Newsletter

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HESMOS
Virtual Energy Lab

SEVENTH FRAMEWORK PROGRAMME

Welcome to the third issue of the **HESMOS-Project Newsletter**. HESMOS is a so called STREP-Project funded by the EU under the 7th framework Programme. During the runtime of the project several newsletters will be published. For further information and downloads please visit our website. There you can also register if you want to receive this newsletter automatically. **In this issue**, HESMOS presents the **Energy Solver** software developed and provided by Technische Universität Dresden, Institute for Building Climatology.

HESMOS – PROJECT OBJECTIVES

HESMOS - **H**olistic **E**nergy Efficiency **S**imulation and Life Cycle **M**anagement Of Public Use Facilitie**S**. The overall objective of HESMOS is to develop an **Integrated Virtual Energy Laboratory** (IVEL) which allows decision makers to design and compare several energy and life cycle cost optimised alternatives as well as to optimize the operation of Public Private Partnership Projects (PPP). To achieve this objective **HESMOS IVEL** enhances existing Computer-Aided Design (CAD) and Facility Management (FM) tools with information from energy simulation and cost calculation as well as up-to-date data from the Building Automation Systems (BAS). To evaluate the functionality of the HESMOS IVEL, an extensive 30-month validation program will be **realized at two PPP projects**.

HESMOS – PARTNERS

TECHNISCHE UNIVERSITÄT DRESDEN

NEMETSCHEK

GRANLUND

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IN THIS ISSUE

Overview Energy Solver

The Institute of Building Climatology (IBK) at the Technische Universität Dresden (Faculty of Architecture) traditionally investigates the theoretical basis of combined heat, air, moisture and salt transport in building materials. An important goal of the IBK's research work is the dissemination of new knowledge to other research institutes, and practitioners. Therefore, the IBK implements a continuous knowledge transfer of new findings via in-house developed user friendly software and calculation tools.

IBK's software programs support other research institute's work, assist students in learning the fundamentals of building physics, and enhance the working capabilities of civil engineers, architects, and other working disciplines in the field.

The software can be used in various applications. For instance, it can be used during the planning phase to estimate the condensation risk of a building construction under various climate conditions, or to investigate the impact of thermal bridges. It can also be used to determine the reason of damage to constructions or materials, or to develop new materials for potential application areas and limits and to help to optimize materials for special application cases.

The targets of the software development work are subdivided into the following topics:

(1) Building materials: Investigation of hygric and thermal properties (deterministic and stochastic approaches), hygrothermal simulation, deterioration and durability analysis, new materials.
(2) Building enclosures: Analysis of micro climate, effects of weathering loads, salt & frost damage, new insulation & advanced retrofitting systems.
(3) Rooms, zone level: Usability, comfort and health, ventilation & mould growth diagnostics, indoor air quality.
(4) Whole buildings and urban physics: Simulation of energy and moisture performance, low energy buildings, renewable and waste energy networks, smart energy management, wind & wind driven rain modelling.

According to the HESMOS objectives the main focus is on the automated data processing and transformation. Starting from the CAD applications, the process continues via the energy solver to the web based visualization of measured and simulated values. Challenges are (1) the interpretation of the IFC data structures, (2) bridging information gaps; (3) integration of energy solvers in the HESMOS framework and (4) serve the information needs of the end user with the help of analysis and reporting.

The following sections contain a brief description of the energy related software tools provided by the IBK. All tools are available for Windows™ based and Linux™ based computer operation systems.

NANDRAD

NANDRAD is a solver kernel for multi-zone building energy performance simulation. It is designed to perform transient solutions to energy balances in thermal zones and discretized construction elements. It provides also thermal comfort evaluation (e.g. indoor air temperature, operative room temperature, temperature of the inner surface of envelope elements). The NANDRAD solver is applicable to buildings with a large number of spaces since the IBK's research and development is focussed on optimized numerical algorithms.

