EnergyVille

Towards an IFC-Modelica tool facilitating model complexity selection for building energy simulation

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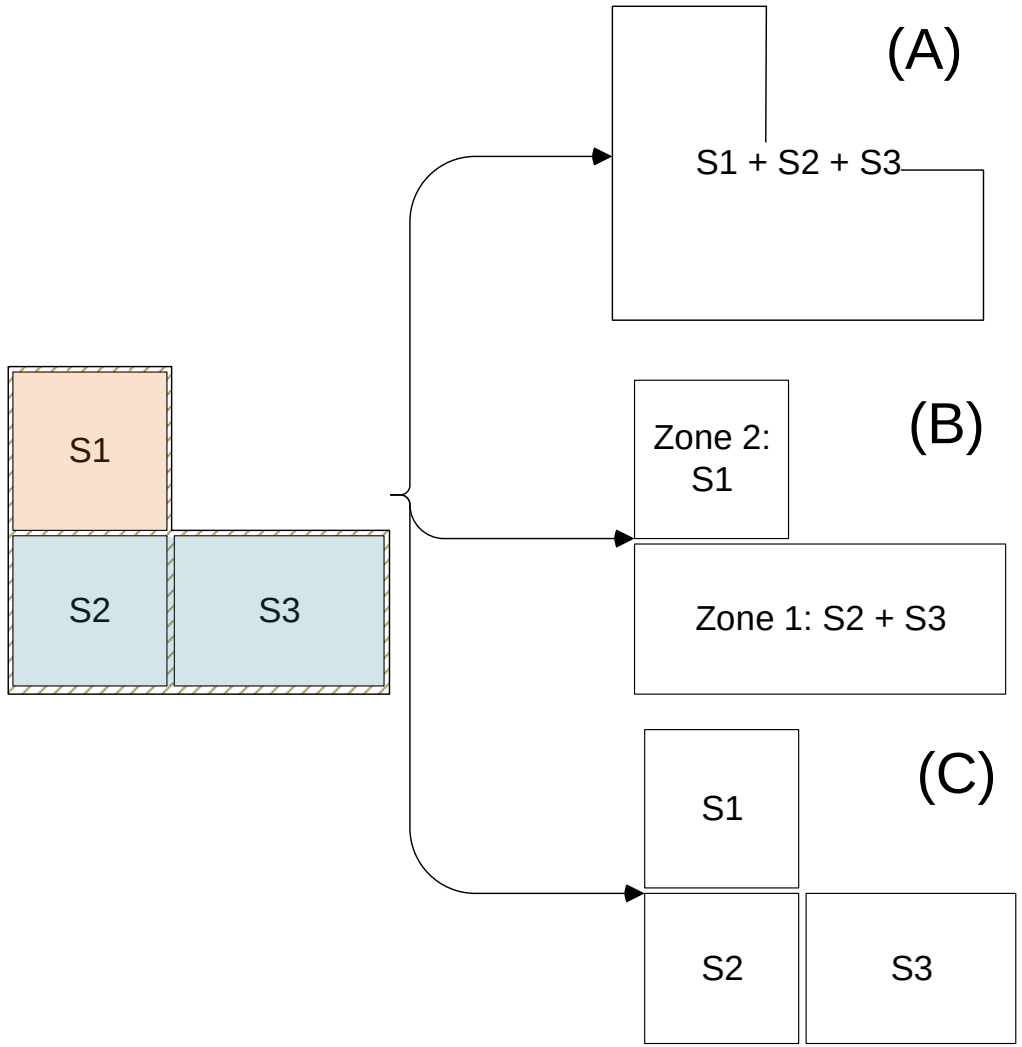
Context: Building Information Model to Building Energy Simulation (BIM to BES)

BIM software and formats

Building energy simulation tools

Gap: Level Of Complexity (LOC)



Possible Levels of Complexity (LOC) of a Building Energy Simulation model.

