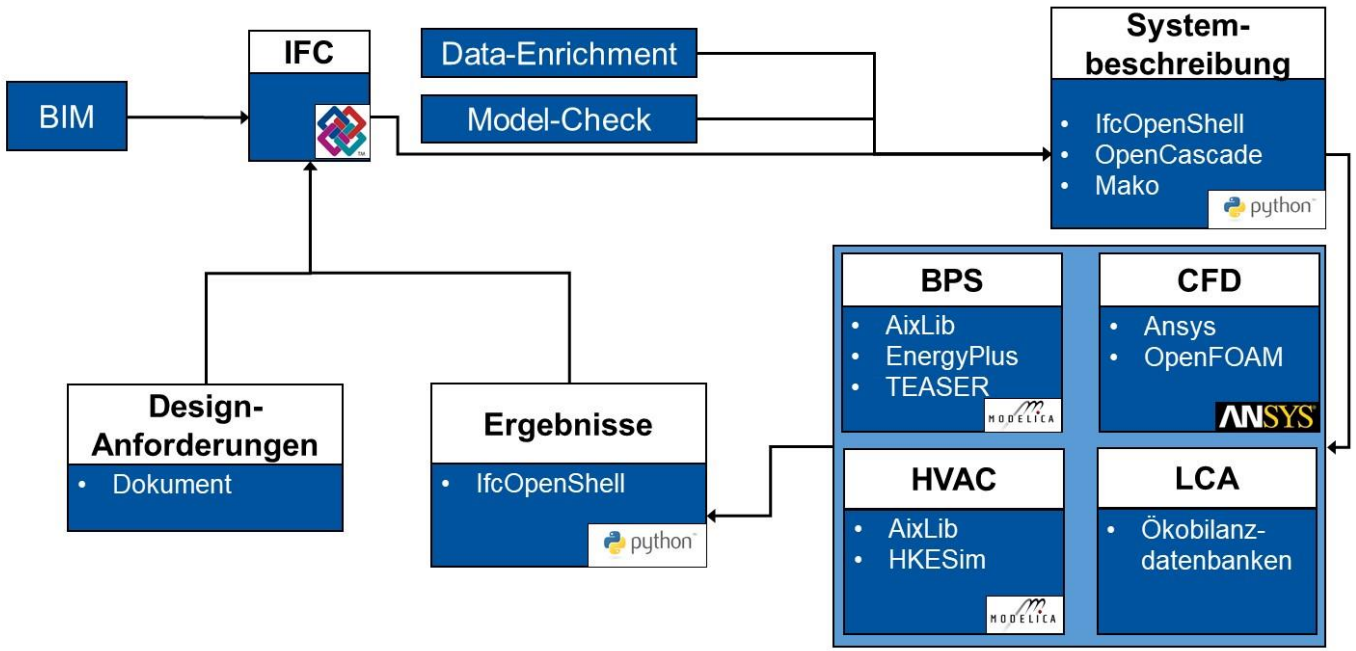
IBPSA Project 1

International Building Performance Simulation Association

Work Package 2.2 - Building Information Modeling (BIM)

Web Meeting, 13 and 14 October 2020

BIM2SIM Workflow



BIM2SIM

Method development for the generation of simulation models from building information modeling data. Subproject: Development of methodology, process chains and interfaces

RWTH Aachen University
Funding Code: 03ET1562A

RWTH AACHEN UNIVERSITY

RoM Rud. Otto Meyer Technik

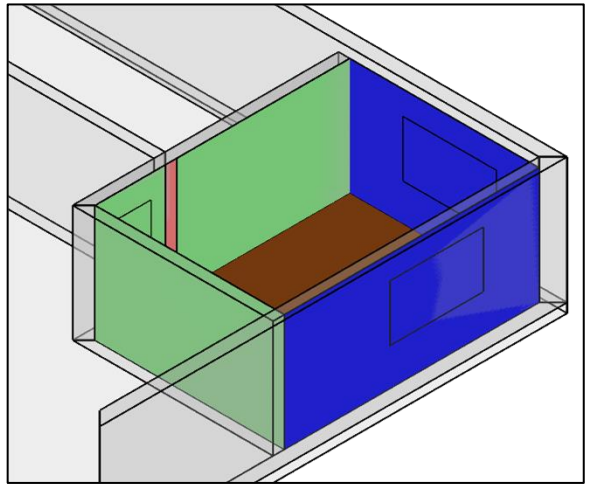
Info: https://www.e3d.rwth-aachen.de/cms/E3D/Forschung/Projekte/~rdrk/Bim2Sim/?lidx=1