Targeted Features:	One-dimensionally discretized wall structure (finite volume method) calculation of wall temperature fields and induced heat flux performance optimized implicit models (building, idealised HVAC) user generated models
Potential user group:	Architects and Specialised Energy Planners
Main target:	Support of complex building geometry, modelling of idealised HVAC systems; simulation support on building element (e. g. wall), single room space and whole building level
Calculation procedure:	transient thermal simulation optimized for discretized wall modelling an non-linear HVAC system
Outstanding properties:	Combination of optimized numerics for standard components in the building simulation with a generic modelling approach for user-specific extensions, advanced computational kernel incl. modern iteration methods, parallelisation, object-oriented programming and state based model evaluation.

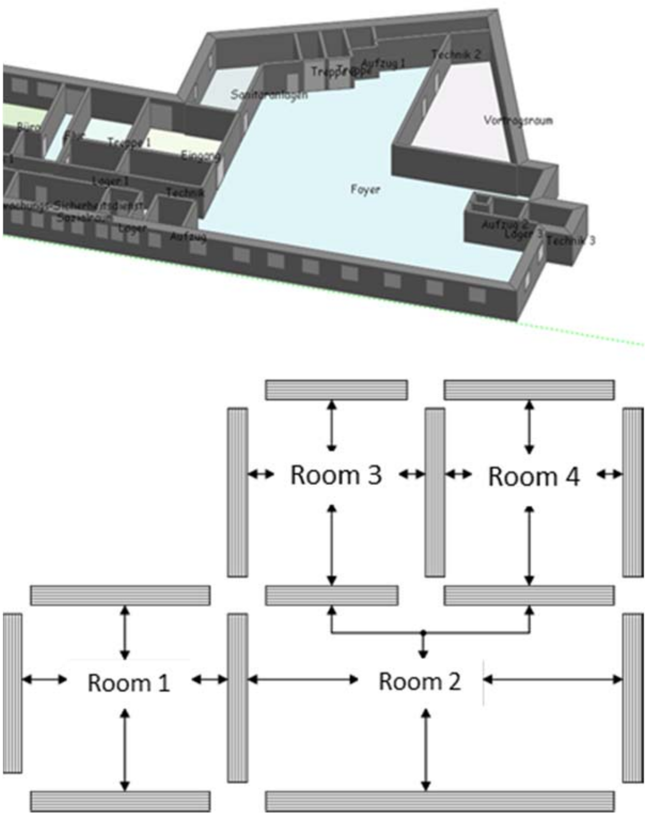

Figure 1: NANRAD - Basic modelling of thermal interdependencies between spaces

THERAKLES

THERAKLES is a desktop application for calculation of the thermal conditions (e.g. indoor air temperature, operative room temperature, temperature of the inner surface of envelops elements) inside a single space depending from outdoor climate, room envelop and idealised HVAC-Equipment over short and long term periods.

Features:	Fast solver; Predefined weather data, construction data, material data and window data included; Concerning idealized heating and cooling equipment; Evaluation of thermal comfort based on operative temperature concerning EN 15251; used via desktop based GUI
Targeted user group:	Architects and Specialised Energy Planners
Main target:	Thermal comfort in summer and winter conditions, e.g. optimization of window area per room, shading systems, prediction of energy demand for heating and cooling
Calculation procedure:	Transient thermal simulation optimized for discretized wall modelling an non-linear HVAC components
Outstanding properties:	Very simple handling, less input required, high calculation speed

