scheme is. Additionally, there is no clear cut, quantifiable and easy to understand ratio depiction of an impact or change, whereas within SuROI this is a fundamental part of the conclusion to the process. The traditional evaluation struggles to adequately compare different forms of figures available. What is the value of one percentage point or one person's response within an evaluation? Is it the same or different to £1 of return? SuROI makes it easy to contrast figures and results, by quantifying them all in the common unit of a monetary value. SuROI can use many different tools within its framework to gauge various impacts from social benefits to wellbeing, to environmental benefits. This makes SuROI a highly flexible and integrated approach. This level of flexibility and integration does not appear within the traditional evaluation. To ensure consistency in approach, SuROI's following of the Social Value SROI guidance principles brings about a discipline to an evaluation that does not appear to be present with the traditional evaluation approach involved with the SRB method. Lastly, with the SRB methodology, it would not be possible to predict the effects of a housing led urban regeneration scheme which is planned for the future. With SuROI, because of the amount of data the method taps into, a more accurate assessment could be gauged to help strategic decision making.

In conclusion, while environmental and social spillovers are largely disregarded because of a gap in the evaluation tools, implementing a more holistic and comprehensive methodology such as SuROI to the housing sector can be extremely beneficial in being able to capture those hidden benefits.

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PLANTING CITIZENSHIP: LESSONS FOR INVOKING SUSTAINABILITY VIA CHILDREN'S CIVIC VOICE

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INTRODUCTION

The critical environmental challenges facing our planet have prompted several decades of theory and practice in sustainable design around the world. This has ushered in a period of "experimenting not only with new technologies and new solutions but also with new approaches towards liveability, sustainability and resilience"[1]. What was once the domain of science is now increasingly the purview of a range of people, including local communities who are being assembled and resourced to teach and learn, to listen and be heard, to lobby and to act together in realising a sustainable, shared future.

Children's participation in this experimentation and decision-making, however, remains elusive, despite the oft-cited concerns that poor sustainability decisions made now will impact children most intensely[2,3]. This lack of children's inclusion also disregards the growing awareness amongst young people themselves of the impacts that unsustainable practices will have on their futures[4]. Children's relegation to passive recipients of sustainability policy and programming, as opposed to active participants in it, also curtails the development of the skills and agency they will need in future discussions about social, cultural and environmental resilience. As planting and nurturing a garden requires a set of skills and knowledge learned best by doing, so too does active citizenship[5].

This paper explores these dilemmas in applied sustainability research and practice, using children's active citizenship as an anchoring point for thinking about new directions in 'sustainability'. Two case studies from Melbourne, Australia will be used to illustrate lessons about how children's active citizenship can be harnessed in tackling questions of eco-sustainability and resilience.

Children's geographies, agency and citizenship

Childhood is a time of learning about preferred environments and of developing personal responsibilities towards environmental care and custodianship (concepts central to much of the literature on environmental protection and sustainability)[6,7,8]. While longitudinal research is scant on how, exactly, people develop a deep and lasting concern for the environment, there is certainly a widely-held view that these connections are made experientially and through the geographies of childhood[9,10] and have "a significance and luminous quality far beyond [their] temporal extent"[11].

Pitted against 'ideal' children's geographies, however, are some stark shifts in children's access to nature in independent and 'agentic' ways. Children's geographies are increasingly urban and 'nature' in cities is largely experienced through the more curated and less wild landscapes of urban parks, nature strips, vacant lots, urban waterways and yards that virtually ignore the needs of children[12]. Rapid generational shifts in children's independent mobility in Australia and elsewhere have exacerbated children's exclusion from their traditional geographies and relegated them, increasingly, to home, school and the back seat of the car[13,14].

These shifts in children's geographies are contributing to what many refer to as a 'nature-deficit disorder', characterised by the loss of environmental knowledge (from spatial navigation and mental mapping to recognising biological species), poorer health and wellbeing, loss of social capital and reduced agency concerning shared resources[15,16]. For "different reasons, and in different ways, children experience the negative impacts of a public realm that is neglected, unwelcoming, unsafe or downright hostile"[17] to their needs and their development as environmental custodians.

This has led to a sense of powerlessness amongst child citizens [18,19] which runs counter to practical and ethical goals of sustainability, goals which often urge protection of the environment for the sake of children and their future. It also runs counter to conceptions of childhood, which have been shifting towards a recognition of the "capacities and interest of children and young people in the here and now"[20] rather than simply as 'citizens-in-waiting'.

Children are not merely future beneficiaries (or victims) of environmental decision-making: they can be co-producers of the 'sustainability' project in a manner that builds "knowledge, skills and social responsibility"[21], both in the here and now and into the future. The following two applied research case studies from Melbourne, Australia are examples of how children's citizenship can be more directly woven into urban sustainability projects.

CHILDREN, AGENCY AND SUSTAINABILITY: TWO CASE STUDIES

Our two cases focus on arts as a tool for environmental sustainability education amongst children (*Running Wild*) and on children's civic participation in neighbourhood redesign as a vehicle for social sustainability in neighbourhoods (the *Citizen Kid Planning Group*). Both cases involved place-based activities in different areas in metropolitan Melbourne, Australia (Figure 1).

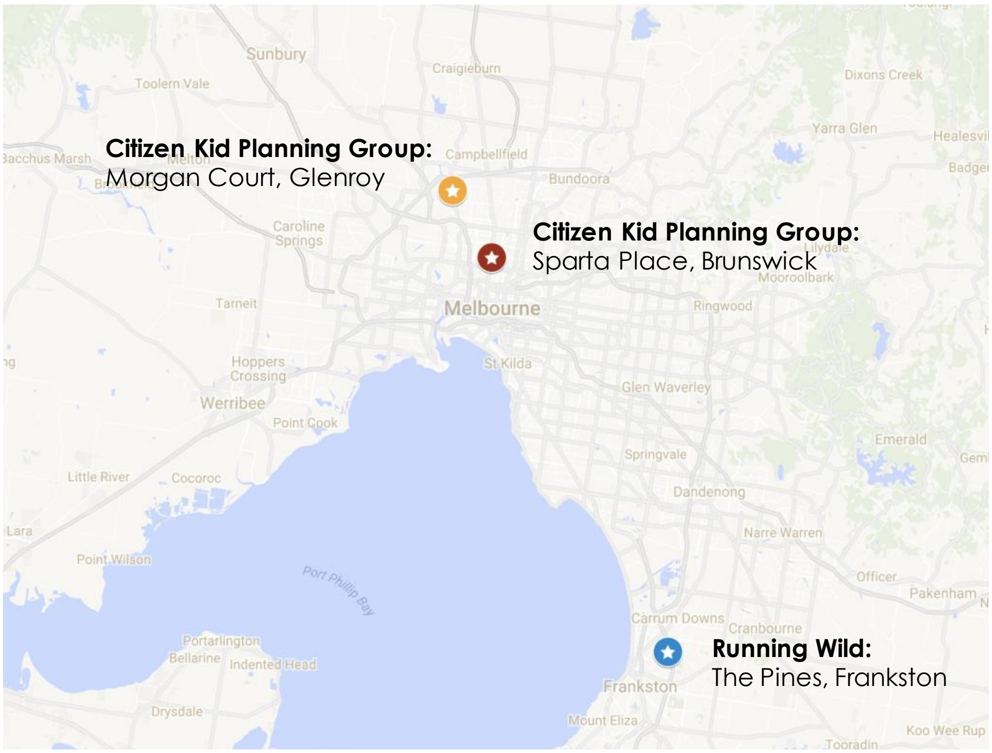

Figure 1: The research sites for Cases One and Two in the metropolitan Melbourne Australia context (source: created by Andrea Cook using Google My Maps)

Case One: Running Wild

Running Wild was conducted in 2016 with the Royal Botanical Gardens Victoria, Polyglot Theatre and Year 6 students from Mahogany Rise Primary School. The aim of the six-week project was to examine children's environmental education and place-making though outdoor learning and nature play at 'The Pines' (a wilderness reserve near the school) in partnership with local teaching artists, Indigenous elders and ecologists.

In *Running Wild*, children became 'designers' of nature habitats in their local reserve, resulting in an installation, short film and performance attended by their families. The project used a number of arts-science activities and tools to activate environmental awareness and identity around nature, materials and ecological processes, including: team building games, cubby-making, animal costume-making,

ecological field visits and indigenous knowledge walks. *Running Wild* sought to change the perception of nature as a distant and unfamiliar entity to one that entices curiosity, connection and agency and to reverse 'nature-deficit' trends seen in local children[22] and more broadly[23].
The activities encouraged team work in negotiating and executing creative ideas but also drew upon psychologist Mihaly Csikszentmihalyi's concept of 'flow': a highly focused mental state that increases awareness, connectivity and well-being[24]. Our aim was to examine how enabling 'flow' in the natural environment – especially in the context of outdoor learning, performing, making or crafting together (as illustrated in Figure 2) – could lead to the children developing a greater understanding, connection and appreciation for their local reserve as well as an increased sense of playfulness, creativity and agency around environmental issues.

Figure 2: Children participating in Running Wild, Melbourne Australia 2016 (photo credit: Kate Kantor)

Case Two: Citizen Kid Planning Group

As with the case of *Running Wild*, the 2012 *Citizen Kid Planning Group* (CKPG) was established to explore children's agency as designers, but with a greater focus on neighbourhoods and built, social environments. The University of Melbourne project teamed with the City of Moreland (a municipality within the metropolitan boundaries of Melbourne, Australia) to explore different methodologies in co-planning with children and how young people engage with the 'realpolitik'[25] of local decision making concerning place-based social sustainability and community building.
Negotiations with Council secured two similar 'live project' sites: Sparta Place in Brunswick and Morgan Court in Glenroy (Figure 3). Both sites were budgeted 'place making' project sites within Council's strategic planning processes but neither site was typical of sites usually chosen for 'child-friendly' co-design work[26] and the CKPG was the first involvement of children in the projects. An implicit goal of the site choice was that the CKPG process might expand children's geographies, spatially, socially and civically.

Citizen Kid Planning Group Site 1:
Morgan Court, Glenroy

Citizen Kid Planning Group Site 2:
Sparta Place, Brunswick

Figure 3: Citizen Kid Planning Group Sites in Melbourne, Australia 2012 (photo credits: Andrea Cook)

The *Citizen Kid Planning Group* brought together 13 children, aged nine to 12, from the two neighbourhoods and eight practitioner adults (urban design/planners, community planners, children's services, health promotion and research officers and an elected Councillor) as co-planners engaged in the tasks and questions illustrated in Figure 4. A methodological assessment of how children and practitioners engaged with the different methods in negotiating outcomes was integral to the analysis of the research.

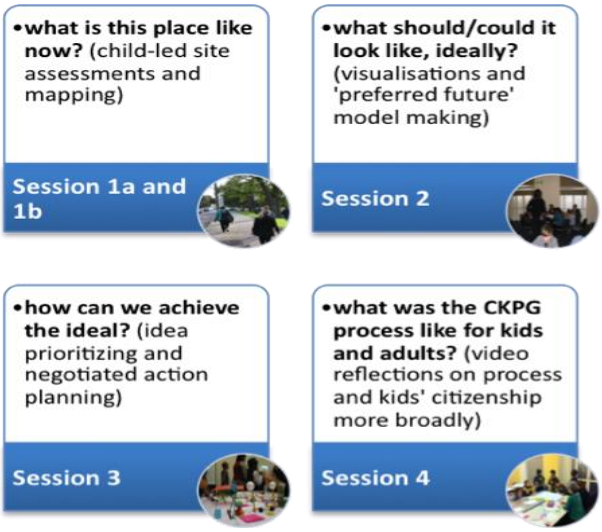

Figure 4: Citizen Kid Planning Group activities (source: Cook 2014)

LESSONS IN 'PLANTING CITIZENSHIP'

Together, these two case studies in 'planting citizenship' prompted a number of lessons for the researchers with respect to children's active engagement with ecological and social sustainability. The following is a discussion of three of those lessons.

Lesson 1: Children's civic participation is central to true sustainability

A key goal of both case studies was to empower children to directly experience what it means to care for their environments and to contribute to their transformation, now and into the future. By exploring creative and participatory approaches to sustainability education, *Running Wild* enabled children to experience their own agency within the natural environment and the *Citizen Kid Planning Group* created similar opportunities for empowering children to engage with social and built environments. In

both cases, this growth in children's civic agency was central to their narratives about sustainability and to their investment in being in nature and in community longer term.

In *Running Wild*, researchers watched children evolving from what might be described as a being in a tentative or 'awkward' relationship with their environments to one of familiarity, responsibility and respect. Feelings of initial estrangement soon fell away as the children were exposed to the multi-layered 'stories of place' through scientific, narrative and experiential learning with ecologists, artists and Indigenous elders. These learnings then informed their own creative responses to making habitats or 'cubbies' in the reserve using materials directly from the site (e.g. fallen branches). From initially complaining about mosquitos, the children soon began to talk favourably about the kinds of animals that might take refuge in their cubbies at night and, when it was time to return to school after one of the workshops, one girl exclaimed from inside her cubby, "but, it's my home!". This illustrated the connections children were experiencing with nature through the process of crafting it.

In the *Citizen Kid Planning Group*, the children used social encounters from their initial site visit as points of reference that they actively worked into their redesigns of the two plazas. Children's discussions with a local restauranteur in Sparta Place fed directly into their plans to encourage and reward child-friendly businesses with an 'Epic Seal of Approval'. At Morgan Court, the children's less positive social encounters (witnessing anti-social behaviours on their visit and experiencing poor perceptions of safety) prompted a vision of "the smell of happy people" (Figure 5) and a plan focused on whole-of-community celebration (e.g. community camp outs in the plaza).

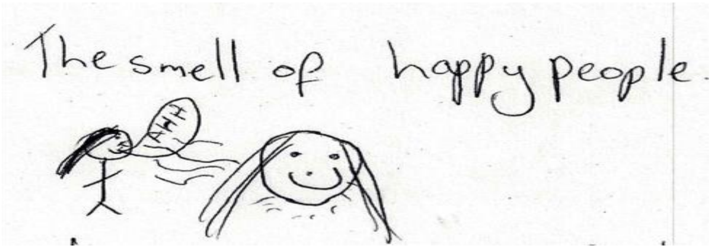

Figure 5: Planning towards the 'smell of happy people' in Morgan Court
(source: Citizen Kid Planning Group guided visualisation by Chloe, aged 10)

In both *Running Wild* and *Citizen Kid Planning Group*, the children's interest in engaging with sustainability issues in an embedded and active way was evident in their comments about project strengths in process evaluation surveying. Children from *Running Wild* enjoyed "learning heaps of different things in the wild", reporting that they would return "to have fun and explore" and "see my tree grow". *Citizen Kid Planning Group* children enjoyed "working with the Council" and being in an environment that valued that "kids are citizens!" In both cases, children also extrapolated their experiences to their future-selves, sharing newfound goals to visit their sites and to investigate careers as rangers or public servants.

Children's growing confidence in their role in 'sustainability' was also narrated via how they shared their work with their families and other adults. In *Running Wild*, the children led 'ranger tours', community planting and performances at the reserve. In the *Citizen Kid Planning Group*, children shared their experiences as conference co-presenters and as ambassadors working with Council on other place-making projects. Both case studies, then, demonstrated the value of children's agency to children themselves.

Lesson 2: Citizenship-building needs facilitation

Just as children gain new skills by their experience of doing, they also learn about agency by exercising it. In both *Running Wild* and *Citizen Kid Planning Group* demonstrated that the development of civic, coproduction and problem-solving skills was not just a spontaneous one but benefited from facilitator support by adults. By providing experiential learning experiences around sustainability that included citizenship-building elements, the two cases helped children to effectively deploy their voice and build political capital about shared spaces while also building technical, artistic

and cooperative skills through working with adults and peers. Such citizenship-building can open up new ways of learning and being together.

At the start of the *Citizen Kid Planning Group*, when asked whether there was anything 'particularly bad for kids' at Sparta Place, Jarod[27], nominated "the trees, 'cause what if someone tried to climb them and fell?" While others immediately started climbing trees during the site visit, Jarod hung back and made several more comments about the risk of the climbing. With help from his new friends, however, Jarod tried climbing (Figure 6). This was transformative for Jarod, shifting his concern about risk and prompting energetic advocacy for the site with the wider community: when a passing mother and her toddler stopped to see what the group was doing, Jarod proudly announced that the CKPG was "gonna make this place good for kids!"

Figure 6: Jarod experiences tree climbing in Sparta Place with the help of other children (photo credit: Andrea Cook)

In *Running Wild*, the making of the cubbies created opportunities for teamwork through re-imagining a site with the materials at hand. Through this process, the children not only learned to connect with nature but also how to negotiate decisions with their peers as well as with the adults supervising the project. New leaders and friendships emerged through the process, highlighting new-found agencies but also, at times, new challenges within the group. As one child admitted, "it was really challenging working with some people that I don't really like", even when the activity of making cubbies was fun.

Adults co-participating in both processes also underwent their own learning curves – to learn when to intervene, and when to allow the children to problem-solve situations by themselves. This meant allowing the children to work through their own team issues, to determine their own aesthetics and to design program and outcome preferences. It also involved helping children when they were unsure how to resolve an issue or go about a task. What emerged was a delicate balance of *supporting* children to realise *their own ways* of relating to 'sustainability' and to actively invest in helping children build agency through a process.

Lesson 3: Sustainability requires mutual learning

While these two case studies reinforced Fincher & Iveson's contention that children don't participate simply like small adults[28], they also highlighted that approaches that work well with children are often 'synergistic with' rather than 'opposed to' approaches that work for adults. Both *Running Wild* and the *Citizen Kid Planning Group* found that co-creating had benefits for both adults and children and that the learning processes were valued in different ways by all involved.

The model-making in the *Citizen Kid Planning Group*, for example, was evaluated as one of the most successful methods, reinforcing that "maps should be built and sculpted as much as drawn"[29] when

working with children. The appeal of model-making was observed for adult participants as well, however. Adults rolled up their sleeves and actively participated alongside the children in the model making (Figure 7) in a way not observed in earlier map making activities, when they hung back as 'observers', despite encouragement to participate. The mutual effort in model-making translated into more useful products, with model making outcomes more represented in the final ideas for action.

Figure 7: CKPG model making draws in children (left) and adults (right) alike (photo credit: Jo Broom and Andrea Cook)

Similarly, the *Running Wild* researchers experienced the most success when engaged in the cubby making process as co-designers with the children. Both parties became immersed the 'flow' of nature-crafting and in the stillness and serenity embodied in the task and space. Again, the tools that connect children to nature are ones that adults can engage with as well and both children and adults found the *Running Wild* tasks "peaceful; interesting; enjoyable; relaxing".
Deliberating and experimenting directly with children can challenge what 'learning' really is[30] and requires an epistemological shift for many adults. This itself can be a revelation. To Michelle, one of the *Citizen Kid Planning Group* practitioners, the most powerful aspect of the process was that it gave adults license to "re-experience the excitement and creativity of being a kid and thinking like a kid" and that this was "a process that opened adults up too, and helped them learn and grow". In *Running Wild*, exploring an environment with an Indigenous elder opened up new ways of seeing nature for adults as well as children and the children regularly reminded adults about the Indigenous significance of a plant or animal. Child citizens, then, are not just learners but also catalysts for what Dewey describes as 'true science': that which employs an "open minded and flexible wonder" characteristic of childhood but often dulled in adulthood[31].

CONCLUSIONS

In experimenting with approaches to building children's agency and civic voice in relation to ecological and social sustainability, *Running Wild* and *Citizen Kid Planning Group* highlighted a number of important lessons. While focused on different aspects of 'sustainability', the two projects illustrated a consistency in viewing children as collaborators in (as opposed to just recipients of) eco-social sustainability. Both facilitated citizenship-building as opposed to just education and developed methods that suited the mutual learning of child and adult audiences.
When a child reflects that one of the important aspects of the project is that "I can collaborate much better than I could before" (*Running Wild*) or that "even kids have a voice and if they use it, they can change things" (*Citizen Kid Planning Group*), they are remarking on the importance of focusing on citizenship-building as a core aspect of sustainability. Experiential learning helps, in the words of a *Running Wild* participant, to "imagine things and try to put them into reality" and supports them in developing new skills – as citizens, not simply as students.
This kind of learning is a key part to children's development of spatial/ecological, social and civic literacies and fosters positive feelings about engaging with nature, society and civic structures, now and into the future. This, we argue, is the very definition of 'sustainability'.

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SUSTAINABLE URBAN RESILIENCE: HOUSING SOLUTIONS FOR ASYLUM SEEKERS

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INTRODUCTION

Currently the world has been facing the worst refugee crisis since World War II. According to the UN Refugee Agency (UNHCR), tens of millions of people were forced to escape from their homes because of war, conflict or persecution. The sharp increase in the number of asylum seekers is affecting the whole of Europe. For geographical reasons, southern European countries have been the main point of arrival for most asylum seekers. Most of them end up in neighboring regions to their countries, many others seek asylum in Europe. The destination of asylum seekers depends on several factors: the travel path or their knowledge of the considered country.

CULTURAL DIVERSITY AS A RESOURCE

The cultural diversity of European societies can pose distinct challenges to human rights, democracy and community cohesion. Designing according to social policies which help to manage diversity as a resource, by boosting social and economic benefits of heterogeneous communities and minimizing its potential negative effects, is one of the biggest challenges of our century.
The intercultural city is a European development programme based on the implementation and evaluation of diversity strategies through inclusive and participatory planning.
In parallel, projects involving the cities and other actors (NGOs - not governmental organizations - professionals and academics), which deal with specific aspects of diversity management and integration of migrants, have been started.
The intercultural city is a model that:
- is based on a set of European values and principles (European Council);
- has a strong research dimension and impact assessment;
- is long-term and, therefore, allows changes in sustainable policy of the participating cities;
- has a multi-disciplinary and multi-stakeholder approach, involving a wide range of actors, thus ensuring the effectiveness and sustainability of change in cities policy;
- is supported by an intergovernmental organization, thereby increasing awareness and political commitment.

ITALIAN AND EUROPEAN URBAN EXPERIENCES FOR IMMIGRATION AND INTEGRATION

Project "shelter for all"

The project "A roof for all" was born in Umbria (Italy), later extended to other Italian regions. Future owners, immigrants and Italians, build or restore houses on public lands. Experts and local associations coordinate the project and provide logistical and technical assistance even regarding the credit access. Since 2001 52 new houses have been built and 72 families have participated in the project, half

of which was made up of immigrants. In the future, when immigrant workers will be able to pay bank loans and leases, the project will be sustainable and autonomous.
A significant example of the project "A roof for all" is the town of Bitonto (Bari), created in 2014. The project includes the restoration of buildings adjacent to the Medici Saints Foundation for the creation of a Ready Reception Center, aimed at being available to those who don’t have a place to sleep. The Welcoming Center will be accessible to needing people including immigrants, provided they have a residence permission. It is a positive model, in line with the existing services in the area: the center will offer hospitality and assistance to people in need with a level of innovation, sustainability and environmental impact in line with the modernity and sustainability principles.

Figure 1 - project "shelter for all" – rendering

The lot is between the railway and the residential fabric with medium and high densities. Accessibility is ensured by a system of infrastructures and links that will enable staff, visitors and residents to get there easily, either by public or private transports. The structure is composed of a main body which is spread over three levels and has been designed to ensure a capacity of about 10 beds.
The functional programme includes:
- an area devoted to residences;
- a general area of support services;
- an area devoted to training and employment;
- connecting spaces.

The container Marzahn district - Berlin

The Marzahn district is located in the extreme outskirts of Eastern Berlin. Among grey concrete Soviet-style towers a series of colourful buildings stands out: a block of large horseshoe-arranged containers with a central soccer field and a playground makes up an area for asylum seekers. There 400 immigrants live, waiting for the German state expresses their future. The containers are made of prefabricated blocks, each of them overlapping one another and side by side, which form single or multiple dwellings. Inside the building there are also professionals and social workers, made available by the State, which support and help refugees for their integration into society. But this is an example of unsuccessful integration: the container inhabitants remain confined within their neighbourhood, constantly supervised by the staff and with the obligation to get home by a certain time, not allowing them to socialize and get fit within the town’s consolidated dynamics.

Figure 2-3 - The colored containers that give life to the Marzahn district

FROM BORDER TO HOME: HOUSING SOLUTIONS FOR ASYLUM SEEKERS

The mission of competition, organized by the Museum of Finnish Architecture in collaboration with the Finnish Association of Architects (SAFA), is to propose concrete solutions to asylum seekers housing in the Finnish State: the proposal has to be achievable in the short term, for its climatic conditions and adverse weather, and have the requirement of reversibility in order to be reused for a second end. The proposal has to meet requirements of technological innovation, energy efficiency, sustainability, cost-effectiveness of the intervention. The key points are the social, cultural and economic life; the proposal concreteness; the feasibility; a positive social impact.

Figure 4 - The regular arrangement of the houses in the city of Helsinki

DESIGN SOLUTION

The area identified for the project hypothesis application is located in the Verkkosaari district in the east-central part of the city of Helsinki. This is a building-free area and destined, as evidenced by the local urban planning, to residential expansion, located close to the city centre. The presence of interest points and landmarks, including tram, bus and underground connections, makes it an area populated and intensely lived by the whole community.

In order to create a constructive continuity with a recurring residential type and present in the areas surrounding the interest one, all units are arranged in rows, aligned horizontally and equipped with independent accesses, immersed in the green almost disguising themselves and blending with the existing vegetation. In fact, when viewed from above the accommodations seem almost invisible: only

by approaching the individual lots observers will notice their regular and ordered arrangement. The project roads merge seamlessly with the existing ones, creating pathways consisting of main artery roads that cut through the affected area and the nearby neighborhoods. A bicycle / pedestrian trail and a green walk go along the entire area from south to north while secondary roads connect the various batches ensuring accessibility and connection between housing and other functions and activities.

Figure 5 – Aerial photo with project inclusion

In addition to affecting the project area, a public park with green spaces, playing and sports areas, football and basketball courts, skate park, playground and small kiosks open themselves to the surrounding neighborhoods penetrating among the existing modern residential buildings. Large areas are also used to house cafes, restaurants, supermarkets, gyms, libraries, media rooms, or functions meant to widen the using range not only to those who live in the area but also to the community. Finally, further areas can be reserved for multi-purpose buildings inside of which administrative offices will be provided for sorting request asylum practices and demands for housing assignment, clinics and medical centres, multimedia classrooms for language and specific tasks teaching, dining rooms and others used for worship and prayer. The result of this careful and participatory planning is a small corner closely linked to the metropolis: a microcosm that represents and celebrates the diversity, where the new connections and relationships created between the buildings and their inhabitants, transplanted in their new Finnish reality, become a metaphor for the life of the neighborhood. It is a social and urban context in constant evolution and change. In such a district every inhabitant of the community has a common area where he can socialize, share and interact with other ethnic groups, but especially with the native population.

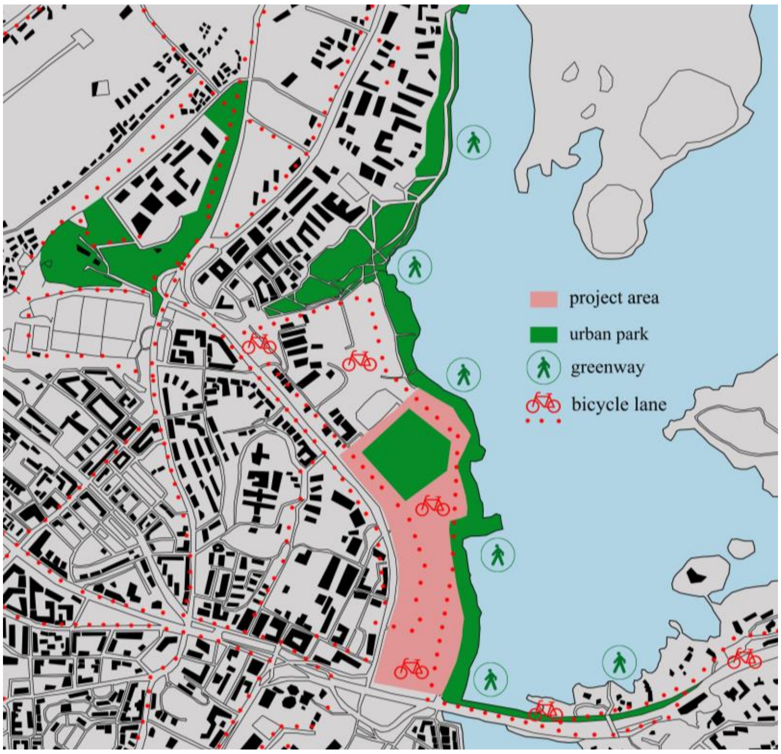

Figure 6 - Masterplan

The choice of technology

The choice to create a structure with wooden technology and XLAM construction system is motivated primarily to give continuity to the local building tradition, but also for the material properties such as flexibility, longevity, stability and fire resistance.
Two other fundamental aspects are the one linked to the prefabrication and the economic one. The reduced weight of the wooden construction reduces the foundation costs while the high level of prefabrication simplifies operations and construction times.
The system sustainability is based on three pillars: economic, ecological and social. In addition, the wooden architecture is characterized by considerable energy performance, with a conductivity coefficient $\mu = 0.123$ W/mK higher than other traditional materials' one, virtually free of thermal bridges.

The type module

The main design target is to create a housing unit type able to fully meet the "home" requirements in terms of living comfort and be fully independent and functional both concerning the space organization and energy efficiency, ease and speed of construction. The basic module has been designed to meet the needs of a four-people family: it is built on a square plan, with a useful living area of about 60 m², composed of two bedrooms, a bathroom and a large living area.
The structure is entirely made of wood, with the vertical walls, the cover and the floor made of structural XLAM panels, supplemented with insulating materials and wood finishes on the face view, in order to ensure an effective protection from cold but also to meet all functional and architectural requirements: the interiors are also entirely made of wood, a material that gives a high degree of living welfare, and equipped with large windows to take advantage of the maximum solar gain during the whole year.

The external finishes are made of wood in order to respect the local building tradition and create a continuity with the buildings of the place, while the cover is constituted by a single sloping of about 30° to avoid an excessive deposit of snow and exponentially load the structure itself.

Figure 7-8
Accommodation type (basic module of 60 m² for 4 people): external and internal view

Starting from the basic module and placing two type units between them, a larger housing (130 m²) is obtained capable of accommodating eight people. The interior is made up of four bedrooms, two bathrooms and a large living area so that we can promote the integration and the knowledge of inhabitants of different culture and origin.

Figure 9-10
Accommodation type (120 m² module for 8 people, from combination of two basic modules): plan and rendering

Technical and Performance Characteristics

The stratigraphy of the outer vertical closing with a final value of thermal transmittance U = 0,20 W/m²K, fire protection REI 30 and acoustic insulation Rw = 44 is composed as follows:
- structural plywood panel in 3 crossed 90 mm thick layers of and a thermal conductivity value λ = 0.130 W/mK;
- insulation panel of 140 mm thick wood fiber, and a thermal conductivity value λ = 0.040 W/mK;

- insulation panel of 22 mm thick wood fiber and a thermal conductivity value λ = 0.047 W/mK;
- breathable membrane for sealing the wind sealed by 0.38 mm thick polyethylene adhesive tape and a thermal conductivity value λ = 0.22 W/mK;
- wood coating for exterior 19 mm thick walls and a thermal conductivity value λ = 0.150 W/mK, on a wooden battens structure 40x60 mm.

The decking slab has a thermal transmittance value of U = 0.186 W / m²K, REI 60 fire protection (EN 13501) and sound insulation Rw and Lw = 56 = 62, and has the following stratigraphy:
- 400 mm thick air layer to create a natural insulation and allow an easy connection with the foundation structure;
- structural plywood panel made of 5 crossed 130 mm thick layers and a thermal conductivity value λ = 0.130 W/mK;
- 100 mm thick polyurethane insulation panel and a thermal conductivity value λ = 0.032 W/mK;
- 1 mm thick protection against infiltrations and a thermal conductivity value λ = 0.20 W/mK;
- 10 mm thick sound insulation and a thermal conductivity value λ = 0.039 W/mK;
- 25 mm thick dry screed and a thermal conductivity value λ = 0.350 W/mK;
- 4 mm thick wooden floor, sized to allow the heating system correct operation.

The building roof is constituted by an approximately 30°inclined flap. The stratigraphy of coverage, with the final value of thermal transmittance U = 0,16 W/m²K, REI 30 fire protection and sound insulation Rw = 47, is composed of:
- structural plywood panel made of 5 crossed 140 mm thick layers and a thermal conductivity value λ = 0.130 W/mK;
- brake screen impermeable to steam for air tightness by 0.38 mm thick double self-adhesive strip and a thermal conductivity value λ = 0.22 W/mK;
- 200 mm thick wood fiber insulation panel, and a thermal conductivity value λ = 0.040 W/mK;
- 22 mm thick wood fiber attic panel and a thermal conductivity value λ = 0.047 W/mK;
- breathable waterproof membrane for sealing the wind sealed by 0.54 mm thick polyethylene adhesive tape and a thermal conductivity value λ = 0.22 W/mK;
- 5 mm thick closing corrugated sheet put together on a 30x50 mm battens structure and wood counter battens.

In accordance with an eco-friendly design, in line with local and European regulations, the housing module is equipped with a mini-wind power plant, particularly suitable in a context such as the Finnish one where the average values of wind speed are estimated in 25 m/s by European regulations (EC1).

The advantages of the construction system

Prefabricated wooden houses are eco-friendly as made of completely renewable or recyclable materials. The white or red fir wood, from forests with certified protocols for reforestation, is a stable and lasting essence, and can completely be recycled and reused. For these reasons, XLAM building can be completely considered environmentally friendly.

A XLAM wooden house lasts as long as any realization made of other types of materials.

Wood has a practically unlimited duration, provided that, while working, appropriate precautions are adopted. The maintenance required by a wooden house is almost identical to those of a traditional building.

In economic terms, the creation of a wooden house is very convenient because the initial building and acquisition costs are amortized over time and savings become constant, with substantial thermal comfort, humidity and noise benefits.

Even the fire behaviour is quite interesting: the carbonization of the outer wood layer forms a protective film that shields the inner layers and, consequently, the resistance capacity to collapse for a long time.
The growing interest in ecological design and energy saving is showing a clear trend in the housing market focusing on quality wood construction, so their value is clearly in contrast with the old and almost completely retrained building market. Sector data suggest that a correctly constructed wooden building can also be worth the 15% more than a corresponding traditional building, with the same initial costs.
With regard to the plant component, the constructive 'dry' system allows maximum flexibility and freedom to maintain, implement and adapt systems, during the life cycle.

Costs and production times

The price of a XLAM panels wooden structure varies depending on several parameters: the final cost depends on the degree of external and internal finish of vertical and horizontal elements, the type of equipment used, the type of foundation.
The economic convenience in using a XLAM system is constituted by the considerable reduction of building time: a XLAM building has a very affordable average construction cost, especially when you consider the cost also inclusive of scheduled and management maintenance costs linked to the building life cycle.
Below are some information prices provided by a manufacturer of XLAM panels:
- external wall: 4-layer 100mm panel, 53 €/m²;
- attic: 5-layer 175 mm panel, 81 €/m², 5-layer 180 mm panel, 85 €/m²;
- inner wall: if carrier, 4-layer 100 mm panel, 53 €/m², if non-load bearing, 3-layer 80 mm panel, 41 €/m²;
- windows: fixing brackets, 8-12% of the total wood sealing tapes;
- Transport: to be calculated on km round trip, € 1.60/km.

The cost of a structural wooden building, without finishing, about 100 m² sizing, can vary between 600/700 € / m2, while, including finishes, it is around 1200 €/m².
The completion timing of a XLAM building is reduced by 40% -50% compared to the technologies and traditional construction systems, with considerable savings on labour costs and on business management.

CONCLUSIONS

The study suggests a design model of temporary housing for refugees and asylum seekers, to be built in the city of Helsinki in Finland. It is in prefabricated structural wood buildings made by XLAM cross-laminated panels.
This material, as well as being in agreement with the local building tradition, appears to be performing by the structural and thermal point of view.
Next to the housing design the attention to urban and metropolitan context of the City of Helsinki plays a vital role: through the creation of urban parks, sports equipment, bicycle paths, pedestrian and green walks in addition to the preexisting strength points in the area, the chosen area can mingle and blend with the urban fabric of an already well-developed city which is in constant evolution and change.

