

IBPSA Project 1

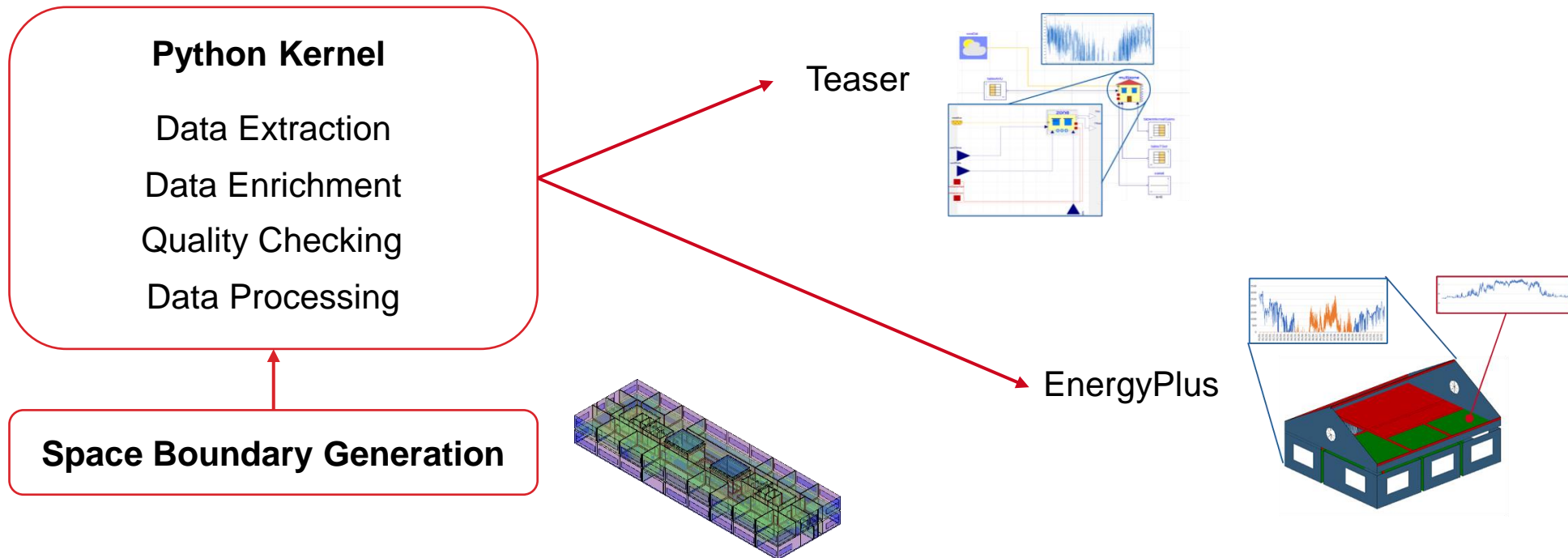
International Building Performance Simulation Association

Work Package 2.2 - Building Information Modeling (BIM)

Web Meeting, 07 May 2021

Goal

- Development of basic methods and tools to derive building simulation models, starting from a digital building information model (IFC4)
- Development of two main components: 1) Python Kernel as simulation preprocessor
2) C++ Space Boundary Generator
- To complete tool chain, usage of existing tools, e.g., IfcCheckingTool



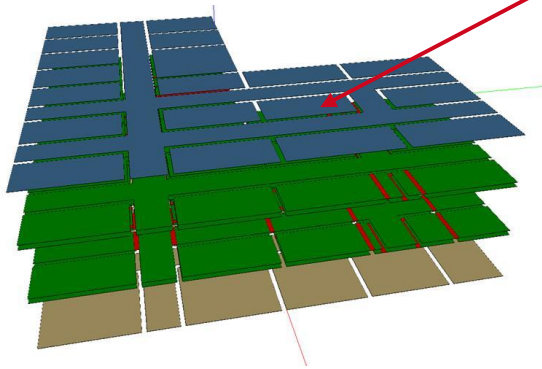
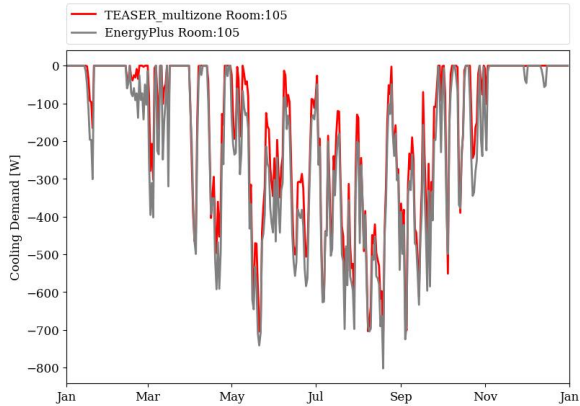
Progress in last half year



