

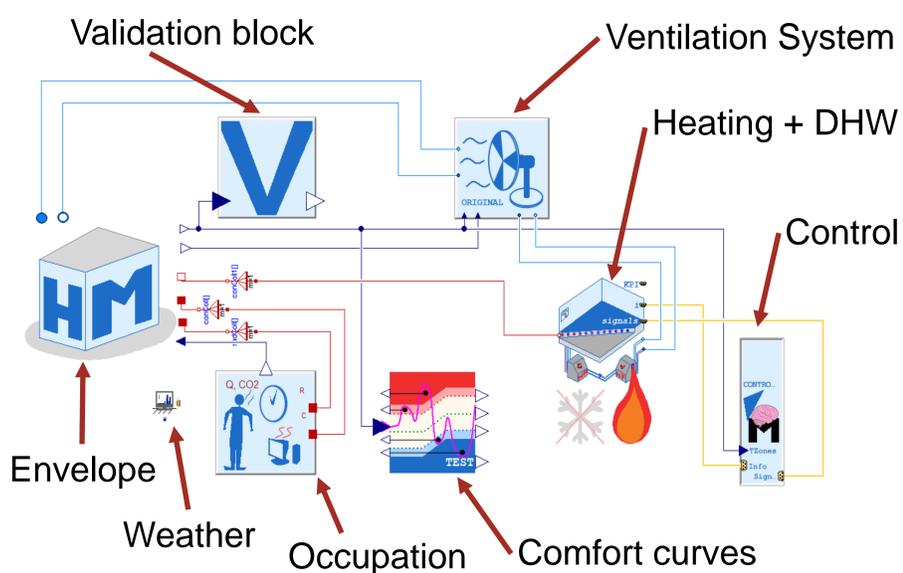
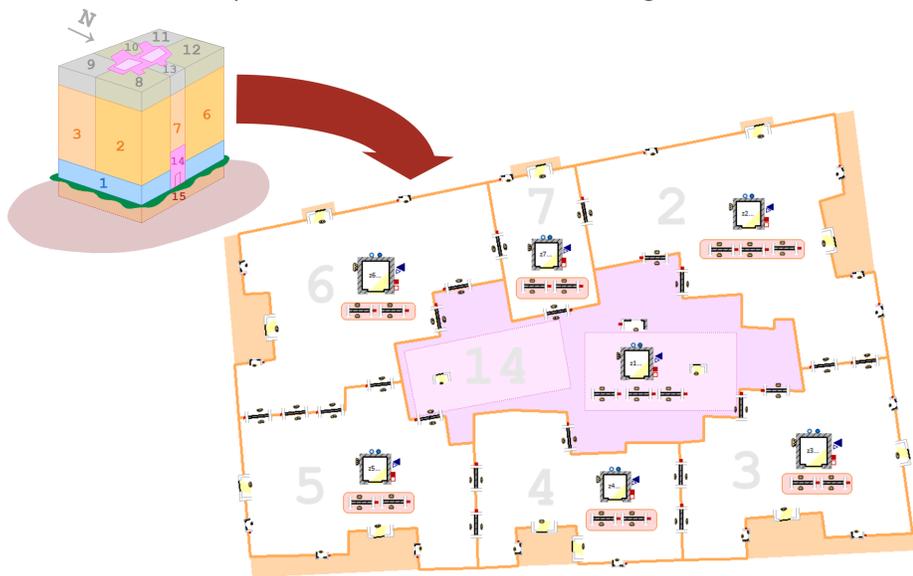
# Model and Validation of a Multi-family Building 'Haus M' Using Modelica

