IBPSA Project 1

8th Expert Meeting - October 18, 2021

WP 3.2 Application

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Goals of WP3.2

Goal 1: To demonstrate capabilities enabled by the use of Modelica for the design and operation of building and district energy systems

Goal 2: To develop user-friendly tools and interfaces to facilitate the use of Modelica

Outcome

Outcome 1: Collection of application case studies

Outcome 2: Python-based tool for automatic generation of Modelica models from 3D urban building models

Outcome 1: Collection of application case studies

Collection of case studies

Participants fill in a “case study template” available at https://github.com/ibpsa/project1/tree/master/wp_3_2_app

Template for description of application case studies – IBPSA Project 1 WP3.2

1. Title and authors

-Provide a title for the application case study

.....

-Name the authors that are responsible for the case study

Name/Institution/Country.....
Name/Institution/Country.....
.....

2. General Description:

-Formulate a general outline of the case study by including: objective, description of HVAC/district system and main results (if already available)

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3. Diagram and picture

-Include at least two pictures for your case study:

1. One diagram showing the layout of the HVAC/district system
2. One picture of Modelica model

4. Thermal zone modeling

-How many buildings have you modelled?

.....

-How many thermal zones per building have you modelled? How many in total?

.....

-What’s the complexity of the thermal zone model (Low order / High order)?

.....

-(only for district simulations) Are network and buildings coupled or decoupled?

☐ Coupled
☐ Decoupled

5. Modelica libraries and tools:

-Which Modelica library have you used? (Keep in mind that IBPSA library is for developers, not for users)