Current Approach in SB Generation

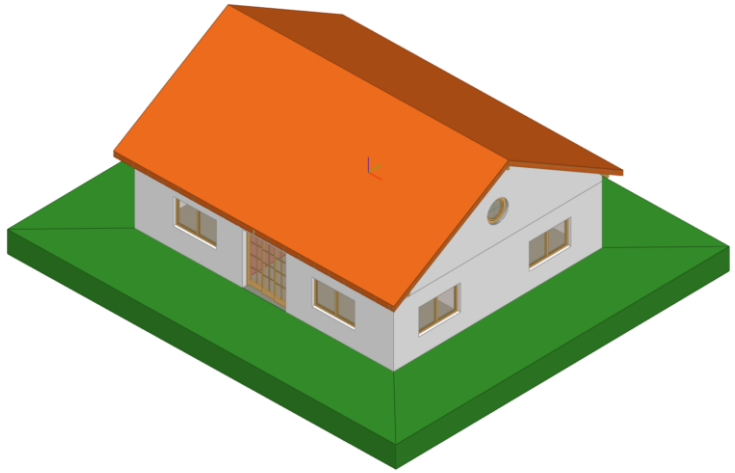
Assumptions

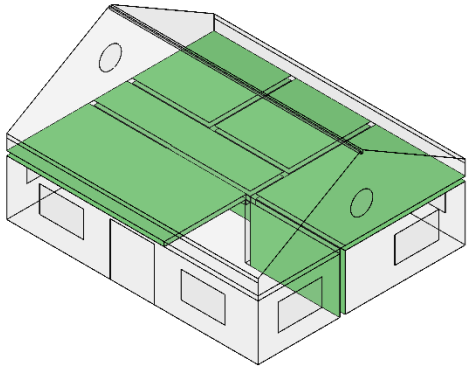
- Included IfcBuildingElements (IfcBeam, IfcWall, IfcSlab, IfcRoof, IfcColumn, IfcWindow, IfcDoor)
- Not included IfcBuildingElements (IfcBuildingElementProxy, IfcStair, IfcRamp, IfcRailing, IfcShadingDevice, …)
- IfcCurtainWall not considered yet, but inclusion planned
- IFC Import and export to Ifc2x3 and Ifc4
- IfcSpaces not considered yet, will be used to get *virtual* SB in future