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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally

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REGENERATION STRATEGIES TO PROMOTE SHARED LIFE AND CONTRAST THE ABANDONMENT OF RURAL SETTLEMENTS

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INTRODUCTION

The paper introduces further steps of a research started by authors in the recent years, as part of a widest international research network, which focus on the forms of shared life and on the recurrent phenomena of abandonment of rural settlements.
The research aims to understand how ancient buildings in rural areas, which originally housed functions for agricultural production, defense from external hazards, have produced a space of collective and shared life. Once abandoned and dismissed their original functions these historical typologies could be regenerated in the present days, keeping their sense of community hosting again shared functions and becoming occasions of transformation of the built environment in order to contrast the abandonment of rural areas, with particular reference to the realities of Europe, China and Central America.
These geographical contexts are rich in buildings, with traditional typologies, which based their organization on sharing of spaces and functions. These buildings, often in a state of complete abandon, are now the subjects of numerous interventions of regeneration, many of which are gained great attention by the international contemporary debate. Among these, ten projects have been analyzed with a predominantly anthological method, with semantic analysis supports and analysis of drawings and pictures that have revealed the distribution and functional characteristics of each individual project (in the past and nowadays).
Then, the research has compared the studied projects by extrapolating the common characteristics that indicate an attitude of sustainability, including: the regeneration of the existing; the limitation of land use and the creation of communitarian environments (not necessarily re-proposing the historical ones).

HISTORICAL TYPOLOGIES

Therefore, the research confirms that several old rural buildings can be regenerated to contrast the abandonment of rural areas by proposing a sustainable approach and new forms of sharing, updated to nowadays, in functions and spaces. Moreover, by analyzing the regeneration projects in those three

different geographical areas, the research outlines some guidelines applicable in a wide range of locations. Despite of the evident difference in economic, social and political conditions between Italy, China and Mexico, the same crisis impacts occur in rural regions so, this scale of investigation may be considered a common ground of understanding with obvious global impact.

Cascina

The word "Cascina" in Italian means an agricultural system common in the north part of Italy. The widest possible dissemination of the farms took place between 1700 and 1800 in which most of the current buildings were born. In the capitalist organization of agriculture of this period, the Cascina spread so much because they were perfect for the rationalization of the agricultural production.[1]
The typology of Cascina is organized, basically, around a central courtyard defined by buildings with residential, production and storage functions.[2] The size of a community farm may vary greatly from 4 to 20 families,[3] all engaged in the production activities of the farm, which were checked by a representative of the landowner who had dedicated one of the main buildings of the complex.

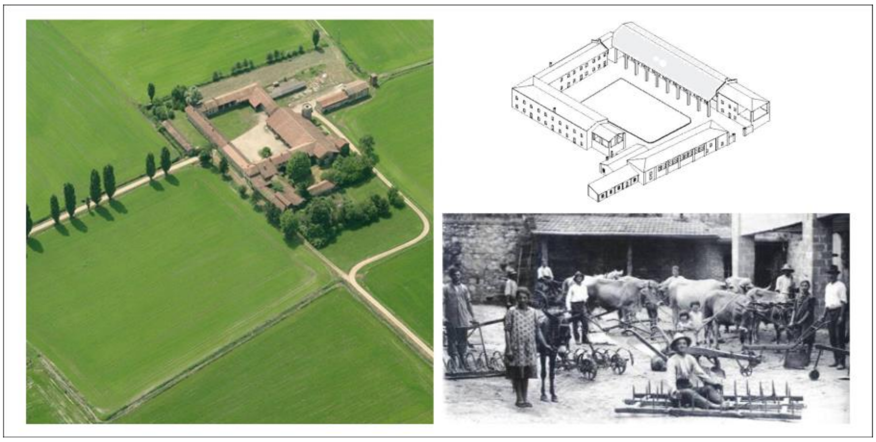

Figure 1. The configuration of a traditional Cascina in the countryside of Milan, Italy.

Tulou

The "earth building" are extraordinary architectural realities, entered in the World Heritage List by UNESCO, spread mainly in the region of Fujian, in southern China, which is a mountainous region whose society was historically based on clan. These buildings, in close relationship with the environment, are almost always located in valleys, following the principles of traditional art "feng shui". Their communitarian values and the defensive function made these buildings known as "a little kingdom for the family" or "bustling small city".[4]
Typically, Tulou has a circular or rectangular shape, in which the residential spaces are set in the perimetral part of the complex, defining a central courtyard, which represents the most important shred space of the Tulou. In the majority of the cases, this central space has shared buildings with several different functions that can vary from ones with religious purposes, to the ones for support of the residential or productive life. All the families living this building have equal private residential spaces, which develop vertically.[5]

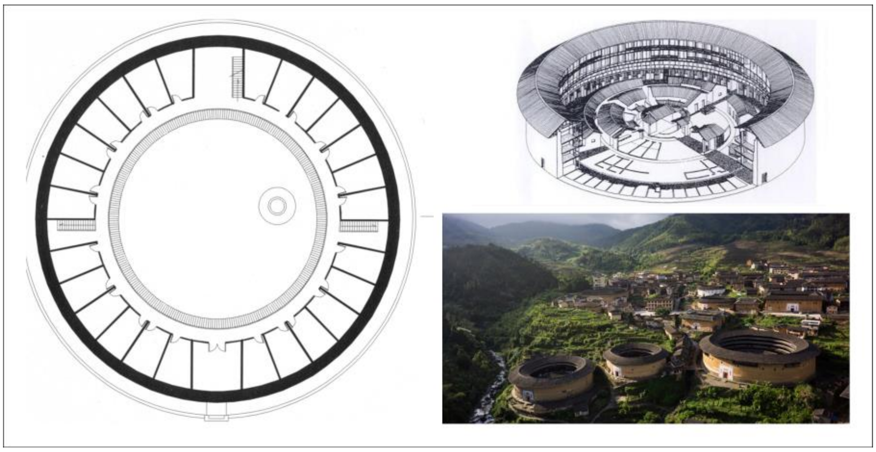

Figure 2. Typical plan, axonometric section and view of Tulou in the region of Fujian, China.

Hacienda

In the case of Mexico, we found the hacienda setting. This settlement was a very successful strategy for colonization mainly due to the similarities found with the prehispanic calpulli, a typology found in Central Mexico before the arrival of Spaniards . The Hacienda had also very similar characteristics in typology and organization as the Italian Cascina, but social interactions differed due to hierarchy levels traditionally used among colonies.

Haciendas typically had several buildings distributed throughout the land, but the main building was the largest in size and hierarchy. It has a rectangular shape with a courtyard in the central area. Owners and managers usually lived in the main buildings whereas workers lived outside but often interacted within the main courtyard as it served for communal areas, having buildings such as a catholic temple and a credit store.

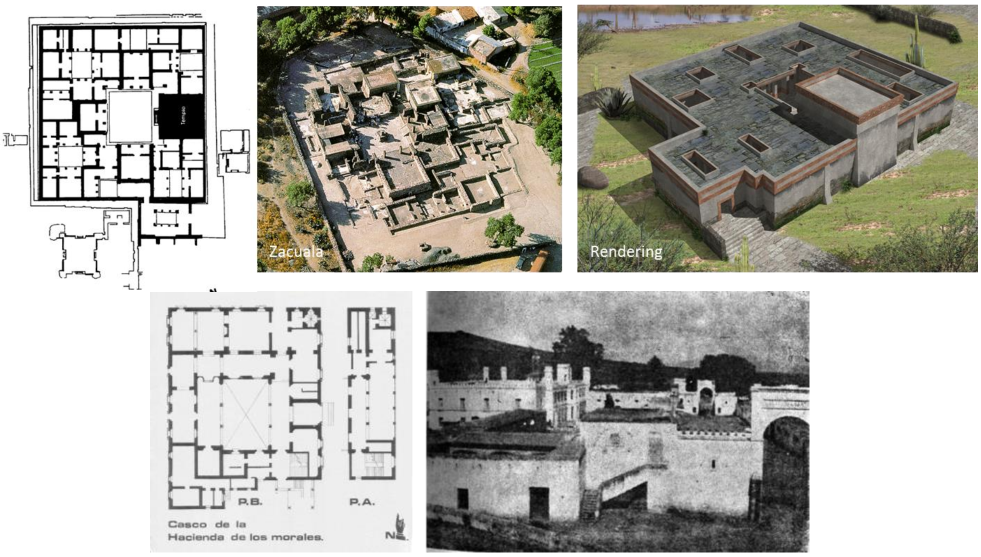

Figure 3. Plan and view of a Calpulli (upper figures) compared to a Hacienda (lower figures).

CONTEMPORARY CASES

The need for community, as a response to many of the challenges posed by the change of the world in the past few decades, is affecting the way of life of more and more people.[6] The need to rediscover natural forms of relations pushes to think new forms of producing (coworking, crowfounding, ...), living (cohousing, airbnb, ...) and experiencing (shared transportations, shared goods, ...).

In recent years, old abandoned buildings are becoming objects of regeneration projects to establish forms of communitarian living. So, practices of social and environmental sustainability are combined, reducing consumption of land, landscape coherence and territorial intensification. This desire to share has clearly effects also on the need to change the spaces and to propose new solutions with respect to the modern spatial configurations.

The different number of projects taken into consideration derives from the different quantitative expression of this regeneration phenomenon.[7]

Cascina

The recovery of abandoned rural buildings is a phenomenon that in Italy and in Europe is having particular interest both from private promoters, both public associations. This is because of the attraction that these places, often still far from cities, can have on people and for the possibility that their recovery can contrast the abandonment of rural areas, revitalizing and intensifying functions.[8] This is even more frequent in a productive region like Lombardy, which lived in the past decades, an important urban growth phenomenon and the abandonment of rural complexes, such as the Cascina. The quantitative and qualitative richness of this existing heritage, meant that the phenomenon had a significant impact on the land and on the society. These interventions were made both on buildings that still preserved their productive agricultural vocation, and on many others that were totally abandoned. In addition, the original production network that the farms formed on the territory meant that, in some cases, regeneration interventions came to pass on a territorial scale and were part of larger projects, of intensification and territorial development.

Cohousing Chiaravalle, 2017, Milan:

Cohousing project promoted by a construction company nearby one of the most important religious centers of Milan’s countryside. The project, result of a deep participatory process, restores all the complex, setting 40-50 families, a 25.000 sm productive gardens and several spaces for shared activities.[9]

Cascina Martesana, 2014, Milan:

An evolving project that nowadays represents a open meeting point for the citizens of the Gorla neighbourhood. It has no residential function, but it is space for sharing of recreational, cultural and didactic activities.[10]

La Corte di Castellazzo, 2007, Castellazzo Novarese:

Restoration project, at the moment still partial, focused on the concept pf family as social and positive concept. The restoration involved residential spaces, a stable for shared and productive activities, wide green areas and places to host external persons, as multipurpose room and a camping.[11]

Cascina Sant’Ambrogio, 2012, Milan:

The project aims to the revitalization of the existing spaces of the Cascina as outpost to bring back the practice of agricultural production in the urban life. The restoration, even artistic, of the complex allows to set new function with social promotion.[12]

Cascina Cuccagna, 2012, Milan:

Cascina Cuccagna, from a typical rural complex, has become an important reality of Milan, completely incorporated, from several decades, in the urban fabric. Although now the complex is in a context completely different from the original, it preserves the attitude towards agricultural production, although actualized respect the new context.[13] The restoration project, in this case, was promoted by an association of citizens eager to promote new lifestyles that are proposed as alternative to the traditional one. The goal, in fact, is to enhance the quality of urban life, not only by increasing the green spaces available to citizens, but above all by increasing the possibilities for socializing, rediscover the traditions and the local culture.[14]

Figure 4. The five case studies of Cascina and the details of the studied Casicna Cuccagna.

Tulou

The changes that China is experiencing in recent years are having a devastating impact on society and on the Chinese territory. On one hand, it means to accommodate in expanding megacities millions of workers who migrate from the countryside; on the other, it means improving the quality of life of those who remain to live in the countryside, working in particular on the sense of belonging and schooling.[15] In this bipolar view, even interventions on the heritage and the cultural heritage of the Tulou are having particularly success, contributing to the rediscovery of this wonderful architectural element of the Hakka tradition. The research wants to represent this double face of social intervention of the Chinese government,[16] investigating and a rural case and an urban one.

Urban Tulou, 2008, Guangzhou:

This project is for affordable housing for low income families and it proposes the redefinition of the traditional shape of a Tulou to set residential functions characterized by a communitarian approach.[17]

Bridge School, 2009, Pinghe:

This project aims to connect two parts of the village, divided by a river, thanks to a bridge that becomes school for the children and a stage for the villagers. As reported by the architects "The main concept of the design is to enliven an old community (the village) and to sustain a traditional culture (the castles and lifestyle) through a contemporary language which does not compete with the traditional, but presents and communicates with the traditional with respect".[18]

This new addition in the village is able to enhance the value of the social context and of the heritage values of the Tulou. Even if, in this case, the intervention is not realized directly on the main building, is interesting to underline as the intervention allows to enhance the value of the Tulou and, since the strong presence of these historical buildings, working in their context means working on the building itself.

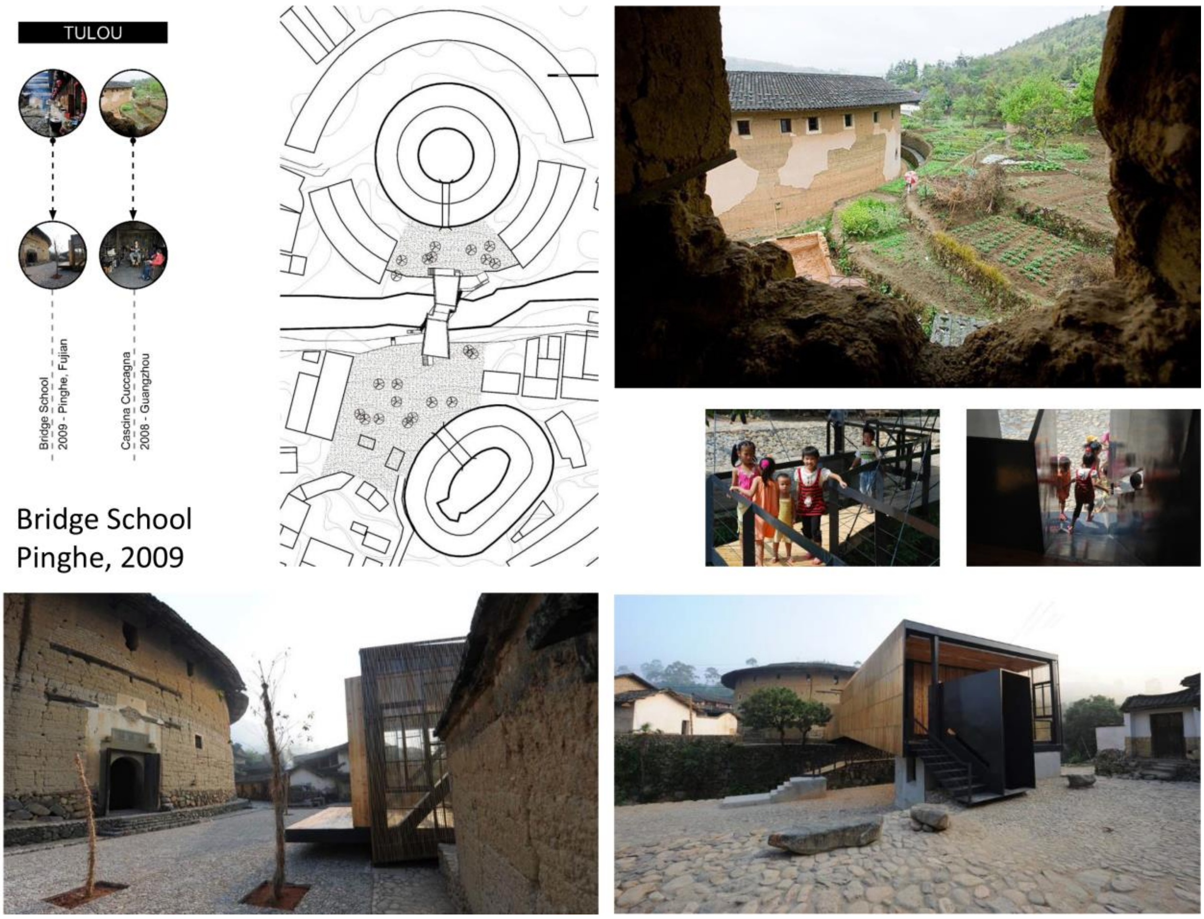

Figure 5. The two case studies of Tulou and the details of the studied Bridge School.

Hacienda

Since 2001, the Mexican government created a program called *"Pueblos Mágicos"*[19] whose main goal is to generate economic development through tourism in abandoned rural towns where cultural or natural richness is found[20]. The creation of this program was mainly to generate new economic resources in rural regions where traditional economic activities have been lost throughout the years due to several factors promoted by capitalistic approaches. The migration from rural toward urban settlements became a primary concern in several cities around Mexico provoking social and economic instability. The reuse and repurpose of traditional hacienda buildings has become a successful solution to discourage rural-urban migration patterns, particularly in central Mexico[21]. The case studies presented in this research highlight this approach.

Cocoyoc, 2006, Yautepec, Morelos:

The main goal of this project was to generate economic development in a town that was traditionally living of cane sugar harvesting. The main building was converted into a resort generating an important economic boost to the community[22]

San Nicolás de Esquirós, 1993, Celaya, Gto:

This is an interesting approach of community appropriateness. Former hacienda workers took over the main hacienda building and converted into an enclosed community. In this case, the importance of community integration is addressed over the architectural heritage[23].

Jalpa de Canovas, 2005, Jalpa de Cánovas, Gto:

In Jalpa, the community embraced the hacienda as main center of the town, using not only its buildings but the unity concept of the hacienda as a promoter of shared life not only within the residents but also with the tourists that come to visit over the weekends. The idea that the family owners have done so much to preserve the community vibrant and active is an important consideration that few times is seen in Mexico.[24] This did not happen in Jalpa, as the owners were the ones who have maintained the Hacienda as a community integrator.

Figure 6. The three case studies of Hacienda and the details of the studied Jalpa de Canovas.

COMPARISONS

As authors, we are fully aware of the important differences between the design approaches, arising from the large differences between the social and geographical contexts. However, the greater the differences between the projects, the greater is the range of projects to which the research results are applicable. In fact, once defined and studied the projects, it has begun the phase of project

comparison[25] through a methodology for text mining, in order to highlight the similarities among the projects.

Differences

As just said, the projects in the three contexts have some differences mainly related with the reasons and the promoters of the projects. In Italy, the main driver of changes is the need of modify the contemporary lifestyle and, so, the main promoters are often private investors or associations of citizens. Vice versa, in less developed countries, the role of the government is higher in promoting social aids or education, in the case of China, or supporting private interventions for business or production, as the case of Mexico.

Common features and semantic analysis

Nowadays the semantic analysis and the text mining operations are highly exploited by the scientific community insomuch as several informatics tools have been strongly developed (T-LAB, ATLAS.ti, R, etc.)[26] and this methodology is finding more and more interest in the field of architecture.[27]

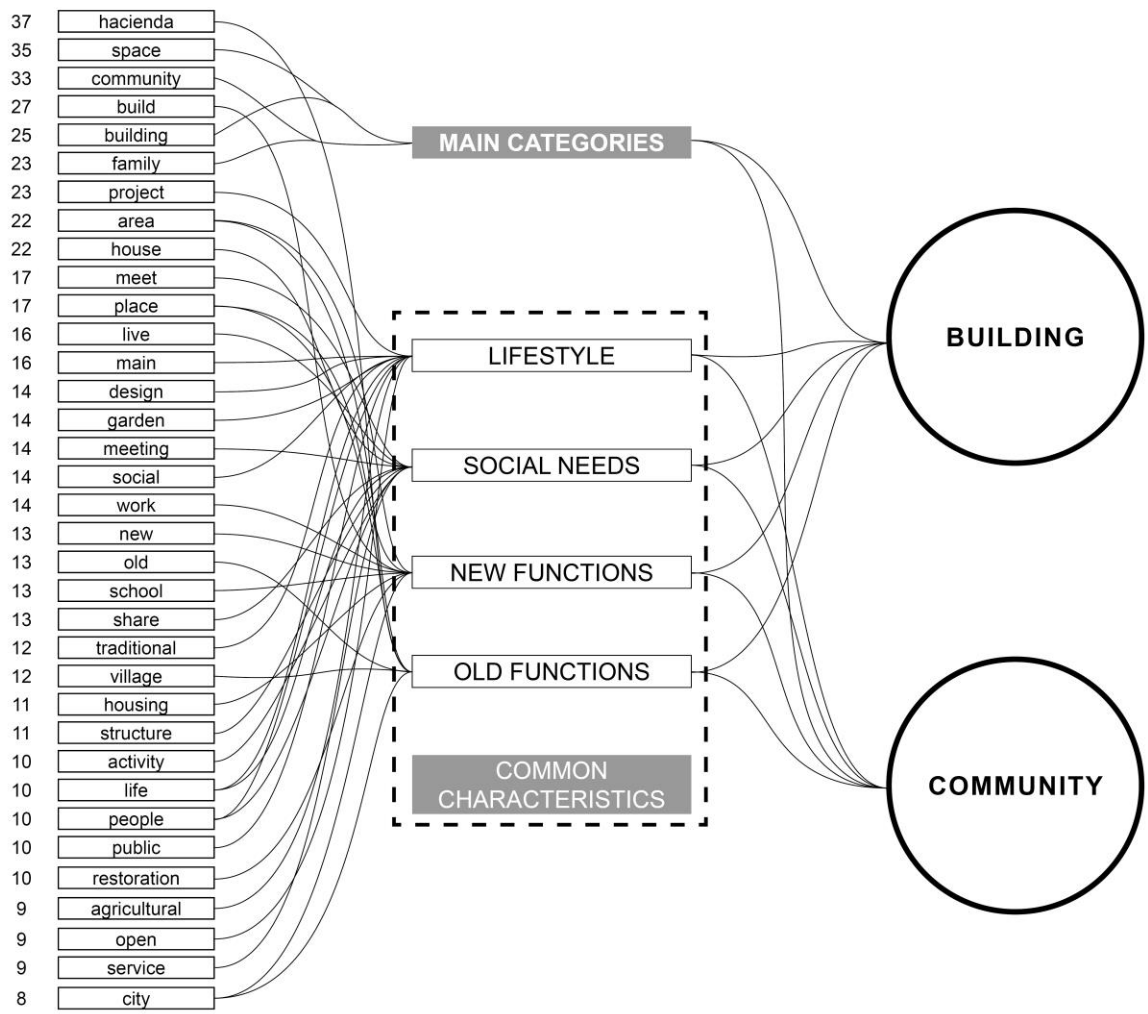

Figure 7. The semantic procedure used to define the concept that describe the phenomenon, gathered in the two main clusters of "Building" and "Community".

A correct procedure for the application of this methodology starts from the definition of the elements that undergo to the exam. For these projects we collected their own literature review of the projects in terms of documents, scientific papers, interviews, websites, magazines, etc. Therefore, for each project we did a synthesis the information, in order to have a similar length (500 words) and the same type of information.[28] This total text has been analyzed by the quoted text mining and semantic analysis approach, using in this case the online software "Vocagraber".[29] With this tool we had the number of occurrences of the words used to describe all the selected projects. After having defined, thanks to this tool and to personal re-elaboration, two main characteristics / clusters, we defined, according to the number of occurrences and to a lower level of clustering (lifestyle, social need, new and old functions), some sentences that can help us to describe the concepts of the common characteristic of the studied phenomenon.

RESULTS AND CONCLUSIONS

The resulting concepts as seen in figure 7 are "building" and "community". Within the "building" concept we found that these spaces were reworked using participatory design approaches in order to accommodate new functions able to connect with actual community members. We, therefore, identified that the community becomes the solution towards specific social needs and new livelihood strategies, interpreting the context towards an attitude for sustainability. This explanation can be seen in figure 8 were we found a functionality shift that goes from a protectionist approach towards a promotional approach, meaning that, while keeping the same typology, the spaces were reworked to allocate new functions, closer to the new rationale of the community living within. We observed the paradigm of these buildings changed from protecting the community, which was the traditional use, to promoting the community, in the sense of improving lifestyle conditions, creating linkages among more diverse communities, reinterpreting the livelihood necessities of the current context.

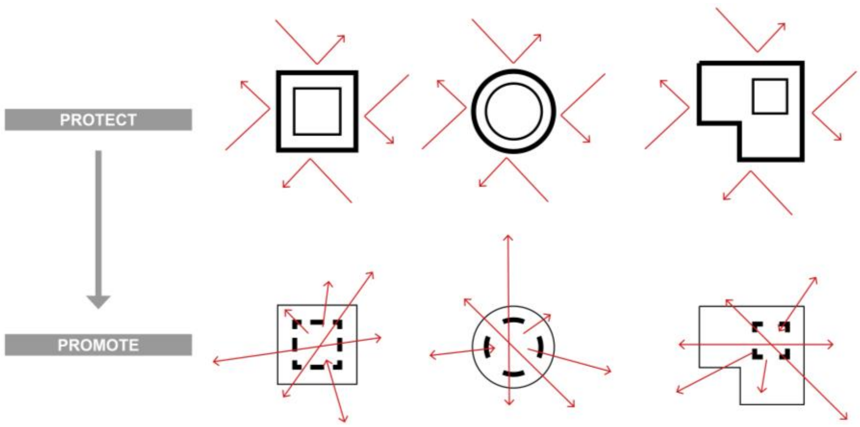

Figure 8. Concept describing the functionality shift in the three typologies: from being an element of protection for the community, to be an element for its promotion and activation.

We can conclude that communities among the three countries analysed developed a need to improve their lifestyle whether in terms of social and economic necessities, better educational approaches, or by introducing a healthier way of living. We identified that buildings triggered the process of creating a sense of community belonging, introducing sustainable characteristics promoting a solution to their starting needs. Although this is seen in many smart growth communities, particularly in urban settings where renovation of historic properties is often the starting point and anchor for the redevelopment of a block or street, this has not yet been studied in the rural setting, where we found a similar phenomenon happening, where the building develops a stronger sense of community that otherwise would have not been.[30]

All the authors agreed that, although the main functions of these buildings lost its primary importance after all these centuries, these typologies, after being regenerated through a process of intensification, have become generators and triggers of landscape values, social values, and communitarian values, creating and renewing a strong relationship between inhabitants and the environment.

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[6] Saskia Sassen, *Expulsions: Brutality and Complexity in the Global Economy*, (Cambridge: Harvard University Press, 2014), 149–210.
[7] In this way, the Italian cases are more numerous because the recovery of farms to establish community is a phenomenon that started earlier than the other two contexts. Since wider, the Italian phenomenon needed therefore a greater possibility of representation within the research to represent all the different expressions.
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[13] Various production functions are, in fact, set in this complex: urban gardening, agri-hood, a market for selling local products, or a restaurant processing km0 materials. Moreover, the renovated spaces are designed to accommodate events of promotion of the local culture, from photographic and painting exhibitions, musical events, classes of art and crafts.
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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally

AMPS, Architecture_MPS; London South Bank University
09—10 February, 2017

SMART RHETORIC; DUMB CITY

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INTRODUCTION

This research concerns the densest city in the world, Mumbai, and the environmental impact of the proposed redevelopment proposals that are likely to increase densities from about 3,500persons per hectare to about 5,000, achieved by demolition of existing 3-5 storey height buildings and replacing them with towers averaging 40 floors. What has become known in Mumbai as 'vertical with a vengeance' (Rathod, 2012).
The study investigates the environmental impact of a proposed redevelopment of a 16.5-acre site. Of the many redevelopment proposals in Mumbai, this is in the most advanced stage and is an exemplar for both Mumbai in its ambition to become a 'global city' and the Indian Government who have identified it as a key development in their proposal to achieve 100 'smart' cities that are claimed to be sustainable, environmentally friendly and 'smart' (Government of India, 2015).
The study uses the extended urban metabolism (Newman et al, 1996) model as a basis of analysis and predicts the flows of water supply (reticulated and rainwater harvesting), drainage, solid waste, electricity supply, potential for solar energy, fuel for transport, carbon dioxide production and sequestration.
From the results of the sample site, the analysis is then extrapolated to the overall impact if similar developments were to be carried out, as is proposed, across all of the Island city of Mumbai.

Defining the smart city

In 2015, the Indian Government proposed 100 "smart" cities (Government of India, 2015a) and named Behndi Bazaar as its exemplar development that was a flagship of 'smartness'. Although the definition of a 'smart city' can be vague the Government has clearly defined their intentions (Government of India, 2015b)) that are summarised below:
i. adequate water supply,
ii. assured electricity supply,
iii. sanitation, including solid waste management,
iv. efficient urban mobility and public transport,
v. affordable housing, especially for the poor,
vi. robust IT connectivity and digitalization,
vii. good governance, especially e-Governance and citizen participation,
viii. sustainable environment,
ix. safety and security of citizens, particularly women, children and the elderly,
x. health and education
xi. reduce congestion, air pollution and resource depletion.

At least half of these criteria are environmental objectives, which can be measured and reasonably accurately predicted. Because, governance, health and education policies could be implemented

without redevelopment, this study focuses on all the environmental elements that are a direct result of the Governments 'smart' proposals.

Data collection of the development

Data was collected from various primary and secondary sources including; physical surveys during site visits, from local government agencies, NGOs, the construction industry and desk-based research. A three-dimensional model of both the existing and proposed developments was constructed (Figures 1 & 2). This was used to establish the morphological changes (building heights, street widths, parking provision, roof areas, open space, landscaping and other aspects of built form). Demographic changes (population density, total population) were based on census data for the existing and the developer's calculations for the proposed development together with an assessment of population based on space provision.

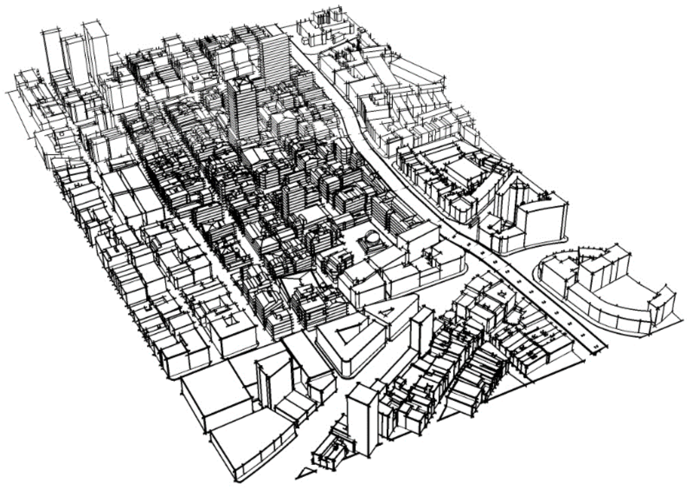

Figure 1. The existing site at Bhendi Bazaar on the Island City of Mumbai

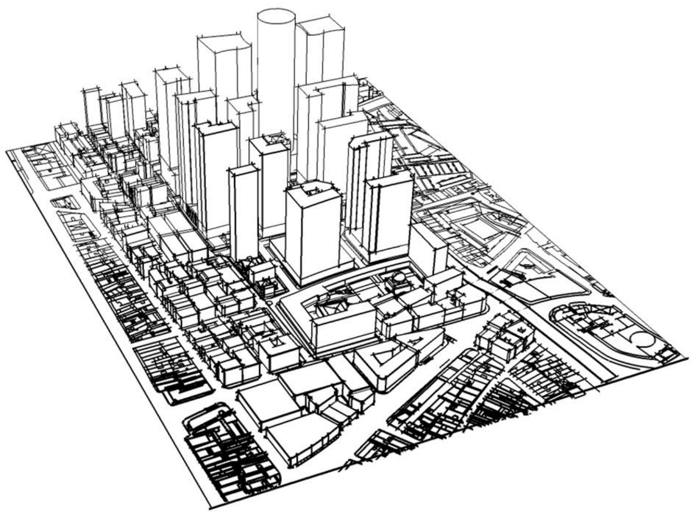

Figure 2. The proposed development that is claimed to be an example for 'smart' cities in India.

Understanding the magnitude of the built form and population increase of the development allowed an analysis of the additional resources required for the new development and hence and assessment of the environmental impact.

Environmental consequences

Water collection and consumption

Water demand in the new development (Figure 3) is calculated to be more than double the existing (232% increase). This is partly due to the cleaning required to the increased amount of common areas and also the amount of trees and shrubs (above ground level) that require irrigation outside the monsoon period. However, the bulk of increased water usage comes from greater use within apartments. The reduction in shared bathing/toilet facilities, increased number of private water taps (sink, basins, showers, washing machine) and the 'take-back' effect of potentially more efficient water control systems being offset by a change of behaviour in the use of the appliances (duration of use of bathrooms or use of washing machines).

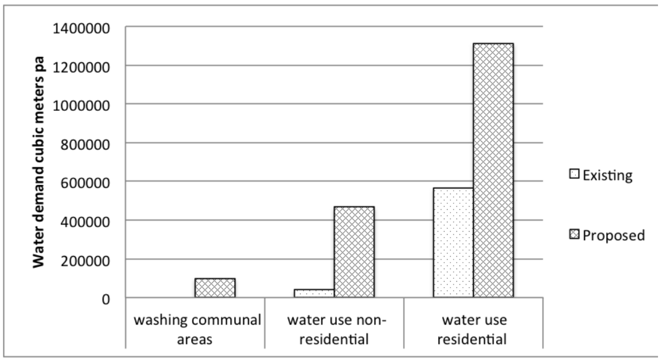

Figure 3. Comparison of existing and proposed water demand by different users

Rainwater harvesting

The reduction in site coverage and the taller, but fewer, buildings results in a decrease in overall roof area of 32% with the same decrease in rainwater harvesting potential (a mandatory requirement in Mumbai) resulting in less than half (45%) the potential amount of rainwater per person (Figure 4).

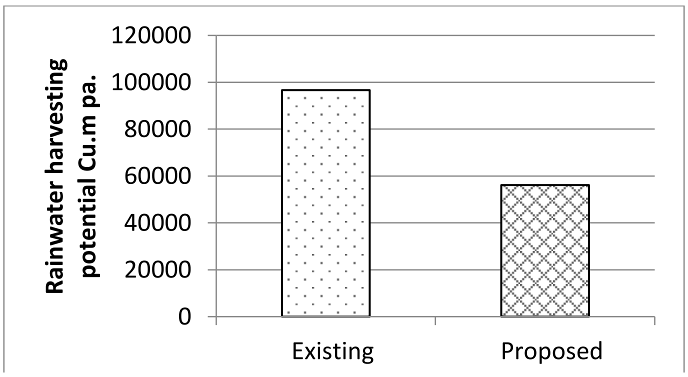

Figure 4. Comparison of rainwater harvesting potential

Sewage and wastewater

Related to the additional water consumption is the sewage and wastewater generated by the new development. Sewage will be proportional to the increase in population. However, there will be significantly more wastewater related to the increased appliances and change in lifestyles.
The increased population on the site, with consequent increased wastewater and sewage, results in a sewage volume that has more than doubled (234% increase) and reached 4.64 million litres per day. At present the sewage treatment plant for the zone (Worli) manages to treat less than 20% of the sewage, the rest is pumped directly to the sea without treatment.

Electricity consumption

Residential electricity is the largest consumer on the site and almost doubles (196% increase) in the proposed development (Figure 5). This is combined with two new loads incurred by the development: i) lighting and ventilation to basement and podium car parks amounting to about 6% of the total residential load and ii) electricity use for other communal facilities that include; pumping water to the towers, lifts and lighting of corridors all of which amount to about 9% of the total residential load.

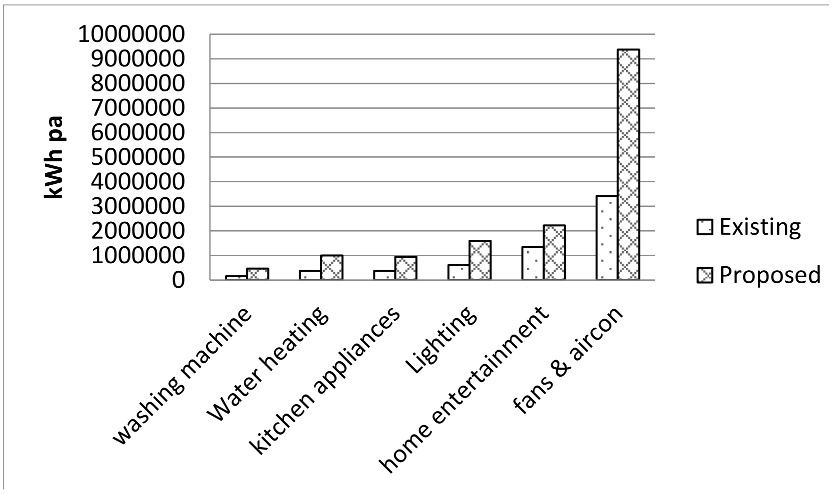

Figure 5. Comparison of residential electricity use

The increased residential electrical load is due to several factors. The average floor area of each unit has almost doubled which results in additional lighting, fans and air-conditioning use. Dedicated water heating with larger volumes of water results in increased hot water usage especially with individual use of modern washing machines. Household appliances (e.g. microwaves, home entertainment and larger television screens) are likely to become commonplace and used more frequently. However, air-conditioning is likely to become the single largest consuming item as the demand for increased comfort and status that comes with air-conditioning spreads (Tembhehar,2011).
Electricity consumed by commercial and retail spaces will more than double (226% increase) in the new development (Figure 6). This is due mainly to the configuration of the commercial areas that, although having the same overall floor area as the existing development, have an external perimeter that has decreased by 63%. This reduces both daylighting and cooling by natural ventilation resulting in increased use of fans and air-conditioning as well as artificial lighting.

