F21 48-733 Environmental Performance Simulations (EPS)
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"*Design of a boat is optimized for sail-driven locomotion. Buildings should be able to sail using free energy of wind, air, sun and internal heat sources to temper indoor environment*", Brendon Lewitt. Based on this viewpoint, this course introduces fundamental knowledge in building physics in relation to a range of environmentally responsive building design principles and computational approaches for increased resiliency for human habitability with minimal reliance on mechanical systems. EPS course refreshes some of the fundamental building physics topics such as building thermodynamics (heat & mass transfer mechanisms), photometric quantification of light and luminous environment, human visual and thermal comfort (psychrometric, thermal modeling and the principles of generating electricity from sunlight (photoelectric effect). Emphasis is given to understanding, analyzing and simulating the natural thermodynamic principles and processes to get instant quantitative feedback for informed design explorations.
EPS course outlines a series of environmental design principles with emphasis on evidence-based design approaches and reviews of building case studies. Focus is also given to integration of multi-valent environmental design strategies into the early stages of performative architectures. EPS also introduces state-of-the-art architectural design & research oriented environmental performance simulation & visualization tools, methods and techniques (based on the algorithmic/parametric modeling ecosystem of Rhino-Grasshopper-Climate Studio programs. Computational introductions will be accompanied with pre-established workflows which are ready for future adaptation and extension by the students.

Fundamental simulation-based approaches to be addressed are categorized as:
(1) Solar Radiation (insolation analysis, sun-path diagramming, shade &shadows, sunlight hours),
(2) Visible Radiation (daylighting simulations – spatiotemporal distribution, availability, human visual comfort and synthetic imaging),
(3) Thermal Radiation (building thermal modeling, heat flux through building envelope, human thermal comfort, urban micro-climatic comfort, psychrometric, and wind analysis),
(4) Generation (solar photovoltaics), and
(5) Optimization (introduction to evolutionary optimization in Grasshopper).

Upon finishing the EPS course, graduate students will have understanding, knowledge and skill sets for the following interactions: Theory (Physics) ←→ Analysis/Analytics (Simulation) ←→ Design (Environmentally Responsive & Re-Humanized) ←→ Representations (Design Ideas + Predictive Data + Quantifiable Metrics). These knowledgebase and skill sets are readily applicable to architectural research-oriented thesis studies and contemporary architectural practices in environmentally sustainable, high-performance and user-centered design.