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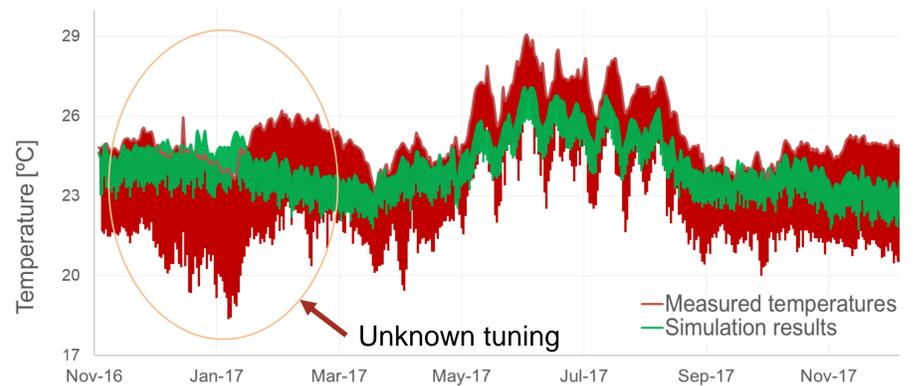
## The model

Haus M is a multi-family building composed of twenty-nine dwellings and a kindergarten. Its heating system is based on a ground source heat pump with horizontal heat exchanger and floor heating as emission system. The domestic hot water is produced by solar collectors and an air-source heat pump that extracts the energy from the air from the ventilation system, which consists in mechanical extraction at a fixed flow rate. The building and its energy systems have been modelled in Modelica considering a typical occupancy profile based on the habits of the tenants and questionnaires. The model uses components from IDEAS and Buildings libraries.



## Validation of the model

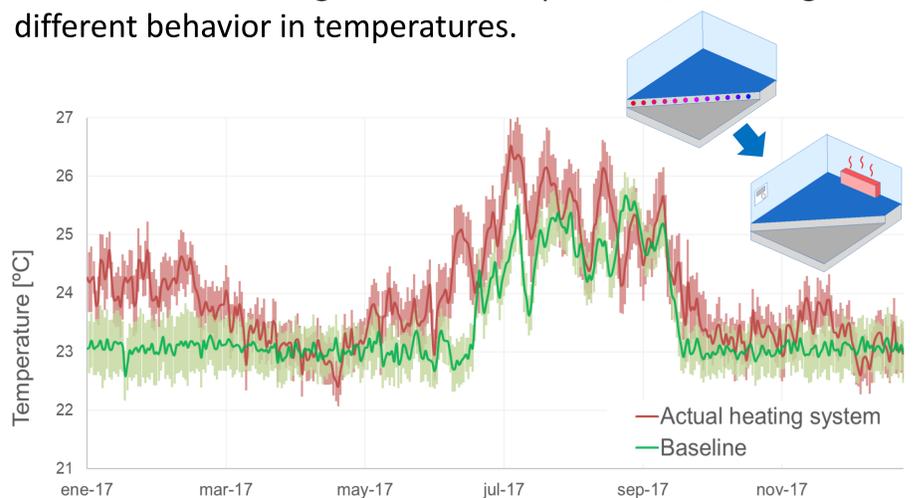
The available data for the validation of Haus M is limited. The compared parameters are the energy use for heating and the temperature of each dwelling and the kindergarten. The first period of the validation shows discrepancies caused by the tuning of the heating curve in the actual building. During that period, the parameters of the heating curve were unknown.



The energy use in the first period represents the 77% of the energy use in the actual building, but this value increases up to 85% in the last periods when the heating curve is known.

## Baseline heating system

A baseline heating system, composed by a natural gas boiler and radiators as emission system, was included substituting the original heating system. In the baseline, the control is based in the average indoor temperature, which gives a different behavior in temperatures.



The annual energy for heating is 2% lower in the baseline, while the provided energy (natural gas and electricity for the gas boiler and electricity for the actual system) in the baseline is 4.2 times the energy in the actual system.

## hybridGEOTABS project

The model of 'Haus M' is part of project hybridGEOTABS. The challenge of the project is to demonstrate the performance of the hybridGEOTABS system and develop a design methodology and MPC-solution. The final objective is to probe the efficiency of GEOTABS and to improve and promote that technology in the industry and in the society.

## References

IDEAS library: [github.com/open-ideas/IDEAS](https://github.com/open-ideas/IDEAS)

Buildings library: [github.com/lbl-srg/modelica-buildings](https://github.com/lbl-srg/modelica-buildings)

hybridGEOTABS: <http://www.hybridgeotabs.eu>