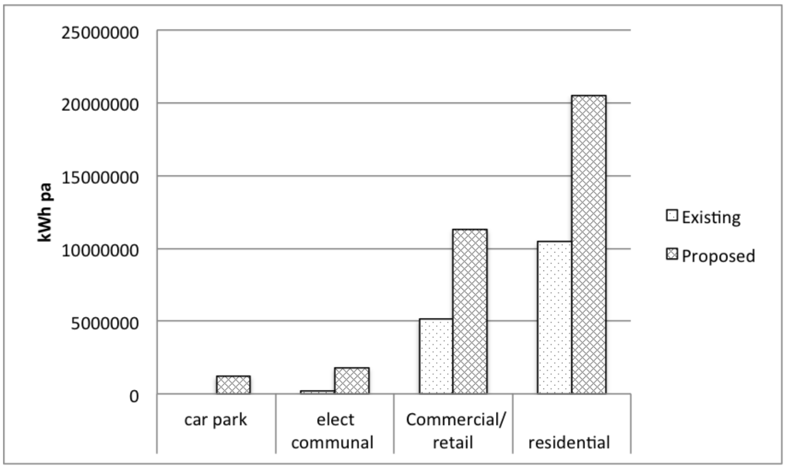

Figure 6. Comparison of all electricity uses.

Carbon emissions

Considering only the carbon emissions in the operation of the development, the two main contributors are the carbon due to additional electricity generation and the emissions due to the additional private vehicles that can now be housed on the site (Figure 7). The carbon emissions in electricity generation in Maharashtra average about 0.9 tCO_2/MWh reflecting the high proportion of coal-fired generation.

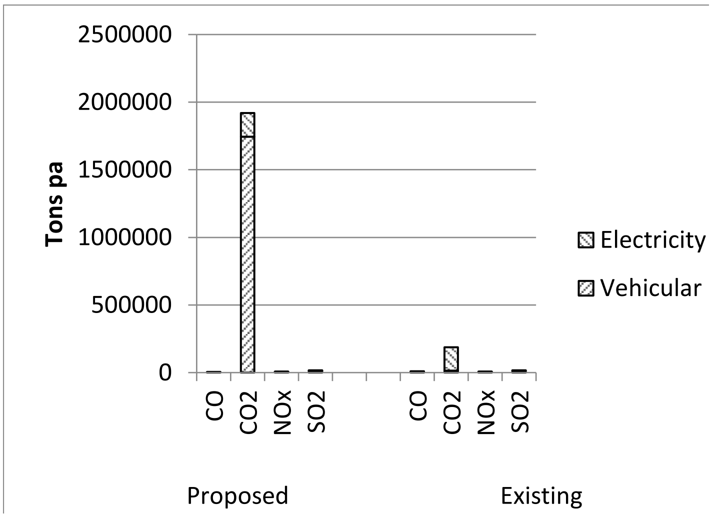

Figure 7. Comparison of Greenhouse gas emissions from electricity production and private vehicles

The total additional electricity use for the proposed development is 18,326 MWhrs/year that equates to16,494 tCO_2 per year. However, only a proportion of this is directly due to the nature of the development. The operation of the car parks (extraction fans and permanent lighting), lifts, pumping, common areas, air-conditioning and lighting, for non-residential, and a proportion of air-conditioning for residential are directly attributable to the nature of the development.
This amounts to approximately half of the additional electricity load, making the development attributable to 8,247 tCO_2 per year due to the increased electricity demand.

The amount of carbon emissions as a direct result of providing car parking spaces, where there were none previously, will depend on the type of vehicles and their travel patterns. The reduction in emissions due to changes of fuel (in particular CNG) has been assumed to be offset due to an increase in congestion as car ownership grows rapidly. Assuming 16 km/litre of fuel, the average carbon emissions per vehicle are 200gCO_2/km. It is assumed that 80% of the 1400 car parking spaces are occupied and used regularly and that the average travel distance is 6km per day for recreation, occasional shopping and school drop-offs. This amounts to 25 kg per day or 491 tCO_2 per year.

Solid waste

The per capita generation of solid wastes in Mumbai has been steadily increasing and reached 0.63Kg/person/day in 2004 (Mahadevia, Pharate, & Mistry, 2005). It should be noted that in addition to the land required for dumping the waste, a considerable amount of energy is spent in sorting, transporting and processing the waste in addition to the greenhouse gases released from their decomposition. The overall increase in solid waste is anticipated to increase by 30% per capita due largely to increased affluence (Figure 8).

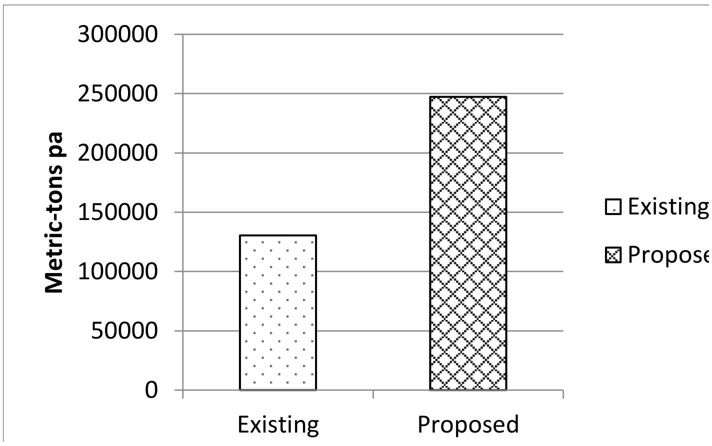

Figure 8. Comparison of solid waste generated

Extrapolating the results across the Island City

Overall, the results indicate that the intensification policy in the Island City would result in 1677 new tower blocks averaging 40 storeys high, 51,780 additional car parking, a reduction in open space per person from 1.27 to 1.15sqm, a new 100 MW power station (probably coal-fired (Gosh, 2010)), a new 100 million litres per day dam to supply water, 160 million litres per day of sewage to be processed, 3570 tons per day of CO2 production and many more adverse impacts. All this will be added to a City that, due to inadequate resources and difficult geography, already systematically rations electricity by blackouts, rations water to a few hours per day, and where 80% of sewage is untreated and washes up on the shoreline (Mandal & Byrd, 2013).

DISCUSSION

With policies of compaction and constraints on the dispersal of cities, urban form will inevitably grow vertically. With verticality grows dependence on centralised ‘flows’ of energy, water supplies and

waste disposal. Dependency leads to vulnerability and insecurity and, while suburbia offers some degree of resilience by its ability to collect energy and water from individual roofs and food from individual gardens, vertical urban form offers little resilience (Byrd & Matthewman, 2014).

While demand is increasing for resources to 'feed' the metabolism of Mumbai, supply from the hinterland is struggling. In the case of electricity supply, the state of Maharashtra consumes almost 12% of India's electricity, having the highest consumer base in the country, it also tops the list for more deficit compared to other states. Consumption of electricity is growing faster than production capacity. The depletion of 'easy to find' coal combined with higher energy demands from industry and air-conditioning is leading to electricity blackouts on a regular basis (BBC News, 2002; BS Reporter, 2006; Rediff News, 2007).

In the case of water supply, the city of Mumbai is facing water shortages, with parts of the city receiving direct supply of water for only a few hours in the day.

In the case of solid waste, most of Greater Mumbai's collected solid waste is disposed of as mere dumping and levelling at the landfill sites at Deonar, Mulund and Gorai that have almost outlived their carrying capacity. Though the Government of Maharashtra has allotted a disposal site in Kanjur Marg, it is likely to be inadequate for the projected solid waste generation (MCGM, 2005 to 2025 a).

In the case of drainage, the discharge of all the storm water and treated sewage is into the Arabian Sea. Tidal variation has a major bearing in the system of storm water drainage resulting in flooding and water logging during heavy rains and high tides (MCGM, 2005 to 2025 b). This is likely to get worse with the risk of sea level rise due to climate change. The sewage system of Mumbai is inadequate, resulting in discharge of large amounts of untreated sewage into creeks, causing degradation of coastal water quality and contamination of the adjoining beaches and seafronts (Kumar, Subramaniam, & Patil, 2000).

The pursuit of cities to become 'smart', 'world-class', 'liveable', 'green' or 'eco', has been promoted alongside increased population densities and urban compaction. This planning goal must reach a point where resources are inadequate for the fully functioning metabolism of a city. While case studies such as Bhendi Bazaar offer an exemplar for the 100 'smart' cities planned by the Indian Government in terms of increased density, improved image and urban regeneration, they do not offer an answer to the problems of providing an adequate infrastructure to support the metabolism of such developments if they were to be significantly replicated.

The results indicate that there is a significant adverse impact on the environment and that the increased metabolism, and hence detrimental environmental impact increases at a greater rate than population increase. On this basis, this exemplar development does not support the case for calling the proposals for Mumbai 'smart' or 'sustainable'.

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SCALING UP RENEWABLE ENERGY TECHNOLOGIES USING SOLAR LANTERN IN RURAL AFRICA

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INTRODUCTION

We need energy to drive socio-economic, human and technological development. There is no MDG on energy, yet access to energy is needed to achieve the MDGs. Access to clean modern energy services is an enormous challenge facing the African continent, despite the fact that the continent is the home of enormous potentials for renewable energy resources. Africa accounts for about 3% of world energy consumption, the lowest per capita modern energy consumption in the world. On the other hand, in terms of biomass energy consumption, the African continent has the highest share in the world, 59% of total energy consumed is biomass[1]. The energy-deprived people are the world's most impoverished, living on less than $2 per day with majority living in sub-Saharan Africa. It has been reported that Africa's electricity consumption remains low, about 8% of global electricity consumption. The majority of the African population does not have access to electricity. In the year 2000, only 22.6% of the population in Sub-Saharan Africa had access to electricity, compared with Asia – 40.8%, Latin America – 86.6% and Middle East – 91.1%1. Lack of access to electricity inflate production cost and make competition in the global market difficult for developing countries. On the supply side, Africa's energy profile shows low production and huge untapped potential. The African energy situation is characterized by a high rate of demand driven mainly by demographic factors, while supply lags significantly behind. About 11.3% of the electricity generated in Africa is wasted compared with world's average of 9.2%[1]. The energy-deprived people are the world's most impoverished, living on less than $2 per day with majority living in sub-Saharan Africa. It has been reported that Africa's electricity consumption remains low, about 8% of global electricity consumption. The majority of the African population does not have access to electricity. In the year 2000, only 22.6% of the population in Sub-Saharan Africa had access to electricity, compared with Asia – 40.8%, Latin America – 86.6% and Middle East – 91.1%1. Lack of access to electricity inflate production cost and make competition in the global market difficult for developing countries. On the supply side, Africa's energy profile shows low production and huge untapped potential. The African energy situation is characterized by a high rate of demand driven mainly by demographic factors, while supply lags significantly behind. About 11.3% of the electricity generated in Africa is wasted compared with world's average of 9.2% [1]. There is significant variation in energy consumption among the different regions and countries in Africa. For example, electricity consumption in sub-Saharan Africa amounts to only 2.9% of total energy consumption, while in North Africa is 15.1% and in South Africa is 25.9%. The reliance on

biomass is highest in sub-Saharan Africa (81.2%). North Africa and South Africa consume 4.1% and 16.5% of biomass respectively of their total energy budget[3]. Thus sub-Saharan Africa continues to rely heavily on biomass. More worrisome is the use of biomass in an unsustainable and in an inefficient way. This over-reliance and unsustainable use of traditional biomass fuel leads to a low levels of energy efficiency and ability to mitigate climate change and high levels of deforestation, biodiversity loss, and health hazards due to indoor air pollution.

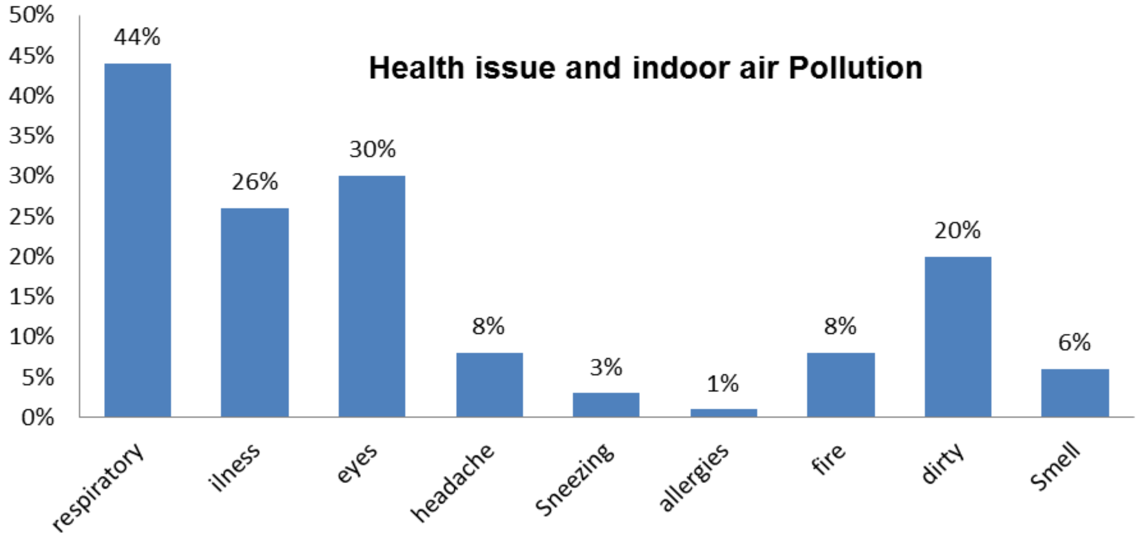

Figure1 Health issue and indoor air pollution

RENEWABLE ENERGY TECHNOLOGIES

Solar energy

Solar energy can be collected using artificial devices called solar collectors. The energy collected is used either in a thermal process or a photoelectric (photovoltaic) process. When used in a thermal process, solar energy is used to heat a gas or liquid. In the photovoltaic process, solar energy is converted directly to electrical energy without intermediate mechanical devices. There are two types of solar collectors, flat plate collectors and concentrating collectors.

RENEWABLE ENERGY AND ENERGY EFFICIENCY DEVELOPMENT BARRIERS IN AFRICA

1) Limited recognition of Off-grid lighting Products as an interim option for rural access to modern energy. Modern off-grid lighting solutions are not explicitly mentioned in the current rural energy development policy discourse in African countries.

2) Absence of incentives for Off-grid lighting.

3) Unlike many African countries where fiscal incentives are established to promote the use of clean energy, particularly solar energy, the prevailing framework in these countries does not encourage the widespread use of clean technologies. High customs duties and other taxes do not favour the dissemination of high quality modern lighting products.

4) High cost of doing business in Sub-Saharan Africa. The existing business environment is a hindrance to private investment. Customs procedures and tax requirements make it cost prohibitive for

private enterprises to invest in the off-grid lighting arena, and increase the perceived risks of doing business in the country, particularly in a new market.

5-Low quality products. The market is dominated by low cost, low quality products. This is in part a result of the absence of quality standards and methods for consumers and other buyers to distinguish high quality from low quality products, the latter of which can spoil the market.

6-Lack of Off-grid lighting market research. The market for modern off-grid lighting products in Cameroon does not exist any market maturity.

7- Difficulty accessing financing. Private companies find it challenging to obtain credit from commercial banks due to high interest rates and huge collateral requirements (up to 215 percent of a loan).

8- Social, cultural behavioural. Non-acceptance of PV, lack of confidence in PV.

9- Lack of Off-grid lighting products in the marketplace. Unlike other Sub-Saharan African countries, where a range of good and poor quality products can be found in the market, with very few good products available to consumers.

10- Low Purchasing power of Off-grid lighting users. The main market is in rural non-electrified areas where the purchasing power of households is very low and they are unable to meet the initial product cost.

11- Very little understanding of or emphasis on promoting energy efficiency from within government or industry.

12- Insufficient international cooperation (e.g., signing of technological protocols) on technological transfer from developed to African economies.

STRATEGIES TO SCALE-UP RENEWABLE ENERGY MARKET.

Use of informal market instrument

By informal markets, we mean a system whereby end consumers of a product can pay for a product in several instalments. Because of the low-income status of the African society, many people are unable to fully pay for a solar water heater, photovoltaic or other renewable energy facilities in a single instalment. Allowing them to spread the payment over a period of time (6 months to 1 year or even longer) will help to broaden access to renewable energy systems. The government, NGOs, the private sector and financial institutions can use the informal market instrument to scale-up renewable energy markets, which will consequently help to increase access to these facilities and consequently more modern energy services. For large scale electricity generation using renewable technology, a hire-purchase type of agreement, underwritten by development bank(s) or similar institutions, but with interest of no more than 3% per annum may help.

Priority investment on renewable energy

Since access to energy is fundamental for development and achieving the MDGs, African governments should increase investment in sustainable energy. Yet few countries in Africa have given priority attention to investment in renewable energy technology for the majority of people now without access to modern energy services. There is need for African government to invest more on sustainable renewable energies such as solar, wind, geothermal instead of large hydro and thermal stations which have taken much of the investment on energy in the continent. Moreover, large dams have been found to contribute to the emission of greenhouse gases[6].

Removal of import tariffs and other trade barriers

On short-term bases, the reduction or appropriate elimination of tariffs and non-tariff barriers on renewable energy facilities may help to stimulate the nascent renewable energy industry in Africa. This should be done in a way to protect local industries. More importantly, emphasis should be laid on strengthening the production capacity of renewable energy facilities, putting in place measures to reduce the burden of high cost of energy and promoting investments on renewable energies.

Policy formulation

In African countries, there is need to develop a comprehensive strategy, policy and investment program for a transition to the use of sustainable energy. Considering the most urgent energy needs and existing capacities of the majority of their population, countries in Africa should develop targets for improving access to modern energy services and develop national renewable energy goals. Such a system should be anchored on the use of renewable energy and energy efficiency. Such policies should be driven by the state in partnership with private sector and active civil society participation. Although many African countries have formulated energy polices, the policies are too often consultant driven and lack inputs from the wider civil society and many policies in the past have passed their implementation life in the shelves of senior government officials. New policies should address all issues such as trade, production, distribution, consumption, investment in renewable energy and end-use and demand-side energy efficiency. There is need for a paradigm shift in energy development.

Improve governance in the energy sector

There is need for improved governance of the energy sector. Since electricity generation and supply require huge investments in the development and maintenance of infrastructure (e.g., transmission technologies), it is important to build upon the existing experience of government agencies in supplying electricity. African government should provide better funding for state owned utilities. Countries could establish a government run utility that is compelled to implement energy efficiency. Policy that encouraged a public-private partnership could be developed. However, the involvement of the private sector should be preceded by policies and legislations that will regulate their activities; private companies could capitalize on social, political and environmental circumstances for exploitation.

Training of African personnel

Training of African personnel on renewable energy technologies is an important factor that will help to scale up renewable energy market in the continent. This will help to minimize the over reliance on foreign experts in the installations and maintenance of renewable energy technologies, consequently helping to reduce the cost of renewable energy services.

Financing

International finance institutions such as the World Bank should give priority investment to renewable energy instead of investing in fossil fuel. The developed countries of the world are responsible for most of the emissions leading to climate change and should sincerely invest in renewable energy. Organs of the United Nations such as UNEP, UNICEP and others commit huge amount of money to health care, education etc. The fact is that all these are essential, but some of these will not be achieved even if money is spent without adequate energy, and one way of ensuring adequate energy is by encouraging renewable energy. Just like African governments will need to reconsider their budget allocation to energy, so also will these international organisations. The new climate investment funds

proposed by the World Bank need to ensure support for renewable energies and technologies that do not impact the environment or the livelihoods of the people negatively and whose impact on Poverty eradication can be measured.

Promote energy sovereignty and energy security

Renewable energy technologies have the ability to give self-reliance to local communities, where they can utilise the excellent renewable energy resources available for their own good. It will allow local people to have control over their energy resources and determine the type of energy to use for their daily needs. In Africa, this issue of energy sovereignty needs to be scaled up and this can only be possible by the use of renewable energy. Renewable energy can also help to limit the insecurity in term of supply of energy and promote access to more vulnerable populations. We therefore advocate that renewable energy should be integrated into local development plan while focusing action on the development of rural enterprise (including local production).

Financial viability

The sustainable introduction of renewable energy into Africa must be founded on commercial viability. This means that the users of renewable energy technologies, and the suppliers of these systems, must all see some form of financial benefits. This will enable the optimum growth of renewable energy market otherwise the use of renewable energy will always be dependent upon external finance, grants and short-term policy obligations.

CONCLUSION

The World Summit on Sustainable Development (WSSD) in Johannesburg in 2002 took an important step in recognizing the important role of energy for reaching the Millennium Development Goals (MDGs). Access to affordable, reliable and sustainable energy is essential to sustainable development. An adequate attention to energy problems will contribute to achieving progress across all pillars of sustainable development: economic, social and environmental and in meeting the UN Millennium Goals. Although there is no specific MDG on energy access, the WSSD recognized that adequate access to energy is vital for poverty alleviation. The United Nations Declaration on the Rights to Development of 1986 recognizes that the human person is the central subject of the development process and that development policy should therefore make the human being the main participant and beneficiary of development. So the human rights approach to development promotes participatory development in policy making, project conception and implementation. The domestic energy crisis in Africa cannot truly be attributed to the expansion of domestic consumption. The problem at this time may be attributed to Government policy conflicts in the energy sector and the overall macro economy. And also, the energy crisis could be attributed to obstacles in the nation's energy planning, management and conservation strategies. As identified during the WSSD, it is imperative for African countries to:"Take joint actions and improve efforts to work together at all levels to improve access to reliable and affordable energy services for sustainable development sufficient to facilitate the achievement of the Millennium Development Goals, including the goal of halving the proportion of people in poverty by 2015, and as a means to generate other important services that mitigate poverty, bearing in mind that access to energy facilitates the eradication of poverty".

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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally

AMPS, Architecture_MPS; London South Bank University
09—10 February, 2017

A FLOOD RESILIENCE MANIFESTO: REFRAMING BRISBANE CITY'S HIGH DENSITY WATERFRONT DEVELOPMENT

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THE UNIVERSITY OF QUEENSLAND

INTRODUCTION

"Living with water" has become a mantra of many capital cities, which are rebranding themselves by embracing the concept of resilience in response to increasing water management issues and flood risk. Blessed by a subtropical climate and the advantageous location as Australia's closest eastern capital to Asia,[1] Brisbane strives to join the international race for the most resilient and liveable city. Like many other cities in the world, Brisbane straddles the flood plain of a major river and is crossed by thousands of overland flow paths that meander along its hilly topography. Its hydrology naturally encompasses cycles of droughts and floods, including riverine floods as well as flash flooding. Its prosperity depends on the correct management of these extremes, which have a significant impact on infrastructures, assets, transport, waterways, parks and community life. The devastating 2011 Queensland floods, paradigmatically preceded, and followed, by prolonged drought, are an alarming warning of this ever-transient condition of the city.

Brisbane City Council's (BCC) aspirations for a built environment where "flooding is expected, designed and planned for" are well summarised in the recently released *Brisbane's Floodsmart Future Strategy 2012-2031,*[2] which marks the fundamental shift to a risk-based approach to flood management. The strategy stipulates how the city's built form should be shaped to increase resilience to flooding, and specifies the need to "locate the right land use in the right place" and "new growth areas where there are few flood constraints or where the effects of flooding can be managed", which is also echoed in the *2014 Brisbane City Plan.*[3]

Despite these aspirations, Brisbane has seen rampant high-density development occurring well within the floodplain. Preliminary research has found some 13,000 apartments are currently approved or under construction in flood risk areas, driving Brisbane's contemporary urban design tension between economic forces and its ecological disposition.[4] Figure 1 shows the prevailing building footprint of such developments on low lying, riverside post-industrial sites, in contrast to BCC's flood risk areas in shades of blue (Table 1).

This intense infill development in areas at risk of flooding means that Brisbane could serve as a unique laboratory in which to develop and test design solutions for improving quality and performance of public space, green and water infrastructures, and the urban fabric. This opportunity has been neglected due to risk-averse policy constraints and a frantic, investment-driven housing market.

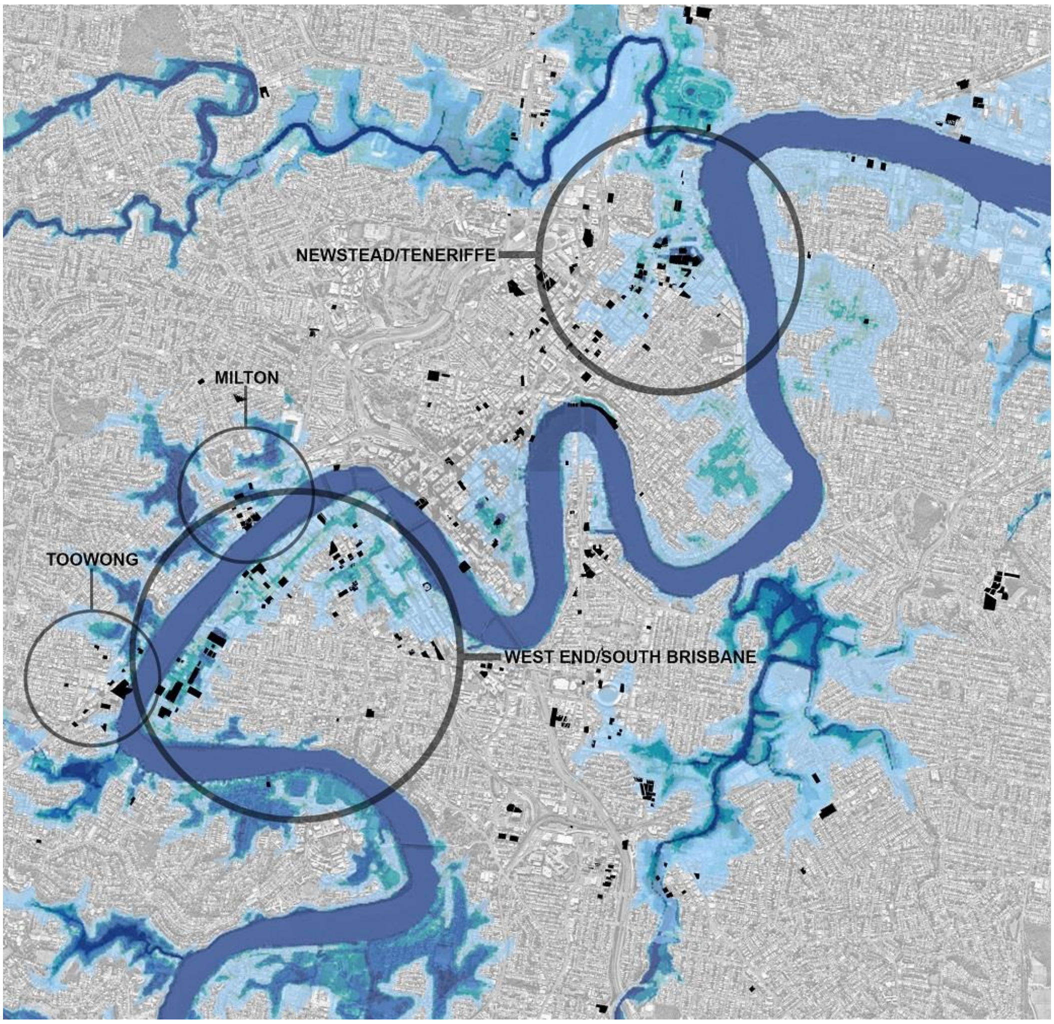

Figure 1. Footprints of multi-residential developments currently approved or under construction[5] *overlaid with Brisbane City Council's flood risk planning zones in blue.*[6]

Table 1: Apartments under construction and approved until April 2016 [3]

Apartments under construction (April 2016)	
Suburb	**Number of apartments**
West End/South Brisbane	2,815
Toowong/Milton	678
Newstead/Teneriffe/Fortitude V.	2,275
Other	125
TOTAL	**Min. 5,893** (from approvals with indicated apartment numbers)
Apartments approved (April 2016)	
Suburb	**Number of apartments**
West End/South Brisbane	3,225
Toowong/Milton	1,468
Newstead/Teneriffe/Fortitude Valley	2,072
Other	1,899
TOTAL	**Min. 8,664** (from approvals with indicated apartments numbers)

This paper therefore presents and discusses alternative design approaches to achieve greater flood resilience without compromising urban liveability. It analyses the impact of post-2011 flood policies on design of new high-density development of Brisbane's flood plains and, learning from successful international examples, proposes tailored water sensitive urban design solutions developed through design-based research by Master of Architecture students of the University of Queensland.

BRISBANE´S APPROACH TO FLOOD RISK MANAGEMENT: POLICIES AND THEIR DESIGN IMPACT

The 2011 floods in Queensland were hailed as "Australia's most expensive natural disaster."[7] Overall 200,000 people were affected, including 12,000 displaced, and more than 15,000 properties inundated by flood waters.[8] Given their social and economic impact, the 2011 floods sparked a series of reactions from authorities, leading to the publication of the *2014 Brisbane City Plan* where flood risk management was explicitly addressed in the *Flood overlay code*.[3]

Table 2: Permitted BCC Accommodation activities and Flood category Planning Areas.[3]

Accommodation activities	**Brisbane River flood planning area sub-category**						**Creek/waterway flood planning area sub-category**					**Overland flow flood planning area sub-category**
	5	4	3	2B	2A	1	5	4	3	2	1	
Community residence	Y	-	-	-	-	-	Y	-	-	-	-	-
Dual occupancy	Y	Y	-	-	-	-	Y	-	-	-	-	Y
Dwelling unit	Y	Y	-	-	-	-	Y	-	-	-	-	Y
Multiple dwelling (1–3 storeys)	Y	Y	-	-	-	-	Y	-	-	-	-	Y
Multiple dwelling (4+ storeys)	Y	Y	Y	-	-	-	Y	-	-	-	-	Y

Table 3: Room types and floor level requirement categories.[3]

Flooding source	**Minimum design floor or pavement levels (m AHD) (refer to Table 4 for assignment of these categories)**				
	Category A	**Category B**	**Category C**	**Category D**	**Category E**
Brisbane River	Residential Flood Level + 500mm	Residential Flood Level + 300mm	Defined Flood Level	5% AEP flood level	5% AEP flood level
Creek/ waterway	1% AEP flood level + 500mm	1% AEP flood level + 300mm	1% AEP flood level	1% AEP flood level	5% AEP flood level
Overland flow	2% AEP + 500mm	2% AEP flood + 300mm	2% AEP flood level	2% AEP flood level	5% AEP flood level

ARI = Average Recurrent Interval (expected duration between occurrences of a specific flood event)
AEP = Annual Exceedance Probability (likelihood of a flood of a given size occurring in any year)
Defined Flood Level (DFL) = 1% AEP at individual property level
Residential Flood Level (RFL) = 2011 level (often higher than the DFL).[5]

The approach to flood hazards taken by BCC implies the adoption of controls to ensure residents,

business and properties are not exposed to an "unacceptable" flood risk. The risk standards, both in land use and building height, manifest as design criteria for buildings in areas subject to flooding. BCC set out 22 Performance Outcomes (PO), which can be summarised as rules controlling floor height, habitable and non-habitable spaces, under-croft design, access, location of plant and stipulations regarding neighbouring flood impact. Floor height requirements are divided into categories, based on the building programme, with habitable levels generally tied to the 100 year flood event, and service spaces falling between a 50 year and 20 year event (Table 2, Table 3 and Table 4).
Under-croft designs for areas such as carparks include requirements for material resilience and permeability of structures to allow flow and debris to pass through the site. Electrical and mechanical services must be protected or elevated above the 100 year line for both public safety and asset protection purposes. The policy also includes a "no adverse impact" clause by which no building intervention, can indirectly or directly increase material flood risk on an adjacent property.
While the approach embodied in the Flood overlay code has been praised as a valuable advance in effective flood protection,[8] various POs have manifested in adverse design solutions in new high-density developments in Brisbane. This paper analyses the impact of these policies in key study areas in inner city Brisbane.

Table 4: Floor level requirements and development categories (see table 3 for definitions). [3]

BCA building classification	**Development types and design levels, assigned design floor or pavement levels**	**Category – refer to Table 3 for flood planning levels**
Class 1–4 (Residential Dwellings)	Habitable room (Kitchen, Living Area, Bedroom)	Category A
	Non-habitable room including patio and courtyard	Category B
	Non-habitable part of a Class 2 or Class 3 building excluding the essential services control room	Category B Risk management approach to Brisbane River flooding is permitted
	Parking located in the building undercroft of a multiple dwelling	Category C
	Carport, unroofed car park; vehicular manoeuvring area	Category D
	Essential electrical services of a Class 2 or Class 3 building only	Category A
	Basement parking entry	Category C + 300mm

MAPPING FLOOD RESILIENCE OF BRISBANE'S HIGH-DENSITY DEVELOPMENT

Understanding the extent, features and urban implications of recent development in Brisbane's flood risk areas is key to building the case for alternative planning policies that target green and blue infrastructures as shared public space. With the aim of analysing the design impact of BCC's policies for flood risk management, selected students of the Master of Architecture Program at the University of Queensland carried out a comprehensive mapping exercise between July and November 2016. The investigation was one of several initiatives implemented within the School of Architecture to fulfil its research commitments as a member of the *Cooperative Research Centre for Water Sensitive Cities* (CRCWSC), which has been driven cross-disciplinary research into urban planning and water management in Australia and overseas since its establishment in 2012.[9] Students surveyed areas of high-density development in Brisbane - West End, South Brisbane, Newstead and Milton (Figure 1 and Figure 2) – to evaluate the provision of public space, ground floor use, street activation and

infrastructure, through the production of maps that illustrate the extent of diachronic public spaces - those designed to accommodate multiple uses, activities or purposes changing over time, at different times or during different conditions. They can be generated through an innovative approach using public space doubling as infrastructure. In a time of limited funding for public projects, the ability to find alternate sources of capital from infrastructure and private development in order to create public space has become an increasingly interesting idea for designers.

Figure 2. BCC Flood planning areas show the extension and degree of exposure of new development.[5]

Regulated by the Development Codes of the *Brisbane City Plan 2014* and specific Neighbourhood Plans (NP), various new residential developments have been built within the study areas since 2011. Interestingly, the purpose of most of these NPs is to guide the transition of the former industrial fabric to medium and high-density residential development, generally emphasising “site amenity such as deep planting, well-connected and publicly accessible spaces, protection of existing vegetation, landscaping and public art.”[10] Yet, analysis shows that new high-density developments commonly fail to deliver quality public space and amenities.

This is demonstrated in West End for example, where outcomes for a master planned approach of the area are defined, encouraging pedestrian-friendly connections to the river and its adjacent parklands. The NP however, does not include any reference to flood resilient design, relying on the city-wide *Flood overlay code*. One of the obvious design consequences of this is the prevalence of carparks and other vehicular areas on the ground floor, with residential spaces sitting above the required Residential Flood Level (RFL). This stark separation between private and public realms undermines the potential of high-density development to activate streetscapes through mixed uses requiring ground floor

access. With their floor heights set to the Define Flood Level (DFL), commercial spaces in riverfront development cannot be at grade, while carparks occupy street fronts in areas with 10 to 15 storey-high developments (Figure 3).

Figure 3. Detrimental effects of BCC flood management on streetscapes: pervasive use of hard surfaces and disconnected spaces with blank walls at ground level.

Despite existing parklands along the river, which incorporate walking and bike paths, playgrounds and barbecues, and easy access to public transport, the lack of cultural, hospitality and commercial facilities results in un-activated streetscapes. Pedestrian and cycle routes are often convoluted or fragmented, reflecting the lack of an adequate network of green infrastructures, with fenced properties to confirm the absence of an integrated water management strategy. Developments, attending the obligation to prevent neighbouring flood impacts, have become “siloed” in their treatment of water, which is inefficient and expensive, and miss opportunities to generate a greater network of green and blue infrastructures over a larger district area.
The scattered nature of buildings creates an unappealing frontage and fails to activate the streets. Most buildings display hard surfaces below the flood line, such as concrete and rendered block wall. Only localised and limited planter boxes and landscaped side strips are provided, with actual entries raised

above the footpath level, creating a major disconnect between private and public realms. Hard treatments of car parking within commercial and industrial properties increase impervious surfaces. At pedestrian level, street activation through openings, 'floodable' uses, or accessible green spaces is rare, creating a physical and psychological threshold for the public (Figure 3).