- **IfcSpaces** and **IfcRelSpaceBoundaries** are created by the algorithm

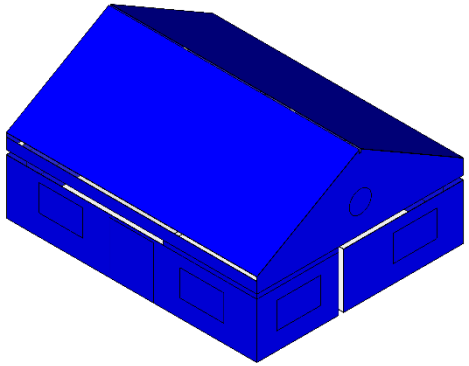


Example Result 1 – FZK Haus

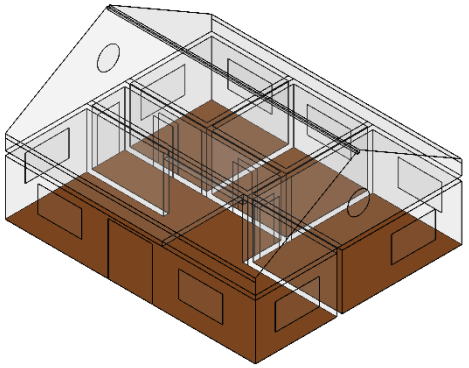




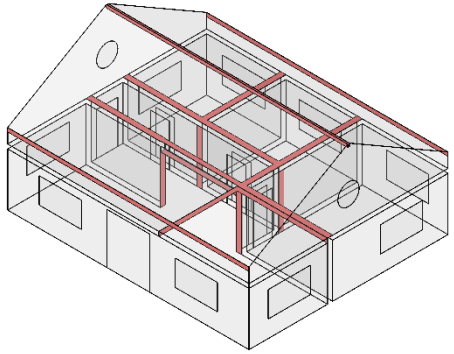
2a, internal



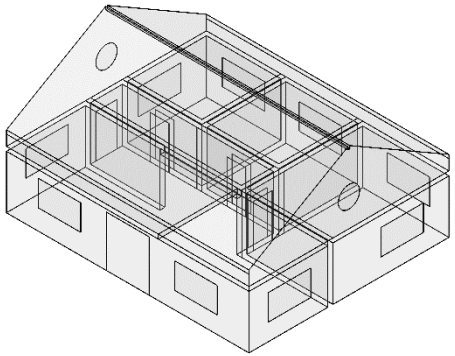
2a, external



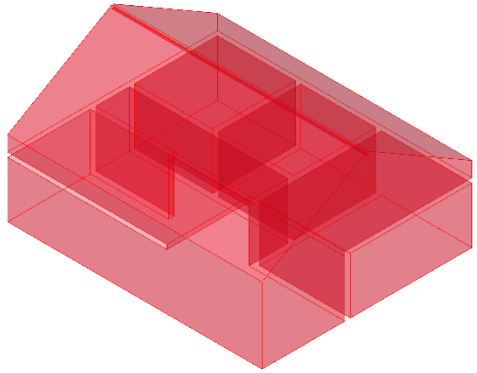
2a, external_earth



2b

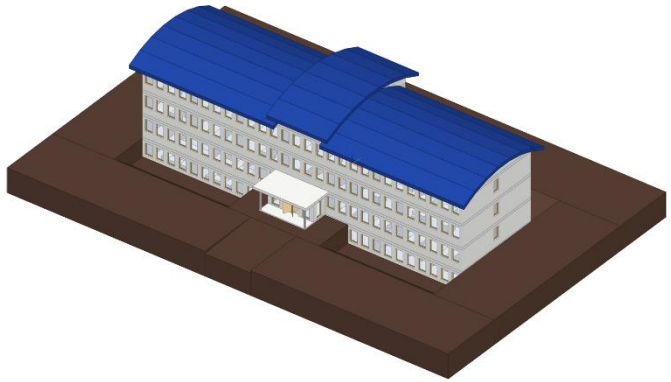


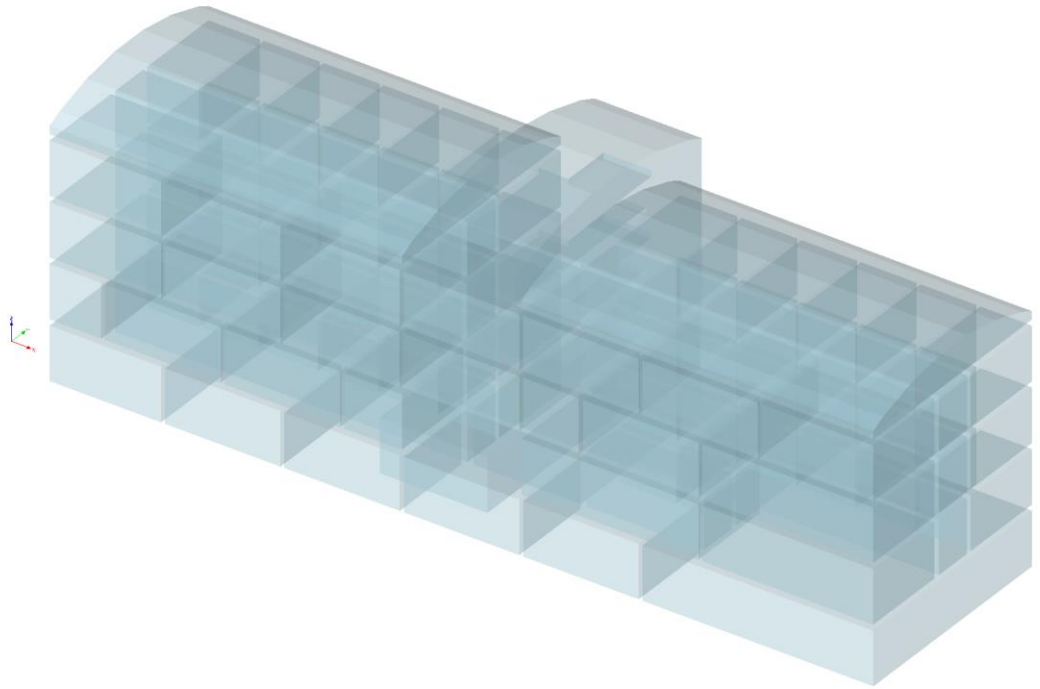
blank



IfcSpaces

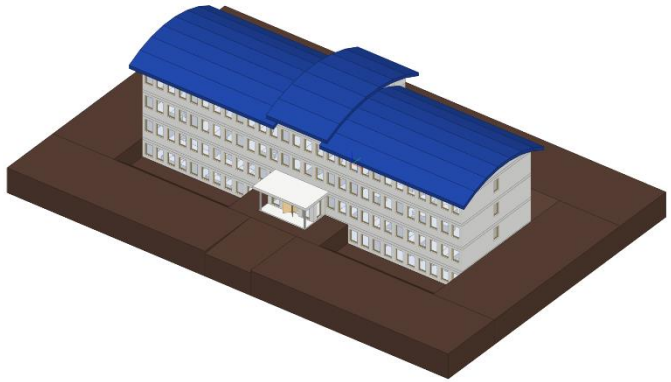
Example Result 2 – KIT institute

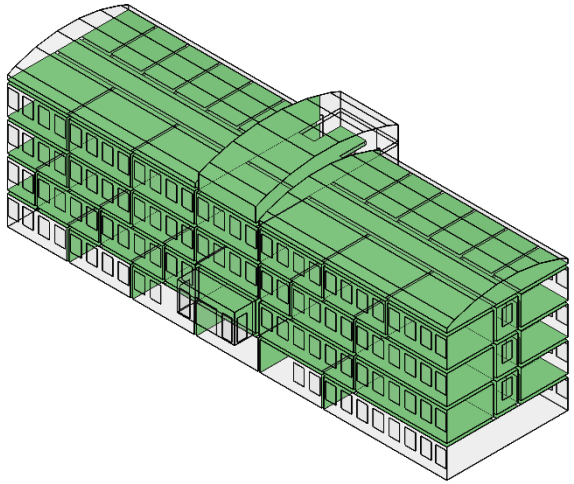




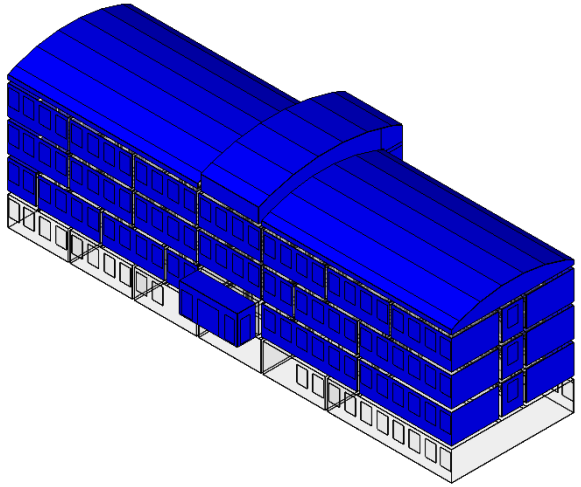
IfcRelSpaceBoundary	
#270114 -> #72946	
Name	2ndLevel
Description	2a
IFC OID	270125
GUID	2suVx6kob8rQoZ$dRazRv7
Related Buildingelement	IfcSlab[Floor] (#72946)
Physical/Virtual	PHYSICAL
Internal/External	INTERNAL
ConnectionGeometry	
#270114 -> #105247	
#270114 -> #125284	
#270114 -> #113099	
#270114 -> #101958	
#270114 -> #103994	
Name	2ndLevel
Description	2a
IFC OID	270184
GUID	3Jap8oTUj9WOt2szK6Si0C
Related Buildingelement	IfcDoor (#103994)
Physical/Virtual	PHYSICAL
Internal/External	INTERNAL
ConnectionGeometry	
#270114 -> #94567	
Name	2ndLevel
Description	2a
IFC OID	270195
GUID	16oOTUHwfAtfYnFU6RnADH
Related Buildingelement	IfcWallStandardCase (#94567)
Physical/Virtual	PHYSICAL
Internal/External	EXTERNAL
ConnectionGeometry	
#270114 -> #98235	
#270114 -> #95575	

