• Paper / Proposal Title:
Integrating Analog Design Techniques and Building Performance Simulation – From Intuitiveness to Counter-Intuitiveness in Architectural Design Process

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• Abstract (300 words):
The paper presents a pedagogical approach to use conventional architectural analysis techniques to enhance the learning of building performance simulation for design-oriented students, in line with a recent trend in the architectural education in the US and internationally. Solar tracing diagram and physical model construction were the adopted techniques for their familiarity and tangibility. They were used in analyzing an envelope system design and its adjoining interior space with a prepared climate analysis, prior to the more complex tasks of computer simulation. On the solar tracing diagram, the trajectory of natural light was intuitively approximated under a set of seasonal solar altitudes, focusing on the interaction of beam radiation with the envelope’s geometries and materials. For the identical scope of work, a scaled model was constructed 3-dimensionally and visually analyzed with the student-implemented light setting, leading to revisit and refine their solar tracing diagrams. Switching the mode of analysis to the computational, students digitally reproduced and simulated the envelope system design for daylight and thermal performances. With an added
information in daylighting simulation and its results, the intuitive approximations on the conventional analysis techniques were refined again, which in turn provided the students with a base knowledge to understand, interpret, and validate the result from the thermal simulation. The proposed approach showed an enhancement in the student learning on assessing the environmental performance of a building and its envelope system design. Students recognized that the adopted conventional techniques helped 1) implementing a design-specific simulation strategy, 2) interpreting the complex dataset in simulation results, and 3) correlating design and its performance for a climate. Cross-comparisons among modes of analysis allowed students to discover the benefits and uncertainties of each mode. The presented pedagogical approached modeled a way to expand the use and the role of building performance simulation in design studios.

• Author(s) Biography (200 words each):

Dr. Kim is an Assistant Professor of Architectural Technology at the City University of New York where he teaches sustainability and climatic adaptability for undergraduate architecture students. He formally taught graduate students at the University of Pennsylvania where he acquired his doctorate degree in architecture, focusing on environmental technology. In his dissertation, he has pioneered new algorithms to assess urban forms for their impact on local wind condition, particularly integrating topographic effect. Dr. Kim has worked as an architect, building scientist, and a consultant on a wide range of projects with a sustainability focus. Some of his key expertise is listed below.

- Advanced environmental simulation
- Bioclimatic architectural design optimization
- Environmental system integration for energy and comfort
- Low carbon neighborhood design