Technology Collaboration Programme
by IEA

IEA Technology Collaboration Programme

International Energy Agency

Technology Collaboration Programme on

Energy Storage (ES TCP)

Storage for renewables and flexibility through standardized use of building mass

Questionnaire: SIMULATION

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Contact:

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Dear madam or sir,

thank you for taking the time to fill out this questionnaire! In order to provide a good overview of available **simulation tools** / simulation **models** dealing with **thermally activated building components**, we require your knowledge and expertise. Please use this opportunity to make your work known or provide useful information for other interested parties about tools or models you use or have experience with.

If you give us your personal information, we can keep in touch and maybe consider you as a co-author in possible publications or reports.

Personal Information *(optional)*	
Name: *(Family name, given name)*:	Heidenthaler, Daniel
E-Mail:	daniel.heidenthaler@fh-salzburg.ac.at
Contact	☒ I am available for follow-up questions

Company / Institution	
Name:	Fachhochschule Salzburg GmbH
Country:	Austria
Type:	☒ University / Education ☐ Research Institution ☐ Company using simulation software ☐ Company developing simulation software

Please give feedback on categories of simulation software you are developing and / or using.

We distinguish between two different categories of mathematical models, depending on their intended usage: ***Detailed* simulation models** should reproduce measurements as precisely as possible and are intended for planning, e.g., in construction. ***Prediction* models** have reduced complexity and can be used for very fast simulations or even within optimization problems, e.g., in control tasks, to predict how changes in the operation influence the temperature and comfort of residents.

Please provide information on one or both of the simulation types, depending on your professional experience.

Note that your responses will be made available to the task participants and may be used in the preparation of official reports that will be made publicly available.

Please send the questionnaire to daniel.muschick@best-research.eu once you have filled it out.
Thank you!

Detailed Simulation Models

Detailed simulation models are used to calculate the behaviour of systems in reality (temperature propagation, heat bridges, constructive stability, humidity, dew points, …) as precisely as possible. They may also be used to test control strategies, which may depend on simplified prediction models, before implementing them. The parametrization of the models is done by specifying physical and geometric properties, i.e., It is not necessary to have real measurement data to setup a simulation.

The focus is on simulation algorithms and tools either with a special focus on activated building components or which at least can handle them well.

Detailed simulation models are typically part of a software package (TRNSYS, Modelica) or are a dedicated software tool themselves (IDA ICE, …). If your input is more about the method than the tool, please feel free to add information in the "Additional information" field.

If you have experience / information on multiple tools, please feel free to copy the table.

Detailed Simulation Tool / Model		
Name:	HTflux	
Homepage:	https://www.htflux.com/	
Relationship to you:	☐ I / my company are developing this software ☐ I / my company are using this software on a daily basis ☒ I / my company are using this software sporadically ☐ Other:	
License:	☐ Not publicly available; developed in-house, e.g., in research projects ☒ Commercial license ☐ Free software ☐ Open source ☐ Other:	
Type:	☒ Stand-alone software ☐ Library / Plugin for: ☐ Other:	
Co-Simulation Interfaces:	☒ None ☐ FMI / FMU ☐ Custom (e.g., call to DLL) ☐ Other:	
Consideration of TABS:	☒ Ceiling ☒ Floor ☒ Wall ☐ Other:	☒ Concrete ☒ Brick ☒ Wood ☒ Other materials: materials can be defined by user

Method to consider TABS[1]:	☐ Ordinary differential equations (ODE) ☐ Partial differential equations (PDE) ☒ Finite Element Method (FEM) ☐ Other:
Scope:	☒ Component ☐ Room ☐ Building ☐ City (quarter) ☐ Other:
Main application:	*Analysing the 2D behaviour of TABS with steady-state (heat flux, heat distribution) and transient simulations (e.g. heat storage capacities, heating-up and cooling-off behaviour), investigating innovative constructions with TABS (e.g. phase-change materials, TABS in wooden constructions…)*
Integration of control:	☐ None (e.g., steady state calculations only) ☐ Controllers defined in model ☐ External control possible with co-simulation interface ☒ Other: no advanced control, given temperature profile with timestamps for boundary conditions (e.g. medium temperature, room air temperature, outside air temperature) in dynamic simulations
USP: *(unique selling point)*	Easy implementation and investigation of innovative and uncommon constructions/systems – detailed analysis of components (in contrast to simplified models in whole building simulation software), free for non-commercial research
Alternatives:	*If you know about similar solutions, please denote them here.* *Ideally, copy this table and fill it out for the alternative as well.*
Publications on method:	*E.g., own publications on the simulation method; review papers.* *For commercial products: Link to publicly available information*
Publications on applications:	*https://www.sciencedirect.com/science/article/pii/S0360544221013864*; https://www.htflux.com/en/category/applications/
Additional Information:	*Please provide any information you consider of interest, e.g., provide details only asked of simplified simulation models*

Open Challenges for Detailed Simulation Models
Focus is only on the component itself, no simulation of total system and interaction possible – combination of detailed simulation models (such as in HTflux) with simulation of control could provide useful insights regarding heat storage capacities and transient behaviour – computing capacity vs. level of detail remains a challenge, more holistic software like IDA ICE use simplified TABS models

[1] How are thermally activated building components represented in the simulation? If, for example, the entire slab is considered as one block (1D model), this would correspond to an ODE. If piping space can be considered, it could be either PDE or FEM