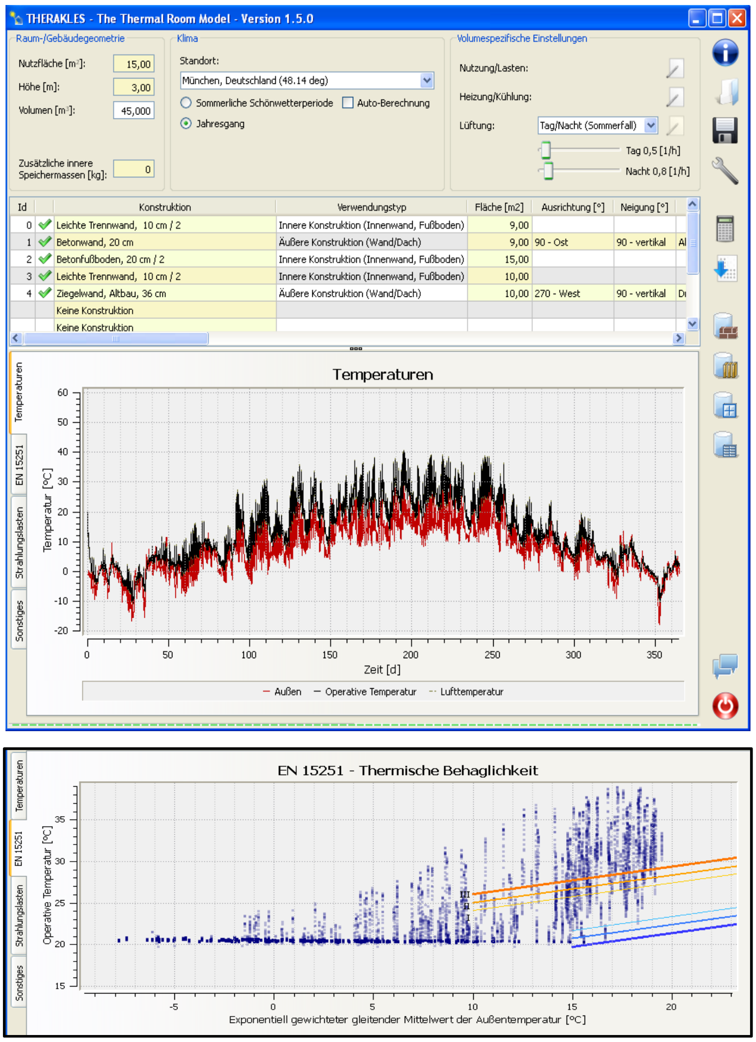

Figure 2: THERAKLES - Screenshots of various inputs and result plot

DELPHIN

DELPHIN is a desktop application for numerical simulation of coupled heat and moisture transport in building construction elements (walls, roofs and floors). The focus is on constructional details, such as window-wall connections, heat bridges or connections of floors/ceilings to external walls.

Features:	1D, 2D and rotation symmetric 3D modelling Optimisation of the component's layered structure Particular calculation of various characteristic values
Targeted user group:	Designers, engineers, manufacturers, r & d, material development
Main target:	Investigation of construction elements in terms of heat and moisture protection
Scope:	Dimensioning of construction elements in terms of heat and moisture protection, development of materials and systems, modelling the transport of several kinds of porous solid media, durability against damages caused by salt, modelling of HVAC components in soil
Calculation procedure:	Transient heat and moisture transport, variable equation systems
Outstanding properties:	High flexibility, support of modelling complex geometry, detailed const-raints, full access to constraints and input data, different combinations of accounting equations, material equations free definable