ALTERNATIVE APPROACHES FROM INTERNATIONAL EXAMPLES

A number of international case studies have been investigated to find design alternatives to the BCC POs in relation to floor height, habitable and not habitable spaces, safe access and escape routes, and neighbouring flood impact. Cities in Europe, the US and Asia serves as examples where increased flood resilience is not only reducing the physical impact of flood events, but creating public spaces and urban amenity.

Floor Height

New York City Planning has published a series of urban design principles emphasising the need to maintain a liveable streetscape while designing for flood resilience with increased elevation levels, similar to the RFL in Brisbane. Strategies are proposed to carefully design transitions between levels using stairs, ramps, and landscaping as well as setbacks to calibrate to the human scale[11]. In the same vein *Hafen City* in Hamburg mandates that all new buildings stand on artificial "warts" eight meters above sea level, with guidelines on the integration of lower streets and walking levels including infrastructures such as amphitheatres, seating edges and ramps which add to street life.[12] *Parkroyal on Pickering*, a hotel by WOHA, in Singapore presents a detailed edge treatment to the building that intentionally designs a three level transition, remarking continuity (Figure 4).

Figure 4. Park Royal on Pickering, in Singapore presents an elaborate transition edge to fill the height gap with greenery and water, while connecting private and public space (Leardini, 2017).

Habitable and non-habitable spaces

Another alternative risk-based strategy is to allow for flexibility in the programming of spaces in areas at risk of flooding, as shown in New York City, Singapore and The Netherlands. This makes an active street level possible while still avoiding sensitive uses and fragile construction and equipment. The

adequacy of uses is determined by measuring potential damage to property and safety risks in case of flooding against social as well as economic benefits during the majority of the lifespan of the constructions. In New York City compulsory ground floor activation serves as the clearest counter example to Brisbane´s ground floor neglect, where temporary barriers are permitted in some areas allowing commercial activity on the ground floor.[11] Similarly, street activation is achieved by Singapore's "void decks", a standard feature of all high-density public housing developments: in these open ground -and intermediate- floors activity is not regulated and the space is public, which allows for spontaneous temporary occupation, encouraging community networking and integration.[13] Dutch examples demonstrate how flexible programming can also be combined with flood mitigation infrastructure giving birth to a hybrid typology, such as the "water square" which serves as a public amphitheatre next to a training school as well as a retention basin.[14]

Safe access and escape routes

At Hafen City, an entire infrastructure of roads and bridges is elevated to permit emergency access and ensure egress during storm surges. Because the development is organised in a multi-level fashion, these routes blend in without becoming obstructive (Figure 5).[12] Similarly, in order to provide safe passage through the public space even in the event of flooding, the Dutch water squares reserve higher ground for walkways that cross the space linking existing pedestrian routes integrated in the design concept.[14]

Figure 5. Hafen City water edge: public space and active use. ((C) Michael Eichental, 2012).

Neighbouring flood impact

International built examples show how water infrastructure can be included into the urban fabric at the precinct level without compromising the flood resilience of its parts, and increasing its liveability. This is the driver of diachronic public spaces, which serve a social function in times of unexceptional

weather but turn into a flood management facility when required. For example, the Dutch water squares have been built to decrease surface water runoff by storing excess rainwater in open sports fields and playgrounds: these are converted into ponds at peak rain times and release water slowly afterwards (Figure 6). The extension of the infrastructure goes beyond the square itself and affects many streets and lots.[14] Houston's Buffalo Bayou also demonstrates an integrated approach where public parks serve as a network of retention basins allowing development to occur uphill.[15] Similarly, the 7 mile BIG U project for Manhattan uses a series of temporary barriers and berms as an integrated public space infrastructure to protect existing and future New York development from storm surges.[16]

Figure 6: The Water Square in Benthemplein, Rotterdam, after a flood event (Leardini, 2016).

DWELLING IN FUTURE WATERSCAPES

Working in collaboration with BCC and the CRCWSC, in 2016 The University of Queensland's School of Architecture organised a Design Studio within the Master of Architecture program to investigate resilient building options for different flood prone areas in Brisbane. The project sites were located in suburbs that are separated from the CBD only by the Brisbane River; they have been identified by BCC as suitable for accommodating future urban growth. While their existing fabric is mainly made of one or two storey detached houses with isolated examples of low rise apartment buildings, the current NP allows new construction up to eight storeys and proposes medium to high-density mixed-use precincts where water and green public space are integrated. Building in these flood areas means rethinking the relationship between landscape and urban fabric, private and public space in the pursuit of flood resilience through design at different scales.

The Design Studio took a holistic approach from regional to building scales. The studio started with a planning workshop[17] involving an interdisciplinary group of academics, professionals and representatives of water agencies, which was one key generator of design ideas for the semester. Leveraging this experience, students undertook a survey of project site constraints including planning, flood data and current development characteristics, to generate flood resilient alternatives to the status quo. International examples provided a catalogue of design solutions to be adapted and tested locally, as flood resilient responses to existing policy.

All projects shared a planning approach at the district scale, emphasising the potential of larger green and blue networks that override property boundaries. The main strategies of sponge urbanism - store, delay and adapt - were tested: most student projects adopted hybrid design responses to manage flood hazards through diversification of functional layers and raised platforms, where lower levels (below DFL and RFL) are either 'sacrificial' or fully protectable during flood events, but are otherwise integral parts of the community life – echoing solutions adopted in Hamburg and The Netherlands.
This approach addresses flood events of variable intensity affecting the area. Minor episodes can be mitigated through parkland and adjacent wetlands retaining excess water and releasing it slowly, reducing surrounding impact. Low-lying waterfront spaces and facilities are floodable in significant events, with car parking under the podium doubling as a retention basin. The podium itself is above the major flood level, ensuring protection for private and cost-intensive activities, as well as access to transport and escape routes.

Figure 7. Students adopted precinct-scale approaches to flood-resilient design allowing the strategic use of master plans for the inclusion of diverse solutions of diachronic spaces and rain gardens (Chan Yan Yan, 2016)

Considering that the design sites are affected by diverse riverine and creek flood as well as overland flow, the idea underpinning the design proposals revolved around interactions with water and the landscape in a variety of ways. The proposed masterplans manipulated the creek and its natural setting, to generate public space while securing room for water during flood events -paraphrasing the Dutch program "Room for the river."[18] By either restoring the original course of Norman Creek, or uncovering streams like Kingfisher Creek (Figure 7), the water edge was broadened and activated: the riparian zone was redeveloped as a buffer to improve water quality while reducing flood risk.
The envisaged medium to high-density developments work as transition zones between the natural environment of the creeks and the surrounding city fabric. These building clusters are "about cultivating community, work, production, resources, movement and education in a sustainable manner"[19], in contrast with more compartmentalised city zoning programmes. The proposed urban water management solutions go beyond protection and integrate into a place-making process that utilises consolidated water management tools such as green roofs, rain gardens or swales, as well as

innovative spatial solutions like the Dutch Water Square for prioritizing public space and amenities (Figure 8).

Design variations confirm how flexible policies, encouraging flood resilience instead of risk-averse solutions, would drive urban development on principles beyond solely economic interest.

Figure 8. The work of students explored liveable flood-resilient ground level landscapes. (Poorvi Mehrotra, 2016).

CONCLUSIONS

The overlap of development areas and natural floodplains in Brisbane has led to prescriptive regulations concerning positioning and use of the ground floor, with direct consequences on streetscape and public space quality.

Rotterdam, Hamburg, New York City, Houston, Singapore and other cities provide alternative green-blue urban designs that could inform a novel vision for Brisbane's flood-resilient urbanism. They demonstrate that a lot can be done to improve BCC's attitude toward flooding if district-level design is prioritised with careful analysis of the context, leading to customised solutions.

Working towards this goal, Master students at The University of Queensland's School of Architecture drew from these international examples and existing local knowledge to shape a range of alternative solutions for future high-density urban development in Brisbane's floodplains - building the case through design-based research for substantial modifications of the current *Flood overlay code*. Overriding existing policy constraints, they embraced an urban scale design approach to flood resilience, primarily modelling vibrant public space through the adoption of multipurpose and diachronic green and blue infrastructures, flexible use of ground floor space and seamless transition from public to safer private realms. Their next challenge is to carry this acquired awareness into practice.

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GREEN DREAM
ARCHITECTURE IN THE AGE OF THE ANTHROPOCENE

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THE DAWNING OF A NEW AGE

In 2008, a 7.9 magnitude earthquake devastated the province of Sichuan, in China, killing at least 80 000 people and leaving more than five million people homeless. At the time, international scientists and environmentalists accused the construction of the Three Gorges Dam in the neighbouring Hubei province for the tragedy[1]. In fact, since the plans for the dam were first approved, in 1992, several specialists have been arguing that tinkering with water levels on a reservoir that sits on a seismic fault could have disastrous effects. Despite an initial refutation, the Chinese authorities surprisingly admitted problems with the undertaking[2], acknowledging that the construction of the world's largest dam could in fact be "triggering landslides, altering entire ecosystems and causing other serious environmental problems"[3]. When considering that the construction of the dam destroyed the habitats of endangered animals, erased historical archaeological locations and entailed the enforced relocation of over one million people [4], the paradox becomes obvious: the three gorges dam, a symbol of human ingenuity and technological optimism that intended to signal a move towards a more sustainable system of energy production has led to uncertain and potentially catastrophic ecological effects and deleterious social consequences.

To provide some historical context, this was not the first verified human-induced earthquake triggered by the construction of a dam: "The first observation of possible reservoir–induced seismicity (RIS) was noted for Algeria’s Quedd Fodda Dam in 1932; the first extensive study of the correlation between increased earthquake activity and variations in reservoir depth was made in the 1940s for Hoover Dam. Today there is evidence linking earth tremors and reservoir operation for more than 70 dams. Reservoirs are believed to have induced five out of the nine earthquakes on the Indian peninsula in the 1980s which were strong enough to cause damage"[5]. Also, we are now aware of the dramatic effects that earthquakes have on our planet. A 2005 NASA report claimed that the filling of the Three Gorge reservoir would "increase the length of day by only 0.06 microseconds and make the Earth only very slightly more round in the middle and flat on the top" and "shift the pole position by about two centimetres"[6]. And, to be clear, to argue that all these disruptive outcomes should be weighed against its positive effects, such as the fact that the dam effectively reduced coal consumption by 1 million tonnes per year, avoiding 100 million tonnes of greenhouse gas emissions, millions of tonnes of dust, one million tonnes of sulphur dioxide, 370,000 tonnes of nitric oxide, 10,000 tonnes of carbon monoxide, and a significant amount of mercury [7], would be to miss the bigger point. We just need to point out the Aral Sea crisis[8] or the 'Four Pest Campaign' of Maoist China[9] to begin to grasp how externalities of human intervention have the drastic unforeseen consequences to the environment. This means that Human interventions on the planet's geology can have ramifications that will endure, perhaps even after our species ceases to exist. In fact, human impact on Earth's ecosystem is so profound that some scholars argue that we are witnessing the dawning of a new geological era: The Anthropocene. Despite not yet being officially recognized as a subdivision of geological time, there is a growing consensus that we have entered a new

age characterised by understanding human activity as a geological activity and human living as inexorably intertwined with the 'spectral' omnipresence of radioactive elements, Styrofoam, plastic, carbon and concrete micro-particles and artificial fertilisers[10]. An academic study uncovered that we are eating up to 11 000 plastic fragments in our seafood each year[11]. The average person ingests about 2 µg (around 1/15,000 of an ounce) of uranium in food and water every day[12]. For Timothy Morton, the Anthropocene is a key concept when thinking about contemporary society and our built environment, because, on the one hand, it necessarily implies that all humans live in the same 'house' because there is no outside space where the unwanted consequences of our collective actions could be sent to disappear, while on the other, it makes it impossible to maintain the borders that traditionally separate nature from man[13]. Let us not forget that Ecology is etymologically composed by the Greek terms oikos (habitat) and logos (science), that literally means the study of the house, which, from an architectural point of view, makes the concept very appealing. The Anthropocene puts the constructed ideas regarding our nature-culture environment under a new light, in an analysis that seem to relevant and crucial to advance the debate regarding Sustainable Architecture and Urbanism.

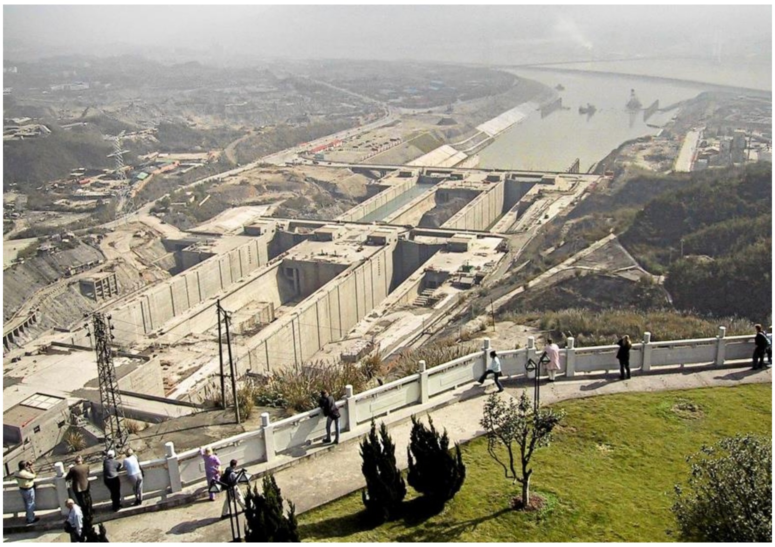

Figure 1: The Three Gorge dam, world's largest power station under construction, in 2002.

THE NATURAL RECOMPOSITION OF ARCHITECTURE

Transcendental Determinism

“In an age of ecological emergency, it is imperative not to be hidebound by a concept that developed during the very period that created the crisis. This concept, Nature, is indeed partially responsible for the current situation. (…) What is required is a view that recognizes nonhumans as partners on “this” side of social space, no longer conceived as exclusively human. (…) In sum, we need to transition from the time of nature to the time of coexistence.”[14]

It is clear that this growing awareness of the fragility of the planet has fuelled the view that sustainability should become the core concept for a theory and design practice of the 21st century. Since sustainability intertwines the study of the habitats and functioning patterns of both human and non-human organisms with with the domain of economics, it has the potential to provide a more systemic reflection regarding the on-going transformations in the territory, therefore providing agency to ecological analyses. In the literature on green design, from the outset, there is a clear emphasis on exploring the connection between humans and nature and understand architecture as‘part of the living habitat’, ‘closely connected to their

site, society, climate, region and the planet', 'in harmony with the nature'. This idea can arguably be typified by cradle to cradle, a philosophical concept and a life cycle assessment product benchmark co-invented by the award winning leading green architect William McDonough. Cradle to cradle crossbreeds science with a deeper, broader, more holistic vision of the environment. It notoriously presents the cherry tree as a model for design: The cherry tree "…enriches the ecosystem, sequestering carbon, producing oxygen, cleaning air and water, and creating and stabilizing soil. (…) it harbours a diverse array of flora and fauna, (…) And when the tree dies, it returns to the soil, releasing, as it decomposes, minerals that will fuel healthy new growth in the same place"[15]. For McDonough "Nature is a source of both sustenance and exquisite design (...) Form can become a celebration not simply of human intelligence but of our kinship with all life"[16]. Green guru David Orr praises McDonough's approach to design as an example of what calls 'full spectrum design', "…a strategy rooted in the ancient meaning of the word 'religion', which means 'bind together'"[17]. The word religious here is not to be taken lightly: what is really being envisioned here is nothing less than the foundation of a new physical and transcendental relationship between man and the environment. Earlier in the Hannover principles, McDonough states "Respect relationships between spirit and matter. Consider all aspects of human settlement including community, dwelling, industry and trade in terms of existing and evolving connections between spiritual and material consciousness"[18].

Figure 2: Huangbaiyu Cradle-to-cradle Eco-Village, China: Site plan (2004) and street view. Only one phase one has been completed, and by 2006 only two families had moved in.

Yet, after an initial period of enthusiastic popularity, the Cradle to Cradle benchmark has recently been under heavy criticism, in part because there seems to be an ingrained conflict of interests, since McDonough is a hired architect or consultant for the companies whose products Cradle to cradle is certifying. Also, some of McDonough’s designs have been called into question because of its unexceptional environmental performance and design failure: Post-occupancy monitorization of some of their buildings detected severe discrepancies between the real energy sourcing and consumption and what the cradle to cradle certification stipulated[19]. But perhaps more revealing is McDonough's failed project for Huangbaiyu. Huangbaiyu was supposed to be the model for a low density self-sustaining rural community to be replicated throughout the Chinese countryside. Only the first phase has been completed, consisting of arrays of rationally ordered and centralised detached housing units reminiscent of a typical American suburbia, that even include a garage when the farmers do not own or can afford a car. The biogas plant designed and built specifically to power the houses of this community was supposed to run on farm crop waste, but leftover corncobs and stalks constitute the winter food supply for the cattle, so in order to function, the biofuel has to be imported[20]. While intending to “provide a higher quality of life for the villagers and to exemplify a more hopeful future for the children”[21], McDonough project is a flat rejection of the existing modes of inhabitation and production that imposes an inadequate and authoritative design process. Its sheer reliance on an idealised natural determinism founded on a self-righteous transcendentalism actively contributes to disconnect design practice from the socio-economic materiality of the site, exposing just how treacherously seductive the concept of nature can be as a marketing tool.

Figure 3: Vertical Forest in Milan and Liuzhou Forest City (CGI). Vegetation as a piece of urban infrastructure.

Re-naturalising Architecture

A contrasting, but growingly popular mode of imbuing nature on the design process is the literal greening of buildings. Edouard François (Flower Tower), Jean Nouvel (One Central Park Sydney) and Herzog and de Meuron (Beirut Terraces) are some architectural practices that have toyed with the concept, but its most systematic application can probably be found in Sefano Boeri's work. His award-winning Vertical Forest, a two-tower residential development whose generous balconies feature 900 trees and over 2000 shrubs. This concept is taken to another level in his Liuzhou Forest City. It is a new city for 30 000 inhabitants in which all buildings, offices, houses, hotels, hospitals and schools are entirely covered by plants and trees. In fact, trees in buildings will outnumber humans[22]. Boeri claims that these projects are a testimony for a 'democratic environmental policy' a non-anthropocentric urban ethic that 'subtracts our species from its pedestal' - a genuine celebration of the newfound architecture's role as a generator of microclimates and instigator of biodiversity: "We must think of accepting a relationship with nature on equal terms in cities, ensuring that it has its own autonomy and is not unendingly influenced by the needs of man. We must begin to foresee spaces for a nature that is close to us and yet is not controlled, toned down, or made artificial."[23]. But we have to wonder if appending trees on a high rise is not in itself a deeply non-natural approach that contradicts its conceptual framework. As Slavoj Zizek argues, a true ecologist should be "horrified at perfect gardens, clean surroundings and so on. That is what he fears, that's the nightmare for him."[24]. Is this project a serious exploration of the emergent properties of a newly attained ecological consciousness or is it an ostensive manipulation of 'nature' in order to fabricate a fashionable piece of green iconography? Are not we sanctioning a territorial vision of landscape eco-tokenism? Despite its undeniable tectonic ingenuity, Boeri's Urban Forests seems to end up reinforcing the rigidity of the disciplinary boundaries of the architectural practice it is trying to dissolve, reflecting a compulsion for immediacy and sense of anxiety that troubles contemporary 'sustainable' practices.

Figure 4: Re-naturalized nature.
A tree, pulled by a crane, about to be rooted in its new habitat above ground in a Milanese balcony.

Surely when Prince Charles appealed architects to "work with the grain of nature" [25] he did not have something like Boeri's Vertical Forest in mind. This comparison may be absurd, but it is revealing of nature's all-embracing ideological spectrum. These architectural projects are constructed on the foundational premises that we are alienated from our immediate 'natural' surroundings and that contemporary practice should attempt to reconstitute the idea of the supposedly balanced, harmonious and smooth circle of nature, but end up treating the social realm as a passive participant while creating the illusion that we are solving ecological problems because, in fact, we are just promulgating the

mythical concept of nature. According to Slavoj Zizek, Timothy Morton and Bruno Latour, it is precisely sustainability's idealistic fantasy of environmental redemption that prevents us of realising the extent to which nature is already hardwired into social space[26][27][28]. In fact, to raise the argument that 'non-sustainable architecture' is incompatible with nature makes the same sense as saying that a prosthetic leg in a dismembered person is incompatible with its human host. So maybe, the first step towards the constitution of sustainable design would be to oppose this romanticized and static notion of nature and, as a consequence, to dissolve the idea that architecture's new mandate is to protect 'nature' or save the environment. Therefore, a more adequate path towards sustainability could be traced by accepting the reality of the ecological crisis in its paradoxical and senseless actuality, by abandoning the compulsion of instigating a radical break from the rest of the unsustainable world, and finally, to liberate design from original sins and ultimate ends.

THE GARDEN IN THE MACHINE

Modern Redux

"Ecology-conscious buildings will change modern architecture more radically than perhaps any movement we have seen since the beginning of the modern movement"[29]

Despite claiming to foster a strong sense of environmental responsibility, when we look at green architecture we usually see designs fixated in measuring and assessing energy consumption patterns, greenhouse gas emissions, material usage and waste management. One very tangible outcome from the advance of green architecture is the rise of a new range of architectural vocabulary: LEED, BREEAM, SmartCode International Energy Conservation, Code for sustainable homes, ASHRAE 90.1, energy standard, cradle to cradle, Factor 4, carbon credits, ecological footprint, eco-efficiency, biomimicry, biophilia, adaptive design, low-energy home, carbon-neutral building, passive solar house, energy-plus building, self-sufficient home… these novel concepts are indicative not only of the myriad of differing ideas, tactics and methods that are emerging from the domain of sustainable design but also of the emergence of competing environmental benchmarks. Green architecture has become undeniably dependent on the building's 'ecological rating': the quantitative data produced by assessment models that certify the environmental friendliness of a building's design, but recent inspections have revealed major failings in green standards[30]. And given that each green benchmark is able to define its own criteria, it is not surprising to realise that to 'prove' the sustainability of any architectural project it is sufficient to pick the most favourable assessment model and tweak some of the buildings features[31].

Despite these shortcomings, these technocratic environmental standards seem to be playing a fundamental role in contemporary architectural production. One of the most recent Norman Foster's projects, the Bloomberg's European Headquarters in London, made headlines by achieving an unheard of BREEAM rating of 98.5%: "We've raised the bar to a new high"[32] claims the architect. It is well known that Foster, one of the world's leading green architects, is a fierce believer in science and technology's ability to solve social and urban issues. In a 2015 interview, Foster claimed that "the whole climate change issue, which many would argue is about the survival of the species, comes down to urbanism"[33]. It is undoubtedly an inspirational quote, but one that seems to be at odds with the interview's headline 'Norman Foster: I have no power as an architect, none whatsoever'. But the bigger point here is that sustainable architecture seems to be proposing a radical reconceptualization of the architectural object as a performance-oriented machine with the expectation of achieving redemption from the recent abuses of civilization, in a way that is reminiscent of the fundamental premises of 20th century Heroic Modernism. This connection has been pointed out by Catherine Slessor, who introduced the concept of Eco-tech: "Examples of this might include a structural system based on and engineered to resemble a giant organic ribcage or a translucent cladding panel that has a high level of insulation, or an environmental control system that can forecast the demands of building users and respond

accordingly."[34]. Eco-tech seems to portrait an upgraded and up-to-date version of high-tech architecture that now takes nature into account.

Figure 5: Shaped by nature. The computational model of the Swiss Re showed that a cylindrical shape responds better to air currents than a square one and reduces whirlwinds.

Let us take a closer look at London's first ecological tall building and an instantly recognisable addition to the city's skyline'[35] a much celebrated Foster's project, the Swiss Re. The author explains that the building's slender profile "reduces wind deflections compared with a rectilinear tower of similar size, helping to maintain a comfortable environment at ground level, and creates external pressure differentials that are exploited to drive a unique system of natural ventilation"[36]. In fact, the generation of architectural form is explicitly contingent to the digital processing of nature: sunlight exposure, wind patterns, energy flows, air movements are run through computational models to effectively shape design[37]. Here, architecture becomes a digital literal metaphor of 'nature'. But this is a process that contributes to the expansion of the apparatuses of control over the 'natural' space, ironically furthering the 'artificialisation' of our environment. It is not so much that 'nature' has been made part of the design process, but that design has found digital processes to absorb selective elements of nature-data. "Monitoring, regulating, controlling flows: is ecological ethics and politics just this?"[38] asks Tim Morton. But arguably the most emblematic example of sustainability on a large scale is Masdar, a planned zero carbon city in Abu Dhabi. Masdar embodies the fundamental paradox of sustainability: inside the city walls we are in a sustainable environment, but once we step outside, we are in unsustainable territory. The decision itself of creating a tabula rasa, self-sufficient, self-centred, technology-driven urban utopia in the desert (as opposed to, for instance, being conceived as an extension of an existing settlement) is telling regarding the way sustainability is, maybe unconsciously, recouping a time when architecture had a clairvoyant vision, a global mission and a universal path towards a hopeful future. Now that the development has halted and it has been declared that the partially built city will never reach its green goals, Masdar may soon become the world's first sustainable ghost town[39].

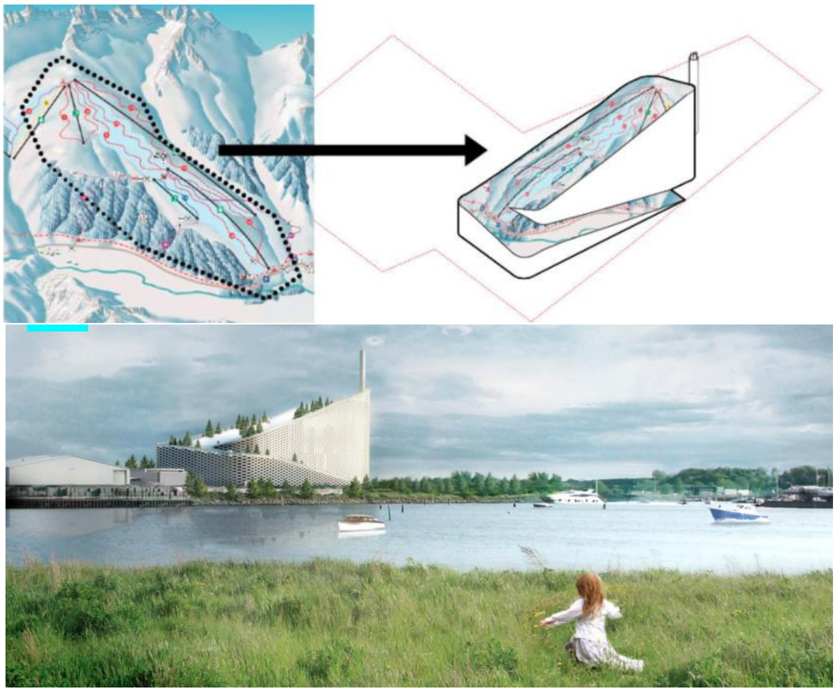

Figure 7: Unapologetic biomimicry: BIG's Amager Bakke Waste-to-Energy Plant in Copenhagen

Nature Redux

There is hardly a better example of biomimicry than BIG's Amager Bakke Waste-to-Energy Plant in Copenhagen: a building that not only has the topography of an existing mountain but also is to be used as a mountain. In a Ted talk in 2011[40], the Danish architect argued that Sustainability's fundamental problem lies on its branding, claiming that sustainability is too attached to a message of sacrifice and moderation when, the hybridization between ecology and design should exacerbate the idea of human enjoyment. Hence, the architect introduces the concept of Hedonistic Sustainability, whose ultimate expression can be found this project, a power plant that doubles as a ski slope whose shape replicates a section of an actual Swedish mountain. To increase the levels of irony, the mouth of the chimney is designed to puff a gigantic smoke ring (30m in diameter) per 100kg of co2. Ingels explains that "One of the drivers of behavioural change is knowledge (…) If you come to Copenhagen in 2016, you just have to count the smoke rings and when you've counted 10 of them we've just emitted 1ton of co2."[41]. The predicament here is self-evident. The waste originated from our unsustainable lifestyles is transformed into an object of desire and celebration. "Sometimes, the thing itself can serve as its own mask —the most effective way to obfuscate social antagonisms being to openly display them."[42], argues Zizek. The project addresses our ecological predicament by projecting a (symbolic) message into the real, as an attempt to conceal the irreducible gap separating the real from the modes of its symbolization. It meaning is precisely to have meaning, to be an island of meaning in the flow of our less meaningful daily life. A useful notion here is Zizek's concept of fetishistic disavowal: the pervasive collective attitude of passive acceptance ('I know very well but…') of the adverse social and ecological consequences of our civilized society that make the smooth-functioning of everyday life possible by focusing on the pleasures by it provided[43]. The project only creates the illusion that it is contributing to solving the ecological crisis, while, in reality, it is just keeping it at a distance by removing any traumatic notion of human behaviour. With this disarming approach, all tensions between humans and the environment disappear. The underlying result of this project is the elimination of any need for social change because it is in itself the materialisation of the eco-social revolution we longed for.

Figure 8: Up in smoke. Computer simulation of a smoke ring from the Amager Bakke Energy Plant.

GREEN DREAM

"If we concede too much to facts, the human element in its entirety tilts into objectivity, becomes a countable and calculable thing, a bottom line in terms of energy, one species among others. If we concede too much to values, all of nature tilts into the uncertainty of myth, into poetry or romanticism; everything becomes soul and spirit. If we mix facts and values, we go from bad to worse, for we are depriving ourselves of both autonomous knowledge and independent morality."[44]

Being consumed with the character of urgency that surrounds our present ecological crisis, sustainable architecture has not been fixated on envisioning proposals that clearly assert a radical break from our existing non-green habitats and wasteful lifestyles. It is this state of anxiety that allows sustainable architecture to be continuously pushed towards two opposite and self-contradictory gravitational poles: toward the modernist belief in the utopian purity of its design principles and toward the ontological primacy of the environment. By promoting the restoration of a hopeful 'natural balance', sustainable architecture thinks it is projecting itself as a beacon of hope for the future when it is, in fact, an agent of political neutralization. It provides the illusion of a move towards ecological justice, by becoming a symbol that replaces the need for societal change. By promoting an emphasis on the ecologic accomplishments of isolated 'pockets' of sustainability, architecture primary role becomes the creation of boundaries that correctly and efficiently regulate the exchanges between inside and outside of a building's envelope. But, as we have seen, there is no outside, sustainability, if anything, is about realising the inexorable interconnectedness of the world, and, as a result, about recognising the paradox of its own impossibility. An architecture liberated from the shackles of a fetishist 'nature' and from the doctrinaire codes of environmental standards becomes free to accept and enjoy the contaminated essence of the world, and is now able to focus on engendering new modes of techno-natural coexistence through architectural form by establishing links of continuity with what is already there, possibly paving the way for the construction of new pathways that truly embody the issues brought by sustainability in the age of the Anthropocene.

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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally

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MIDLIFE CRISIS: RETROFITTING AUSTRALIA'S AGEING APARTMENT BUILDINGS FOR THE CHANGING CLIMATE

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INTRODUCTION

Since 2003 all new houses in Australia are required to comply with energy efficiency rules of the National Construction Code (NCC), with the result that new dwellings now use as little as 25% of the heating and cooling energy of a similarly sized pre 1990 house.[1] While more than 1.2 million dwellings have been built since the introduction of energy efficiency rules, there remain some 7.8 million older dwellings with poor to very poor energy efficiency; it is estimated that less than 1% of all pre 2003 dwellings would comply with the current NCC rules regarding energy efficiency.[2] With no incentives or legal requirements for energy retrofitting, there is increasing use of air-conditioning to provide thermal comfort, which drives electricity use and greenhouse gas emissions (CO_2e) up when they need to be reduced.[3]

The amount of heating and cooling energy used in buildings will change along with the climate, [4] at a pace that depends on both current climate and the extent to which global CO_2e emissions are reduced. Other researchers have examined impacts of climate change on energy use in new houses in various parts of Australia[5] but there is little existing research on impact of climate change on energy use in Brisbane's buildings. Additionally, the energy retrofitting of pre 2003 detached housing, which accounts for nearly 60% of Australian dwellings,[6] is comparatively well understood[7] but the energy performance of Australian multi-residential buildings is a relatively unexplored field, even though more Australians live in apartments than any dwelling type other than detached houses.[8]

This paper presents ongoing research into energy retrofitting of older multi-residential buildings in Brisbane. It builds on previous work establishing the energy use, thermal comfort and viable retrofit strategies for an existing apartment tower in Brisbane. In this paper, the energy performance of the same case study building and retrofit packages are tested in the climates predicted for Brisbane under three different global greenhouse gas emission scenarios.

MID-LIFE CRISIS FOR APARTMENT BUILDINGS IN BRISBANE

Before 1950 there were few purpose built multi-residential apartments in Brisbane, but numbers expanded rapidly from 8,275 in 1961 to more than 65,000 in 1981.[9] The multi-residential apartments constructed in this period are almost entirely masonry structures: external walls are cavity brickwork while internal walls are double or single leaf brickwork and floors are suspended concrete slabs. Internally the brickwork is usually plastered and the underside of the concrete slab floor above is typically exposed as the ceiling of the unit below. Roofs are predominantly low profiled metal sheeting over timber framing with little or no insulation.

These buildings are now between 35 and 55 years old, and are showing their age. Cavity brickwork skins and concrete framed structures are very durable but other components are not ageing as well. Roof sheeting, windows, elevators and other important building elements are reaching the ends of their service lives, and many buildings have complex plumbing and electrical problems arising from years of patchwork repairs to long out of date pipework, wiring and switchboards.

Substantial retrofitting will be required to bring these buildings up to current codes and to keep them safe and comfortable, especially as the climate warms and places additional stress on the building envelope and services. Substantial retrofits may extend the life of these buildings by 25-40 years, so it would be wise to understand how these buildings and any potential retrofits will respond to the predicted changes in the climate over this period.

ENERGY RETROFITTING IN THE PRESENT CLIMATE

This paper builds on the results of a previous paper,[10] which examined heating and cooling energy use in a mid-rise apartment building in Brisbane, consisting of five storeys of apartments over two levels of car parking. The floor plan of each storey is identical, with three apartments separated by a lift shaft, fire stair and shared lobby. The apartments are generously sized at 100m^2 for the two bed apartments on the South and North East, and 140m^2 for the three bed apartment on the North West.
The heating and cooling load of the existing building was established by energy modeling with FirstRate V5.0, one of the three software packages approved for use under the NCC. Four different retrofit packages aimed at the maximum improvement in energy efficiency were examined. Each retrofit scheme consisted of a glazing option paired with an insulation option along with a base set of upgrades, including external shading, weatherproofing, ceiling fans and improved partitions between living and service areas.

