48-722 BUILDING PERFORMANCE MODELING (BPM)

The BPM course focuses on conceptual foundations and practical applications of advanced and integrated whole-building energy simulation programs with emphasis on architectural building envelope systems, mechanical electrical building systems and their controls (electric lighting and HVAC systems) and building integrated solar photovoltaic power systems. Students are engaged in project-based collaborative studies with emphasis on analytical methods of simulation-aided high-performance building design. Theoretical lectures and software demonstrations are supported with discussions of relevant building case studies and particular design solutions which exhibit an innovative character with the application of whole-building energy simulations in the evaluation and improvement of the total building performance starting from early stages of design development. The BPM course also discusses the Building Information Modeling (BIM) concept and its connectivity to Building Energy Modeling (BIM) with lectures dedicated to BIM-to-BEM approaches with contemporary workflows and their challenges. Theoretical lectures include basic refreshers of building physics concepts, thermodynamics and heat transfer mechanisms, human thermal and visual comfort as well as mechanical-electrical building systems with focus on high-efficiency equipment design. The BPM course has the goal of introducing the use of state-of-the-art whole-building energy simulation tools (e.g. Autodesk Conceptual Energy Analyzer (CEA), IESVE, and Design Builder/EnergyPlus) with special focus on “building energy systems” and “on-site renewable energy systems” as well. Simulation tool introductions are carefully synthetized with introductions to theoretical foundations of performance modeling and analytical approaches with emphasis on data visualization techniques for enhanced inter-disciplinary design decision making. Selected energy performance assessment techniques are demonstrated along with the introductions of contemporary design approaches for environmentally responsive, energy efficient and healthy buildings.