High-Rise Office Building achieves zero energy use with optimization-driven design technology

Evangelia Despoina Giouri, MSc graduated from the Faculty of Architecture and the Built Environment of Delft University of Technology, used modeFRONTIER to assess the energy performance and thermal comfort towards zero energy high-rise buildings.

Challenge

Currently 40% of European Union's final energy consumption and 36% of greenhouse gas emissions are attributed to buildings. New strategies to design nearly Zero Energy Buildings (nZEBs) are essential to meet climate targets set by the European Energy Performance of Building directive.

This research applies process automation and optimization technologies to develop a new integrated simulation methodology to design nZEBs in a mediterranean climate. This concept has been applied to a high-rise office building featuring photovoltaic panels integrated in the facade walls, located in the hot-dry climate of Athens, Greece.

> **modeFRONTIER helped to achieve 33% reduction on annual building's energy consumption.**

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Solution

The goal is to define which construction parameters have the highest impact on annual energy demand and thermal comfort in the building. The simulation process was created in modeFRONTIER workflow coupling Rhino/Grasshopper modeling environment and EnergyPlus software to simulate energy consumption and daylight illuminance levels. Two optimization runs have been executed to investigate the influence of building parameters that can have contradictory impact on cooling, lighting, heating energy loads and four different facade orientations.

Integrated multi-objective optimization strategy to assess energy use-adaptive thermal comfort.
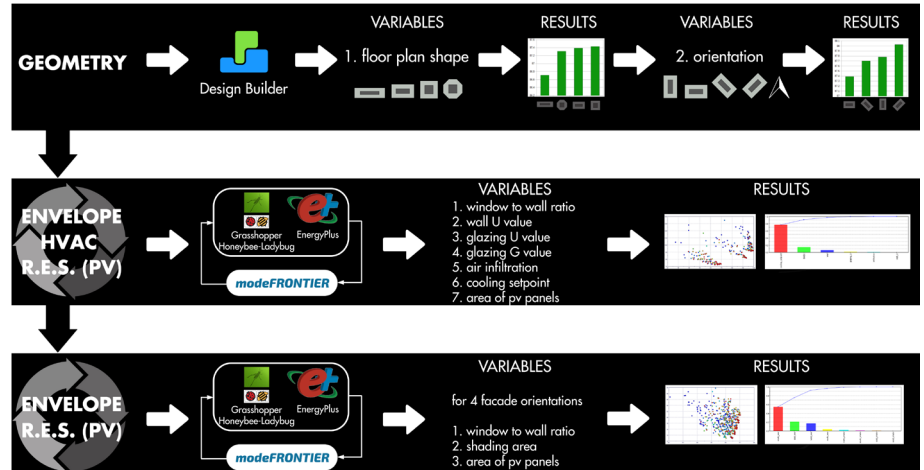
Benefits

The genetic algorithm NSGA-II allowed to perform 1000 evaluations in order to find the trade-off solutions for several design issues affecting energy performance and thermal comfort levels. "We were able to achieve 33% reduction on annual building's energy consumption (from 109.12 kWh/m2 to 73.13 kWh/m2) comparing to standard data provided by the current Greek legislation. Moreover, modeFRONTIER engineering and data intelligence capabilities enable us to visualize optimization trends and perform sensitivity analysis to assess the impact of the various facade parameters on the energy use and adaptive thermal comfort performance of the building" said Evangelia Despoina Giouri, MSc graduated from the Faculty of Architecture and the Built Environment of Delft University of Technology.
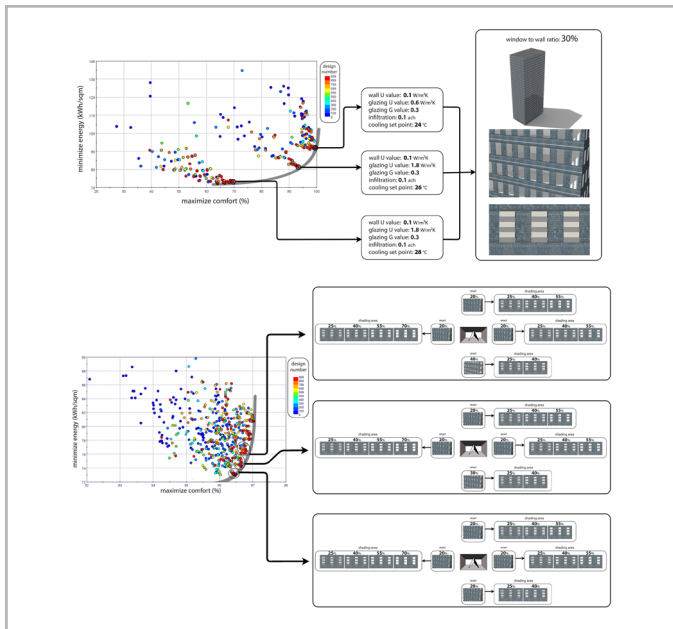
Parallel Coordinate Chart allows to identify which parameters are relevant to obtaining better designs.

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