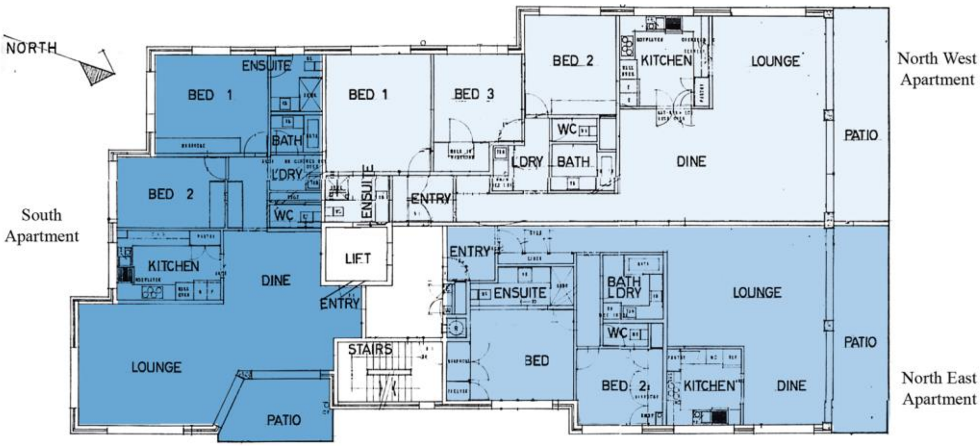
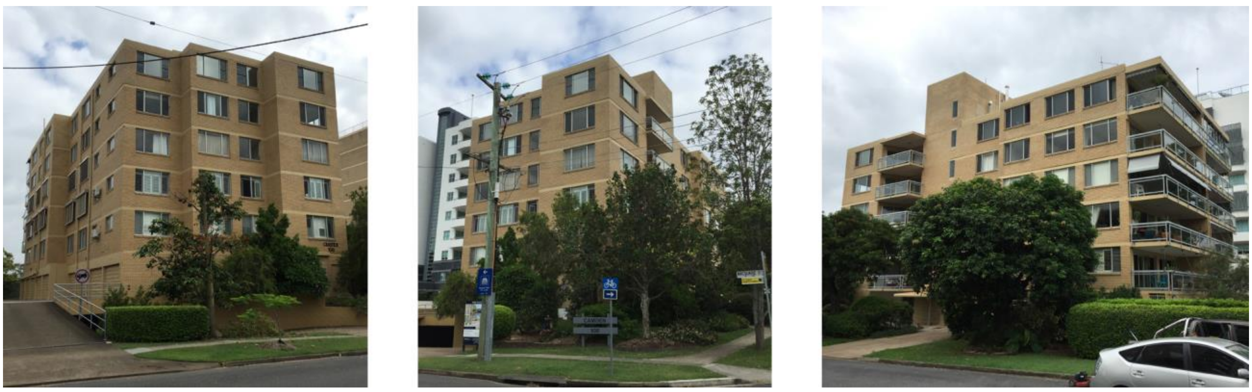


Figure 1 – Typical Plan of Study Building[11]



Figures 2, 3 & 4 – Views of Case Study Building from Macquarie and Munro Streets – Photos by Author

Table 1 - Energy Retrofit Scheme Descriptions

Item:	Details:
Common features to all retrofit schemes:	Extensive shading to windows, ceiling fans to bedrooms, doors to separate living areas from service zones, sealed vents to exhaust fans, weatherproofing to windows and doors.
AG glazing	Low E Single glazing in aluminium frame: U value = 4.6 W/m2K, SHGC =0.36
BP glazing:	Double glazed fibreglass frames with low E glass and argon cavity U value =2.0 W/m2K SHGC = 0.18
IN insulation:	R 4.0 to level 5 ceiling, R 1.0 glass fibre insulation to cavity of brickwork walls. R2.0 to level 1 floor.
EX insulation:	R 4.0 batts to level 5 ceiling R 4.0 EPS to external walls and clad in fibre cement panels. R2.0 batts to level 1 floor.

The two glazing options are an affordable glazing system of high performance glass in aluminium frames (AG) and the best possible glazing available in FirstRate (BP) while the insulations options are in-cavity bulk insulation (IN) and external expanded polystyrene insulation behind a new lightweight cladding (EX). The retrofit schemes are referred to as AG+IN, AG+EX, BP+IN and BP+EX and are fully detailed above in Table 1.
The results of the energy modeling for the base building and each retrofit option are shown below in Figure 4. The modeling confirms that the heating and cooling demand of this case study building can be significantly decreased, with reductions of 73% achieved by the BP+EX scheme. The graph also shows that cooling loads dominate, and overall energy use is likely to increase as the climate warms.

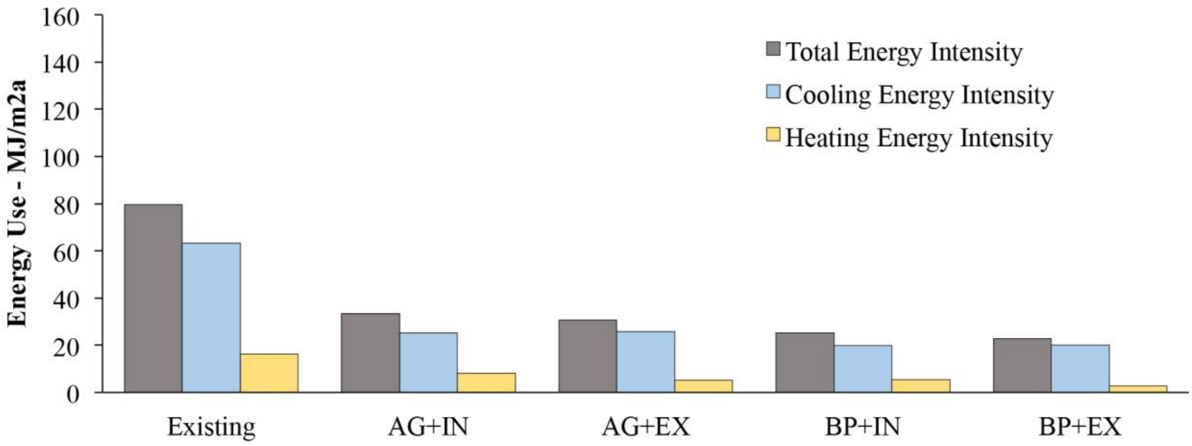


Figure 4 - Averaged Heating, Cooling and Total Energy Intensity by Retrofit Scheme

PRESENT CLIMATE AND PREDICTED CHANGES

FirstRate divides Australia up into 69 climate regions based on weather observations over the past 40 years;[12] although each region covers a significant area, dwellings in each climate region are unlikely to require significant differences in design to reach a similar energy efficiency.[13] Climate zone 10, containing Brisbane, the Gold Coast and the Sunshine Coast, is warm and subtropical with average temperature ranges from 20.6 – 29.4 °C in Summer to 9.5 – 20.4 °C in Winter.
A large body of research has confirmed that the climate is changing, with the global average temperature predicted to rise between 0.3 and 4.8 degrees above 2005 levels depending on future CO_2e emissions.[14] The Intergovernmental Panel on Climate Change has identified three key emission scenarios, which it refers to as Representative Concentration Pathways (RCPs)[15]. RCP 2.6 represents very strong emission reductions starting in 2020 to reach a CO_2e concentration of 420 parts per million

(PPM) by 2100. RCP 4.5 is based on slower emission reductions that stabilize CO_2e levels at 540 PPM in 2100, while RCP 8.5 assumes an increase in emissions leading to a CO_2e concentration of 940 PPM in 2100.[16] In comparison, the current level of CO_2e is 405.25 PPM[17], while the Paris Agreement goal is to keep CO_2e levels below 450 PPM[18].

Using these RCPs, the Commonwealth Science and Industrial Research Organisation has produced a 'Climate Analogues' tool that predicts the future climate of an area and matches it to the current climate of another area in Australia.[19] Table 2 shows the potential changes to the climate, the climate analogues and the corresponding FirstRate climate zone for Brisbane through to the year 2100 under the three main RCPs. The tool shows that in the 2020-2040 period, the climate of Brisbane will come to resemble that of present day Tannum Sands and Bundaberg, between 300 and 400 km to the North, regardless of the RCP. This represents the amount of climate change already 'locked in' by present CO2e emissions.[20] In the 2040-2060 period climate futures diverge and, unless we take action to reduce emissions, Brisbane's climate is likely to resemble that of Yeppoon & Rockhampton – more than 600 km to the North. Potential climates diverge further beyond 2060 but, as the energy retrofits under consideration only have a 25-40 year lifespan, this expanded range of climate is not considered here.

Even though these scenarios indicate similar outcomes for Brisbane's climate, particularly in the near term, they differ vastly in other ways. Rainfall will become more erratic and extreme under RCP 4.5 and RCP 8.5 leading to increasing likelihood and intensity of droughts and flooding. Tropical cyclones, which only rarely reach Brisbane at present, are likely to become more common as well as of a much higher intensity.

Table 2 - Analogous Climates for Brisbane

Emission Scenario:	Period		
	2020-2040:	2040-2060	2060-2100
RCP 2.6	+1 degree, -1% rainfall Tannum Sands, Bundaberg NCC Climate zone 36	+1 degree, -5% rainfall Tannum Sands, Bundaberg NCC Climate zone 36	+0.9 degree, -4% rainfall Tannum Sands, Bundaberg NCC Climate zone 36
RCP 4.5 Maximum Consensus	+1 degree, -1% rainfall Tannum Sands, Bundaberg NCC Climate zone 36	+1.0 degree Tannum Sands, Bundaberg NCC Climate zone 36	+2.2 degree, -3% rainfall Yeppoon NCC Climate zone 7
RCP 8.5 Maximum Consensus	+1 degree, -4% rainfall Tannum Sands, Bundaberg NCC Climate zone 36	+1.9 degree, -5% rainfall Yeppoon NCC Climate zone 7	+4.2 degree, -23% rainfall Woorabinda, Home Hill NCC Climate zone 19

Due to the similarities of the climate analogues for Brisbane, the climate scenarios that resemble Tannum Sands and Bundaberg have been labeled as Future Climate 1 and those resembling Yeppoon as Future Climate 2. These future climates relate to NCC climate region 36 and climate region 7 respectively. By using these climate regions in the FirstRate model we can simulate the heating and cooling energy use of the case study building. This approach may result in potential errors and inaccuracies, as the shift to a more northern climate region alters sun angles and altitudes as well as levels of global solar radiation experienced by the building. However, we believe that the results will be valid as climate zone 10 is nearly 700 km from North to South and the extent of changes to sun angles and global solar radiation are as wide across this distance as they are from Brisbane to Tannum Sands (395 km) or Yeppoon (656 km). Additionally, global irradiance depends as much on cloud cover as it does on latitude and season[21] and the reduced rainfall forecast under all RCPs will bring an increase in irradiance to Brisbane.[22]

RESULTS AND DISCUSSION

The energy intensity of each retrofit scheme in future climates 1 and 2 is shown below in Figure 5, and clearly indicates a substantial increase in energy use in both scenarios: average energy intensity increases 41.6% in Future Climate 1 and 80.2% in Future Climate 2. These results are comparable to those produced by Wang et al in their testing of detached dwellings in cooling dominant climates under similar climate change scenarios,[23] reinforcing the integrity of the methodology for this work as well as the validity of CSIRO's climate analogue tool. In spite of this, the retrofit schemes reduce overall energy intensity in both future climates. Even the least effective AG+IN scheme in Future Climate 2 manages an energy reduction of 22% on the existing building in the present climate while the most effective BP+EX scheme achieves a 43% reduction.

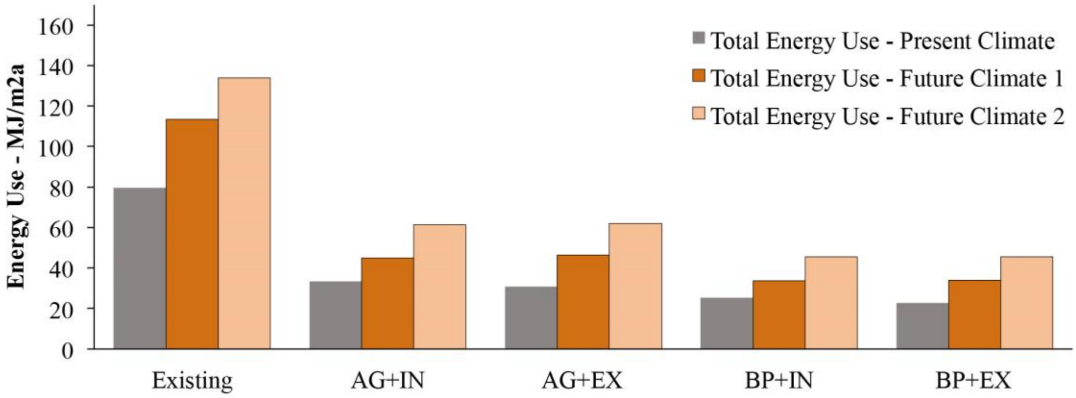


Figure 5 – Total energy intensity by retrofit scheme and future climate conditions

Table 3 provides a complete comparison of energy use in the unmodified building to energy use in the retrofitted building in each climate. Although there is an increase in energy use in both future climates across all retrofit schemes, each retrofit scheme preserves its effectiveness as the climate changes - the best performing BP+EX option maintains energy intensity reductions of 66-72% from the unmodified building as the climate warms. As these buildings are cooling energy dominant, architects and designers in Brisbane can be confident that well designed energy retrofits will continue to be effective as the climate changes. Other building types and climates may face the situation in which currently effective energy retrofits to address heating energy load or balanced heating and cooling loads become much less effective as the climate warms.

Table 3 - Reduction in energy use by retrofit scheme

Retrofit Scheme	Retrofit Scheme Climate Condition	Existing Building Comparison Climate		
		Current Climate	Future Climate 1	Future Climate 2
AG+IN	Current Climate	58%	-	-
	Future Climate 1	43%	60%	-
	Future Climate 2	23%	-	55%
AG+EX	Current Climate	62%	-	-
	Future Climate 1	42%	59%	-
	Future Climate 2	23%	-	54%
BP+IN	Current Climate	69%	-	-
	Future Climate 1	58%	70%	-
	Future Climate 2	43%	-	66%
BP+EX	Current Climate	72%	-	-
	Future Climate 1	57%	70%	-
	Future Climate 2	43%	-	66%

Previous research identified that the BP+EX retrofit option resulted in 84,557 MJ (23,488 kWh) less energy used per year of operation than to the unmodified building, equating to a saving of A$5,750 in electricity costs and 19.03 tonnes less CO_2e released into the atmosphere.[24] As the energy intensity of the building increases in future climates 1 and 2, and the effectiveness of the retrofits remains more or less constant, the energy retrofits actually make a larger overall reduction in energy use and CO_2e emissions. Under Future Climate 1 a total of 147,605 MJ (41,001 kWh) less energy is used by the BP+EX option, equating to reduction of 33.21 tonnes of CO2e and a saving of A$10,090 (at today's prices and CO_2e per kWh rates), while in Future Climate 2, a total of 167,049 MJ (46,402 kWh) less energy is used by the BP+EX option, equating a saving of A$11,429 and 50.62 tonnes of CO_2e. The combination of smaller CO_2e emissions and larger savings on electricity will provide a growing incentive for energy retrofitting of this building cohort as the climate changes.

CONCLUSION

Climate change driven increases in energy use by the built environment are a significant issue that will need to be addressed if Australia is to reduce its greenhouse gas emissions. Building owners in Brisbane and similar subtropical cities in Australia currently have little incentive to upgrade their buildings, given low heating and cooling costs due to a benign climate and cheap electricity. As the local climate changes, a significant increase in energy use for thermal comfort can be expected, leading to a greater incentive to undertake energy retrofitting.

Simulations using FirstRate show that energy retrofitting of older multi-residential buildings can provide a significant reduction in heating and cooling energy as the climate warms, even compared to the unmodified building in the present climate. Although the warming climate will make these buildings more energy intensive to occupy, energy retrofitting will become increasingly viable part of efforts to limit the impact of climate change as it provides increasing reductions in the emission of CO_2e as the impact of climate changes increases.

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CRITIQUE OF BUILT ENVIRONMENT PRACTICES IN CARE AND EXTRA-CARE SETTINGS FOR PEOPLE ACROSS THE AGEING LIFESPAN

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BACKGROUND

Baby-boomers approaching old age brings an unprecedented demographic change and societal challenge. This affects the way we view and provide accommodation for people across the lifespan. The demand for extra-care housing as the preferred option of the 75+ age group is expected to increase, as emerging evidence support its contribution to improved well-being.[1] Also, older people by moving to extra-care might exercise control over their lives by planning ahead to move to more suitable accommodation before significant care needs develop[2.] However, currently for most people moving is triggered by care needs, maintenance issues and security concerns; a move they consider as a 'home for life'[3]. In the UK, the provision developed primarily for older people means occupants either rent or purchase self-contained dwellings with agreements that cover care, support, domestic, social, community or other services[4.] Public funds for provision of care is increasingly scarce; models for care in the community are progressively explored and capital and running costs are expected to be kept low as the affordability of the next generation is on the decrease. Besides typologies needing to facilitate choice and control to older people, healthcare architects explore environments for salutogenesis, i.e. environments supporting health and sense of coherence[5],[6] for the need to accommodate an increasing demand for dementia; a need to maintain networks and family relations and most of all people's need to remain socially and economically involved and to age in place. This presents challenges and opportunities for the built environment, including unplanned and planned care[7.]

Gray[8] associates locally integrated support networks as means of avoiding loneliness and isolation, facilitated by provision of long-term residence and active community involvement. In stable communities, local networks help with personal care and combat loneliness. Opposite, 'private restricted support network' focused on the household with a low level of external contact proved the least effective[9]. Therefore, facilitating mutual support in communities promotes wellbeing.

This paper focuses on whether accommodation for people across the lifespan can foster social connections to reap benefits of social capital important in later life.[10] The paper aims to explore if current models of building types reconcile needs fully; or if a stronger evidence base is needed for new prototypes. For that, purpose-built typologies, where people tend to move to most often due to pressure by family, friends and professionals who foresee a better quality of life, are investigated for their capacity to foster social capital in ageing[11.] Additionally, the ability to retain place identity and community networks[12] is revisited. This is important since for the very old, the notion of community may be compromised as fragility prevents maintaining networks and social contact. However, people still living in ordinary houses but who receive regular support from visiting trained staff, i.e. people in extra-care, present less impairment and multi-morbidities compared to people in care homes. For those people, improvements in social life inside extra-care homes helped reduce loneliness. Nevertheless, we should consider that people tend to post-rationalise the choice to move[13]. This paper focuses on the relation of accommodation to the broader social network rather than the social networks in these facilities.

METHODOLOGY

To identify contributions to social capital in accommodation across the lifespan, we examined two very different types of accommodation: extra-care homes and a care home for dementia. These types sit at opposite ends of service provision for ageing: extra-care is closer to autonomy, requiring minimal environmental interventions. The dementia village, oppositely, requires specialised staff and built environment. As research in psychiatric settings indicated, user participation is essential for specialised buildings[14]. Thus, we involved the first group directly, through interviews. For the dementia village residents, though, direct involvement would require resources beyond the means of this research.
The locus of the study comprised rural extra-care homes in Lincolnshire as the geography and demographics present challenges not necessarily met in densely populated settings. Additionally, the dementia village of the Netherlands, was chosen for its' pioneering model compared to former institutional provision for dementia.
User-inclusive research involved two workshops on housing for ageing and individual interviews with stakeholders and end-users: one workshop with 30 service providers who ranged from staff who worked with older people on ground to decision makers at strategic level for older people's services and one workshop with 30 older people, plus individual interviews with 15 older people and service providers in Lincolnshire. Additionally, we conducted a socio-spatial analysis of the dementia village. The two groups differ considerably, therefore, any similarities found might present substantial value. To understand how community and care needs may be reconciled we talked to older people and service providers to establish the challenges and opportunities faced in local contexts. We conducted a series of workshops and interviews with service providers and people over 70, with varying degrees of disability, living in their own homes. Service providers ranged from those who had immediate contact with older people on a regular basis delivering a range of care services and people in strategic positions in the housing and care sector for ageing in Lincolnshire. It was less important to talk to people living in certain typologies because people could post rationalise their choice to move there. We also observed older people in three care homes in different geographical locations across the county. Further evidence was gathered on locations, plans and facilities of all Extra-care housing in Lincolnshire, strategic planning documents for Lincolnshire and literature reviews extending the current understanding of the typology. Then, as a learning exercise to inform the development of new prototypes, we also looked at the built environment of the first village-type accommodation for dementia, De Hogeweyk in Weesp, Netherlands. The Hogewey, accommodates patients with progressed dementia. Data collection involved literature review, maps, plans, photographs and two-day observation of common areas, indoors and outdoors. The physical environment was evaluated according to the current state of the art on built environments for dementia and moreover, a Space Syntax analysis using Depthmap software was performed, to understand the social logic of the spatial configuration of the village.
Finally, although small adaptations and retrofitting are important for the extra-care homes cohort of people, in this research we only looked at purpose built Extra-care homes.

FINDINGS

The current stock of Extra-care homes were generically similar in built forms, plans, and facilities which have developed as a large housing blocks towards the edge of town facilities to provide access to town centres (figures 1, 2).

Figure 1: Typical setting in the neighbourhood

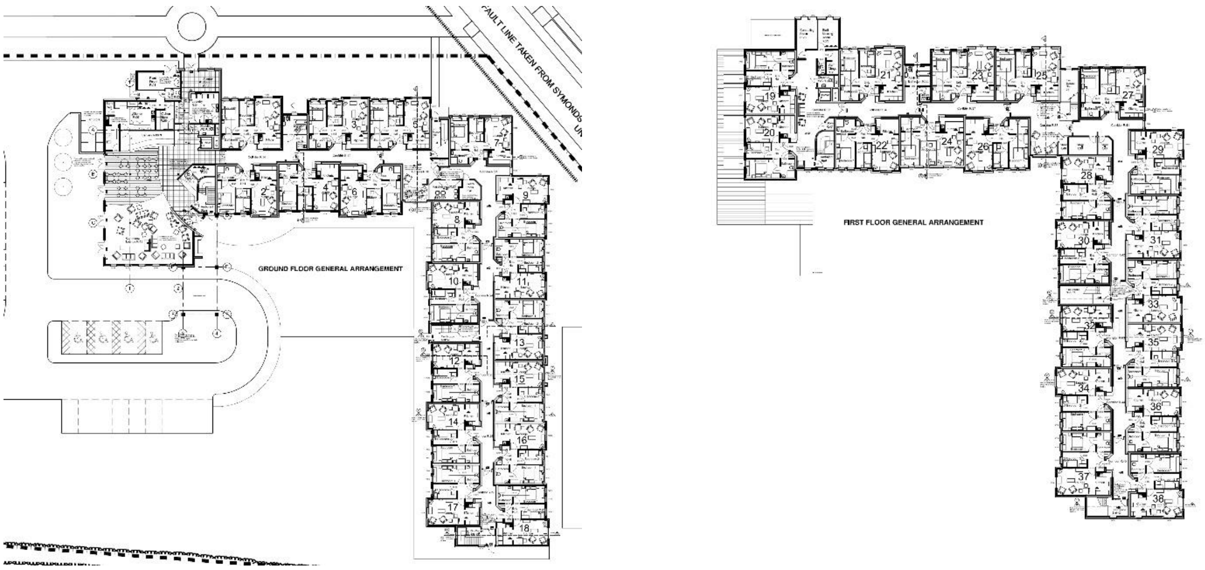

Figure 2: Typical floor plans

The need to deinstitutionalise Extra-care homes was a key message from older people and service providers. This was also the case behind the establishment of the Dementia village[15] and the reason if its international appeal, i.e. the urge to de-institutionalise accommodation for people across the life-span. Regarding Extra-care, there was wish to remain in the community through downsizing. Characteristically, one decision making stakeholder expressed for working in rural communities, *"of older people in rural communities expressing a housing need,… looking to downsize but … stay in their own community. They've got no alternatives, really. That's part of the challenge for Lincolnshire … There is a large proportion of older people in rural communities where they'd like to stay and I think where it would be most appropriate for them to stay because that's where they have their networks. Uprooting and moving away from your own community in the later stages of life is not necessarily the*

best answer." Moving to a place of own choice was regarded as a lifestyle change by the older people who wished to be empowered for this decision. They felt that they lacked the opportunity to downsize within their communities at an appropriate time; '*before the limiting fall and not after*' as one stakeholder put it, to ensure continuance of networks to enjoy a better quality of life.

Older people stated a strong need for a range of tenures as they found '*nothing much between owner occupied and sheltered accommodation now*', describing the current models as not perceived as a life style choice for the varying range of affordability levels, and want to be helped to make the choice with sufficient information and guidance. A range of downsizing options in alternative locations planned around delivery of professional care as well as community based care can reap the benefit of the higher social capital in rural communities where even buses are described as mobile community centres[16]. Older people were clear about their needs and they conveyed that to decision makers: *"we're recognising that older people, usually home owners, are taking the trouble to make us aware of their housing circumstances and future housing needs.... We also get a lot of feedback, about ... not need(ing) to build more affordable homes; allow older people to downsize, their homes would be recycled and could be available".*

This lack of choice at various dependency levels in rural communities might create a discordance between need and provision. Thus, Extra-care homes might have to cater for more dependent people than the optimum. A decision-making stakeholder stated: *"people come to extra-care housing usually for a couple of years with a high level of need and that's because there's not enough. Whereas the concept of extra-care was intended to be a balanced community of needs and abilities, partly mutually sustaining...*". This difference between original planning and dependency, does not allow care homes to be smoothly integrated in their communities, as they were not originally designed for their use. This creates isolation and breaks the flow of social capital. More analytically, expectations for mutual benefit in a 'balanced' community is believed to increase with reminiscence and social contact resulting from long term residency as intangible assets such as goodwill, bond and trust defined as Social Capital that develops among groups. Such intangible assets resulting from common values, attitudes and behaviours can become a resource to serve common goals/needs in older people. Social capital evolves depending on associated networks as a bonding capital usually among close kith and kin, family, friends, even perceived neighbourhood relations with an expectation of social support. A bridging social capital is built upon contacts and acquaintances. Elders need with younger people for continuity, emotional and practical support, a problem to those without children[17.] This is difficult to be sustained when extra-care homes, function as care homes for more dependent people.

Apart from the physiological characteristics of residents, physical networks and connections might be an additional challenge for rural communities. As the most disconnected county in the UK regarding road connections[18], inadequate public transport and as a result, high car ownership rates need to think on care delivery to villages and the role of Extra-care in home based care. Moreover, service users are not a homogenous group. A service provider comments on this diversity; *"in Lincolnshire it's got to be an organic way and a mixed economy of provisions because there are different aspirations across different parts of the area with older people coming from different backgrounds. Some people who are migrating in want to come to a particular type in a part of the world, and some are doing it because they've had to...*". A home for life allows for mutual exchange between incoming older people to the county, who are known to be more affluent, long-time residents and those in Extra-care.

Typologies need to consider the diversity of localities to inform design. Service providers mentioned *'that's really important again in that wider context about people maintaining their social contacts, their family connections, their part time work, whatever that might be, that it has that focus as well'.* This is in accordance with literature[19] suggesting that bonding in older age is affected by class, former occupation status, and gender, impacting on the support received, with neighbourhood contacts and frequency of meeting people having the greatest effect[20] . With the few available Extra-care homes scattered across the vast geographical area in Lincolnshire, moving to an Extra-care home involved moving to a different geographical area even for a cohort of older people with lesser degrees of impairment.

Finally, care within and from the community depends on connections and social capital developed over time. More robust evidence based design that considers facilities and opportunities available at a range

of radius such as from 1m, to 4km considering the opportunity for active healthy ageing where connections can be built beyond the perimeter of the homes will simultaneously allow for social capital to evolve; for older people the happy places used on everyday basis is within a 4km radius from where they live and even buses are considered as community centres in rural communities who have a higher percentage of social capital. The design built forms including location and layout can have an impact on such community integration. The recent Housing white paper[21], has reiterated the importance of these needs, expressed by the service providers "*The capital to make those changes is difficult because it's market driven rather than driven by need. Whereas now there's kind of a boom in construction of what you might call a granny flat… a place for things like dementia villages, if that's what people want to live in, but then a lot of people also would rather still feel like they were a part of a more holistic community. And so there is more market development of that*."

DISCUSSION

While the evidence base can shed more light, the current models hinder integration with neighbourhood. Typologies should respond to the specifics of the locality. Providers have felt this need and have incorporated a range of communal facilities that the surrounding community could use of such as shops, restaurants or even hair dressers. Currently, these must be accessed through the front door of care homes. This was also the case in the Dementia village, where similar integration was sought. It is not a surprise that the facilities are not used as expected in neither context. Reversing this order where possible or offering dual entrances could be an option to explore. This need for integration means that the urban design of the public, semi – public and private realm of individual houses should be resolved to create new typologies that are set in the mainstream neighbourhood morphologies.

Face to face interaction is facilitated by locally based solutions. The physical design of accommodation for ageing and their integration into the wider neighbourhoods can therefore impact on social capital which creates opportunity for forms of physical and psychological support in ageing bringing a range of benefits for older people. Opportunities for face-to-face interaction can foster a sense of belonging and reinforce norms and membership over time. By providing opportunities for formal and informal social interaction in public and semi-public spaces, and encourage residents to stay can contribute to the element of trust and reciprocity which in turn help to build social capital within a community. In the dementia village this was provided in the internal street network and communal areas, yet patients had to travel long distances to reach social places. For carers and especially older partners that could be a considerable burden as they too could face issues of frailty or neglect or spending time travelling regularly could even result in self-neglect.

The local neighbourhood remains key for social identity with weak ties making an important contribution to social capital in the UK[22] . Spontaneous interactions encourage a sense of trust and connection between people and the places they live. Accumulated over time, these connections have been theorised to be significant for fostering "a web of public respect and trust" and a resource in time of personal or neighbourhood need. These points that derived from literature and workshop findings and interviews of providers or people across the lifespan. All groups recognised the need to retain social networks and access to provision enabling social involvement and interaction.

The one-size-fits-all approach currently in place, is inappropriate for the urban or rural environments integrated in urban or village grains and morphologies. Older people do not perceive current Extra-care homes which have a spatial arrangement and morphology distinctive from the familiar neighbourhoods as a lifestyle choice to move to a new home. This familiarity was a key element behind the dementia village concept but again this regarded the internal configuration but not the actual sitting of the village in the town grid. Yet, since the Extra-care housing in Lincolnshire tend to be like hotels in scale and morphology resulting from rooms arranged around a lounge and a corridor, identifiable as an institution distinctive from the morphology and urban design patterns of the surrounding neighbourhood. The scale of people's homes set in a landscape and geography create people's identities and place making practices which should be taken account of in finding appropriate solutions[23]. Contrary, the dementia village even though was accommodating people of decreasing cognition as well as people who faced challenges associating with their local neighbourhoods was deliberately shifting from that hotel model, as too

institutional. Thus, the design concept was to recreate the neighbourhood through smaller clusters (figure 3) of homes arranged in a so-called village configuration and each one presenting a different style to cater for the various personalities and tastes. However, issues such as the co-habitation with strangers and the inability to accommodate spouses as well as the peripheral location of the village were still the case.

Figure 3: Bird-eye view of Hogewey village

CONCLUSIONS

The research identified exclusionary building practices, which could impact on residents' interaction with personal and social networks including families. Overall, these exclusionary mechanisms that the isolated, fully enclosed typologies, might foster, eventually might endanger fragile bonding and bridging capital. This combined to the growing evidence encouraging socially inclusive practices. That could be achieved by revisiting and investing in existing village hubs, especially in those almost abandoned villages in deprived rural areas[24] and revitalise them as socially inclusive communities, active in silver economy.

In rural locations retirement destinations, could be developed in areas with a relatively flat topography and without extreme weather conditions and low house prices. Such an area could be Lincolnshire, where indeed the 65+ age group increased above national average. However, despite this potential, Lincoln has the fewest number of Extra-care housing in the UK[25]. For that reason, it would be important to implement the current plan of building new facilities to cater for the projections for increasing demand.

New typologies in Extra-care need to be developed as they could contribute in developing and mobilising social capital among older people. The older people themselves as well as those working in older people's services are aware that "*Well, the housing sector is slightly on the back foot because housing still isn't necessarily seen to play that important role. But then of course it does*".

This is ideal period for research to inform policy, as the White paper presented to the UK parliament[26] on 'Fixing our broken housing market' targets *"offering older people a better choice of accommodation can help them to live independently for longer and help reduce costs to the social care and health systems".*

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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally

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EXAMINING THE ECONOMIC, PSYCHOLOGICAL AND PHYSIOLOGICAL BENEFITS OF RETROFITTING HOLISTIC SUSTAINABLE AND BIOPHILIC DESIGN STRATEGIES, FOR THE INDOOR ENVIRONMENT

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INTRODUCTION

A recent report from the United Nations estimates that by 2030 more than 60% of the World's population of 8.5 billion will live in cities, and by 2050 it will rise to 70% and 9.7 billion[1]. The task of surviving this dystopic future appears almost insurmountable, as poor living conditions, airborne contamination and energy consumption, continue to rise and threaten civilisation. It therefore seems obvious, that in future our buildings must support our health and wellbeing.

The Biophilia hypothesis[2], proposes that humans share a deep-seated propensity to be surrounded by nature, and that exposure to the natural world is therefore important for human wellbeing. It is becoming increasingly clear that Biophilia has a real and measurable impact on human performance metrics such as productivity, emotional wellbeing, stress reduction, learning and healing according to Kellert et al[3].

Up to now there has been limited research that examines the benefits that the combined retrofitting of Biophilic design and sustainable nanotechnology could have, on enhancing the outcomes of commercial interior design practice. The need therefore, to understand more about the specific contribution of this holistic design strategy to the design process, is now paramount. Not only in terms of wellbeing but also in terms of sustainability, and a better understanding of what these combined strategies could provide, to optimise building performance.

Therefore, could the retrofitting of a combined, Biophilic design and sustainable nanotechnology strategy provide an effective solution to help built environment professionals combat some of these problems? This paper therefore questions whether it's possible to yield a greater understanding of the mechanisms and potential for retrofitting holistic Biophilic design and sustainable nanotechnology strategies, to provide the greatest benefits to building occupants.

Rationale

Biophilia and Nanotechnology are terms that are not normally associated with one another, or even used together to tackle the same problem. However, adopting different tactical combinations like this, to help address some of the major environmental issues of our age, will hopefully become the norm, as we progress through the 21st century. The paper focuses on some of the seminal issues surrounding population growth, pollution of cities and the ensuing housing problem. It forms part of a wider research interest of the author, in fostering collaboration between local industry and academe for real world sustainable applications.

The drivers for change

In 2013 the Department of Energy and Climate Change[4] stated that the UK had an increasingly serious housing problem, as we had some of the oldest and most energy inefficient housing in Europe. With over 50% of our 24.4m homes being built, even before a basic level of thermal insulation was introduced into the Building Regulations in 1965. In response, the UK building industry embarked on a retrofitting campaign, to help improve the energy efficiency of our ailing housing stock.
If we have already started a retrofitting campaign, then why do we need Biophilic Design Strategies as well?

> 'Each year in the UK, around 40,000 deaths are attributable to exposure to outdoor air pollution which plays a role in many of the major health challenges of our day. It has been linked to cancer, asthma, stroke and heart disease, diabetes, obesity, and changes linked to dementia. The health problems resulting from exposure to air pollution have a high cost to people who suffer from illness and premature death, to our health services and to business. In the UK, these costs add up to more than £20 billion every year'.
> The Royal College of Physicians, 2016.

Energy retrofitting is only one solution for a healthier future, as the Royal College of Physicians[5] (RCP) know only too well. They have recently appointed UK architects AHR[6] to design a new Biophilic HQ for them in Liverpool, to ensure that their staff are kept in the best possible health. This is to be a new build, not a retrofit of an existing building; but with architect Sir Denys Lasdun's 1964 current RCP HQ in London as the standard to follow, and now Grade 1 Listed, Liverpool and AHR have a big task on their hands.

What are Biophilic Cities?

Biophilic Cities[7] are biodiverse cities where residents always feel close to the natural world.
Our desire to be close to nature for our health and wellbeing is not an entirely new phenomenon. Biophilic Cities are reminiscent of William Hogarth's Pleasure Gardens[8] of London in the 17th to 18th Century, and echo Ebenezer Howards' Garden City Movement[9], first established in 1898.
Although for a while in the UK we seemed to forget our heritage when developing urban areas, but now Birmingham is the first city in the UK to have been awarded the Biophilic City status. Setting it alongside San Francisco, Singapore, and Oslo. It has more parks, than any other city in Europe, and the number is increasing. Birmingham City Council sees the value of open and green spaces as 'Natural Capital' and a positive way of bolstering its working population.

Singapore, which is often celebrated as one of the leading Biophilic Cities, and it has had a continuous biophilic retrofitting policy for creating a Garden City for over 50 years. More recently Singapore's policy has moved it more towards becoming a 'City in a Garden', with its Green Plan[10]. A recent example of their determination to achieve this is Supertree Grove 2012 in 'Gardens by the Bay', see Figure 1.

Figure 1. Supertree Grove, Gardens by the Bay, Singapore 2012

Complementary solutions

So, what are our other options for reducing the pressure on what Bauman[11] in 1999 called the 'unholy trinity, of uncertainty, insecurity and unsafety'?
One of the other options to complement Biophilia is nanotechnology, which is science, engineering and technology conducted at the nanoscale. If introducing Biophilia isn't feasible, then nanotech coatings could provide direct solutions to many urban, interior and architectural problems by simplifying quite complex engineering issues. Nanotech coatings have broad reaching compositions, with uses from keeping buildings clean on the outside/inside façade, to reductions in damp and condensation, energy efficiency and other properties that absorb air pollutants and expels them as clean air over a 12-hour period.

