Office Building Optimisation Using the Energia Design Synthesis Method

Dóra Zetz1\*, Zsolt Ercsey2, Péter Novák3, István Kistelegdi 4

1 Marcel Breuer Doctoral School, Faculty of Engineering and Information Technology,  
 Boszorkány u. 2, H-7624 Pécs, zetzdora@gmail.com

2 University of Pécs, Faculty of Engineering and Information technology, Institute of Information and Electrical Technology, Department of Systems and Software Technology,   
Boszorkány u. 2, H-7624 Pécs, ercsey@mik.pte.hu

3 University of Pécs, Faculty of Engineering and Information technology, Institute of Information and Electrical Technology, Department of Systems and Software Technology,  
 Boszorkány u. 2, H-7624 Pécs, novakpetya@yahoo.co.uk,

4 University of Pécs, János Szentágothai Research Centre, Energy Desing Research Group,  
 Ifjúság útja 20. H-7624 Pécs, kistelegdisoma@mik.pte.hu

\*Corresponding author

Office buildings represent one of the most common public building with extremely high cooling energy demand and corresponding negative environmental impact in Central Europe. Due to the high wall-window ratio of this building type, the indoor thermal and visual comfort suffers, as a consequence of characteristic summer overheating and winter heat loss.

The current office building design method develops a sole plan, based on experience, without any type of optimisation in connection with the complete building and its most important space organisation and building body shaping design possibilities. On the other hand, multiple studies deal with improvement and optimisation of comfort and energy performance concentrating only on subsystems for instance, façade, glazing, shading or HVAC systems.

The heuristic Energia Design method creates multiple design versions and assess comfort and energy performance by applying high-tech building physics simulations. The results support decision making in design concepts. However, this method is limited to some numbers of considered concepts, therefore the optimal office building case is not ensured.

This research integrates a self developed synthesis step in form of the Energia Design Synthesis method as the only technology for the generation of optimal office buildings in energy and comfort. The P-graph methodology serves as an important inspiration for the Energia Design Synthesis that applies mathematical modelling and combinatorial optimisation, in the field of architectural design. Due to the fact that almost 80% energy saving can be achieved by passive strategies, the current study focuses on space organisation optimisation in a generic office design. A series of rules were defined using a modular geometry system to model all potential office geometries. A back-tracking algorithm generates all office building geometries satisfying the rules. In a dynamic thermal simulation framework building physics performance is calculated to generate a ranking in thermal comfort, daylighting, indoor air quality and energy performance.

**Keywords:** optimisation, residential building, synthesis, active design strategy