(A) *simplified configuration focusing on the building envelop,*

(B) *HVAC zones modelled separately, can be used for HVAC design,*

(C) *detailed model to assess the building performance at the detailed design.*

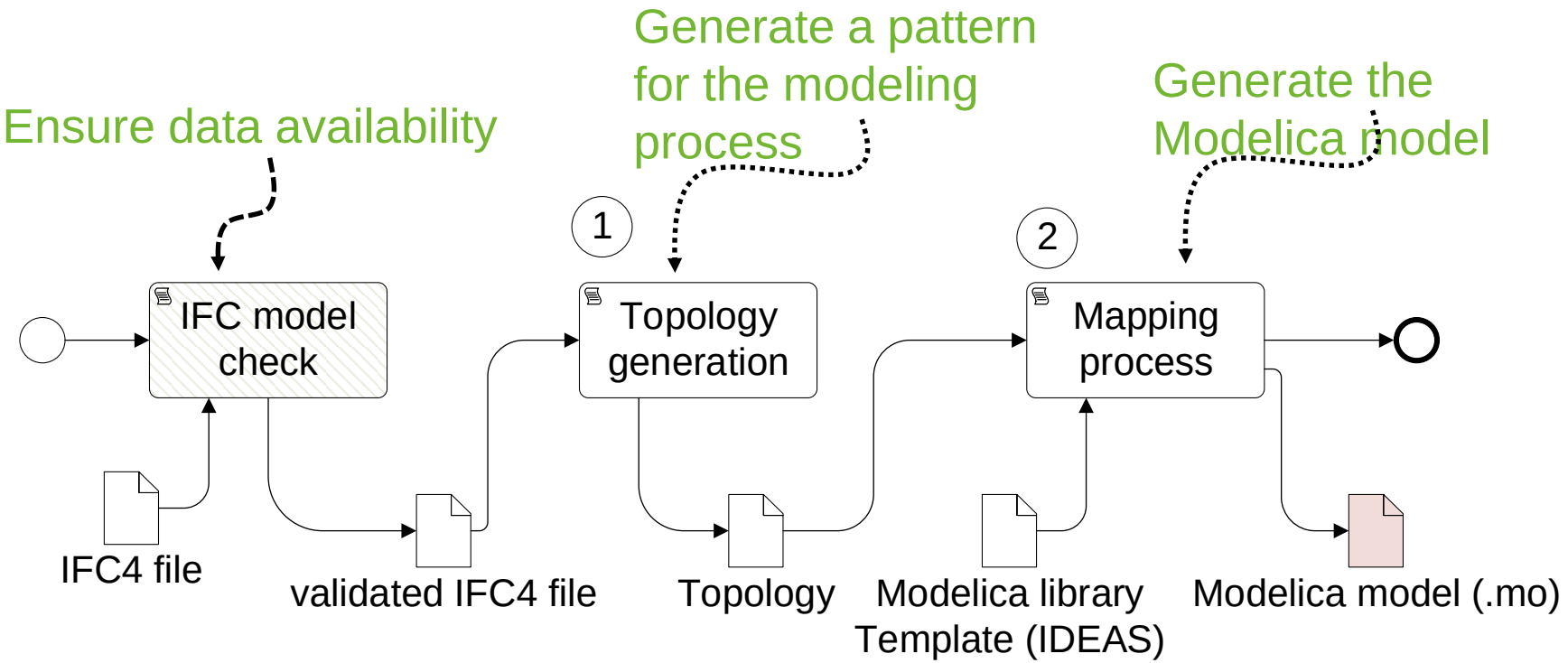
Goals:

- Improve the existing IFC to Modelica, BIM to BES methodology (*Ifc2Modelica [1]*) to generate four levels of complexity.

- Apply the toolchain on a real life case study (IEA EBC Annex 58 Fraunhofer IBP TwinHouse case).

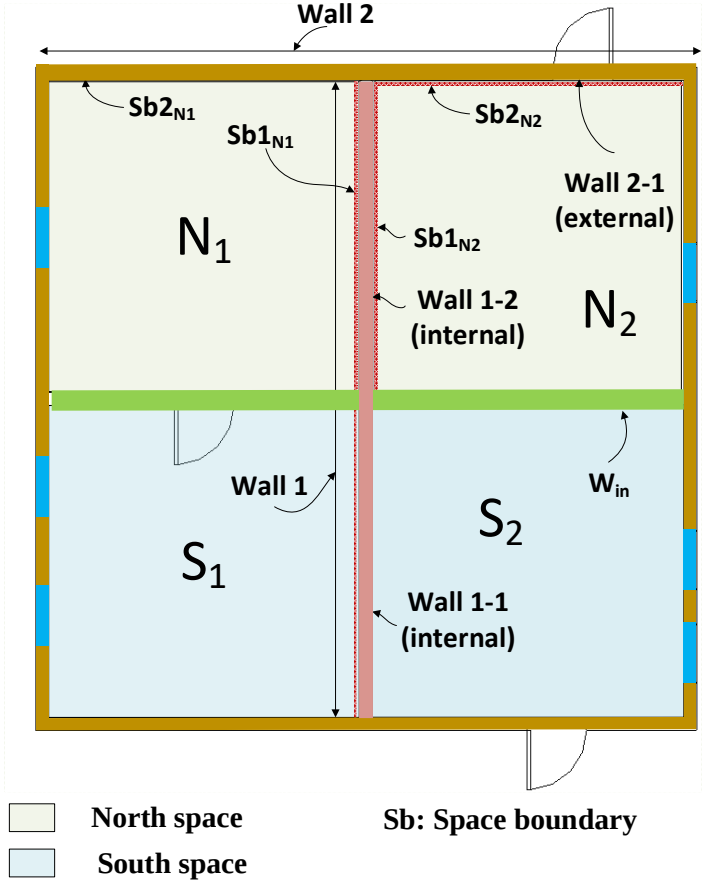
[1] Andriamamonjy, A., Klein, R. & Saelens, D. (2016). IFC-assisted building energy performance simulation implementation. Development of a python package. In: *Proceedings of the 3rd IBPSA-England Conference, Newcastle, 12th-14th September 2016, 1094*. 2016.