USA company Dry Wired's product LumActiv[12] is particularly successful at disabling pathogens in airborne pollutants; it can be sprayed onto the interior as well as the exterior of a building and is considered a sustainable alternative. Its' titanium dioxide component is triggered by light energy, and works towards decomposing organic compounds at a molecular level breaking down VOCs and NOx in the air see Figure 2. It can also be applied towards LEED and WELL credits for improving air quality.

As aforementioned, the problems of pollution however affect not only the exterior, but most importantly the interior as well; as we spend approximately two thirds of our lives inside buildings. Another way to control this in the future, can be measured by the impact that the materials and finishes specified by the designer, have on the Indoor Air Quality (IAQ)). Therefore, as well as nanotech coatings and Biophilia, if we use Winchip's[13] 2007 theory for guidance, by considering the Whole Life-Cycle (WLC) of the

materials and products, we create a 'cradle to cradle' system that closes the loop. Ensuring that the materials used in the interior, can be recycled, reused or safely decompose in landfill, at the end of their usefulness. However, some of the smaller design practices may struggle to convince their clients of the economics of this method so, unless its statutory and regulated unfortunately it won't happen.

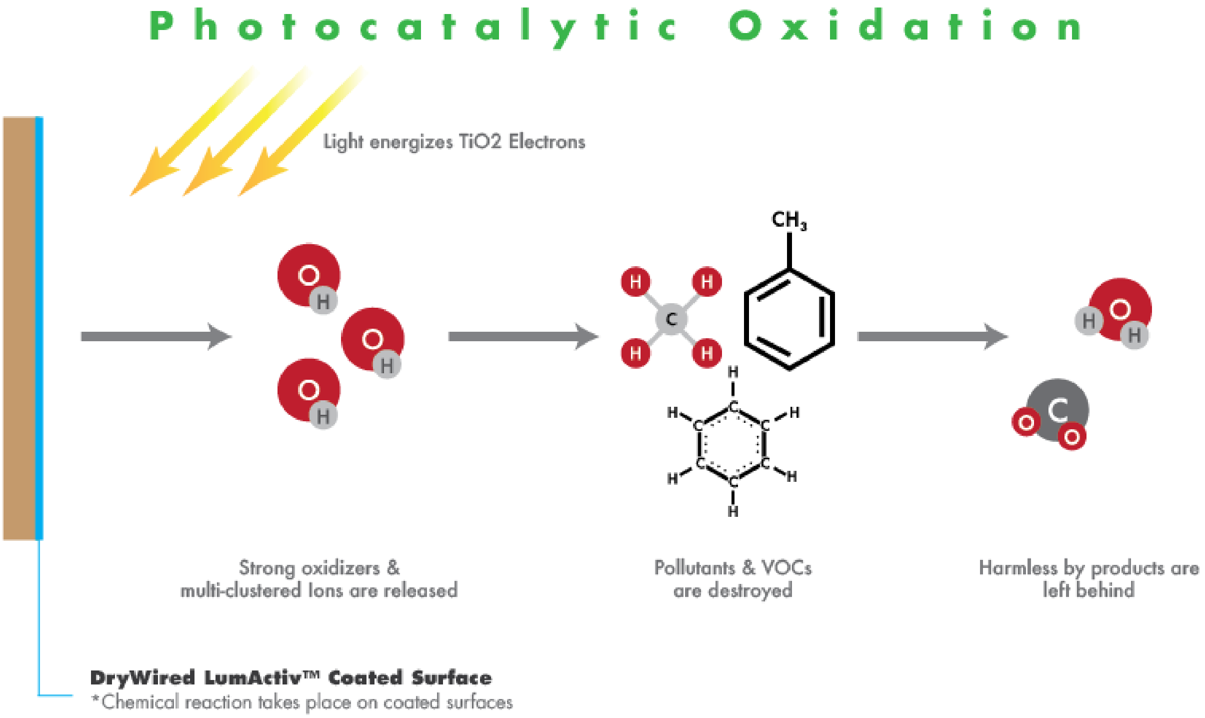

Figure 2. Chemical reaction diagram of nanotechnology coating LumActiv, by Dry Wired

OPPORTUNITIES

Therefore, apart from retrofitting existing building stock for improving energy efficiency, it seems obvious that we could easily consider nanotechnology and Biophilia as well, for improving the health and Well-Being of our citizens.
In Biophilia's case Kellert[14] *et al* in 2008 defined the three pillar concepts that serve as the tenets of Biophilic Design, as follows: 'nature in the space', 'natural analogs'; and the 'nature of the space'.

1) 'Nature in space' refers to the incorporation of plants, water (and animals) into the built environment to provide a direct connection to these elements;

2) 'Natural analogs' are described as one degree away from 'true' nature and refer to materials and patterns that evoke nature (e.g. representational art work, ornamentation, biomorphic forms natural materials); and

3) 'Nature of the space' is based on the idea that humankind developed in the Savannas of Africa, resulting in an unconscious infinity for similar environments (Kellert *et al.*, 2008).

Kellert and Calabrese[15] in 2015 also outlined 24 attributes of Biophilic Design, which pertain to the three experiences outlined above, see Table 1.

Table 1: Experiences and Attributes of Biophilic Design (after Kellert and Calabrese, 2015)

Pillars of Biophilic Design	Design Attributes
Direct Experience of Nature	Light
	Air
	Water
	Plants
	Animals
	Weather
	Natural landscapes and ecosystems
	Fire
Indirect experience of nature	Images of nature
	Natural materials
	Natural colours
	Simulating natural light and air
	Naturalistic shapes and forms
	Evoking nature
	Information richness
	Age, change and the patina of time
	Natural geometries
	Biomimicry
Experience of space and place	Prospect and refuge
	Organised complexity
	Integration of parts to wholes
	Transitional spaces
	Mobility and way finding
	Cultural and ecological attachment to place

Meanwhile, leading proponents of Biophilic Design, Terrapin Bright Green (environmental consultants), have identified 14 design elements or special patterns, which they clustered, in line with Kellert's three pillars, Browning[16] *et al.*, 2014. These are not new inventions, but rather codify the science behind why human's respond to certain traditional design elements, see Table 2.

Table 2: 14 patterns of Biophilic Design: improving health and wellbeing in the built environment, after Browning et al., 2014.

Pillars of Biophilic Design	Design Elements
Nature in the space (direct experiences of nature)	**Visual Connection with Nature.** A view to elements of nature, living systems and natural processes.
	Non-Visual Connection with Nature. Auditory, haptic, olfactory, or gustatory stimuli that engender a deliberate and positive reference to nature, living systems or natural processes.
	Non-Rhythmic Sensory Stimuli. Stochastic and ephemeral connections with nature that may be analysed statistically but may not be predicted precisely.
	Thermal & Airflow Variability. Subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments.
	Presence of Water. A condition that enhances the experience of a place through seeing, hearing or touching water.
	Dynamic & Diffuse Light. Leverages varying intensities of light and shadow that change over time to create conditions that occur in nature.
	Connection with Natural Systems. Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosystem
Natural Analogues (representations of nature)	**Biomorphic Forms & Patterns.** Symbolic references to contoured, patterned, textured or numerical arrangements that persist in nature.
	Material Connection with Nature. Materials and elements from nature that, through minimal processing, reflect the local ecology or geology and create a distinct sense of place.
	Complexity & Order. Rich sensory information that adheres to a spatial hierarchy similar to those encountered in nature.

Nature of the Space (preferred spatial experiences found in natural settings)	**Prospect.** An unimpeded view over a distance, for surveillance and planning.
	Refuge. A place for withdrawal from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead.
	Mystery. The promise of more information, achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment.
	Risk/Peril. An identifiable threat coupled with a reliable safeguard.

In addition, Browning[17] *et al.* in 2014 identify seven key Biophilic Design patterns:

1. **Visual Connection with Nature.** A view to elements of nature, living systems and natural processes.
2. **Non-Visual Connection with Nature.** Auditory, haptic, olfactory, or gustatory stimuli that engender a deliberate and positive reference to nature, living systems or natural processes.
3. **Non-Rhythmic Sensory Stimuli.** Stochastic and ephemeral connections with nature that may be analysed statistically but may not be predicted precisely.
4. **Thermal & Airflow Variability.** Subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments.
5. **Presence of Water.** A condition that enhances the experience of a place through seeing, hearing or touching water.
6. **Dynamic & Diffuse Light.** Leverages varying intensities of light and shadow that change over time to create conditions that occur in nature.
7. **Connection with Natural Systems.** Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosystem.

Many of these principles are all now being adopted by some of the world's leading corporations Apple, Google and Amazon in their workplaces. Hopefully the rest of the world will soon follow.

Ratings tools

How do we know that it's working? Rightly or wrongly ratings tools have the ability, to shift the 'conversation' in the building industry as proven by the introduction of LEED and BREEAM to support sustainable decision-making. There are therefore benefits of incorporating Biophilic Design into rating systems to measure performance.

Biophilic Design was incorporated into the Living Building Challenge[18] from the International Living Future Institute, in 2016, which is perhaps the most progressive Green Building rating tool on the market. To achieve 'living' certification, a building must meet the requirement for each of the 20

imperatives, including Biophilic Environments. Design teams must look at the six Biophilic elements as proposed by Kellert[19] *et al*. (2008), and demonstrate how they have been incorporated into the design.

The WELL[20] Building Standard is a new rating system. Launched in 2014 by the International WELL Building Institute (IWBI), focuses on human health and wellbeing in the built environment. It has two areas dedicated to Biophilic Design, one of which is compulsory and modelled on the Living Building Challenge Biophilic imperatives. **NB** architects AHR are aiming to achieve a Platinum grade with their designs for the RCPs new Liverpool HQ.

Biophilic building strategies therefore, should not just aim to minimise adverse environmental impacts, but also maximise end user 'satisfaction' through improved health and wellbeing, and provide a sense of connectedness with the natural environment. Whether it's a vertical garden for a corporate HQ, a single domestic wall planter, or even an illusion it's all beneficial, see Figure 3.

Figure 3. 'Biophilic Illusions' from Sky Factory, installed in Vendome hospital, France

The efficacy of combined strategies

While many of the leading examples of Green Building design incorporate aspects of Biophilic Design, many do not. This is something that should be remedied as the Green Building movement continues to evolve. Biophilic Design should be incorporated for two primary reasons:

1. It is becoming increasingly clear that Biophilic Design elements have real, measurable benefits relative to such human performance metrics as emotional wellbeing, stress reduction, learning and healing; and

2. From an environmental standpoint, Biophilic Design features foster an appreciation of nature, which in turn, should lead to behaviours that support Climate Change amelioration, as well as efforts to eliminate pollution and other environmental concerns.

As aforementioned research indicates, Kellert[21] et al in 2008, that Biophilic buildings can influence human health and wellbeing at three critically important scales:

1. Directly at the individual level through providing 'optimised' indoor environments.
2. Directly with also economic improvements in productivity and reductions in absenteeism.
3. Indirectly through reduction in energy use and the reduction in air pollutants.

Biophilic Design strategies provide flexible solutions to improving the built environment. 'It's a 'Non-formulaic approach' says Irish Landscape Architect, Joe Clancy, co-author of Terrapin Bright Greens' '14 Biophilic Patterns'. 'We ensure each building is treated as being unique. It's a transdisciplinary effort depending on what's required i.e. reductions in stress levels, views out, improved indoor air quality, all decisions are made to suit the site'.

Concluding thoughts

The arguments for finding solutions to halt our inexorable slide, back into the 'pea soup' foggy days of the 1950s, are very encouraging. Architects and interior designers will soon be able to further convince their clients of the salutogenic[22] benefits of Biophilia on the interior as well as exterior environments; as the Building Research Establishment (BRE) and the IWBI are gathering evidence based design data in test spaces for The Biophilic Office Project [23]. Which they have constructed at the BRE HQ in Hertfordshire, UK.

Furthermore, the two institutions have combined their Credit Rating systems, Building Research Establishments Environmental Assessment Method (BREEAM) and WELL respectively. The economic benefits are therefore there for all to see, and can be measured in the reductions in absenteeism, increases in productivity and the lessoning of the burden on the National Health System (NHS).

However, what they haven't considered yet is the efficacious role that nanotechnology coatings, might contribute to the exercise. Whilst these costs may initially be expensive, what price should be levied against our children's right to breathe clean air, in the long term future?

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EXTRA-LONG RESIDENTIAL INFRASTRUCTURES. THE OUTDATED PROGRAMME IN THE COLLECTIVE HOUSING ON THE LARGE-SCALE

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EXTRA-LONG RESIDENTIAL INFRASTRUCTURES

The term of Extra-Long Residential Infrastructures is assigned to the constructions of one block or a blocks settlement (preferably only one of them), whose façade perception is longer than 400 metres of length, its scale is urban and it wraps a territory[1]. In this way, XL is an appropriation of the fashion and textile world, using scales defined by Koolhaas and Mau[2], and wants to reference to those extra-long objects instead of extra-large buildings. Therefore, these developments should have an extra-length, which is longer than the length of the standard buildings. In the same way, the Infrastructure concept is referred to a human construction designed and led by professionals from Architecture, Civil Engineering or Urban Planning, providing the support for the development of uses, in this particular case, mainly housing and secondary other complementary uses. Therefore, we could define these buildings as support artefacts. According to Fernandez[3], these social condensers were developed in Soviet Union at 1927, in the competition for new residential proposals by the group's journal Sovremmennaya Arkhitektura. The XL Residential Infrastructures would have to hold a complete residential programme, what includes housing, but also entrance streets or galleries, community areas, green spaces, and so on. This one is the same situation of the Infinity Loop or 8 House and little tower, whose author defined it as "vertical suburbia" [4], using terms as "big block" with an "enormous green area", "emerging plaza", "stepped streets" and "mountain paths", resuming "where the public life traditional is tied to taking place on the ground floor, flat as a pancake, with everything above privatized" and understanding "the public life" as the relationship between the city and "the privatized life" as the community life.

Mostly, these cases have a standard section with a unified aesthetic, normally concrete, and they are usually not urban icons. Their functional programme distribution is like a mille-feuille with housing units located in a supporting structure, public streets in the sky (although they could have restricted use or, in other cases, they could be transited at different speeds), and other services intermittently located[5].

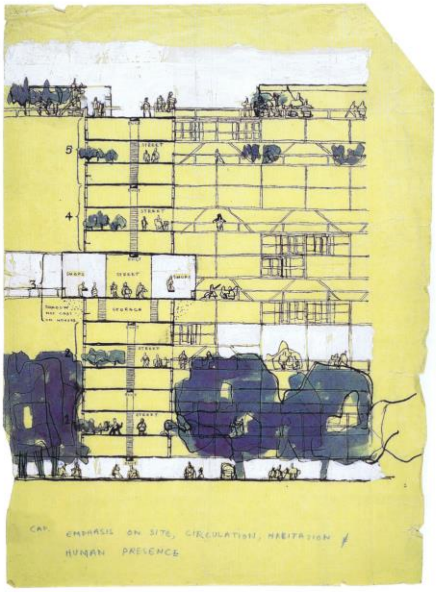

Figure 1. Robin Hood Lane by Alison & Peter Smithson

In some cases, these infrastructures could be composed of different blocks, and each one should have common characteristics that allow it to be recognized as a settlement, either by a similar aesthetic (formal characteristic), by a standard section (programmatical characteristic) or by a community feeling (humanistic characteristic). Then, a disaggregated composition becomes a unitary entity. This is the case of New Corviale[6] (1973-1981), which is composed of two blocks and was divided in five community units, although it is considered a unit settlement.

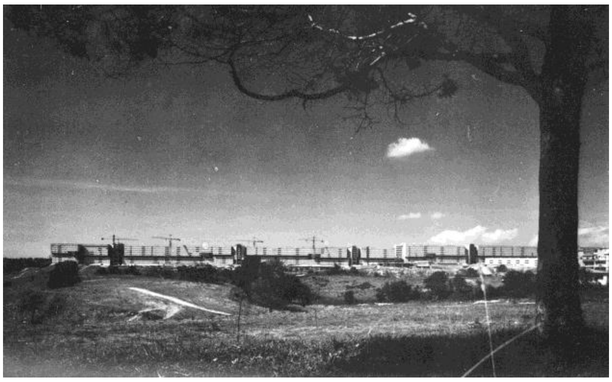

Figure 2. New Corviale (Rome)

Among 63 detected cases so far, we could emphasize the case of Park Hill housing (1955-1961), in Sheffield, designed by Ivor Smith and Jack Lynn, with a façade length of 1,010 meters and capacity for 3,448 people; Forte di Quezzi social housing (1956-1968) in Genoa, designed by Luigi Carlo Daneri and Eugenio Fuselli, with a façade length of 1,550 meters and capacity for 2,010 people only in the main building (block A); Rozzol Melara Estate (1969-1982), in Trieste, designed by Carlo Celli, with a façade length of 837 meters and capacity for 2,500 people; Byker development (1970-1980), in Newcastle upon Tyne, designed by Ralph Erskine, with a façade length of 980 meters (adding the 3 blocks) and capacity for 1,900 people (only in its longitudinal building); New Corviale (1973-1981), in Rome, designed by Mario Fiorentino, with a façade length of 958 meters and capacity for 8,953

people; or 8 House and small tower (2006-2010), in Copenhagen, designed by BIG, with a façade length of 640 meters and capacity for 1,500 people.

Figure 3. Park Hill housing (1955-1961), Forte di Quezzi social housing (1956-1968), Byker development (1970-1980) and New Corviale (1973-1981)

As shown with these examples, the most part of these cases were built more than 30 years ago, in particular from 1927 to the 1970s. In this time, the behaviour patterns of these communities[7], forced to live in stackable cities, could not generate a united cluster. Furthermore, we should consider their populations have changed and evolved and, as a result, the constructions are outdated because their communities do not have known how to adapt them to their contemporary needs. For this reason, these artefacts are currently failures of contemporary cohabitation that we must research to propose solutions that allow their living together and being enabled to hold a daily routine in harmony.

Figure 4. Community areas at Forte di Quezzi (Genoa), visited in August 2014

RESEARCH QUESTIONS

As a result of the latest developments and due to threats of demolition, detecting the problems of these constructions and providing solutions to allow a social cohesion are a priority since the logistical complications are excessive to focus the problem only through the re-homing of these people. In this way, we propose the study of these architectures focusing on community areas, interior streets, entrance galleries, and so on, places understood as in-between-spaces. We understand the in-between-spaces as the connections between the housing scale and the urban scale or as every space contained in the infrastructure with horizontal spatiality or with capacity to hold a different use from the circulation or movement. In this way, we would like to research about how people who live in these XL Residential Infrastructures have evolved during operating life of these buildings, analysing the uses that have been developed in the community areas. Therefore, we would board topics more closely linked to the community concept that should be generated in these areas due to the community feeling. Furthermore, we would like to research which are the problems located in the community areas. We wonder which would be the magnitude of community concept linked to XL Residential Infrastructures and if the community feeling is reinforced by being linked to an architectural space or if is an outdated concept. In addition, we are questioning how they have faced over the years or what would be the processes that can be applied to reinforce the community unity that allow living together so different people.

RESEARCH DESIGN

For the analysis process, we have designed a qualitative matrix. With this instrument, we cross the qualities of interest of the 63 cases detected as Extra-Long Residential Infrastructures, which have

been collected from the consultation of different representative research journals in the architecture world, since the early 20th century.

The cases list contains the following examples:

1. Road Town by Edgar Chambless (1910)
2. Horizontal Skyscraper by Friedrich Kiesler (1925)
3. Vertical city by Ludwig Hilberseimer (1925)
4. Plan Voisin, in Paris (France), by Le Corbusier (1925)
5. Siedlung Römerstadt, in Frankfurt am Main (Germany), by Ernst May (1927-1929)
6. Karl Marx Hof, in Vienna (Austria), by Karl Ehn (1927-1930)
7. The Britz, in Berlin (Germany), by Bruno Taut and Martin Wagner (1927-1929)
8. Project for Spandau-Haselhorst Apartments, in Berlin (Germany), by Marcel Breuer (1928)
9. The Jarrestadt, in Hamburg (Germany), by Fritz Schumacher (1928-1930)
10. Urban plan for Rio de Janeiro (Brazil), by Le Corbusier (1929)
11. Skyscraper Bridge Apartments, in New York (US), by Hugh Ferriss (1929)
12. Manhattan proposal for 1950, (US), by Raymond Hood (1929)
13. Langer Jammer in Siemensstadt, in Berlin (Germany), by Otto Bartning (1929-1930)
14. Public-housing for 500 Individuals (Soviet Union), by Mikhail Okhitovich (1930)
15. Design for a Row House Complex by Friedrich Kiesler (1931)
16. Plan Obus, in Algiers (Algeria), by Le Corbusier (1933)
17. Resort Prora, in Rügen Island (Germany), by Robert Ley and Erich Putlitz (1936-1939)
18. Pedregulho Residential Complex, in Rio de Janeiro (Brazil), by Affonso Eduardo Reidy (1946-58)
19. CUPA, in Mexico City (Mexico), by Mario Pani (1947-1949)
20. Falchera Ina-Casa Residenctial Complex, in Turin (Italy), by Giovanni Astengo (1950-1960)
21. Catacumbas Residential Complex, in Rio de Janeiro (Brazil), by Alfonso Eduardo Reidy (1951)
22. Golden Lane Project by Alison and Peter Smithson (1952)
23. Marques de San Vicente Residential Complex, in Rio de Janeiro (Brazil), by Affonso Eduardo Reidy (1952-1955)
24. Blue Ribbon, in Helsinki (Finland), by Viljo Revell (1952)
25. Les Courtillieres Residential Complex, in Pantin (France), by Emile Aillaud (1955-1960)
26. Park Hill housing, in Sheffield (England), by Ivor Smith and Jack Lynn (1955-1961)
27. Forte di Quezzi social housing, in Genoa (Italy), by Luigi Carlo Daneri and Eugenio Fuselli (1956-1968)
28. II Treno, in Bologna (Italy), by Giuseppe Vaccaro (1957-1962)
29. Ecological Artic Town by Ralph Erskine (1958)
30. Residential Complex in Sundbyberg, in Stockholm (Sweden), by Sven Markelius (1958)
31. Housing at Nockebyhov, in Stockholm (Sweden), by Sven de Backström and Leif Reinius (1958-1960)
32. New Babylon, (US), by Constant Nieuwenhuys (1959)
33. Vila Isabel, in Rio de Janeiro (Brazil), by Francisco Bolonha (1960)
34. Motopia by Geoffrey Jellicoe (1960)
35. City in the air, in Shinjuku (Tokyo), by Arata Isozaki (1960)
36. Pioneering housing scheme Le Lignon, in Vernier (Switzerland), by Georges Addor (1960-1971)
37. Sant Ambrogio Residential Complex, in Milan (Italy), by Arrigo Arrighetti (1964-1971)
38. The Bijlmermeer, in Amsterdam (Netherlands), by Amsterdam planning department (1965-1975)
39. Proposal for residential area Ruhwald, in Berlin (Germany), by Stefan Wewerka (1965)

40. The Jersey Corridor Project, in Jersey (US), by Peter Eisenman and Michael Graves (1965)
41. Polykatoikia Asyrmatos, in Athens (Greece), by Eli Vasilikioti (1965-1967)
42. Neighbours Set n3 Elviña, in A Coruña (Spain), by José Antonio Corrales (1965-1967)
43. Toulouse le Mirail, in Toulouse (France), by Georges Candilis, Alexis Josie and Shadrach Woods (1965-1975)
44. Hyde Park Residential Complex, in Sheffield (England), by Sheffield's city Architects Office (1966-1970)
45. Gallaratese Residential Complex, in Milan (Italy), by Carlo Aymonino and Aldo Rossi (1967-1972)
46. Parallels Districts, in Berlin (Germany), by Archizoom (1969)
47. The Continuous Monument by Superstudio (1969)
48. Robin Hood Gardens, in London (England), by Alison and Peter Smithson (1969-1972)
49. Rozzol Melara Estate, in Trieste (Italy), by Carlo Celli (1969-1982)
50. Bridge city by Alan Boutwell (1970)
51. Asse Attrezzato, in Rome (Italy), by Studio Asse (1970)
52. Falowiec, in Gdansk (Poland), by unkown (1970-1975)
53. Byker development, in Newcastle upon Tyne (England), by Ralph Erskine (1970-1980)
54. Exodus, in London (England), by Rem Koolhaas, Elia Zenghelis, Madelon Vriesendorp and Zoe Zenghelis (1972)
55. New Corviale, in Rome (Italy), by Mario Fiorentino (1973-1981)
56. Economic restructuring of Valle de Elia, in Sicilia (Italy), by Vitrorio Gresotti (1976)
57. Building “de peperklip”, in Rotterdam (Nederlands), by Hoogstad Weeber Schulze Van Tilburg (1979-1987)
58. First City in Antarctica by Amancio Williams (1980-1983)
59. El Ruedo housing in M-30, in Madrid (Spain), by Francisco Javier Saenz de Oiza (1986-1991)
60. Apartments Moabit Werder, in Berlin (Germany), by Georg Bumiller (1997-1999)
61. Linked Hybrid, in Beijing (China), by Steven Holl (2003-2009)
62. Vanke Center, in Shenzhen (China), by Steven Holl (2006-2009)
63. 8 House and small tower, in Copenhagen (Denmark), by BIG (2006-2010)

Thereby, the analysed variables are data and parameters that focus several dimensions as:

- whether it is a construction which generates a limit or a wraparound building;
- whether its section is regular or adjustable;
- whether it is an urban icon;
- whether it is functioning isolated;
- whether there are shops on ground floor;
- whether there are shops on raised levels;
- whether there are other services in the block;
- whether the streets in the sky are public or private;
- whether people can move by different means of transport;
- whether the housing solution is the same standard dwelling for every localization;
- whether there are community areas;
- whether there is an intention to create a community;
- whether there are green areas.

		const generates limit	wrapped construction	regular section	adjuntable section	iconic	isolated functioning	shops on ground floor	shops on raised levels	other services	public streets in the sky	private streets in the sky	different speeds	standard dwellings	community areas	community intention	green areas
1910	Road Town by Edgar Chambless	O		O			O	O	O	O	O		O	O	O		O
1925	Horizontal Skyscraper by Friedrich Kiesler		O		O			O		O	O			O	O		O
	Vertical city by Ludwig Hilberseimer		O	O			O	O		O	O			O			
	Plan Voisin by Le Corbusier		O	O				O		O	O		O	O	O	O	
1927	Siedlung Römerstadt, by Ernst May		O	O										O		O	O
	Karl Marx Hof by Karl Ehn		O	O										O	O	O	O
	The Britz by Bruno Taut and Martin Wagner		O	O		O								O		O	O
1928	Project for Spandau-Haselhorst Apartments by Marcel Breuer	O		O		O				O				O	O	O	O
	The Jarrestadt by Fritz Schumacher		O	O				O						O		O	O
1929	Urban plan for Rio de Janeiro by Le Corbusier	O		O			O			O		O	O	O	O	O	O
	Skyscraper Bridge Apartments by Hugh Ferriss		O		O								O	O			
	Manhattan proposal for 1950 by Raymond Hood		O		O					O			O	O			
	Langer Jammer in Siemensstadt by Otto Bartning	O		O										O	O	O	O
1930	Public-housing for 500 Individuals by Mikhail Okhitovich	O		O			O			O				O	O		O
1931	Design for a Row House Complex by Friedrich Kiesler	O		O						O		O		O	O	O	O
1933	Plan Obus, in Algiers by Le Corbusier	O		O		O	O			O	O		O	O	O		O
1936	Resort Prora, in Rugen Island by Robert Ley and Erich Putlitz	O		O			O			O		O		O	O	O	O
1946	Pedregulho Residential Complex by Affonso Eduardo Reidy	O		O		O	O				O		O	O	O	O	O
1947	CUPA, in Mexico City by Mario Pani		O	O				O		O				O	O	O	O
1950	Falchera Ina-Casa Residenctial Complex by Giovanni Astengo		O	O			O			O				O	O	O	O
1951	Catacumbas Residential Complex by Alfonso Eduardo Reidy		O	O		O	O				O		O	O	O	O	O
1952	Golden Lane Porject by Alison and Peter Smithson		O		O		O	O	O	O	O	O		O	O		O
	Marques de San Vicente Residential Complex by Affonso Eduardo Reidy		O	O		O					O	O	O	O			
	Blue Ribbon by Viljo Revell	O		O						O				O	O	O	O
1955	Les Courtillieres Residential Complex by Emile Aillaud		O	O						O				O	O	O	O
	Park Hill housing by Ivor Smith and Jack Lynn		O		O	O	O	O			O		O	O		O	O
1956	Forte di Quezzi social housing by Luigi Carlo Daneri and Eugenio Fuselli	O		O			O	O			O		O	O	O	O	
1957	Il Treno by Giuseppe Vaccaro	O		O				O						O			
1958	Ecological Artic Town by Ralph Erskine		O		O		O		O	O	O	O			O	O	
	Residential Complex in Sundbyberg by Sven Markelius		O	O			O			O				O		O	O
	Housing at Nockebyhov by Sven de Backström and Leif Reinius		O	O				O						O		O	O
1959	New Babylon by Constant Nieuwenhuys		O		O		O		O	O	O	O			O		O
1960	Vila Isabel by Francisco Bolonha		O	O		O			O		O			O	O		O
	Motopia by Geoffrey Jellicoe		O	O			O	O		O	O	O	O	O	O	O	O
	City in the air by Arata Isozaki		O		O		O		O	O	O		O	O	O		O
	Pioneering housing scheme Le Lignon by Georges Addor		O	O		O						O		O	O	O	O
1964	Sant Ambrogio Residential Complex by Arrigo Arrighetti		O	O						O		O			O	O	O
1965	The Bijlmermeer, by Amsterdam planning department		O	O			O	O		O		O		O	O		O
	Proposal for residential area Ruhwald by Stefan Wewerka		O		O		O	O						O	O		O
	The Jersey Corridor Project by Peter Eisenman and Michael Graves	O		O			O	O	O	O	O	O	O	O	O		O
	Polykatoikia Asyrmatos by Eli vasilikioti	O		O				O		O	O	O		O	O	O	O
	Neighbours Set n3 Elviña by José Antonio Corrales		O		O				O	O	O			O	O	O	O
	Toulouse le Mirail by Georges Candilis, Alexis Josie and Shadrach Woods		O		O			O				O	O	O	O	O	O
1966	Hyde Park Residential Complex by Sheffield's city Architects Office		O		O	O		O			O		O	O			O
1967	Gallaratese Residential Complex by Carlo Aymonino and Aldo Rossi		O		O		O			O				O	O	O	O
1969	Parallels Districts by Archizoom	O		O			O	O	O	O	O		O	O			O
	The Continuous Monument by Superstudio		O	O			O		O	O	O		O		O		
	Robin Hood Gardens by Alison and Peter Smithson		O	O				O		O		O		O	O	O	O
	Rozzol Melara Estate by Carlo Celli		O	O		O			O	O	O	O	O	O	O	O	O
1970	Bridge city by Alan Boutwell	O			O		O		O	O	O		O		O		O
	Asse Att Rezzato studies by Studio Asse		O		O	O	O		O	O	O		O		O		O
	Falowiec, in Gdansk by unkown	O			O			O				O		O	O		O
	Byker development by Ralph Erskine	O			O	O						O		O		O	O
1972	Exodus by Koolhaas, Zenghelis, Vriesendorp and Zenghelis		O	O			O			O	O		O		O		O
1973	New Corviale by Mario Fiorentino	O		O		O	O			O	O		O	O	O	O	O
1976	Economic restructuring of Valle de Elia by Vitrorio Gresotti		O	O					O	O	O		O	O	O		O
1979	Building "de peperklip", by Hoogstad Weeber Schulze Van Tilburg		O		O			O		O		O		O	O	O	O
1980	First City in Antarctica by Amancio Williams		O	O			O		O	O	O		O		O		O
1986	El Ruedo housing in M-30 by Francisco Javier Saenz de Oiza		O		O									O	O	O	O
1997	Apartments Moabit Werder, by Georg Bumiller		O	O						O				O	O	O	O
2003	Linked Hybrid by Steven Holl		O		O				O	O	O	O		O	O		O
2006	Vanke Center by Steven Holl		O		O				O	O	O	O		O	O		O
	8 House and small tower by BIG		O		O			O			O		O		O	O	O

Figure 5. Qualitative matrix

On the other hand, we proposed a comparative graphic analysis among particular case studies based on the method used by Cánovas, Espegel, Lapuerta, Martínez Arroyo and Pemjean[8] in which the analysis of case studies is conducted through their redraws. The case studies selected for this more specific analysis were: Pedregulho Residential Complex; Park Hill housing; Forte di Quezzi social housing; Neighbours Set n3 Elviña; New Corviale; and 8 House and small tower. As a researchers, we understand these cases need to be observed in almost four different scales as the territorial or infrastructural scale (1: 20,000), the urban scale (1:7,500), the residential scale (1:1,000), and the unit scale (1:350 and 1:150). In other words, we think these cases should be studied in an additional scale than the scales suggested previously by the authors, because these examples are on the large scale. In the same way, the scale dimensions have been adapted for these settlements.

Nevertheless, due to the raised research questions, we have considered only the residential scale because in it we will understand the infrastructure as a built element within the city, which could define a landscape or operate as a boundary. Moreover, the relationships among the public space, the community one, and the private one could show some problems of functioning in these settlements, maybe related with the different gradations of privacy. Bearing in mind that these XL Residential Infrastructures solve their problem of accumulation of dwelling as cells of a honeycomb or the "wine rack" system of Le Corbusier, we should observe the strategies proposed to generate community life. This point could be fostered by community areas and streets in the sky, which could form a neighbourhood contained in a building[9].

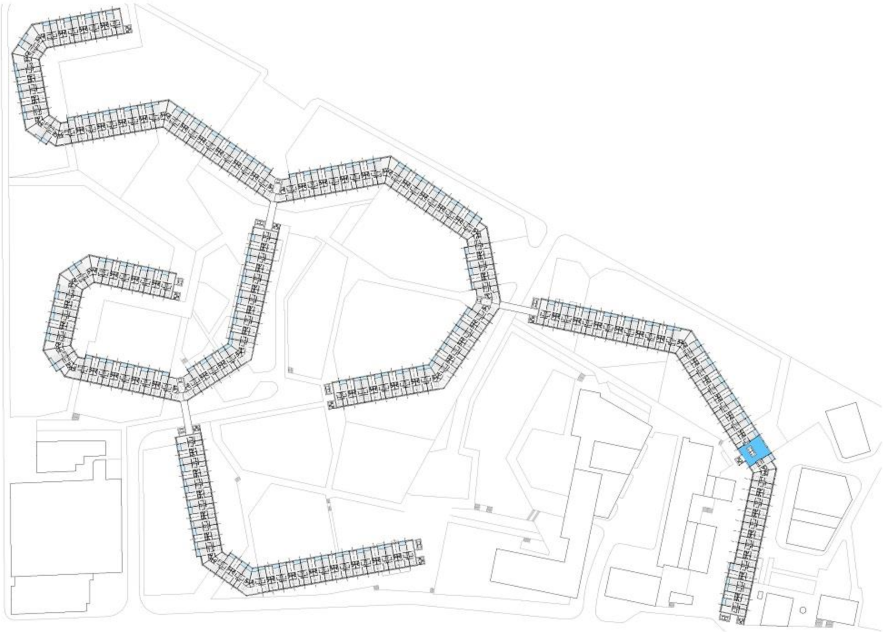

Figure 6. Redraw of Park Hill (Sheffield)

Figure 7. Redraw of Forte di Quezzi (Genoa)

In order to confront these results, we have implemented another research instrument: the in situ observation. In this way, we have visited six cases in different dates: Forte di Quezzi social housing (Genoa) in August 2014; Rozzol Melara Estate (Trieste) in March 2016; New Corviale (Rome) in November 2016; Park Hill housing (Sheffield) in February 2017; Robin Hood Gardens (London) in February 2017; and Polykatoikia Asyrmatos (Athens) in April 2017. These visits were made to check the reality of these settlements currently, to take notes about community behaviour and to take photographs about the building situation.