Example Result 2 – KIT institute

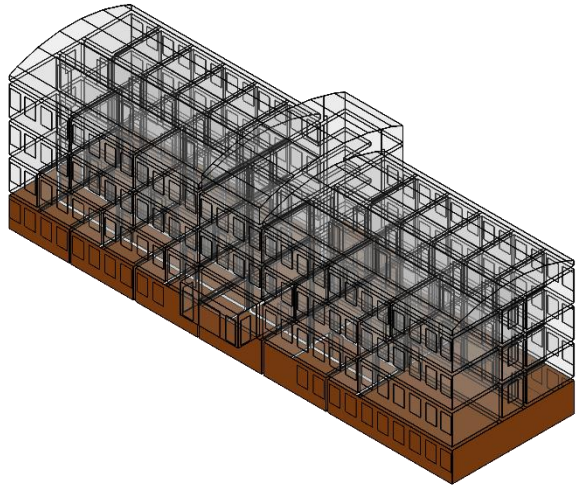




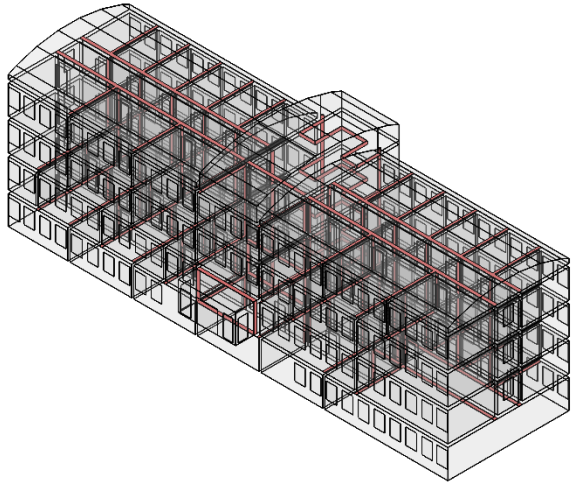
2a, internal



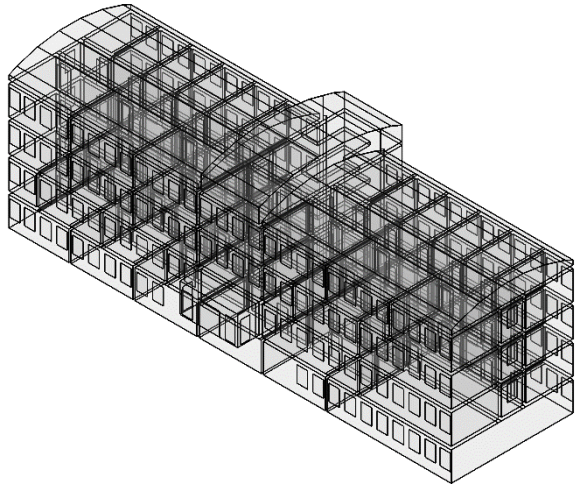
2a, external



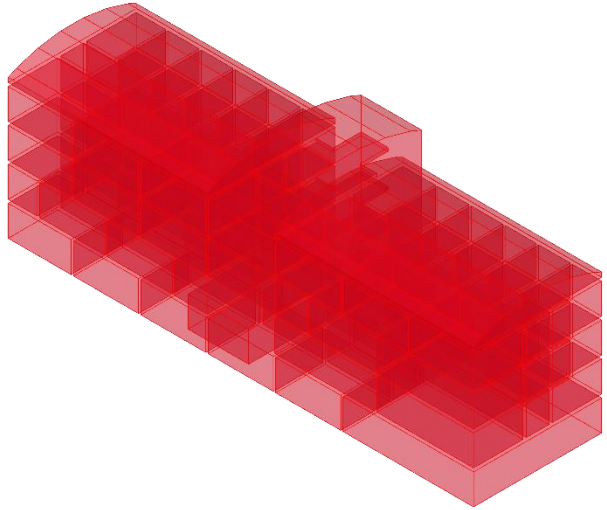