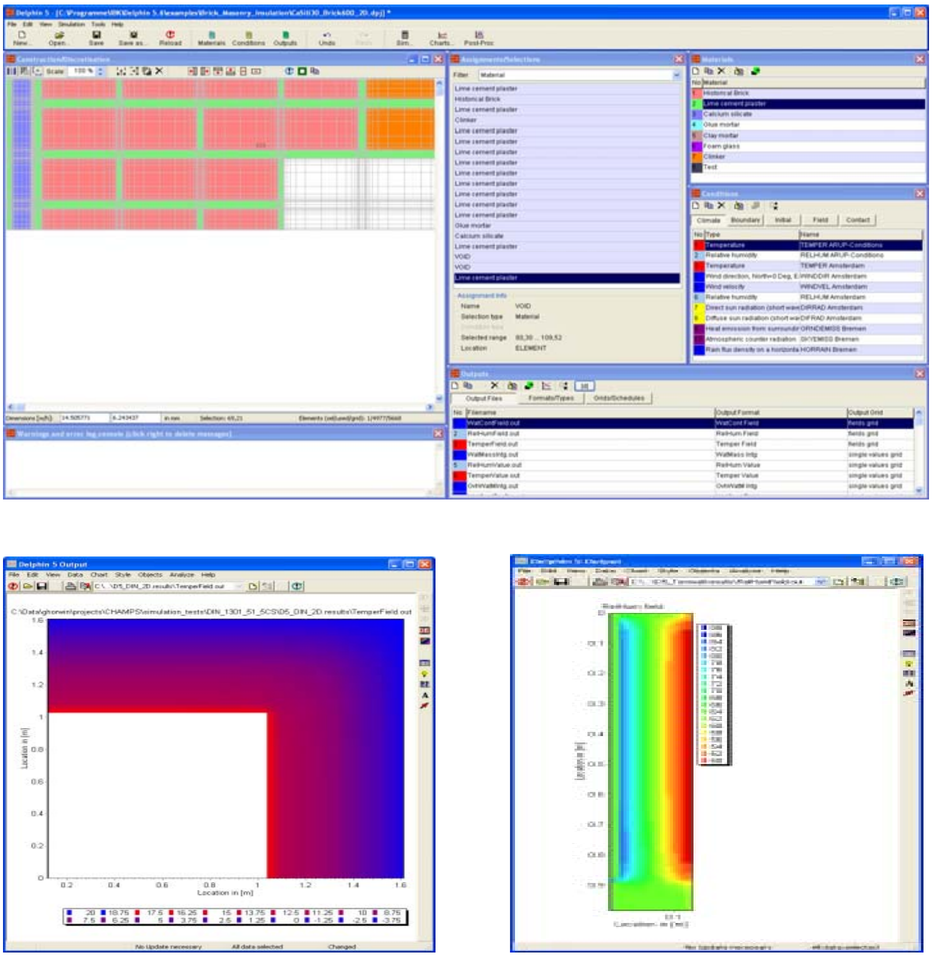

Figure 3: DELPHIN – discretization and 2D temperature fields inside a wall

PARTNER PROFILE IN THIS NEWSLETTER: TUD-IBK

TECHNISCHE UNIVERSITÄT DRESDEN – Research

Technische Universität Dresden (TUD) is one of the oldest and largest technical universities in Germany. It is member of the group of the nine leading Technical Universities in Germany ("T9 Board"). It is a full-scale university with 14 faculties, 36,000 students, over 4,500 employees and about 600 professors. TUD is represented in HESMOS by three institutes, namely the **Institute of Construction Informatics** (CIB), the **Institute for Building Climatology** (IBK) and the **Chair for Technical Information Systems** (TIS) of the Institute of Applied Computed Science.

INSTITUTE OF BUILDING CLIMATOLOGY

The Institute of Building Climatology (IBK) consists of two Chairs, the Chair of Building Physics and the Chair of Building Services, and three Research Divisions, the Software Development Group, the Building Physics and Materials Laboratory and the Knowledge Transfer and Engineering Experts Group. The staff of IBK comprises 20 Scientific Employees (3 permanent), 10 PhD Candidates (3 external) and about 20 Student Research Assistants.

IBK's research work focuses on building energy performance and sustainable construction technology:

1. Building materials: hygric and thermal properties (deterministic and stochastic approaches), hygrothermal simulation, deterioration and durability analysis, new materials
2. Building enclosures: laboratory testing methods & on-site monitoring, analysis of weathering loads, salt & frost damage, new insulation & advanced retrofitting systems
3. Whole buildings and residential areas: energy and moisture performance, low energy buildings, renewable and waste energy networks, smart energy management, plus energy residential areas
4. Usability, comfort and health: ventilation & mould growth diagnostics, indoor air quality
5. Urban physics: wind & wind driven rain modeling

The knowledge transfer to other research institutions, to building practice and to students is supported by the IBK's software development. The IBK's in-house software tools are publically available and can be applied to the major aspects and questions in building physics and building science.

IBK is scientifically represented at national and international levels and it is organiser of several international building science congresses.

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