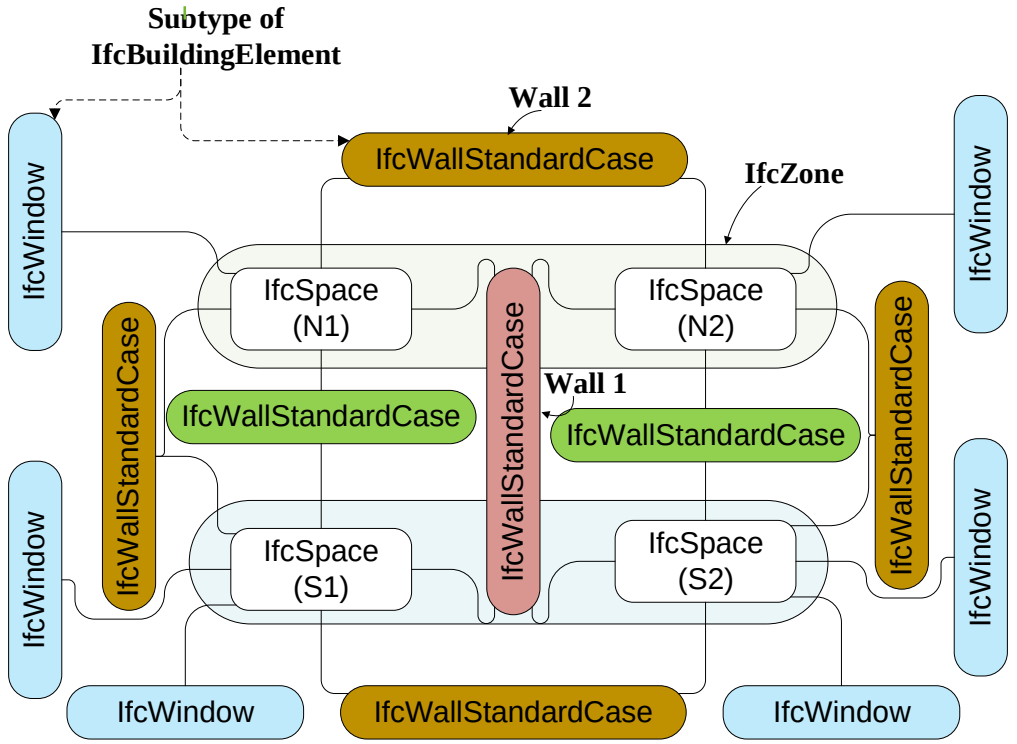
Methodology: A summary of *Ifc2Modelica*