☐ AixLib
☐ Buildings
☐ BuildingSystems
☐ IDEAS

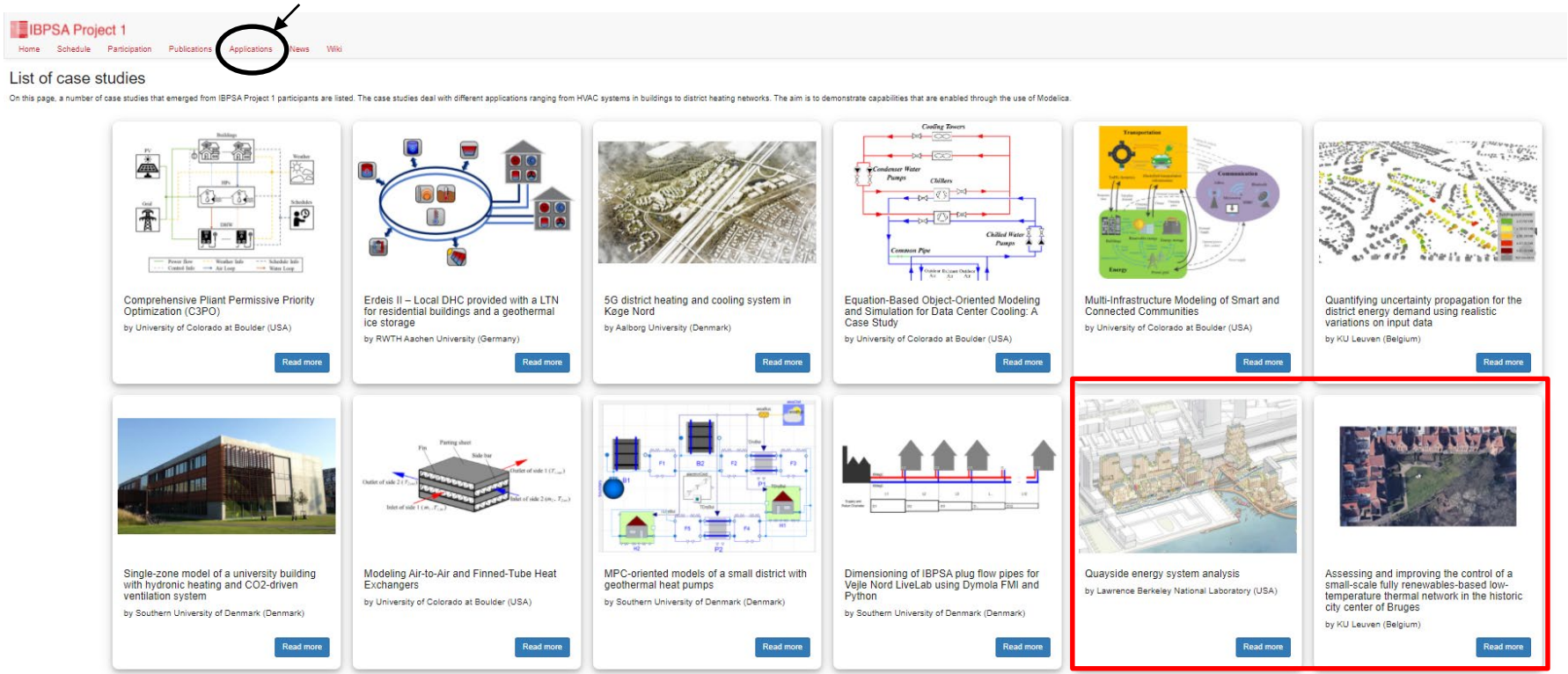
List of case studies

	Title	Institute	Scale	Status	
				Template received	Case study uploaded to website
1	MPC-oriented models of a small district with geothermal heat pumps	University of Southern Denmark	District	✓	✓
2	Single-zone model of a university building with hydronic heating and CO2-driven ventilation	University of Southern Denmark	Building	✓	✓
3	Dimensioning of IBPSA plug flow pipes for Vejle Nord LiveLab using Dymola FMI and Python	University of Southern Denmark	District	✓	✓
4	Multi-Infrastructure Modeling of Smart and Connected Communities	University of Colorado Boulder	District	✓	✓
5	Equation-Based Object-Oriented Modeling and Simulation for Data Center Cooling	University of Colorado Boulder	Building	✓	✓
6	Comprehensive Pliant Permissive Priority Optimization (C3PO)	University of Colorado Boulder	District	✓	✓
7	Modeling Air-to-Air and Finned-Tube Heat Exchangers	University of Colorado Boulder	Component	✓	✓
8	Feasibility study of DHC system in Køge (Denmark)	Aalborg University	District	✓	✓
9	Erdeis II – Local DHC provided with a LTN for residential buildings	RWTH Aachen	District	✓	✓
10	Quantifying uncertainty propagation for the district energy demand	KU Leuven	District	✓	✓
11	A zero-fossil-fuel energy concept in the historic city center of Bruges	KU Leuven	District	✓	✓
12	Quayside energy system analysis	LBNL	District	✓	✓

Recently added

https://ibpsa.github.io/project1/applications.html

Uploading case studies on IBPSA Project 1 website



Recently added

Outcome 2: Python-based tool for automatic generation of Modelica models from 3D urban building models

Development of BAGEL (**B**lender-based **A**utomated **G**enerator of **E**nergy **L**oads)

- Graphically create 3D urban building forms
- Assign building properties (e.g. U-values)
- Export Modelica models for calculation of heating and cooling loads

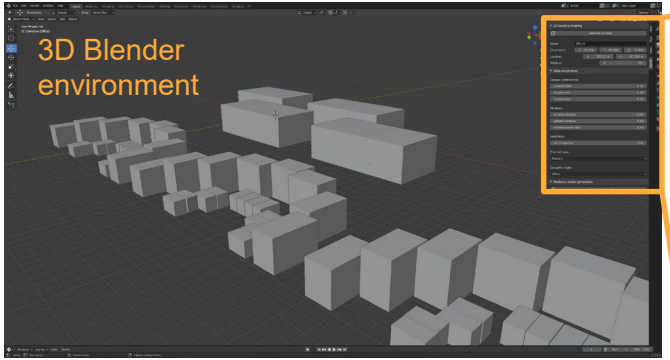
Blender

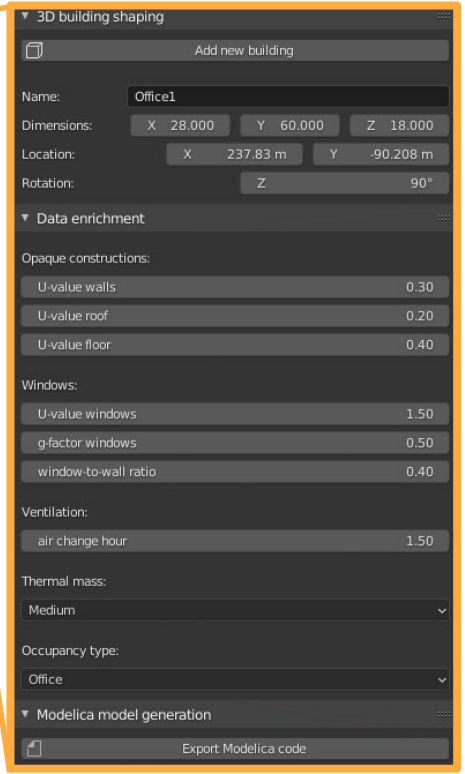
bagel
(add-on for Blender)

Modelica

What is Blender? 3D computer graphics modeling software
Why Blender? Free and open source / Blender Python API

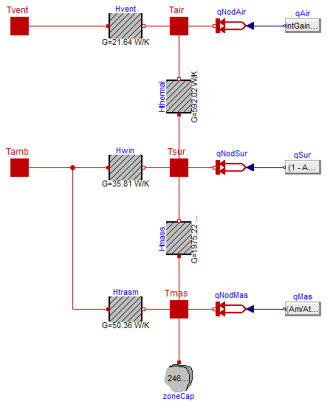
BAGEL (**B**lender-based **A**utomatic **G**enerator of **E**nergy **L**oads)