RESULTS AND DISCUSSION
Comparative matrix analysis

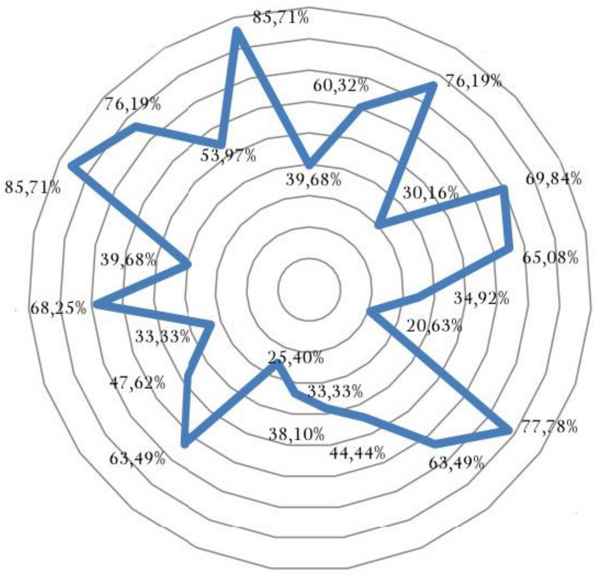

Figure 8. Results of comparative matrix

As results of this analysis, we highlight that almost 70% of these case studies involve a territory or are the link between two situations or sites. In this way, the XL Residential Infrastructures protect or identify a green area or landscape, located on the same elevation of the city.

The 65.08% of the cases have a regular section, point which reinforces the hypothesis of that these artefacts are formed by the superposition of horizontal layers, what we have named previously pancake or mille-feuille. The most part of the no-regular section have been designed since 1950.

Although it could seem its opposite, the iconic intention is only attributable to the 20.64%, because these residential developments are focused on solving a great housing lack and they try to create a residential mass where to accommodate one or several communities of neighbours. This is the case of Forte di Quezzi social housing[10] whose reason for its construction was to generate employment for a significant number of jobless, building dwellings for low-income families and recovering the construction activity. Therefore, these blocks were a real huge city mass with a residential programme.

Notwithstanding, a large part of these examples, in particular, 44.44%, are able to operate autonomously, with a quite small dependence on the city services. This point strengthens the idea about the creation of a city into another city, with its own functioning by itself.

33.33% of these settlements have shops on the ground floor and only the 25.4% on the raised levels. Most part of the developments, which show local commerce programme in the higher levels, were designed between 1950s and 1960s. Surprisingly, and concerning the autonomy of the social condenser, a 63.25% contains other integrated services in conjunction with its residential programme.

The public streets in the sky, which start to emerge in projects designed from 1910 to 1927, are in 47.62% of the examples, while 33.33% have access to the housing units through restricted streets or galleries. Overall, a 68.25% of the case studies propose public or restricted streets in the sky. In relation to the dimensions and width of these streets, we could highlight 39.68% of these ones, which are enabled to facilitate the movement at different speeds. With this last term, we would like to reference to people who use cars, motorbikes, bikes, or skates to move.

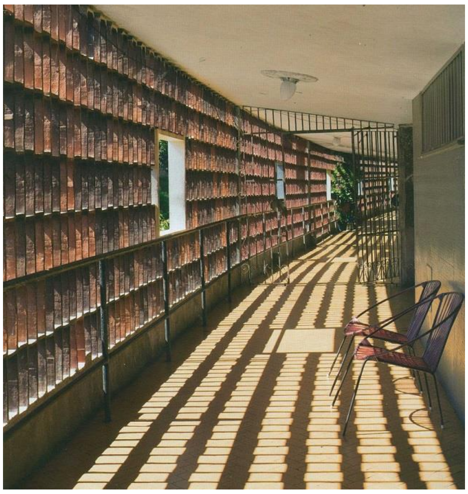

Figure 9. Street in the sky of Pedregulho Residential Complex[11]

The huge housing lack promoted the irrelevance of dwellings design that was minimal, using the repetition of housing units as the standard residential solution in 85.71% of the cases. It means that the housing solution is the same for the different orientations and locations.

In regard to the community areas, 76.19% of these developments include spaces to make community activities and to leverage the community life. The XL Residential Infrastructures that show a population with community characteristics are 53.97%. This reflects that almost half of these sets have not been able to link the population and the architectural space, unleashing a rejection of these buildings. In addition, we have found that populations, who form communities, have a dimension around 600 and 1,000 neighbours. The lack of this whole feeling has propitiated several criminal activities and causing the neighbours disruption and the space detriment.

Eventually, 85.71% of these examples have green areas. Bearing in mind that the green areas are the direct relationship with the city, the rejection of the city to the XL Residential Infrastructure could be explained due to the enveloping shape of the settlement.

Redraws of case studies

The case studies selected to redraw have been: Pedregulho Residential Complex; Park Hill housing; Forte di Quezzi social housing; Neighbours Set n3 Elviña; New Corviale; and 8 House and small tower. As results we can indicate all cases are located close to the city centre, working as a structuring element of the landscape or as a new neighbourhood, with the exception of New Corviale. Furthermore, we have observed two different positions in relation to their context: the first one as a limit which becomes independent from the urban complex, normally due to an impressive topography; the second one as an enveloping shape, with green areas and services which implement the set.

The characterization of the streets in the sky is linked to their dimensions and width. They are open in one of their sides and sometimes they don't have roofs. These streets allow to access to dwellings, shops or other services. Frequently, the ground floor is higher and more public than the other levels. The housing units are stacked and absorb the irregularities of the block shape.

Figure 10. Comparative of floor plants redraws

The slope characterizes the terrain; therefore, the building could be a retaining element or a cutting instrument. In this way, the block could leverage this situation for introducing bottom levels or could be settled on the territory. Therefore, the transversal behaviour of the building is permeable, many times in duplex, with two directions dwellings and large holes. This point shows a reality illustrated in every instrument: the XL scale is understood only in comparison with other elements. In the same way, observing the sections, we could understand all cases have the same character.

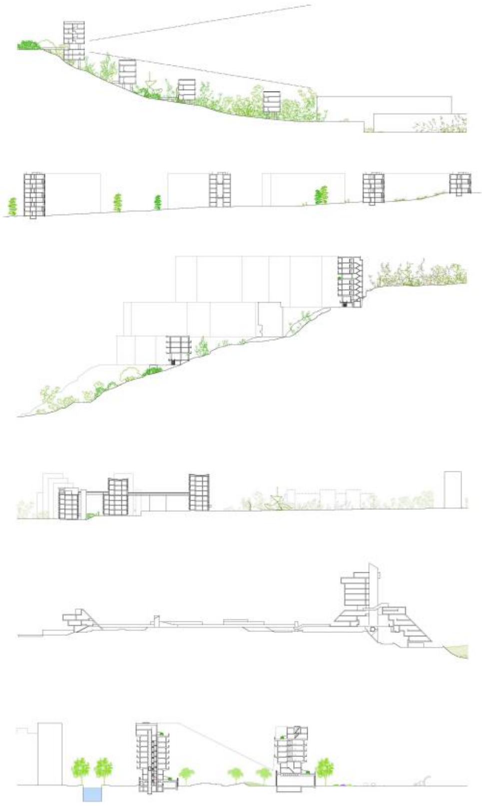

Figure 11. Comparative of sections redraws

Observation in situ of case studies

The existence of the four diverse scales is revealed during the visit because these sets represent an urban strategy on the large-scale, in territorial terms, which is sensed on the different localizations of the city instead of the rest of the housing standard constructions. Furthermore, the logistical effort is registered in many buses and means of transportation to go to these settlements, and these sets several have several bus stops to connect them to the city. As well, the particular legislations for rubbish collection are implemented for these large communities. This is the situation of Forte di Quezzi (Genoa) or New Corviale (Rome).

Figure 12. Forte di Quezzi from Genoa

The urban scale could be represented by the relationship between these suburbs and the city context. In this way, we observe the interactions happened between both elements, considering firstly whether the set is closed on itself or whether it is associated to the city, facilitating a situation of urban density intensification. In this regard, we have found four different circumstances as:

- Direct relationship with the street. The block enjoys a public street or open access to get to dwellings, and the built shape is parallel to the urban street. This is the case of Forte di Quezzi (Genoa) and New Corviale (Rome).
- Visual direct relationship with the street and access restricted to residents. The block enjoys a public street whose entry could only be opened with a key to access to dwellings, and the built shape is parallel to the urban street. This is the case of Polykatoikia Asyrmatos (Athens).
- Denial of the city with permeable accesses. The block wraps a public green area, which is used only by residents, allowing the admission through large holes to the green areas and public streets. This is the case of Rozzol Melara State (Trieste).
- Denial of the city with visual permeable accesses restricted to residents. The block wraps a public green area, which is used only by residents, allowing the admission through large holes to the green areas and restricting the access to the private streets whose entry could only be opened with a key. This is the case of Park Hill (Sheffield) and Robin Hood Gardens (London).

In the same examples, the sets could be satellite elements of the cities, similarly to a dormitory town. This situation is illustrated in three of the six cases visited as Forte di Quezzi (Genoa), New Corviale (Rome) and Robin Hood Gardens (London), due to the community areas conditions are not appropriate for the community live, either by uncomfortable or non-existent furniture, by lightless streets, or by excessive dirty and poor maintenance. On the other hand, in the rest of examples, the same qualities of the community areas are detected as positive conditions which allow their use. For example, Park Hill (Sheffield) holds between one and three levels with offices, nursery school, and so on, in such a way that one part of the daily life is carried out inside the set. Polykatoikia Asyrmatos (Athens) is close to this last case, holding a nursey school and shops on the ground floor. A similar

situation is illustrated in Rozzol Melara State (Trieste) which holds different shops, associations, cafeterias, a post office, and so on, in its public gallery.

Figure 13. Uncomfortable furniture in New Corviale (Rome)

We should note that these case studies have been revisited and have been the main topic in performances, conferences and international competitions[12]. For example, between 2002 and 2009, Forte di Quezzi was the focus of the project leaded by plug_in - laboratorio di architettura e di arti multimediali. In this proposal[13], they coordinated activities as “Pic-nic al Biscione” or “Una giornata al Biscione”, to focus on the approach between the settlement and the city inhabitants and vice versa.

Another case, which has been the objective of multiple revisits, competitions and researches, is New Corviale (Rome). This set has suffered many acts of vandalism, among them, the stealing of the mailboxes, which propitiated their self-made or their purchase by the neighbours. Furthermore, we have observed more than four family names have mentioned in the mailboxes, so we could confirm the overpopulation in this development. Terraces have been closed, expanding the kitchen or living room or, in other cases, obtaining a new room. In addition, at the beginning of the 1990s, ten years after the end of the construction, the fourth level started to be inhabited by squatters. Currently, this level is occupied with self-construction dwellings, which are organized around community areas. A great part of the population of this level is illegal, while another part are inhabitants who owned a theoretical dwelling in this level and decided to start the construction by themselves. The main problem is the lack of economic cooperation to the community expenses. Also, the security deficiency and the increasing number of non-payment inhabitants, have resulted in the division of the settlement every 100 meters by the neighbours, generating 10 management units, in contrast to the 5 units which were raised at the beginning. Eventually, this condition managed to legalize 120 illegal inhabitants from the fourth level, when the public administration authorized a renovation project developed with the neighbours. Moreover, some community areas, as the laundries located on the top of the building, are totally abandoned.

Figure 14. Abandoned laundries in New Corviale (Rome)

Due to their huge dimension, the streets in the sky of these sets need a specific naming and numbering. This point is shown in all cases with the exception of Robin Hood Gardens (London) and Polykatoikia Asyrmatos (Athens), which are the shortest. Curiously, these same streets with their own numbering accept several means of transportation as cars, motorbikes, bikes, skates, and so on.

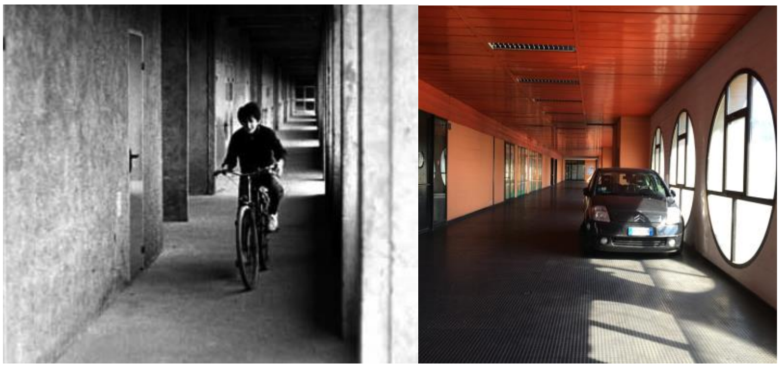

Figure 15. Street in the sky of Toulouse le Mirail (Toulouse) vs Rozzol Melara Estate (Trieste)

To facilitate the cohabitation, we have been able to identify the existence of community regulations, from different periods. In this way, in Forte di Quezzi we can find regulations of 1968 and 2014, with their consequent differences. The current rules are restrictions about the ball games and the circulation on bicycle, skateboard, and so on. The original rules were restrictions about the access to foreign people; placing objects in the community areas; dirtying stairs, streets, and so on; disturbing between 13.30 and 15.30; allowing access to homeless; and so on. This means that we could observe the differences between the previous and current life styles.

Figure 16. Street in the sky of Park Hill (Sheffield) 1961 vs 2017

It is a fact that use of social media has changed the way of understanding human relationships. In this way, the neighbourhood's life has been replaced with the virtual communication among our confidence circles. However, these media are starting to be used to visualize the individual and community activities. In this regard, a Forte di Quezzi profile was created on Facebook with the popular name "Il Biscione" to update several events that the neighbours perform. Nevertheless, it has very few followers (114 followers[14]) and on its posts are shared pictures about food, landscapes, and so on. On the other hand, this neighbours community has a website to manage the set, publishing regularly resolutions of its meetings.

With these visits, we have consolidated the idea that these sets are accumulations of housing units which have neglected the characteristics of the communal areas. On this basis, the residents have damaged their property, because they have not recognized it as their home. Following this, since the 1980s some voices request the demolition of these buildings[15] and the others with similar characteristics. However, it is impossible because it would be necessary to transfer between 1,000 and 7,000 inhabitants, depending on the case. This one was the case of Hyde Park (Sheffield), which was demolished in 1992. In the opposite side, there is the example of Park Hill (Sheffield) which has been rehabilitated through a complex process in 2007, which has not restructured the communal areas, that could trigger the same abandonment of the streets in the sky.

CONCLUSIONS

Some conclusions of this research could be the following points:

- The XL Residential Infrastructures are constructions or constructions sets that can operate as dormitory towns. This situation is fostered by the denial of the city through the architectonical design. In consequence, the city context rejects the XL Residential Infrastructures residents.
- Internally, the XL Residential Infrastructures are constructions that consist of dwellings units and in-between-spaces or places where the inhabitants can share activities as community areas, interior streets, entrance galleries, and so on. These in-between-spaces are the connection between the housing scale and the urban scale.
- The residents of the XL Residential Infrastructures have damaged their property since they have not recognized it as their home. This is due to two reasons: on one hand, the inappropriate design of the communal areas, with uncomfortable or non-existent furniture, lightless streets, and excessive dirty and poor maintenance; on the other hand, the change of the life style has promoted the abandonment of the neighbouring activities to the virtual connections. In consequence, the communal areas have been abandoned and disused.
- The community areas have been looted, burned and turned into dumps. Furthermore, their walls are covered with graffiti and their lightless conveys insecurity. A better maintenance of these areas would require the economic cooperation for the community expenses. This point results

very complex owing to the dimension of community managed. The recommended size for a administration unit is between 600 and 1,000 people or 100 and 200 dwellings, being organized by an external manager. The process of self-management is not possible because this one is adequate for communities between 100 and 300 people.

- The prohibition of circulation by car, motorbike, bicycle or skate is detrimental as well, due to the strengthening of the abandonment of public and private streets in the sky. By contrast, allowing the movement with different speeds could improve the relationship between neighbours, facilitating occasional meetings.
- In the same way, it would appear as necessary to review of the cohabitation regulations, allowing the use of games areas and plazas and fostering the human relations. Therefore, a moral code could be designed, permitting the peaceful cohabitation.
- The process to reinforce the community unity could start through the visualization of the individual and community activities on the virtual media. Facebook, Twitter or Instagram profiles could facilitate neighbours' connections, in the same way that a web support would make easier the communications about the neighbours' meetings.
- The activities to strengthen the informal cohabitation and educational processes, involving the neighbours, improve the understanding of set benefits instead of the detriments.
- The final objective would be to generate a community linked to the architectonical construction in such a way that the neighbours are a group of people who have specific elements in common and who feel pride of them.

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HOUSING EQUITY AND HEAT VULNERABILITY: A CASE STUDY FOR INDIGENOUS DESIGN AND CONSTRUCTION IN ARIZONA

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INTRODUCTION

How Prepared is Phoenix for an Extreme Heat Event?

In today's world, one half a billion people die each year due to extreme weather effects.[1] Between 2000 and 2012, 1,535 deaths from exposure to excessive natural heat occurred in Arizona.[2] In Arizona, heal-related deaths are increasing with 38% more deaths in 2015 compared to 2014, with the most common place of death being at the residence. The majority of homes were not cooled by air conditioning (AC). For those that had AC, the AC was not functioning, not in use, or the house did not have electricity.

According to Climate Change Central, Arizona is currently the fourth fastest warming state in the USA, with Phoenix being the second fastest-warming city in the USA.[3] Currently, Arizona averages more than 50 dangerous heat days a year, the second highest in the nation. A dangerous day is defined as a day when the heat index is above 105 degrees Fahrenheit or 41 degrees Celsius.[4] By 2050, Arizona could reach 80 dangerous days a year.

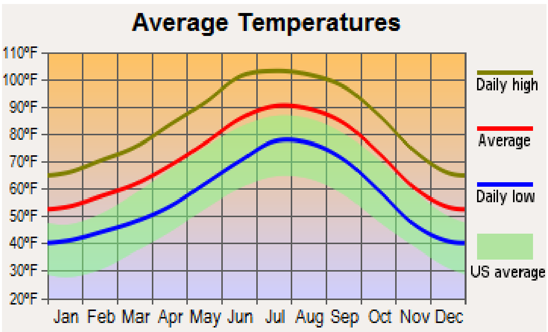

Figure 1. Phoenix Climate Data.[5]

Climate Change Central rated Arizona C+ for its level of preparedness in planning and adopting heat-related adaptation measures. The rating was due to Arizona's lack of state-level programs and climate change projections. As a comparison, California, which is ranked as the third in the USA for extreme heat danger, received an A grade with initiatives and resources such as Safeguarding California and the CalAdapt tool.[6] A power outage during a heat wave in Arizona is a considerable threat, and an event that will affect populations beyond those identified as 'most at risk.' A comprehensive strategy is needed, one which moves beyond local preparedness to examine industry practice, policy and the human capacity to adapt to extreme weather.

Re-examination of vernacular architecture and the underlying principles, is a vital part of a comprehensive solution. Most of the world's architecture prior to the 20th century, was climatically responsive, and could be considered bioclimatic.[7] This study will look at 'extreme heat' architectural strategies identified by GRIC members during our two-year research period. Four principles emerged

from these conversations that may be used to inform extreme heat architecture: *Variable Construction and Adaptive Living Space; Outdoor Liveability; Thermal Mass;* and *Earth Coupling*.

Vulnerability in Tribal Populations

There are three primary factors of heat vulnerability - socioeconomic, elderly/isolation and unvegetated areas.[8] According to the Phoenix Department of Health Services, two indigenous communities located adjacent to the city of Phoenix, Salt River Indian Community and Gila River Indian Community, have been identified as vulnerable. According to a recent study, the poverty rates on the Gila River Indian Community are more than three times higher than those of the State, 48% versus 15% for Arizona.[9] For children under 18 years of age, 61% live in poverty. For those 65 and older, 37% live in poverty. Leadership at Gila River brought forward the idea of building with traditional adobe material as a means to lower cooling costs for residents adversely affected by high utility bills, but also to increase economic resiliency by reinstating traditional self-building techniques.

Local Construction Contributing to Energy Vulnerability in Phoenix, Arizona

Phoenix is a new city, with 50% of the residential homes built after 1990.[10] Despite the newer housing stock, the bulk of Phoenix buildings rely heavily on active cooling systems. Over 90% of Arizona households use AC, with 86% of homes employing a central AC system. A recent study indicates that 25% of the energy consumed by Arizona homes is for air conditioning. This is more than four times the national average. Arizonians are faced with 30% higher electricity consumption than in USA.[11]

CASE STUDY: GILA RIVER INDIAN COMMUNITY

In 1859, the Congress of the USA established the Gila River Indian Community. Located adjacent to the City of Phoenix, the land base is 640 square miles, or 372,000 acres. It is home to two distinct tribes, the Pee Posh (Maricopa) Indians and the Akimel O'Odham (Pima) Indians. In 2010, there were nearly 12,000 members living on the reservation. Surviving in a desert climate, led to a number of innovations. In addition to developing a variety of climatically adaptable traditional architectures, a system of water canals was engineered and built by the ancestors of the Pima people, the HoHokam. The canals are known to be the largest prehistoric irrigation system in North America.[12]

GRIC (Pre-Colonial) Settlements

Traditional Gila River living settlements allowed for seasonal, daily and functional adaptations. Settlements were comprised of both core and auxiliary structures. Core structures included the domed ki or ava, the jacal (waddle-and-daub structure), the adobe house, and the sandwich house. Auxiliary structures include the ramada or vathos (shade structure), the storage shed, the storage hut, the storage platform, the brush kitchen, and menstrual or birthing hut. Most of these buildings were multifunctional, having primary and secondary uses.

Family household complexes ranged in size from accommodating one individual to a large extended family. The complexes occupied a 430 sq.ft. (40 sq.m) area, and were separated from other households by 330 to 500 feet.[13] In addition to storage, sleeping, cooking and social areas, there were areas designated for pottery, weaving, maintenance, as well as gardens and cisterns. Typical composition of the housing complex included a ki or ava (or later an adobe house), a brush kitchen, an open rectangular frame and/or an enclosed rectangular frame (known as a vathos or ramada). The location of the clusters was strategically positioned with access to fields, waterways or transportation. Families often had two living locations, a permanent home within a settlement or village, as well as one more ephemeral structure for access to resources such as planting crops.

Methodology

In 2016, the Gila River Indian Community through the Governor's office, entered into discussions with the Del E. Webb School of Construction at Arizona State University (ASU) regarding solutions for sustainable housing. To date, the process included: a review of historical building documents, a tour of a self-built adobe residential form, a preliminary housing design report, an adobe block making demonstration in the community, a housing survey and a design charrette with community members. This section will focus on the last three activities.

The methodology used in this study is the Indigenous Placekeeping framework (IPKF). The IPKF was presented and submitted to the Scholarship of Social Engagement, University of Kansas (Oct 20-21, 2016),[14] and is a four-part process for tribal research: *Community-led*, *Reciprocal*, *Process-based* and *Place-based*. Community-led or Tribally-led means Indigenous people take control of problem definition, data collection, research design and dissemination of findings. Reciprocity requires that research should be viewed as a mutual exchange, with *value* being defined by the community. *Process-based* relies on eight understandings for academic researchers when engaging with indigenous communities: slow engagement, building trust, uncertainty with another way of knowing, watchful listening, responsive methodologies, repeat exposure, moderating researcher expectations and advocacy. *Place-based*, is geared to local ways of understanding, knowing and learning about the world, with *place* as a response to local cultural histories and moralities.[15]

Research Activities and Findings

Activity One: Adobe Block Making Demonstration

The first community activity was an adobe block making demonstration. The activity took place at the Gila River Mul-chu-tha Fair & Rodeo (2016). The intent was to explore the act of *making* of adobe bricks within a community setting. The session was intended to invite dialogue from community members, partake in watchful listening (listening beyond personal thoughts and assumptions),[16] and set the stage for ASU's co-design research methodology to develop.[17] Two display boards contained images of contemporary initiatives in earth building as well as an adobe housing design done for GRIC by a doctorate architecture student were on display. There were approximately 130 visitors to booth, of which approximately 60 participated in the block making. For those not participating, they were invited to talk with the ASU team and engage in an unstructured dialogue on their experience and knowledge of adobe. Conversations were not recorded.

Activity Two: Survey

On the basis of the initial conversations with community members at the 2016 Fair, GRIC (assisted by ASU) conducted a questionnaire at 2017 Gila River Mul-chu-tha Fair & Rodeo, asking community members what they envisioned in terms of the future of sustainable housing. There were over 100 community members who took the survey while at the event and another 148 responses were collected either online through the GRIC Utility Authority (GRICUA) website (www.gicua.net) or in person at the Gila River district offices. A total of 248 surveys were completed. As a common protocol of tribal data sovereignty and protection, all results remain under the control and ownership of GRIC. Results were provided to ASU only for the purposes of understanding housing needs, housing design, construction preferences, and future planning.

Activity Two: Findings

The findings of the survey indicate a number of critical areas for investigation, four of which are relevant to this study. First in terms of materials, 43% of residents choose adobe and less than 3% choose wood frame construction (GRIC's current construction method). Rammed Earth and Sandwich Panel (a method local to GRIC, clay and straw packed into the walls of a structural frame) were mentioned by 4% of the respondents.

The second finding from the survey was on the topic of outdoor amenities in residential living. Responses included spaces non-typical to current housing design in Gila River. In order of popularity: outdoor cooking area (64%), shade structure (or 'vatho') (61%), play space for kids (53%); social space for visiting (51%); an outdoor sleeping space (13%) and an outdoor bathroom (12%).

The third finding in the survey, is that 54% of the residents said they were interested in self-building their own homes. Comments associated with self-building included: speed (versus current waiting list for a home), skill development, durability, pride, design control and quality control.

The last finding, relevant to the study here, are non-typical family structures including multi-generational caregiving. When asked how many people live in your home, the answers in order of popularity were: 4 people and 2 people (tied at 18%), 5 people (17%), 3 people (14%), and 6 people (13%). Respondents who have seven to ten people living in their home reflected 16% of those surveyed. In terms of multigenerational caregiving, 62% of respondents believe elders should within the home, or in a home next to their family (37%). Very few chose respondents choose retirement home (1.5%).

Activity Three: Housing Design & Materials Community Engagement

The Governor's Office and GRICUA, assisted by ASU, held a design charrette in the community cultural center on June 15, 2017, *Sustainable Housing Project Community Engagement.* The evening event was attended by over 65 participants, and was divided into two concurrent sessions: housing design and construction materials. In the first session, participants were asked to organize a home layout, and exterior space, using colored pieces of paper. Once the layouts were complete, community members were asked to provide an explanation of the arrangement of indoor and outdoor living components, and the cultural significance (if any) of the organization. In a concurrent running session that evening, participants were invited to discuss construction materials. The ASU team gave an overview of the advantages and disadvantages of building with a number of construction types. Issues of maintenance, initial construction cost, durability and energy efficiency were expressed for all construction types. Findings from this event are currently being tabulated.

Next Steps

The next stage of this project, as envisioned by GRIC leadership and currently being developed by ASU team members, is to build a small-scale (non-residential) prototype adobe structure in the community, with ASU faculty and students, GRIC master builders (community members who have built with adobe), GRIC youth and a local experienced adobe contractor. The aim is to erect a physical structure for community members to interact with at the 2018 Fair. The suggested use of the building is a SEED storage shed, available year-round, combined with a shade shelter for Elders to be protected from the sun and wind while attending the fair. For ASU, it would provide a physical building sample that could be monitored and tested by ASU team members in the years to come.

PASSIVE ARCHITECTURAL DESIGN STRATEGIES: LESSONS FROM GILA RIVER INDIAN COMMUNITY

The following four passive design principles are gleaned from the work to date with GRIC. They are not intended to be exhaustive or conclusive of the architecture of this region.

Principle 1: Variable Construction and Adaptive Living Space

Gila River housing complexes had a variety of spaces for living and working, from the enclosed thermal mass of the ki or ava, to the shade structures with thatch roof and vertical thatch walls. The combination of high mass and lightweight construction was employed by the Pee Posh (Maricopa) Indians and the Akimel O'Odham (Pima). The variety of construction and architectural forms provided flexibility for daily and seasonal adaptation, and responded well to climate. Heat-producing activities such as cooking

were segregated into auxiliary structures in hot months, or moved inside sleeping spaces during colder months.

GRICs agile mode of living can be seen in a number of global societies living with extreme heat. Structures from Baghdad, Saudi Arabia and Egypt, illustrate climatic adaptations where residents relocate to different rooms or exterior zones (basement, roof top, or near evaporative cooling), over a day or within a season, in order to accommodate extreme heat.[18]

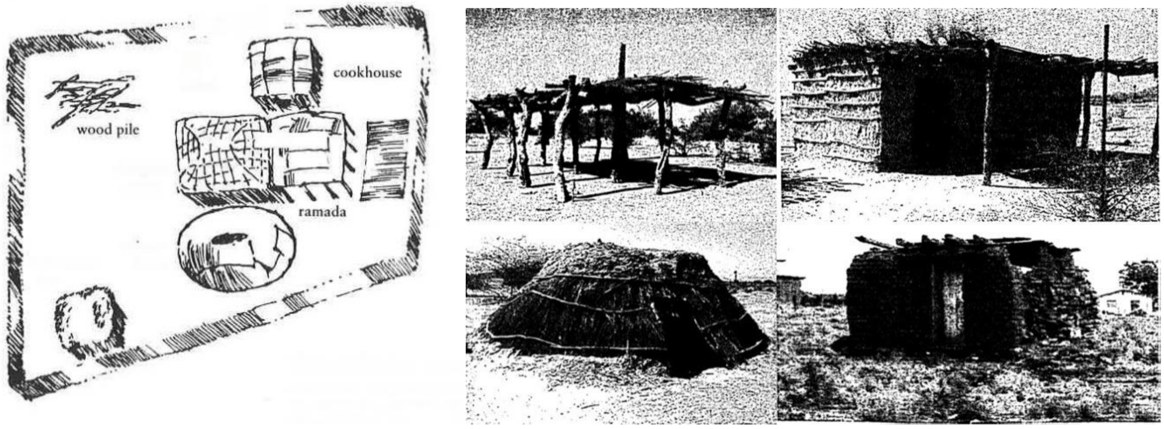

Figure 2. Left: Kickapoo residential compound. Middle left: Multi-post Ramada of forked mesquite. Top right: Jacal made of wattle and daub. Bottom middle: The domical Ki form. Bottom Right: Concho dwelling.[19]

Principle 2: Outdoor Liveability

In Arizona, the climate lends itself to outdoor living. Traditional Gila River residential complexes included open shade structures to encourage outdoor activities, including cooking, sleeping, craft production and food consumption. The vathos protected from sun, but also the wind by creating one or more walls made of thatch.

Globally, one example to look to, is the courtyard concept found in many variations through the Arabian Gulf to the Atlantic Ocean.[20] The outside walls allow for protection from wind, noise, dust, and other climatic threats, while an inner retreat offered light and air, as well as acting as a social space.[21] Common characteristics of extreme heat courtyard houses include: dense materials, minimal exterior openings, courtyard dimensions correlated with solar path, window lattice screens to reduce glare and allow for cross ventilation, and evaporative cooling.

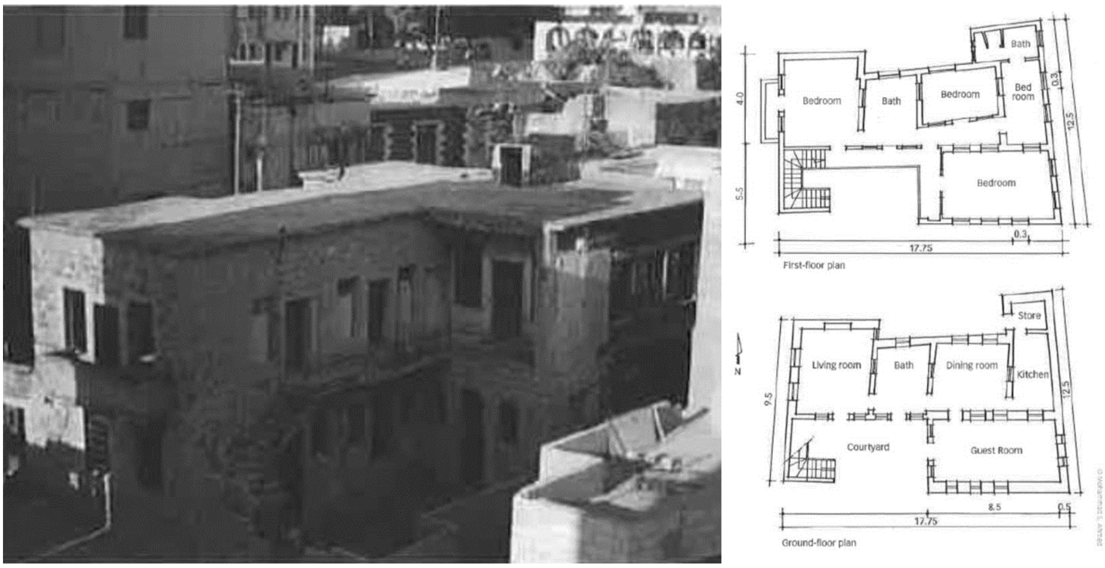

Figure 3. Left: Two-storey house with courtyard, Irbid, Jordan. Right: Ground and first-floor plan of a two-storey house, Irbid, Jordan.[22]

Principle 3: Thermal Mass

Thermal mass is a common global building strategy used to combat extreme heat. Gila River's traditional structures employed stacked earth or mud and lathe with minimal openings. The strategy is found globally from southwest Pueblo communities, to European Spanish hacienda residences which use density to regulate temperature and create a stable indoor microclimate.[23]

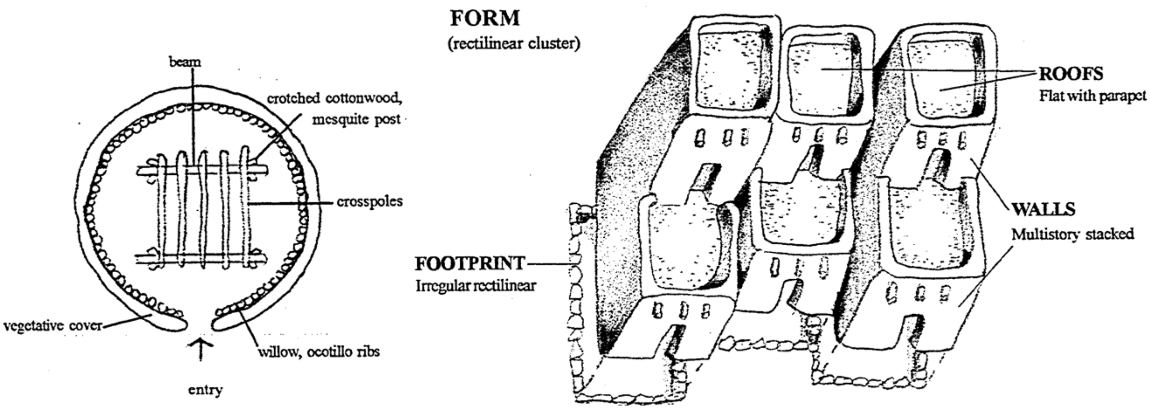

Figure 3. Left: O'odham high mass structure, Ki. Right: Hopi Pueblo dwelling made of earth.[24]

Principle 4: Earth Coupling

Gila River's traditional precedent of the *Ki*, was a partially subterranean structure that took advantage of the cooler temperatures below ground. While current Arizona homes are typically built at or above grade, there are global examples which still utilize earth coupling for extreme heat. In the town of Coober Pedy, Australia, where temperatures reach up to 113 degrees Fahrenheit or 45 Celsius in the shade,[25] nearly half of the residents have excavated their homes, and many are fully underground. Design guidelines are available to guide local building.[26]

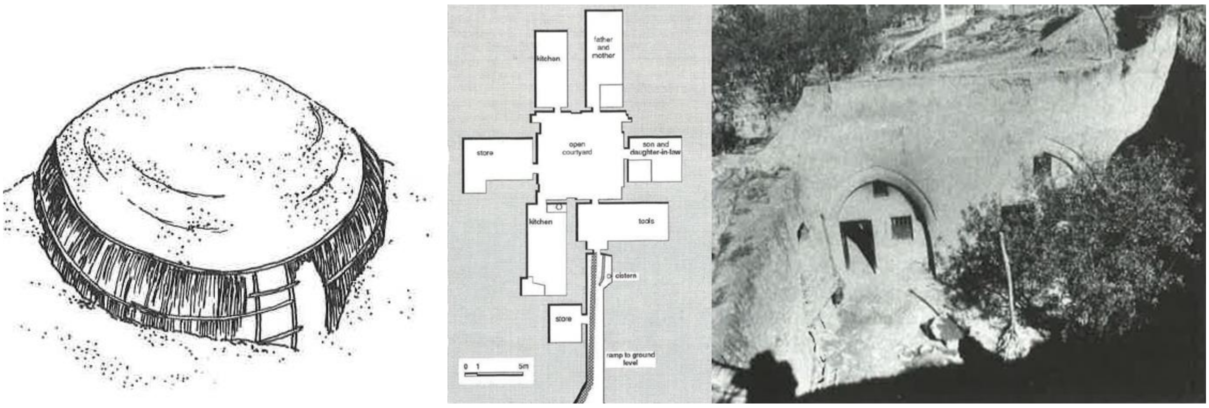

Figure 4. Left: Pima Ki, subterranean construction. Middle: Diagrammatic plan of an extended cave dwelling in the Yuxi region, China. Right: Cave dwellings cut from Loess, north China.[27]

Future: Design, Policy and Building Code

There are a number of interrelated activities that need to occur to facilitate more culturally- and climatically-responsive planning and design processes for local tribal populations. First, Arizona policy makers need to become involved in a comparative analysis of residential construction and energy, measuring how our regional building construction stacks up with other heat prone regions globally. Second, an investigation is required regarding the connection between residential buildings, the likelihood of future heat events in this region, and the potential for occupant adaptation through passive design. Third, passive strategies need to be tested for performance in the Arizona climate, to determine which strategies produce the largest efficiencies for the smallest investment (of initial construction cost and total life cycle costs). Fourth, building coping mechanisms (during an event of mechanical failure and extreme heat event) need to be combined with an awareness campaign targeted at vulnerable communities. Fifth, Arizona's building codes and design guidelines need to be differentiated to encourage performative climatic measures, rewarding developers for innovation in non-energy reliant construction techniques. Finally, global strategies such as (themally-efficient Jalousie windows, wind chimney/tower, and evaporative cooling) can be used to supplement local principles brought forward through the GRIC study.