Modelica model generation process with Ifc2Modelica

Methodology: Topology generation

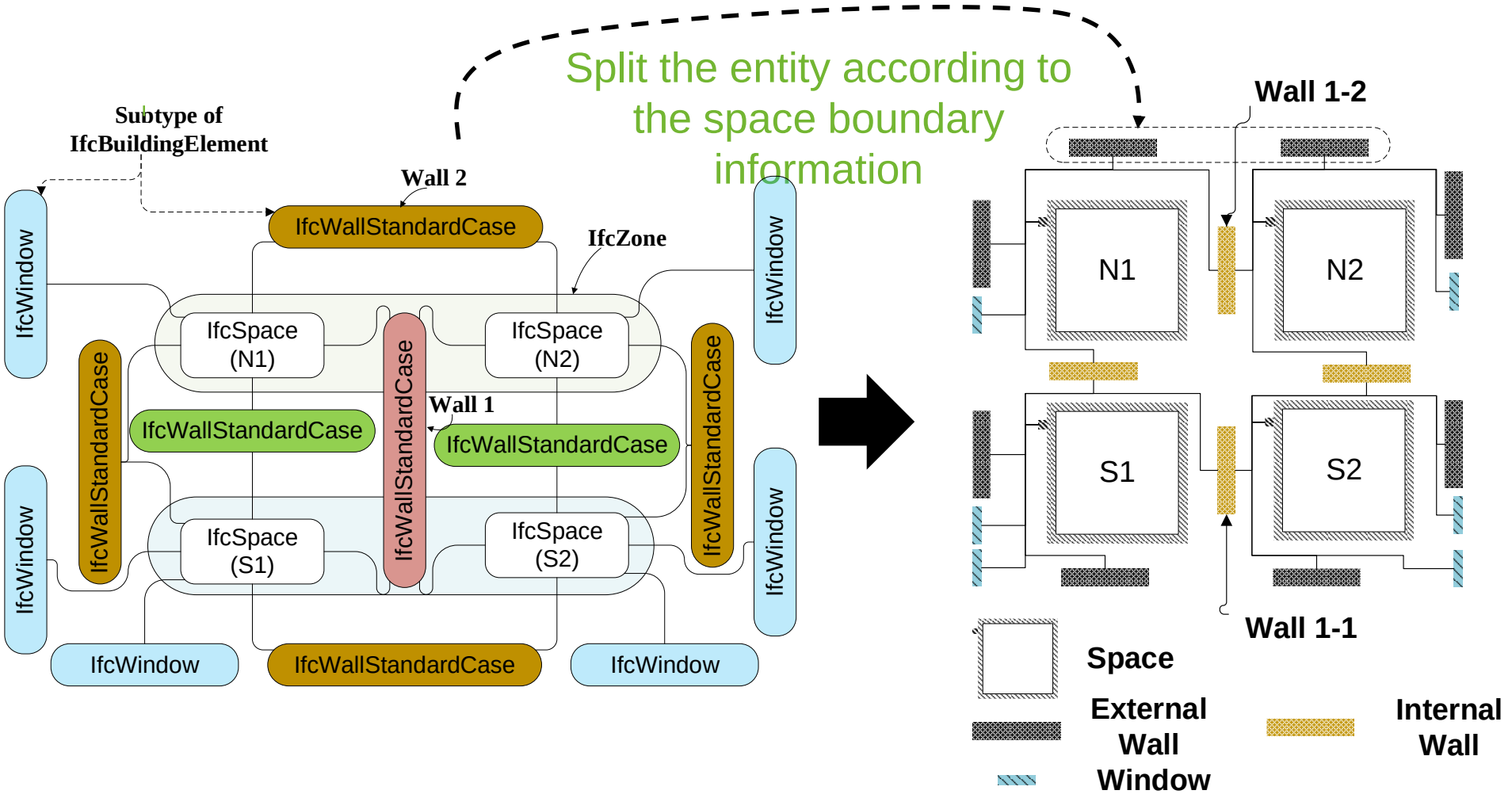




Four spaces, two zones example case

IFC structure of the example model

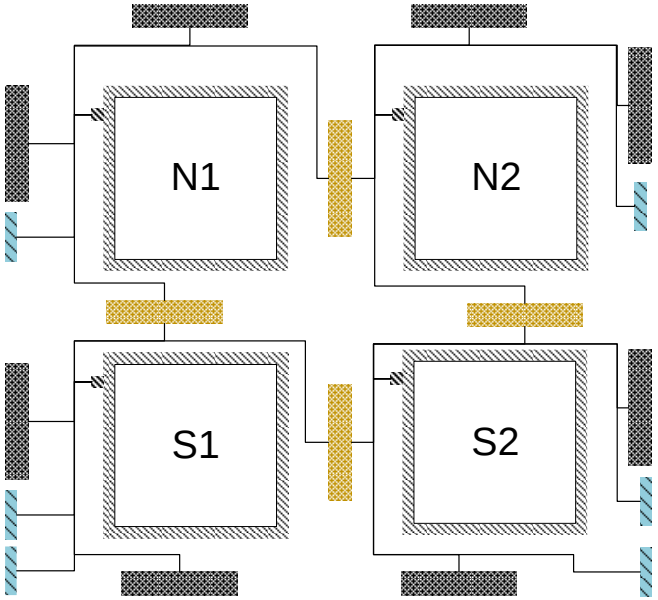
Methodology: Topology generation



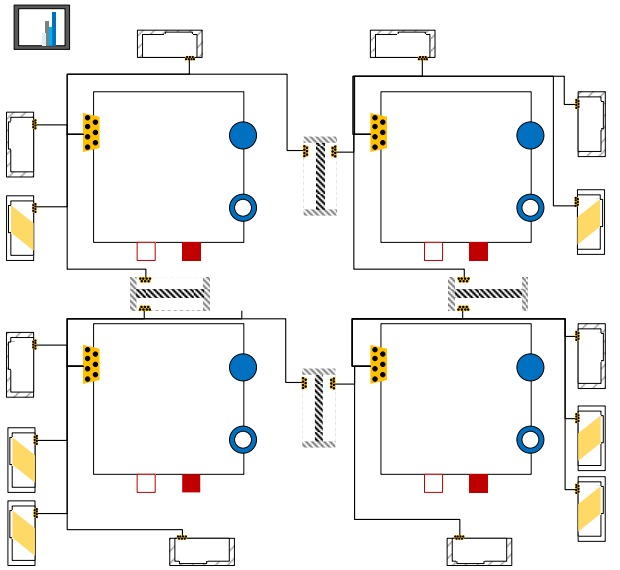
IFC structure of the example model

Generated PYTHON based topology

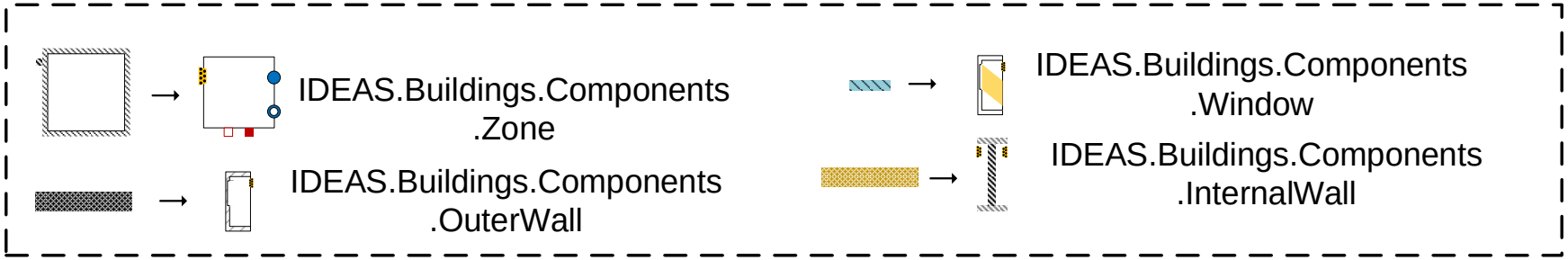
Methodology: Mapping process



Topology

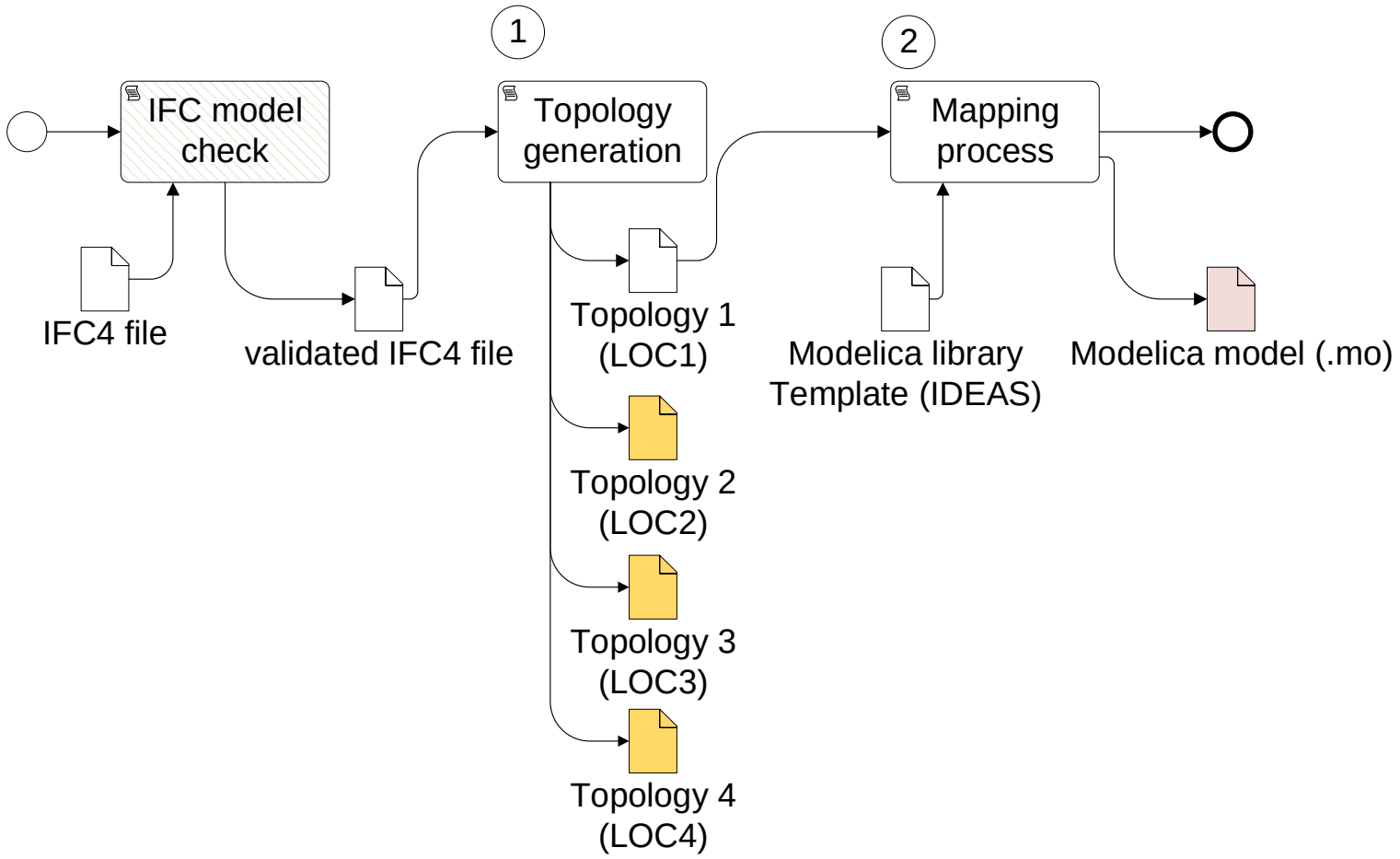