2a, external_earth



2b

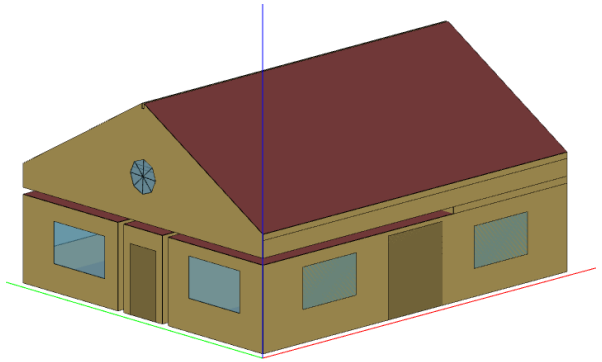


blank

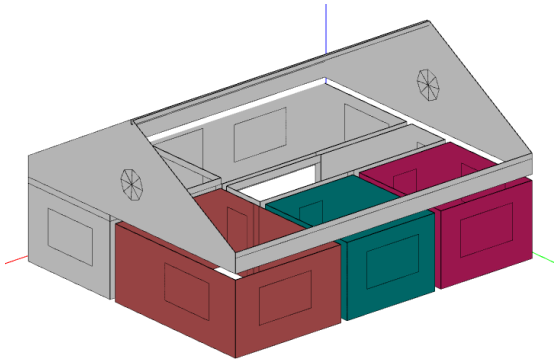


IfcSpaces

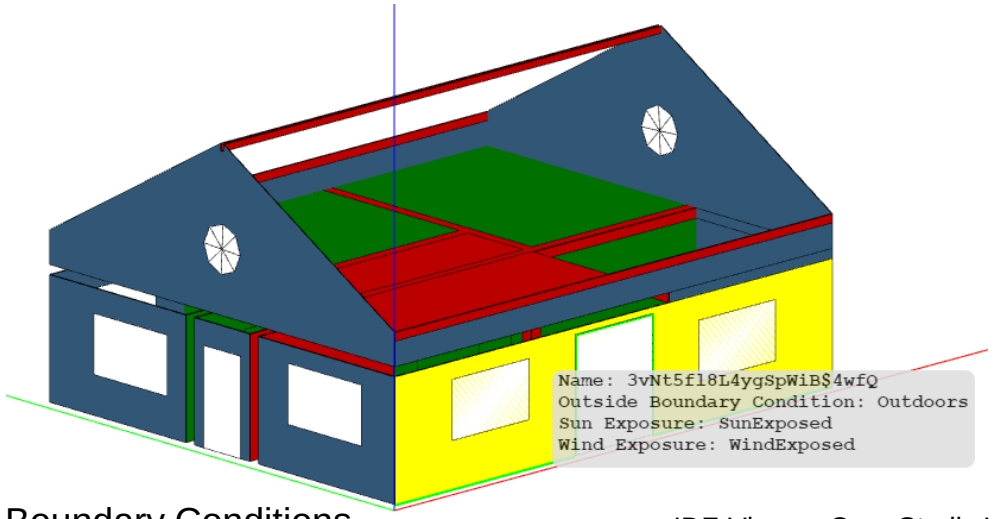
Convert Generated Space Boundaries to EnergyPlus Input