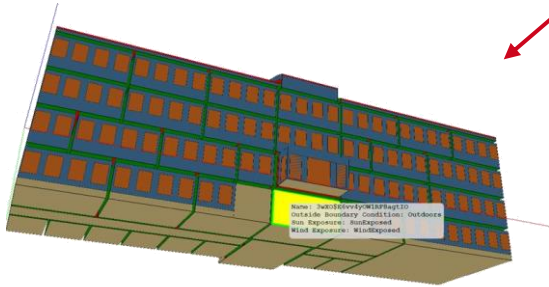
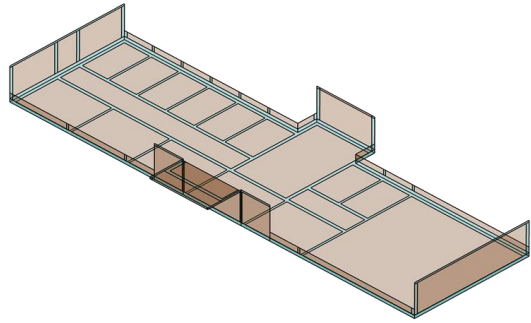
Progress in last half year

Progress in several subprocesses of the kernel, e.g.

- Restruction of kernel code to improve readability, modularization and performance
- Improvements in catching IFC-Enumeration types for various objects
- Improvement of data enrichment (e.g. simplification of required user input)
- Usage of space boundaries in TEASER preprocessing
- Verification of generated simulation models
- Intense testing of multiple use case files
- Improved geometric handling of IFC space boundaries in the kernel (e.g. inner loops in slabs)



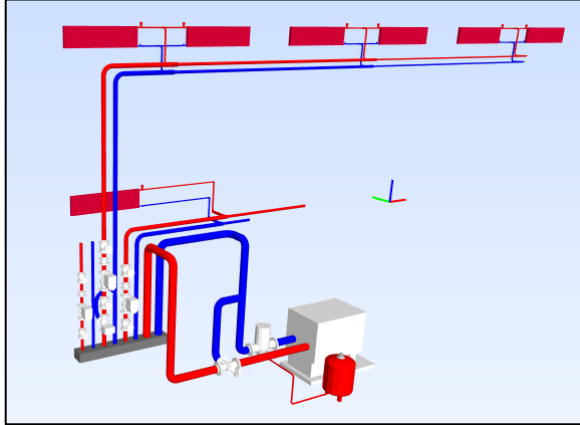
Progress in last half year



Progress in several subprocesses of the space boundary generation, e.g.

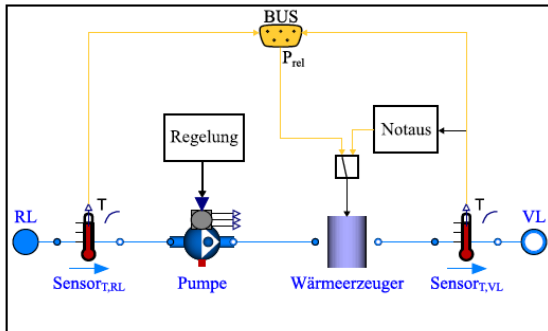
- Intense testing of multiple use case files
- Increasing performance of space boundary generation
- Extension of attribution for generated space boundaries (IFC4 enumerations as „corresponding“ and „parent“ boundaries)
- Usage of provided IFC4 enumerations in Kernel preprocessing
- Export of first and second level space boundaries with new IFC4 types
- Simplification of agglomerated building elements

