Building Simulation in Design Practice

ARCH 8833 (CRN: 40533) Spring Semester 2020, 3 Credits Seminar

Instructors: Roya Rezaee, Marcelo Bernal, Tyrone Marshall

COURSE DESCRIPTION

This course builds up the theoretical and practical understanding of building simulation to support collaborative multi-performances building design practice. It includes computational techniques to help designers generate a large space of design variation, simulate a variety of building performances, evaluate and explore the options, and make informed design decisions in a systematic framework. The modeling and simulation cover the following domains: Solar, Energy, Thermal Comfort, Daylighting, View, and Cost. The course builds professional use of tools oriented towards a practice-based research agenda focused on performance, data-informed visuals, and an integrated data analysis platform. The course critically takes the relationship between research and design innovation seriously.

This learning-by-development seminar is organized in two parts: the first strand deals with basic knowledge of building modeling and simulation using parametric tools and introduction to multi-performances exploration and optimization techniques. The toolset informs the decision-making process and balances the program with performative design objectives. The second strand allows students to develop an integrated model and make use of the work within the framework of realistic challenges such as climate change mitigation and morphed weather files addressing a K-12 developmental school program and building topology. Students work in a team to formulate the research questions, investigate precedents, and construct parametric relationships that describe the geometry and program configuration using the design space construction method (DSC). They then evaluate design variations from their precedents and custom algorithm to test their assumptions and intuition from the multi-performances platform. Finally, the student team will analyze, assess, and visualize the data, extract the insights, and formulate guidelines for unique characteristics that address the architectural problem.

COURSE OBJECTIVE

In addition to participating in real design project with different design questions at different scales, at the end of the course, students should be able to:

- Describe the role of simulation in the evaluation of building performances.
- Select software tools and appropriate modeling strategies for a given problem and justify assumptions.
- Model and simulate new or existing buildings and their systems.
- Perform optimization studies with appropriate tools.
- Analyze simulation results and ascertain their quality.
- Incorporate data and knowledge into the design decision making process in order to improve the rationality of design.
- Interact with data and learn fundamental concepts in data analysis, statistics, and visualization techniques.
- Demonstrate an ability to work in an interdisciplinary team.

COURSE TOOLS AND RESOURCES

Lectures, Presentations, Group Projects and Discussions Simulation Laboratory. The computational tools include: Rhino, EPC Calculator, EnergyPlus, Honeybee + Ladybug, Radiance, DIVA, JMP

DESIRED DISCIPLINES AND PREPARATION

Undergraduate and graduate students with interest and skills in Architecture, High Performance Building, Design Computing, Mechanical, & Systems Engineering, Computer Science.