Generated IDEAS Modelica model



Library template

Methodology: Levels of complexity (LOC) generation

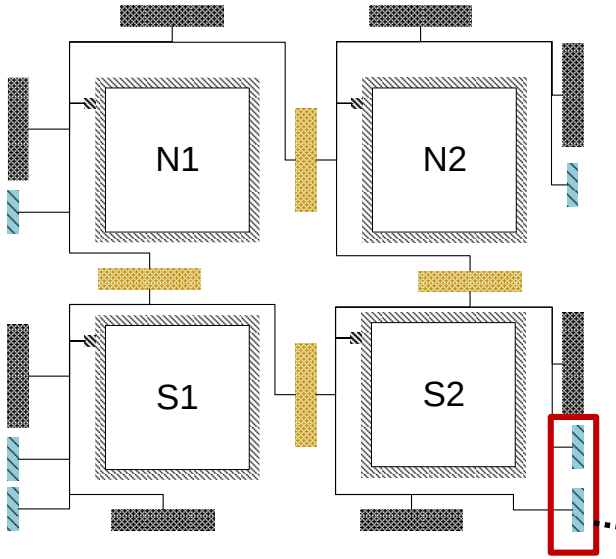


Modelica model generation process with Ifc2Modelica

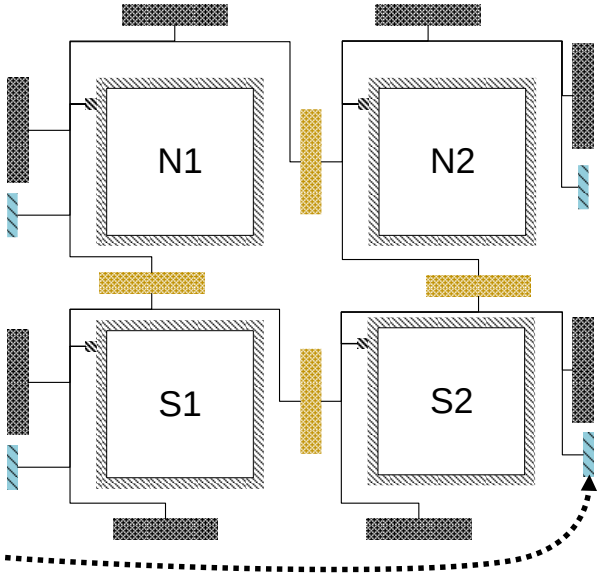
Methodology: Levels of complexity (LOC) generation

LOC 1 and LOC2

LOC 1:



LOC 2:



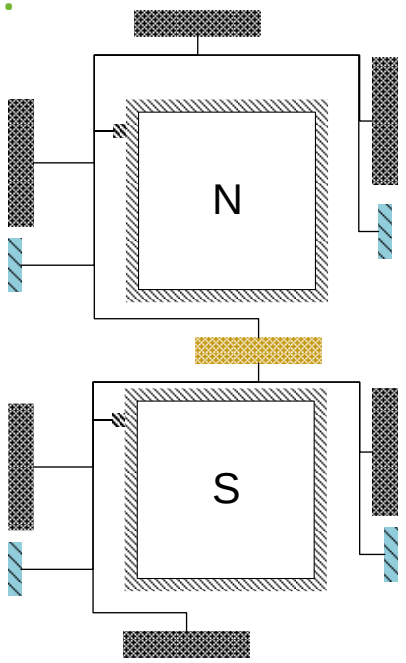
***LOC1**: Normal topology generated by Ifc2Modelica (Example of use: final building design assessment)*

***LOC2**: LOC1 + entities related to the same space having the same type, characteristics and azimuth are merged. The characteristics are lumped and associated to the merged component*

Methodology: Levels of complexity (LOC) generation

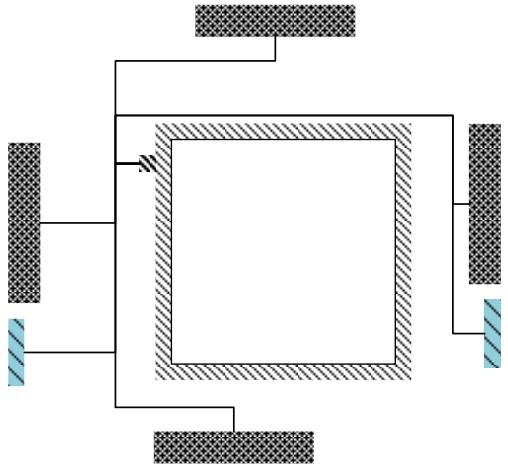
LOC 3 and LOC4

LOC 3:



***LOC3**: LOC2 + Space (IfcSpace) related to the same zone (IfcZone) are merged into one zone. (Example of use: Zoning process during the HVAC design)*

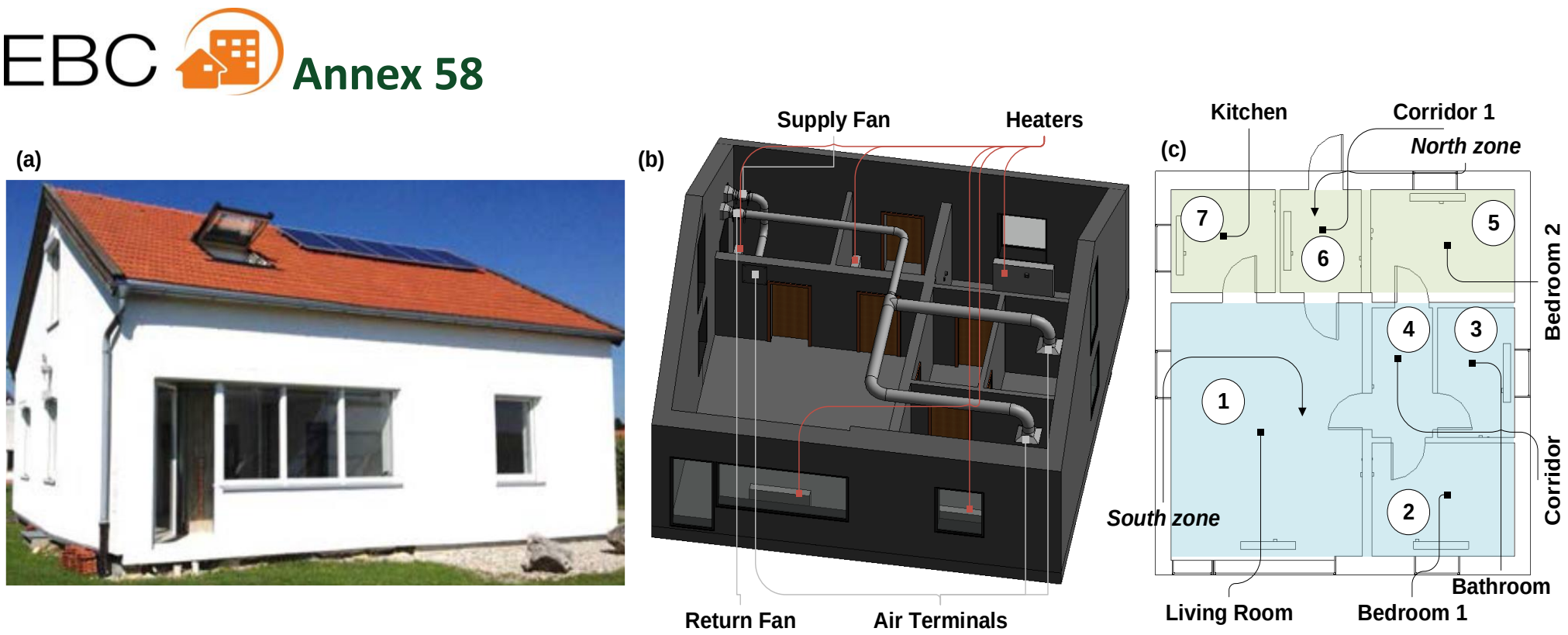
LOC 4:



***LOC4**: LOC3 + Spaces (IfcSpace) on the same floor are merged into an unique zone. (Example of use: Assess the average performance of the building envelop)*

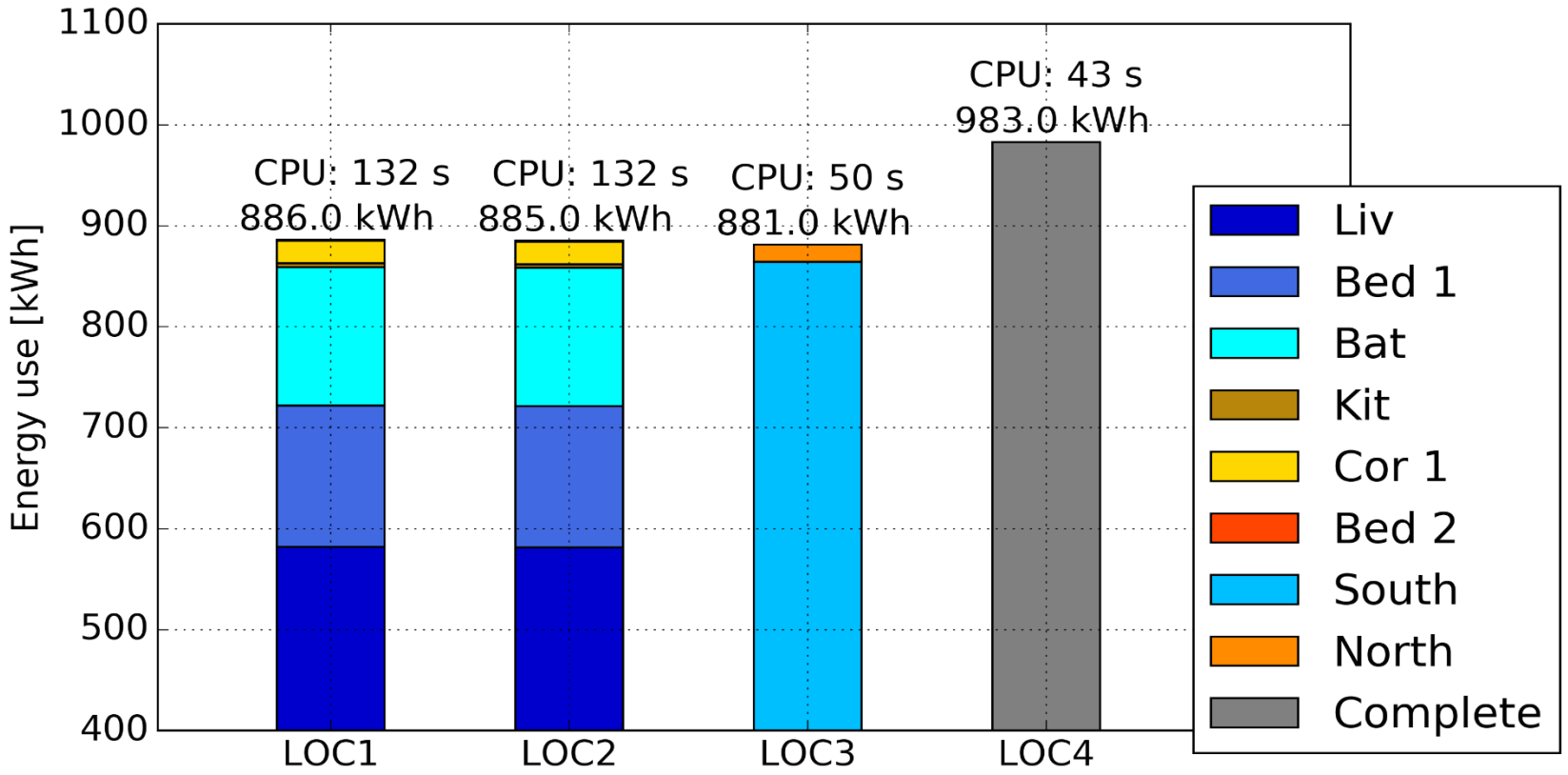
Application: Case study, Fraunhofer IBP TwinHouse

