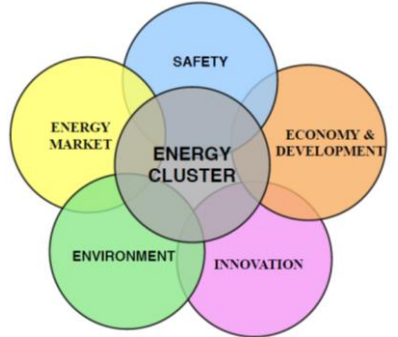
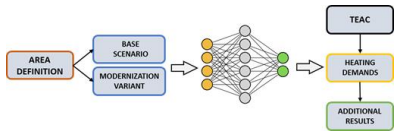
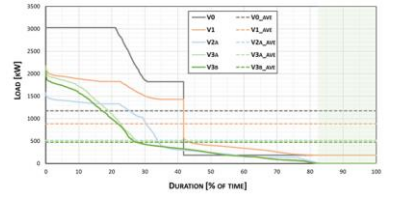




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<p>name of the unit:</p> <p style="text-align: center;">DIVISION OF BUILDING PHYSICS AND SUSTAINABLE DESIGN,</p> <p style="text-align: center;">Department of Building Materials Physics and Sustainable Design, Lodz University of Technology</p>		<p>symbol:</p> <p style="text-align: center;">K-62</p>
<p>head of the unit:</p> <p style="text-align: center;">Prof. Dariusz Gawin</p>	<p>potential promoters:</p> <p style="text-align: center;">prof. Dariusz Gawin, dr. Witold Grymin, dr. Marcin Zygmunt, dr. Iwona Szer</p>	<p>contact person:</p> <p style="text-align: center;">Prof. Dariusz Gawin dariusz.gawin@p.lodz.pl</p>
<p>scope of activities:</p> <ul style="list-style-type: none"> - Designing a sustainable building, Multi-criterial optimization of a building design, Building Energy Modelling (BEM), Economic and Environmental (emissions of pollutants and CO₂) Life Cycle Analysis (LCC and LCA) of a habitable building; - Urban-scale building energy modelling (UBEM), Energy Clusters, Urban-scale Economic and Environmental LCA, Renewable Energy Sources (RES), Deep energy retrofitting of buildings and urban areas, Decarbonization of building sector; Energy auditing. - Numerical modeling of hygro-thermal phenomena in deforming building materials, including material strains during drying, performance of concrete at early ages and at high temperature, performance of porous building materials during freezing; - Application of Artificial Intelligence (AI) methods in the energy analysis and optimization of building design in the context of Sustainable Development - "In situ" testing and monitoring of acoustic and thermal properties of buildings; 		<p>graphic material</p>  <p>Fig. 1: Energy cluster concept</p>  <p>Fig. 2: Application of the TEAC software</p>  <p>Fig. 3: Exemplary results of the UBEM analysis for a suburban area.</p>
<p>present activities:</p> <p>The present activities are mainly dedicated to the Building Energy Modeling and Urban-scale Building Energy Modeling in the context of Sustainable Development and Decarbonization of building sector. The computer software TEAC (Tool for Energy Efficiency Analysis of an Energy Cluster) is being developed for multifamily houses stock in Poland.</p> <p>Other scientific topic, being developed in collaboration with the University of Padova, is durability of concrete structures at high temperature, exposed to freezing, and at early ages.</p> <p>Then, some activity is dedicated to the laboratory and "in situ" testing of thermal and acoustic properties of building envelope, and indoor thermal comfort. Our laboratory is equipped with a hot-box chamber, and two climatic chambers with programmable temperature and humidity conditions, where larger building elements might be tested.</p>		
<p>Future activities:</p> <p>Analysis and optimization of various energy retrofitting scenarios/strategies for a building and larger urban areas, situated both in the city and suburban areas.</p> <p>Further development of the TEAC computer software for the multifamily houses stock in Poland.</p>		



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PROGRAMME

Influence of Global Climate Warming on the energy and hygrothermal performance of Polish habitable buildings stock and choice of best retrofitting strategies.

Publications:

1. GAWIN D., WYRZYKOWSKI M., PESAVENTO F., Modelling hygro-thermal performance and strains of cementitious building materials maturing in variable conditions, *Journal of Building Physics*, Vol. 31, No. 4, 301-318 (2008).
2. WITEK A., GAWIN D., Experimental and numerical study on the efficiency of the polypropylene fibers admixture in reducing pore pressure in heated concrete, *Journal of Building Physics*, Vol. 38, No. 2, 121-137 (2014).
3. GAWIN D., PESAVENTO F., CASTELLS A.G., On reliable predicting risk and nature of thermal spalling in heated concrete, *Archives of Civil and Mechanical Engineering*, Vol. 18 (4), 1219 - 1227 (2018)
4. GAWIN D., PESAVENTO F., KONIORCZYK M., B.A. SCHREFLER, Non-equilibrium modeling hysteresis of water freezing - ice thawing in partially saturated porous building materials, *Journal of Building Physics*, Vol. 43(2), 61-98, (2019)
5. GAWIN D., PESAVENTO F., KONIORCZYK M., B.A. SCHREFLER, Poro-mechanical model of strain hysteresis due to cyclic water freezing in partially saturated porous media, *Int. J. Solids and Structures* Vol. 206, 1 December 2020, 322-339
6. M. ZYGMUNT, D. GAWIN, Application of Artificial Neural Networks in the Urban Building Energy Modelling of Polish Residential Building Stock. *Energies* 2021, 14, 8285.
7. M. KONIORCZYK, W. GRYMIN, M. ZYGMUNT, D. GAWIN, Novel stochastic approach to predict the energy demand and thermal comfort in the office buildings considering materials and human-related Gaussian uncertainties, *Journal of Building Engineering*, Vol. 42, October 2021, 102831.
8. M. ZYGMUNT, D. GAWIN, Application of the Renewable Energy Sources at district scale – a case study of the suburban area, *Energies* 2022, 15, 473

Patents:

„Material storing heat Energy for accumulative heat exchangers, Polish patent application Nr. P.416407.

„Method for producing hydrophobized perlite dust, application of hydrophobized perlite dust, Polish Pat. 238198, 23.04.2021.

Projects:

Degradation of properties due to development of expansive phases in building composites with microstructure, programme "OPUS 2", 2012-2015.

“Towards the next generation of standards for service life of cement-based materials and structures”, Transport and Urban Development COST Action TU1404, 2014-2018.

„Multiscale, fractal chemo-hygro-thermo-mechanical models for analysis and prediction of durability for cementitious composites”, programme "OPUS 8", 2015-2019.

Keywords:

Sustainable development in building construction sector, Energy building modelling, Urban-scale building energy modelling, Environmental Life Cycle Analysis, Hygrothermal phenomena in porous materials, Concrete at early ages, Concrete at high temperature, Numerical modelling of building elements hygrothermal performance

List of internship proposal in this research team:

Application of stochastic methods in the life cycle analysis of energy and thermal comfort for buildings and urban areas.

Application of various optimization methods for deep energy retrofitting and designing of sustainable buildings

Development of software for the energy and environmental analysis, and multicriterial optimization of multifamily buildings and urban areas