Progress in last half year



Progress in HVAC

- Further methods in recognition and aggregation of HVAC systems in IFC
 - Expansion tank identification
 - Dead end identification
 - Generator aggregation
 - Consumer aggregation



- Development of module based heat generators in modelica which are not manufacturer dependent
- Based on preprocessed SDF tables to reduce computational effort and cover large range of devices

Toolchain Example

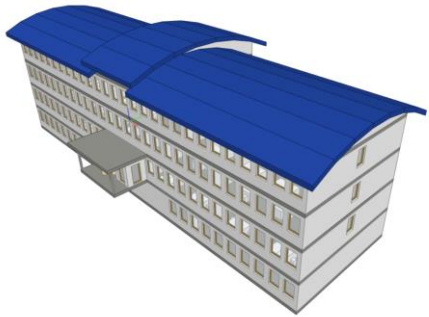
Toolchain Example – Data Requirements

Space boundary generation

- Architectural IFC4 model in Design Transfer View
- Gaps allowed to some extent
- (Spaces)

Preprocessing Kernel

- IFC4
- Geometric representation (mandatory)
- Correct property sets and layer structure (optional)
- IfcSpaces
- Space Boundaries (2nd Level)



Current state

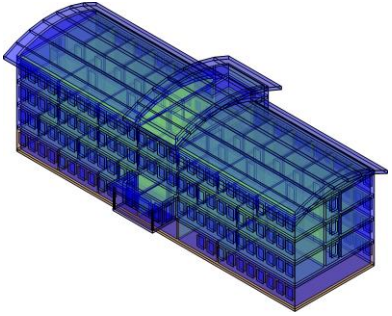
- Space boundary generation relies on few requirements
- Kernel handles IFC4 space boundary data

Further development

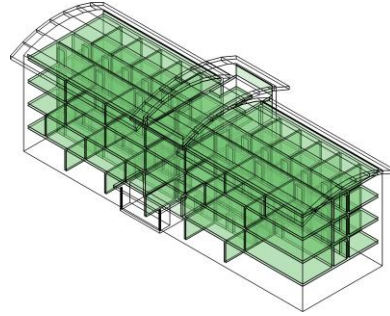
- Space boundary generation could include heuristics to decrease requirement level

Toolchain Example – Space Boundary Generation

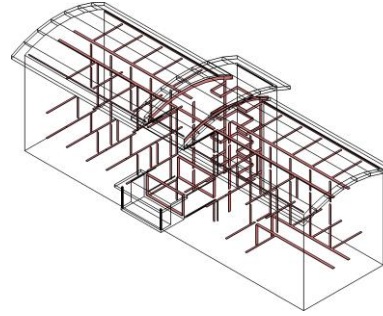
First level



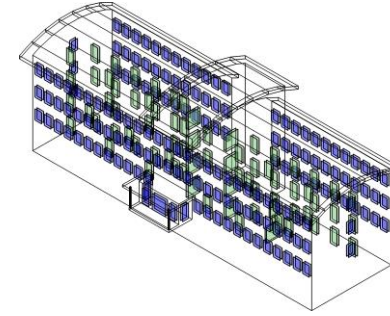
Second level



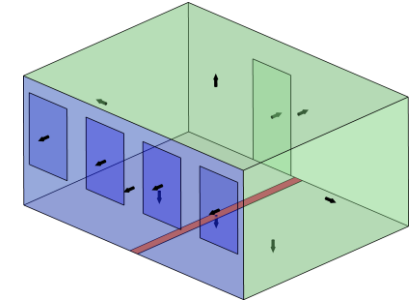
Internal 2a



Internal 2b

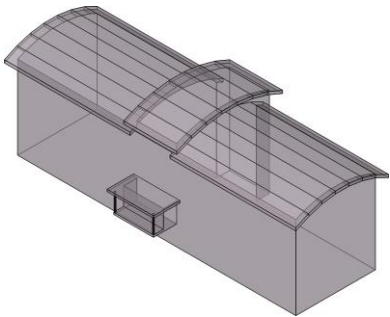


Boundaries with parents

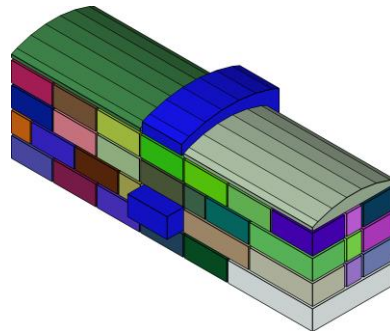


Related to space

Product level



External spatial element



Spaces

Current state

- All IFC4 space boundary classes and attributes supported
- Successful generation tested for multiple use case files
- Modular approach allows extension