EBC Annex 58



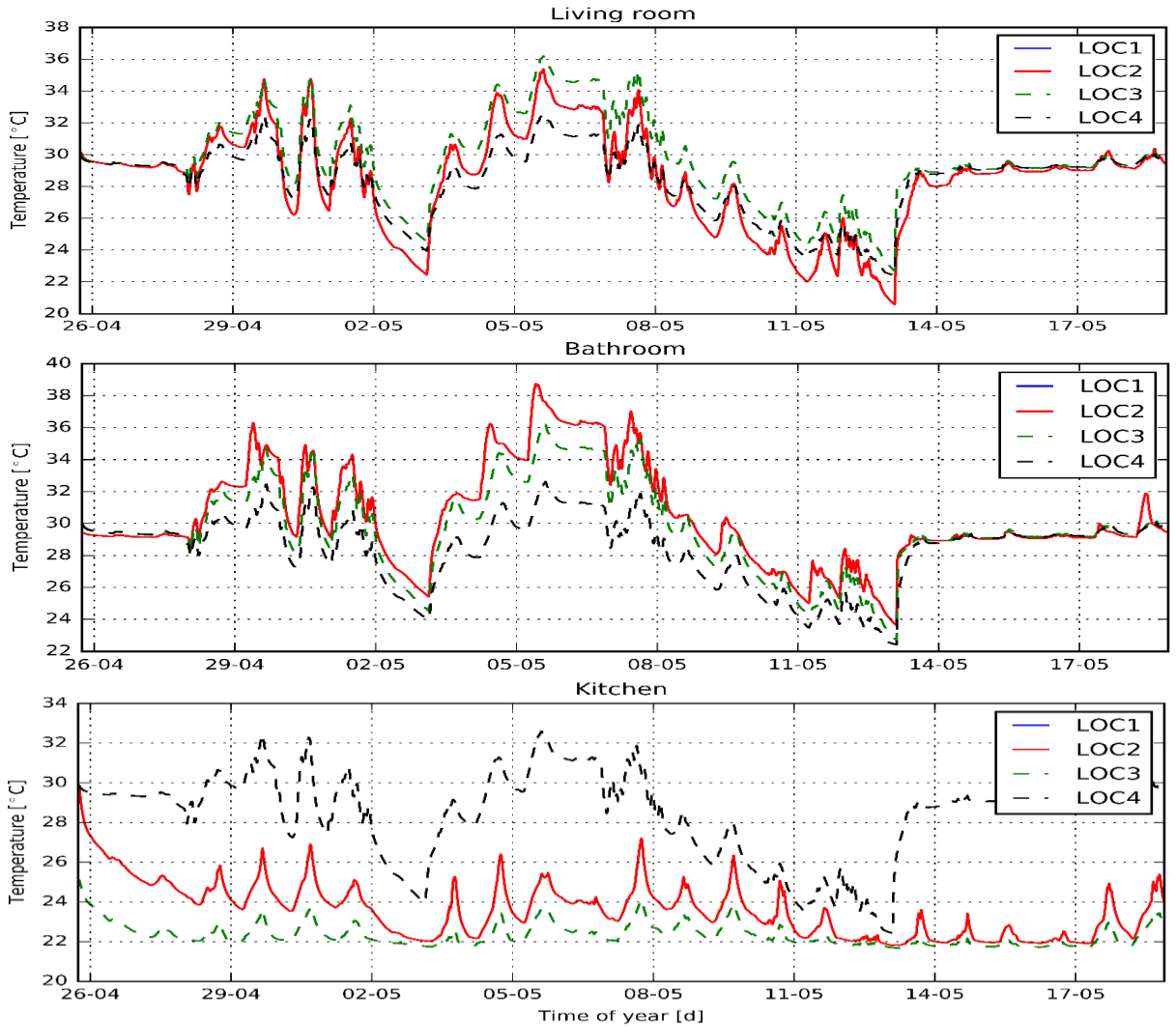
Test case located in Holzkirchen, Germany. (a) Actual building, (b): BIM model of the test facility and representation of the HVAC equipment involved during the experiment. (c): Space and zone partition

Application: Results (Energy use and simulation time)



Comparison of the total energy use for heating and simulation time for the different levels of complexity

Application: Results (Temperature profile)



Indoor temperature profiles for the living room, bathroom and kitchen obtained for the different levels of complexity (LOC1-LOC4)

Conclusions

- IFC2Modelica is a successful Python implementation of a (semi)automated BIM2SIM approach using IFC2x4
- IFC2Modelica allows to extract models with different levels of complexity from a BIM model
- The application was tested on the Annex58 Twin House experiment to show the influence on the simulation time and the accuracy of the results