CONCLUSION

This paper highlights our continued work with GRIC. The aim is to investigate traditional architectural strategies in order to increase climatic, economic and cultural resiliency through architecture. Indigenous vernacular structures contain vital principles for coping with extreme heat. The aim of this paper is not to advocate for reproduction of traditional forms, but to combine local knowledge inherent in traditional forms with contemporary construction techniques. The goal is to find a more suitable construction method for this local tribe aimed at reducing energy needs, increasing local input, and decreasing the potential for human loss from extreme heat.

Gila River Indian Community is part of growing group of citizens initiating dialogue in subjects that impact their lives. ASU researchers, through a responsive methodology called the Indigenous Placekeeping Framework (IPKF) provide support and advocacy needed for this community to affirm their goals.

APPENDIX

The appendix shows the chronology and uses of Gila River traditional precedents. The information is taken from Historic Vernacular Dwellings on the Gila River Indian Community, Arizona, a technical report produced by United States Bureau of Reclamation.[28]

APPENDIX A. TABLE OF HOUSE TYPE DESCRIPTIONS FROM HISTORIC DOCUMENTS

Structure Type	Description	Uses	Construction Technique	Variants	Chronology
Domed *ki* or *ava'*	Core structure. Circular. Not capable of growth through accretion. Not internally subdivided. Efficient use of natural materials having variable characteristics	Sleeping, storage, cooking. Items hung on internal and external frame	Dry construction technique utilizing locally available materials. Four post and rafter framework surrounded by bent willow verticals. Layered in brush and banked with earth. Single arched doorway closed with brush, bark, or cloth. No windows	Round or oval floor plan ranging in size from 18 to 40 meters in diameter. Possibly consisting of arched willow frame covered in mats during the early period. Internal four post frame with arched willow poles layered in thatch and banked with earth prevalent from the middle of the eighteenth century onwards. Large interior supporting posts O'odham floors excavated. Piipaash sometimes included an enclosed porch extending from the door	Prevalent from first contact until the 1880s. Completely abandoned by the 1930s. No original dwellings standing today. Limited modern construction for religious, educational, and cultural affirmation purposes.
Jacal	Core structure. Quadrilateral. Capable of growth through accretion. Can be internally subdivided. Longer supports and beams required.	Sleeping, storage, cooking. Items hung on internal and external frame, or stacked on roof	Wet construction technique utilizing locally available and commercial materials. Four post and rafter framework walled with lathe and mud. Flat thatch and mud roof. Single rectilinear doorway with or without door. With or without windows	One or two rooms of the same or different sizes. Combinations of local and commercial materials depending upon availability. Wall lathe contains vertical or horizontal supports or a combination of vertical and horizontal supports chinked with mud or, more rarely, stone. Ramada often attached. The framed jacal or horcon is a wood-framed rectangular structure containing adobe block walls	Interspersed with domed structures from the middle of the nineteenth century until the 1870s. Commercial materials more prevalent from the late 1800s. Used more often as storage sheds late in the sequence. Some in use as storage sheds today. Some abandoned examples exist. New construction rare or non-existent
Adobe House	Core structure. Quadrilateral. Capable of growth through accretion. Can be internally subdivided. Longer supports and beams required. Ample water required	Sleeping, storage, cooking. Items hung on internal and external frame, or stacked on roof	Wet construction technique utilizing locally available and commercial materials. Adobe brick bearing wall construction with or without corner support beams. Flat, thatched, or pitched frame roof. Single rectilinear doorway with milled lumber door. With or without windows	One or two rooms of the same or different sizes. Rectilinear or L-shaped floor plan. Local and commerical materials used. Ramada often attached	Interspersed with domed structures and jacales from the 1870s until 1930s. Use as a core dwelling declined significantly throughout the twentieth century. Some abandoned examples are evident today. New construction rare or non-existent
Sandwich House	Core structure. Quadrilateral. Capable of growth through accretion. Can be internally subdivided. Milled lumber and beams required	Sleeping, storage, cooking	Rammed earth technique utilizing commercial materials and mud. Framed walls with vertical support beams placed at strategic load-bearing locations such as doorways and windows. Modified lathe-and-wood method that incorporates vertical wood forms wadded with adobe (an adaptation of the adobe form-molded brick technique which is left in situ). Milled lumber door and glass pane windows	Variable in size and number of internal divisions. Flat, thached roofs early in the sequence. Framed, pitched roof made of rafters and sheeting or other roofing material late in the sequence. Ramada often attached.	Indigenous outgrowth of introduced techniques starting in the 1920s. Prevalent as a primary dwelling until the 1970s. Gradually abandoned with the introduction of government-sponsored housing, but some still in use today. Many abandoned examples. The sandwich house concept currently is experiencing a small revival in tribal-sponosred building projects currently underway. Rammed earth houses comprise one several design options for homeowners.

Figure 8. Chronology and uses of Gila River traditional precedents (a).

Structure Type	Description	Uses	Construction Technique	Variants	Chronology
Ramada or *vato*	Auxiliary structure. Quadrilateral. Open shade structure containing four or more load-bearing posts and a stick or thatch roof.	Sleeping, socializing, craft production, cooking and food consumtpion. Items hung from internal supports. Lighter items stored on top. Drying rack	Dry construction technique utilizing locally available materials. Four or more load-bearing posts toped with cross-beams and thatch.	Variable in size and number of posts. One or more sides occasionally walled with thatch or stick cross members for additional shade and protection. Attached to or detached from core structure	Contact period until present. Especially prevalent in communal or ritual activity locations today
Storage Shed or *cocina*	Auxiliary structure. Quadrilateral. Four post, enclosed building	Storage of dry and wet goods on roof and interior. Equipment hung on walls or placed inside of structure. Occasionally used as a kitchen	Wet construction technique utilizing locally available and commercial materials. Typically four load bearing posts toped with mud-covered thatch. Horizontal crossmembers and vertical thatch for walls. Single rectilinear doorway closed with horizontally stacked beams	Variable in size and number of supporting beams. Frequently subdivided into two rooms of equal or different sizes late in the sequence. Walls rarely constructed using waddle and daub techniques.	Possibly parallels chronology of domed structure. Prevalent at the turn of the century. Abandoned examples rare today.
Brush Kitchen	Auxiliary structure. Circular and open brush enclosure with a central fire pit	Food preparation, and storage of cooking utensils	Dry construction technique utilizing locally available materials. Circular arrangement of upright supporting posts and horizontal cross-members. Walled with thatch to a height of two to three meters. No roof. No door. Extremely ephemeral.	Variable in size and quality of construction. Frequently moved.	Possibly parallels chronology of domed structure. Prevalent at the turn of the century. Likely abandoned by the 1930s. Cooking activities moved to ramadas or to core structure
Menstrual or Birthing hut	Ritual structure. Possibly small and low gabled roof built directly on flat ground	Girl's puberty rite, menstrual lodge, childbirth, and for warriors undergoing purification	Dry construction technique utilizing locally available materials. Two posts with one central ridge crossmember. Three to four feet high. Vertical willows leaned against the frame in a circular or rectilinear pattern. Several horizontal cross members tied to these and covered with three rows of vertical thatch. Banked or completely covered in dirt. Opening facing east. Doorway enclosed with stacked, horizontal beams	Circular or rectilinear floor plan.	Unkown chronology, but within the memory of individuals interviewed as late as the 1930s. Modern examples non existent. Mentioned but not described by Russell (1908) for the O'odham. Described more complely for the Piipaash by Spier (1933). Called "va'na'åRa"
Storage Hut	Auxiliary structure. Similar to menstrual hut but built over an excavated pit	Storage of dry and wet goods	Same as menstrual hut above, exept structure built over an excavated pit	Same as menstrual hut above	Same as menstrual hut above. Same term used by Piipaash.
Granery Platform	Auxiliary structure. Small, flat platform built low to the ground	Storage of dry and wet goods	Crib-work platform consisting of two short logs covered with cross members and a layer of thatch. One to two feet high	Unkown	Same as menstrual hut above. Piipaash structure only. O'odham placed graneries on the roof of the shed or core dwelling
Council House	Communal structure. Large domed or quadrilateral building	Communal gatherings for administrative, social or ritual purposes	Larger version of the domed structure or jacal. Domed council house comprised of six or more load-bearing beams and a row of auxiliary support posts near the door	Domed or quadrilateral. Spier (1933) describes a domed council house for the Piipaash. Russell notes a quadrilateral structure at Bapchil	Likely prevalent throughout the early historic period. Russell notes that the last council house for the O'odham was destroyed in 1902. Anglo institutional buildings such as churches and schools began to replace the council house as a communal structure starting in the 1870s.

Figure 9. Chronology and uses of Gila River traditional precedents (b).

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Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally

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SUSTAINABLE HOUSING AND URBAN PLACE MAKING IN EXTREME / HARSH NATURAL ENVIRONMENTS CASE STUDY IN RUNAVÍK, FAROE ISLANDS

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INTRODUCTION

This paper presents a critical reflection on current practices and processes dealing with the design of novel, sustainable social housing typologies. The basis for this discussion is a competition proposal for a flexible, scalable residential neighbourhood in the municipality of Runavík (Faroe Islands) developed by the authors. This project was one of only four finalist entries to the Nordic Built Cities competition, a trans-national initiative to leverage multidisciplinary innovation in the development of urban environments across the eight Nordic countries.

The Faroese context and the notion of the commons

The landscape of the project site (and, by extension, of the Faroe Islands) is a product of its geological origins. The Faroe Islands are the tip of a mountain range of basalt sheets extending from Ireland to Greenland, sculpted by wind erosion and powerful sea currents. Both the layout of the Runavík municipality and the competition site stem from the traditional Faroese system of land subdivision. This system was based on the distinction between an infield (*bøur*) where houses and restricted cultivated areas would be situated, and the outfield (*hagi*) where sheep were kept collectively. The outfield stretched until it met the borders of the neighbouring villages' outfields, and was a key asset insofar it comprised most of the villages' land. Critically, the percentage that each person owned of the infield dictated the same percentage of their total outfield rights (and therefore of their sheep population)[1].

The status of the competition site had a strong resonance with the notion of the *commons* –a series of shared resources that are collectively managed-. Of particular importance with regards to this project was the fact that the commons encompass not only the physical space or resource that is shared, but also the social and political structures that are in place to enable shared management and governance[2]. Such an understanding of commonality was instrumental to inform the development of the design proposal. As David Harvey points out, publicly available spatial commons are needed to foster a number of critical qualities, which in turn define a desirable urban environment. Among those qualities is the availability of basic urban services and resources, but also the potential to build new forms of social relations – therefore constructing, in turn, new categories of public commons-[3]. However, the management and organisation of the commons, particularly with regards to their degree of public accessibility or

enclosure, is far from a straightforward matter[4]. This was also critical in the context of this project due to the privileged relationship of the site with the upper outfield commons, as well as its status of unplanned public property. The competition provided the opportunity to determine degrees of access and enclosure, but also rights of way and spatial continuities. In tune with this, the submitted proposal attempted to provide a basis for the practice of what Harvey denominates *commoning*: the establishment of a collective social relationship with a specific aspect of the environment –urban public space and landscape in this particular case-. Critically, such relationship was intended to be non-commodified, and therefore not governed through the logics of market exchange[5].

The competition context

The Nordic Built Cities Challenge[6] aimed to foster the development of innovative solutions for liveable, smart and sustainable cities. Within this programme, an open competition was run in collaboration with the Runavík municipality, with the goal of designing a new residential area in its lower outfield. The new development would function as a new boundary area between the outfield and the settlement. A critical requirement was achieving a higher population density, hence addressing two recurring issues in the Faroe Islands: Limited available land and the effort needed to mould the steep, rocky terrain. The competition brief explicitly mandated to address the latter by proposing alternative approaches to the established mode of preparation of construction sites, which relies on making very substantial incisions in the basalt soil. Further requirements included developing a broader range of dwelling options and sizes, as well as proposing a more efficient use of space, which superseded the prevalent urban model of private plots with detached single-family houses.

Figure 1. View of Runavik from towards the competition site (top): A nuanced urban image for Runavik and its adjoining region

THE DESIGN PROPOSAL

The proposed image for the Runavík site was based on the notion of sitting on the landscape rather than obstructing it. An overarching goal was knitting the new urban fabric into the outfield land, as a continuation of its natural pattern. Such an image summarised our position with regards, not only to the site, but also to the urban landscape of the conurbation of which Runavík is the largest town. In that sense, the competition proposal was developed in a holistic manner, so that its impact was reflected at the scale of the individual, at the scale of the municipality, and at the scale of the broader context of the Faroe Islands. We understood these three domains as being overlapped and intertwined with one another, and therefore our design process endeavoured to address all of them simultaneously.
The design proposition was grounded on a dual geometrical and typological approach, based on the use of a strip form factor that would allow for minimal excavation on site. Dwelling units were divided into separate modules, aligned into strips and oriented to follow existing lines of maximum slope in the terrain. This dramatically minimised the amount of basalt soil excavation.

Designing a community development tool

This basic approach was developed further to design modalities of collective input into the proposal. In doing so, the proposal was conceptualised as a community development tool, grounded on a modular construction system with opportunities for interactive mass customisation –which was considered as a fundamental enabler of choice in the context of housing provision[7]-. Potential residents would be prompted to pick a plot and choose within a range of modular spaces. Modules would then be aligned into strips and oriented to follow existing lines of maximum slope in the terrain. Each functional module required only one single, reduced area of contact with the ground. Therefore, each housing unit would be adapted to the sectional profile of its particular plot. Further mass customisation opportunities would be enabled by providing a choice of material finishes (Figure 2).

Figure 2. The proposal as a community development tool

With this in mind, nine base typologies were developed. However, a critical feature of the proposal was that variations of these typologies could yield a larger number of different dwellings. This provision of variety –facilitated by a collective platform for user choice- was considered critical in the development of the design proposal, insofar it was identified as an enabler of community identity[8]. Moreover, the establishment of an open design system via mass customisation attempted to address the contemporary criticism directed towards past excesses of mass production in the context of housing provision –particularly with regards to the use of prefabricated concrete structures-[9]. Individual houses were laid out together in lines of four to seven units, forming strips that follow lines of maximum slope in the site to facilitate minimal excavation, often running in parallel to existing water streams in order to minimise any disruptions to the natural profile of the terrain. The competition submission laid out a possible outcome for this system, considering how it could be deployed throughout the totality of the site by responding to conditions such as the local variations in slope or the location of the main road. This procedure enabled both diversity and individual customisation. Moreover, it helped construct a distinctive urban image, where strips provided a form of urbanity that combined continuity with porosity.

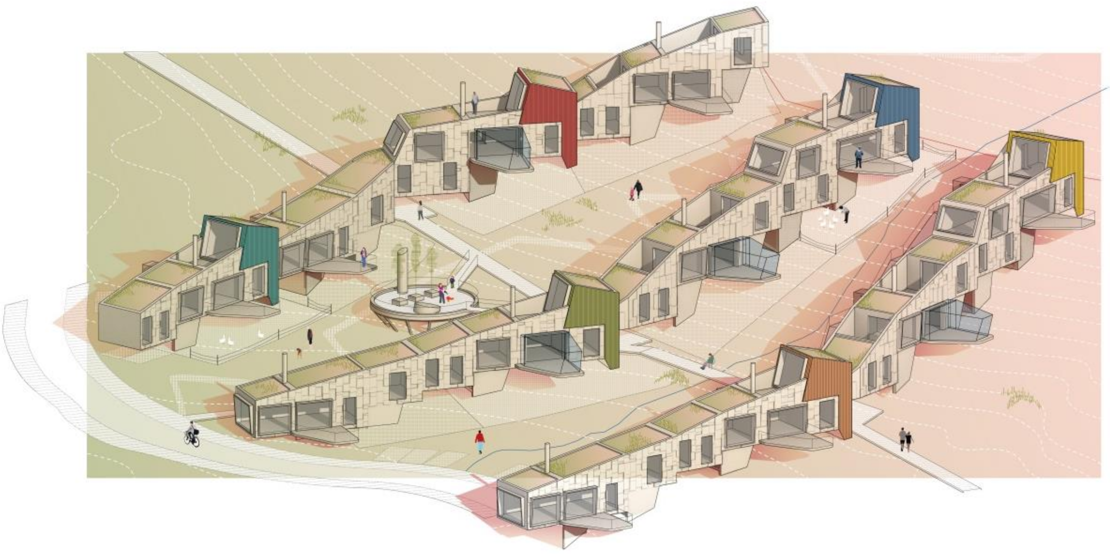

Figure 3. Adaptation to the natural profile of the terrain

The resulting urban image contrasted with the less structured landscape of detached houses and private plots that is prevalent in Runavík. This facilitated a gradation of public and private spaces while simultaneously fostering a sense of density, community and collective ownership. It should be noted that the proposal was strongly informed by Peter Marcuse's defence of non-commodified housing, particularly with regards to the development of housing initiatives with a prevalent public share[10]. In tune with this, our masterplan proposal attempted to maximise public land tenure. Marcuse's work explicitly acknowledged that people do not only occupy buildings, but also neighbourhoods and communities. All these locations constitute a web of relations within the social fabric, therefore linking housing to other public domains such as that of the urban commons[11].

Urban place making

The proposed Master Plan allowed for 95 dwellings of different sizes to be built on the site (see Figure 4). Compared to current averages, this layout provided a significant increase in built density. This was not only helpful from an environmental sustainability perspective, but also promoted interaction and encounters between people, hence facilitating increased social sustainability[12]. With regards to the latter, an explicit design goal was developing a walkable neighbourhood, where pedestrian priority would be encouraged[13]. Car access was intentionally minimized: One single-track road following the lines of minimum slope provided car access and parking places to the entire site, and connected to the existing road infrastructure. A number of linear pedestrian pathways defined fully accessible routes with minimum changes in slope to most houses. This additional network of stepped walkways provided quick connections to the main pedestrian flat paths. Such configuration promoted pedestrian priority within the whole neighbourhood while simultaneously minimising terrain excavation -as illustrated in Figure 4. Moreover, the network of shared pedestrian pathways facilitated casual encounters among neighbours, therefore fostering a sense of communality. This layout reflected an interest in developing yet another quality identified as an enabler of a sense of identity in urban housing: the permeability of public spaces –in the sense that they provide an abundance of potential linkages and thus facilitate public choice in terms of circulation-[14].

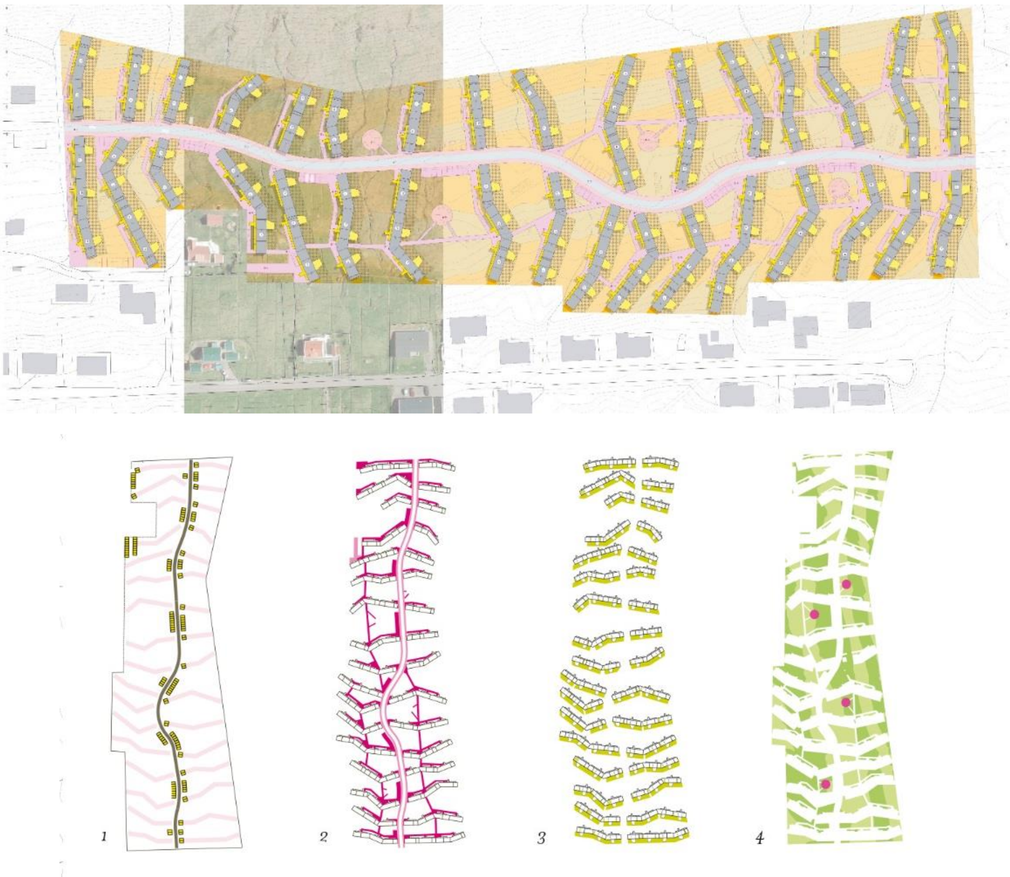

Figure 4. Masterplan configuration: Walkability and Commonality - 1. Main motor vehicle access road and parking spots; 2. Pedestrian access platforms; 3. Private plots and gardens; 4. Public space and common grounds

Individual access to each house was granted through its north facade, ensuring privacy in all the south aspects. Each dwelling included a private garden which ran alongside it south facade, providing access to tool and storage rooms at ground floor level. More importantly, each garden was open to the untouched landscape and water streams, which shaped the main public spaces of the submitted proposal. This general configuration attempted to facilitate Walkability and Commonality while also addressing some of the shortcomings identified in the design of modern social housing neighbourhoods, such as the excessive intricacy of layouts, the abrupt separation of vehicles and pedestrians –thus reducing visibility and therefore diminishing perceived safety-, the lack of allowances for public transportation links, and the failure to provide amenities within walking distance-[15].

The masterplan design maintained as much untouched landscape as possible while promoting uninterrupted connections between the municipality of Runavík and the open outfield uphill. In tune with the explicit ethos of fostering the public commons, unrestricted circulation through public grounds in the site was granted to the community of Runavik. Seizing this allowance of communal land, and tapping into the established link between the quantity and range of outdoor activities and the global quality of public space[16], a substantial provision of such activities was concentrated on the site. These included flat playgrounds -located on the sunnier central spots- and spaces allocated for collective gardening. Moreover, collective covered spaces –intended to perform as meeting places for nearby neighbours- were developed where pedestrian pathways crossed underneath housing strips, attempting to strike a design balance between facilitating access from individual units while avoiding being perceived as 'divorced from the ground'[17]. The provision of opportunities for planned and unplanned encounters and social interaction was considered a key aspiration of the design. The encouragement of both walking and open space activity was instrumental to the development of a diverse, balanced community, with potential for mutual support, surveillance and learning from diverse people. It should be noted that the design of higher-density housing developments has often been criticised for including large amounts of communal -yet unformed- green space that lowers the overall density level below that of detached housing neighbourhoods[18]. In that sense, our design of open space attempted to find a balance between achieving a higher built density than the average in Runavík –thanks to the strip form factor- and providing a ratio of green space that is generous yet manageable while also facilitating various modes of ownership and appropriation.

Figure 5. Detail of housing strips, private plots and common grounds

Designing and building for environmental sustainability

As a fundamental environmental strategy, strips served as barriers from the prevailing northern winds[19], sheltering the southern facades of the dwellings. Furthermore, all 95 dwellings enjoyed a south-facing main aspect. Full direct sunlight penetration from south facade openings into all rooms was guaranteed, thanks to the narrow form factor of the strips. Finally, the general layout prevented strips from casting shadows over one another, even in the worst-case scenarios. The proposed strip layout provided permeable boundaries due to their low contact ratio with the terrain, avoiding disruptions to the development of local fauna and flora[20]. Voids underneath each house were envisioned as productive spaces that articulated an intermediate area between the inside and the outside. These voids could be used as sheltered play spaces, garden extensions, work spaces, connections with lower storage and tool rooms. Such configuration helped define the spatial domain of each dwelling without formally enclosing it or restricting access to and between common grounds. In doing so, the proposal attempted to find a suitable balance between collective and individual solicitations.

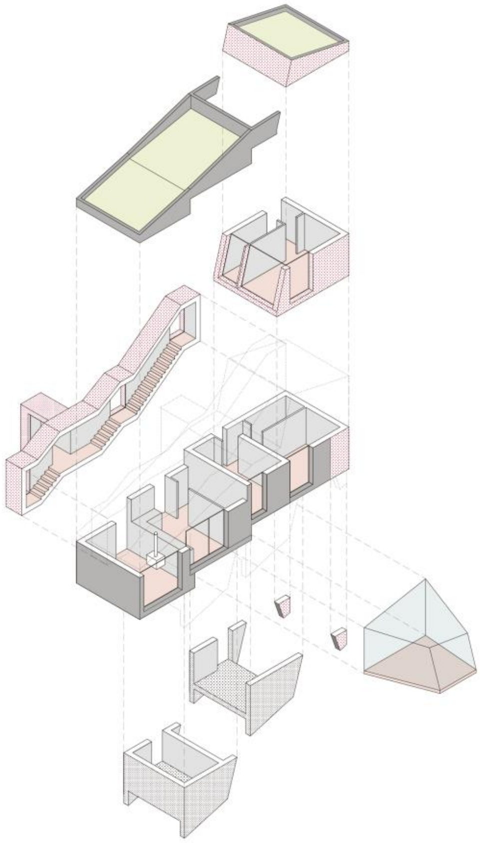

Figure 6. Assembly of modules

With regards to the development of the modular system, environmental sustainability was achieved by minimising its impact on the environment during its all life cycle. Therefore, we proposed using prefabricated timber room modules, dimensioned according to the restrictions of road transport,

manufactured at local factories and assembled on site (see Figure 6). This contributed to minimise the impact of the construction works in the surrounding environment[21]. Due to the high load-bearing capabilities of the basalt bedrock and the need to keep excavations to a minimum, modules transmitted loads through direct supports into superficial foundations cast in situ. This simple system minimised not only terrain excavation, but also structural requirements.

The material palette used on the exterior of the houses fulfilled a dual function. On the one hand, it addressed the existing social and environmental landscape by using materials coming from (or produced at) the Faroe Islands. On the other hand, the material choice allowed for a high degree of customization in each house, therefore fostering a sense of individual identity within the broader community.

Further to this, global passive and active design strategies were implemented in order to minimise energy consumption. This was of particular importance, since the harsh climatic conditions of the Faroe Islands often pose energy demands that can hardly be met using renewable sources only. Therefore, design passive strategies were incorporated to make dwelling units self-sufficient in terms of both heating and electricity demands. These energy-saving measures were extracted from a number of studies carried out at those latitudes that demonstrated that it is possible to build typical single-family houses with a minimal energy consumption without problems concerning building technology or economy[22] and included extensive use of the southern orientation and its subsequent passive solar gains, a thermal bridge-free design using much higher levels of insulation and airtightness than normal to reduce heat loss, and green roofs[23]. Active Design strategies included fulfilling the energy needs of the new neighbourhood through a combination of geothermal heat and wind power via connection to the existing wind-powered grid, and developing an efficient system for both ventilation and heat energy recovery. Finally, modules were designed with disassembly and reutilisation at the end of their life cycle in mind[24].

THE AFFORDANCES AND LIMITATIONS OF SUSTAINABLE DESIGN ENDEAVOURS

Our competition proposal for Runavík provided a comprehensive set of rules that addressed Sustainability from Environmental, Economic and Social perspectives. Within this global set of aspirations, a number of sub-categories were identified: Green Design strategies, Walkability, Compactness, Connectivity, Resilience and Diversity. As shown in the Urban Strategies diagram (Figure 7), addressing each sub-category posed specific design goals and constrains.

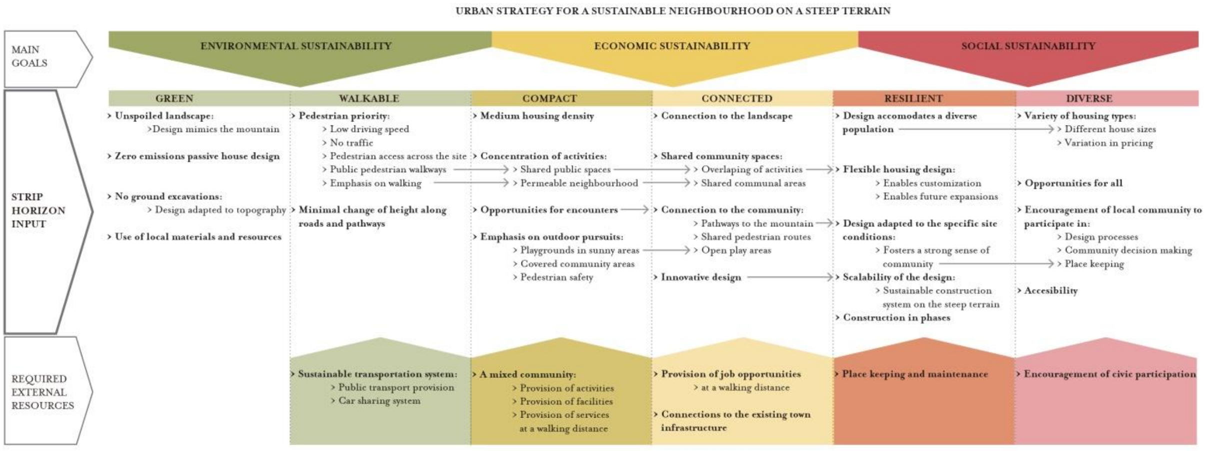

Figure 7. Urban Strategies diagram

In most cases, goals and constrains pertaining to one sub-category were also linked to other sub-categories. For example, and as shown in Figure 8, addressing Walkability through public pedestrian walkways also facilitated Compactness by creating shared public spaces were activities could be concentrated. This, in turn, leveraged Connectivity through the overlapping of those activities, ultimately leading to a flexible scheme where customisation and expansion were facilitated by the density and openness of the public space network. Such flexibility was also instrumental to the fulfilment of the Resilience goal. As this example illustrates, the submitted design proposal emerged out of a process of strategic negotiation, which attempted to articulate the most suitable balance between many different solicitations.

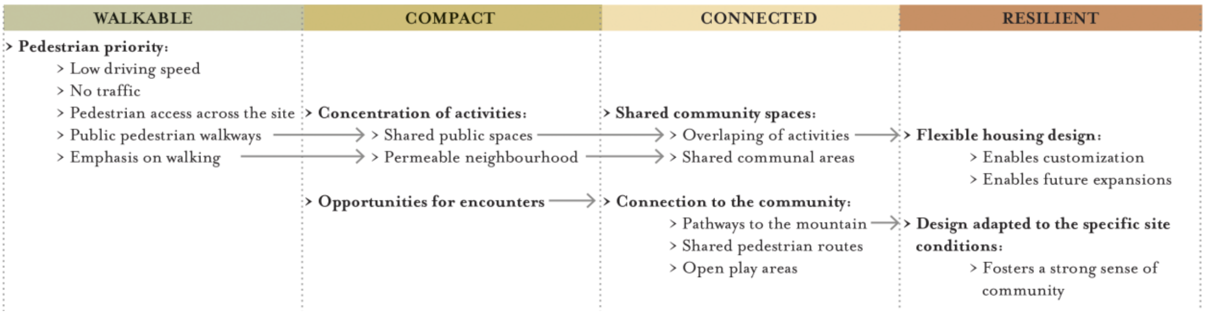

Figure 8. Detail of Urban Strategies Diagram, focusing on the design relationships between Walkability, Compactness, Connectedness and Resilience established by our proposal

In tune with the above goals and constrains, design development focused initially on the scale of the site and its immediate local context. However, and in keeping with the aspirations of comprehensiveness, innovation and exportability posed by the Nordic Built Cities Challenge, our proposal also attempted to identify a wider set of regional scale strategies that were of particular importance to its implementation. On the one hand, these strategies would allow for the new neighbourhood in Runavík to thrive and become a landmark of sustainable urbanisation at regional level. On the other hand, they would also allow us to successfully redeploy it as a repeatable urban scheme in other instances of steep terrain throughout the Faroe Islands.

In formulating these regional-scale strategies, some limitations of the competition brief and its overarching regulatory framework were highlighted: As shown in the bottom row of the Urban Strategies diagram (Figure 7) all strategies required external resources as a condition to facilitate the fulfilment of the environmental, economic and social sustainability goals. A critical example of this had to do with the enforcement of pedestrian priority criteria and the discouragement of car traffic to leverage Walkability. In order to fulfil this goal, additional public transport provision needs to be in place. Another example is that of the additional provision of public services like nurseries and primary schools, especially considering that young families are one of the most important target groups for the new housing development. The provision of such resources fell within the domain of municipal and regional bodies, requiring substantial mutual awareness and trans-scalar co-ordination among institutions. In practice, though, it has been noted that the relevant agents tend to lack an integrated approach, and may often enforce policies that actually 'pull in different directions'[25].

Our reflection –summarised in the Urban Strategies diagram (Figures 7 and 8)- suggested that such co-ordinated provision could not be developed on an ad hoc basis, but rather needed to be articulated as a comprehensive, trans-scalar policy. Whereas such policy should have the provision of alternative forms of housing at its core, it would also need to incorporate the regulatory and the infrastructural frameworks required to implement it within a more sustainable urban model. In doing so, the provision of housing would not become a burden for the existing urban setting, but rather constitute a transformative action towards a truly sustainable, context-sensitive built environment.
Further reflection on the regulatory framework surrounding the competition would lead us to interrogate its legal and economic development model, which was not fully defined at the time of the competition. In lieu of a specific development framework, the municipality of Runavík expected that private developers and the newly created Faroese Housing Association would be interested in undertaking all or part of the project. It must be noted that this was, historically, one of the very first attempts to build denser residential neighbourhoods using non-detached housing typologies in the Faroe Islands (one earlier, not very successful development had already been built in the fringes of Torshavn, the Faroese capital). As a result of this, the proposal submitted by our team was praised for its innovativeness, but also met with substantial reservations with regards to its marketability[26].
As a conclusion to this reflection, it could be argued that both the competition and the development of the four finalist proposals were a remarkably successful pilot initiative for sustainable design innovation. However, and considering the complexity of scalar, infrastructural and regulatory frameworks that is involved in the development of urban design processes[27], we should also acknowledge that, in spite of its transformative ambition and its aspirations of repeatability, this particular initiative operated within a comparatively restricted domain –more so considering that not all stakeholders had been identified at the time of launching the competition-. Because of this, further development of the project will necessarily have to take place on an ad hoc basis, therefore curtailing the potential of future schemes to articulate a truly sustainable urban model.

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In Marcuse's case the strategies suggested to achieve this do not just focus on the modification of current financial and ownership regimes –which are beyond the already broadened scope of our proposed intervention- but also on the expansion of public housing initiatives. Whereas allocating quotas of public and private tenure was outside the framework of the competition, the planning stage was undertaken under public initiative, hence providing multiple opportunities for expanding the public commons.

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[25] Barton. pp. 246-247

[26] A more conventional housing block proposal, developed by a large Danish office, ended up being chosen as the winning entry. Among other qualities, the winning proposal went through great effort to provide a reassuring typological image, which both developers and the public could recognise as a traditional block of flats distributed

around a central courtyard. This option was regarded by the jury as the most palatable from the point of view of both real estate development and public acceptance.

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