Further development

- Ensure robustness
- Enhance performance
- Further testing with other use case files
- Allow virtual boundaries using space geometry information

Toolchain Example – Simulation Preprocessing

Load IFC

Inspection

Inspect IFC

Inspect Thermal Zones

Verification and Enrichment

Use Conditions

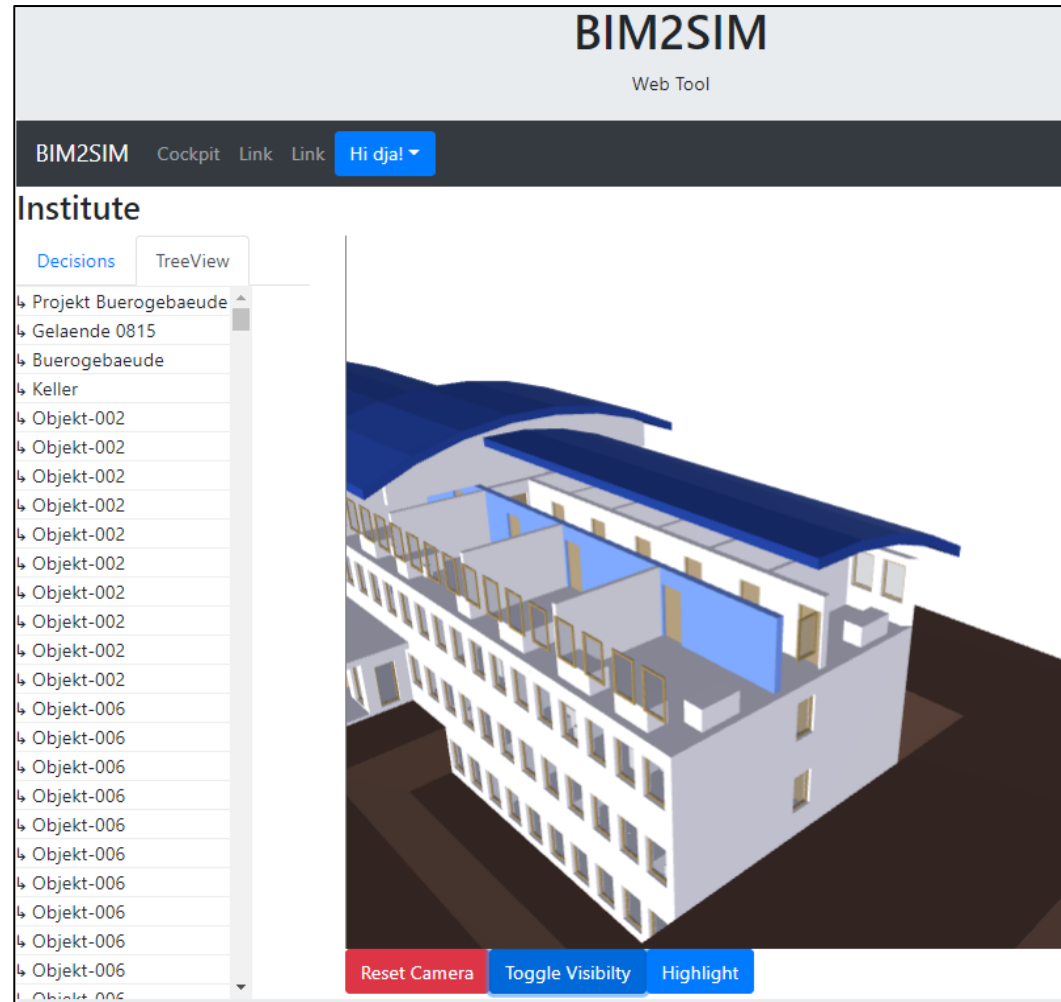
Material

Building

Finalization

Dissaggreagte building
elements

Aggregate thermal
zones



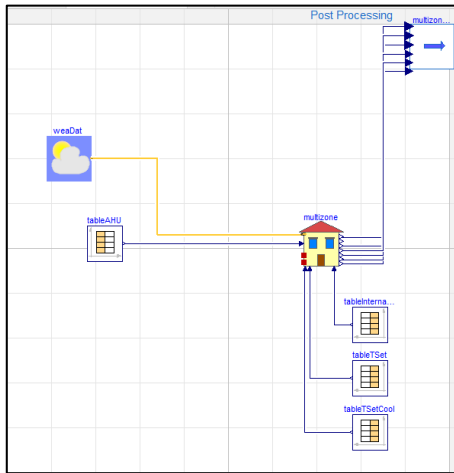
Current state

- Modular preprocessing and data enrichment

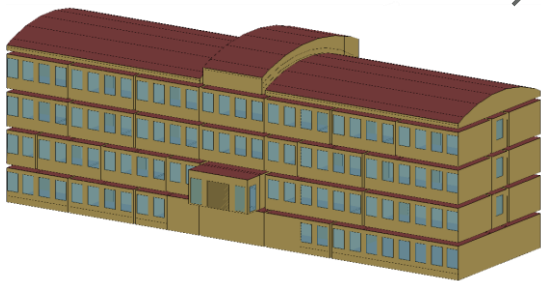
Further development

- Improve robustness + performance
- Further testing with other use case files
- Consider virtual space boundaries
- Usage of all IFC4 Space Boundary attributes if provided

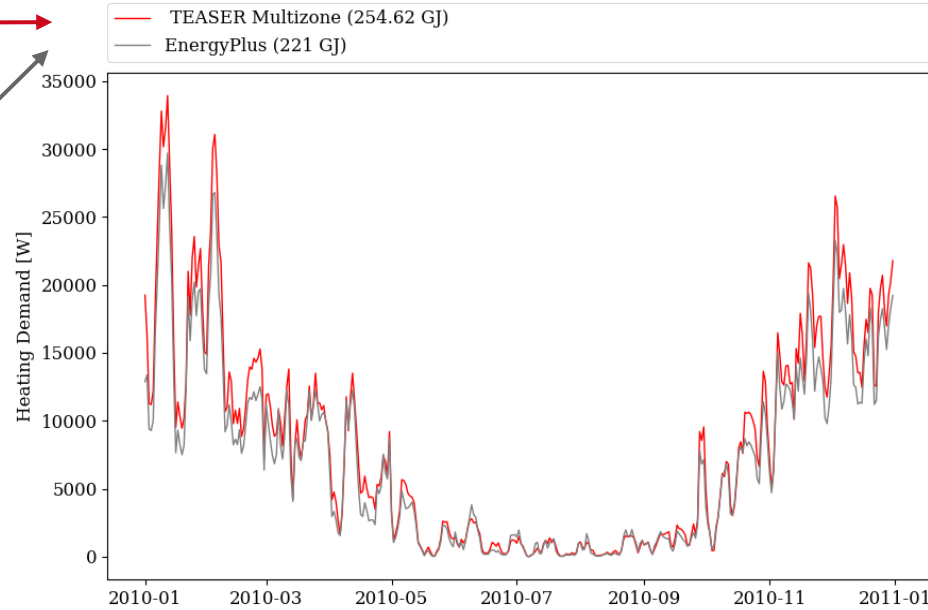
Toolchain Example – Model Export and Simulation



TEASER Simulation Model



Energyplus Simulation Model



Current state

- Successful generation tested for multiple use case files
- epJSON Export

Further development

- Ensure robustness
- Enhance performance
- Further testing with other use case files
- Consider Virtual Space Boundaries
- Shadings

Goal for autumn meeting 2021

- Space Boundary generation algorithm ready for more building files
- Rework kernel structure to clearly separate IfcRelatedElements and IfcProducts
- Consider all provided IFC4 Space Boundary attributes in TEASER and EnergyPlus workflows
- Make python code accessible
- Inspection of multiple different building types to verify and enhance toolchain
- Full integrated export of AixLib modelica in HVAC toolchain working for demo cases
- WebUI fully functional