.mo file

5R1C thermal network

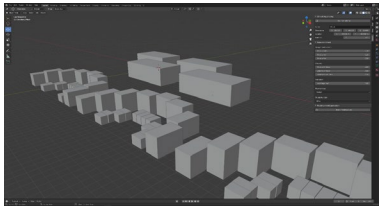


BAGEL – from toolchain to stand-alone tool

Towards an automated generator of urban building energy loads from 3D building models

Alessandro Maccarini[1] Michael Mans[2] Christian G. Sørensen[1] Alireza Afshari[1]

[1]Department of the Built Environment, Aalborg University, Denmark, amac@build.aau.dk
[2]Institute for Energy Efficient Buildings and Indoor Climate, RWTH Aachen University, Germany



bagel

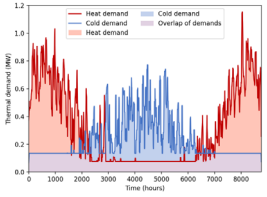
Export Modelica models

.mo file

Import Modelica models

OM

Run simulation



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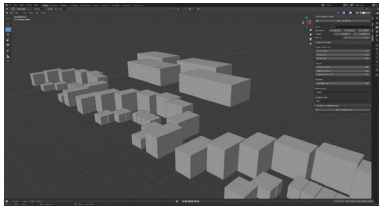

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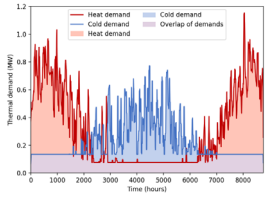

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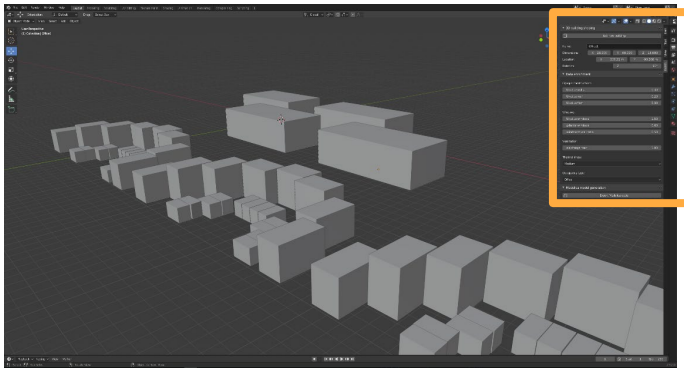

Run simulation

Visualize results

.exe file

bagel

BAGEL – from toolchain to stand-alone tool

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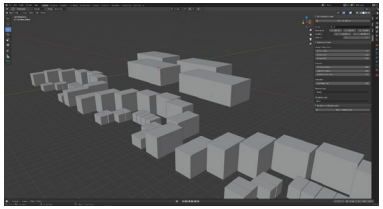

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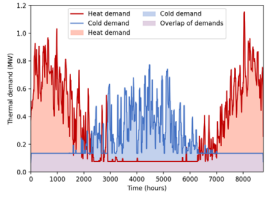

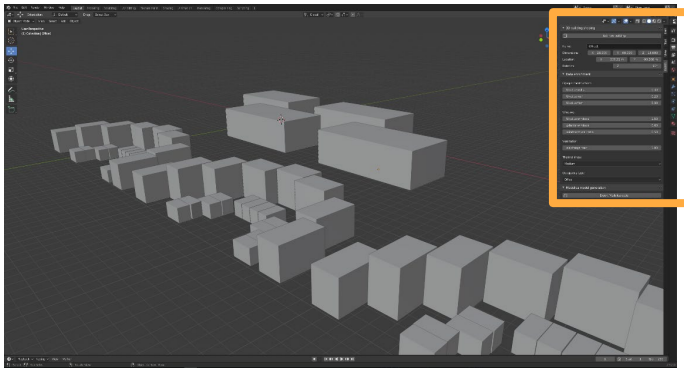

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bagel

OM

fmu

Breakout session

	Content - title	Presenter/Leader	time	comments
Session 1 (Day 1)			**50 min**	
WP3.1 DESTEST update	Current status	Dirk	5 min	Short update
	Update on CE buildings with focus on office building	Arash	20 min	
	Update on CE thermal neworks	Hicham	20 min	
	next steps + commitments	Dirk / Hicham	10 min	
Session 2 (Day 1)			**55 min**	
WP3.1 DESTEST Python Tool	Update on comparison tool	Hicham	25 min	Presentation of tool + discussion on KPI calculation
WP3.2 Application	Case study I - Demonstration project 'De Schipjes': a zero-fossil-fuel energy concept in the historic city center of Bruges	Jelger	15 min (10+5)	Alessandro moderates the session about case studies
	Case study II - Sidewalk Lab - Quayside Energy Systems Analysis	Jianjun	15 min (10+5)	
Session 3 (Day 2)	**Joint session with WP3.1**		**45 min**	
	Status of DESTEST emulator	Dirk		
	from BOPTEST to DOPTEST?			interest from the scientific community
	to be included in follow-up project?			