Surface Types



Thermal Zones

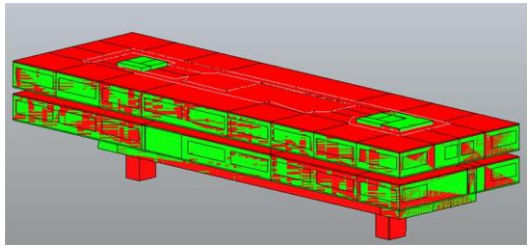


Boundary Conditions

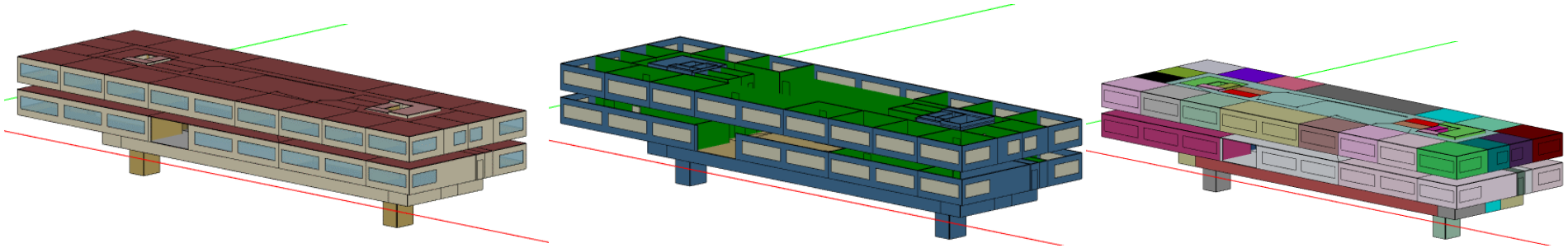
IDF-Viewer: OpenStudio V2.9.0

- **Current state**
  - Use of (generated) space boundary geometry
  - Assignments of thermal zones, material properties and boundary conditions
  - Single thermal zone per single space approach
  - Export of surface geometry and simulation results for CFD
- **Current and future development**
  - Include automatic data enrichment from IFC and customized user input
  - Improve robustness of space boundary import from different authoring tools

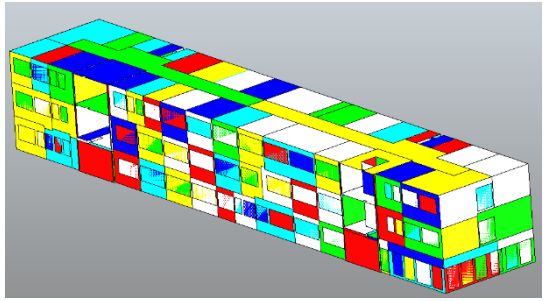
Work in Progress: EnergyPlus Input Files from Revit IFC



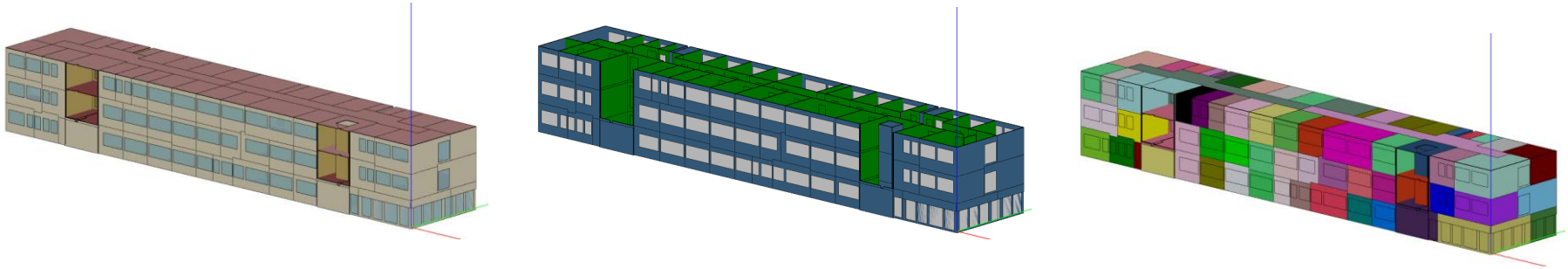
Validate model import from Revit to PythonOCC: Overlapping shapes of space boundaries and spaces



Conversion to EnergyPlus Input: Unprocessed space boundaries for IfcCurtainWall

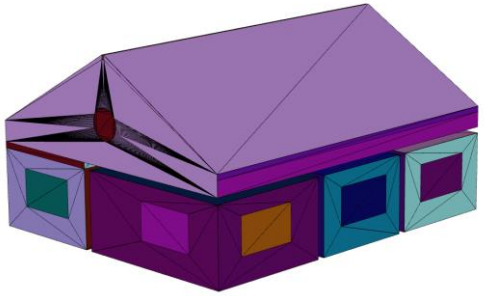


Errors in processing shapes of space boundaries and resulting gaps



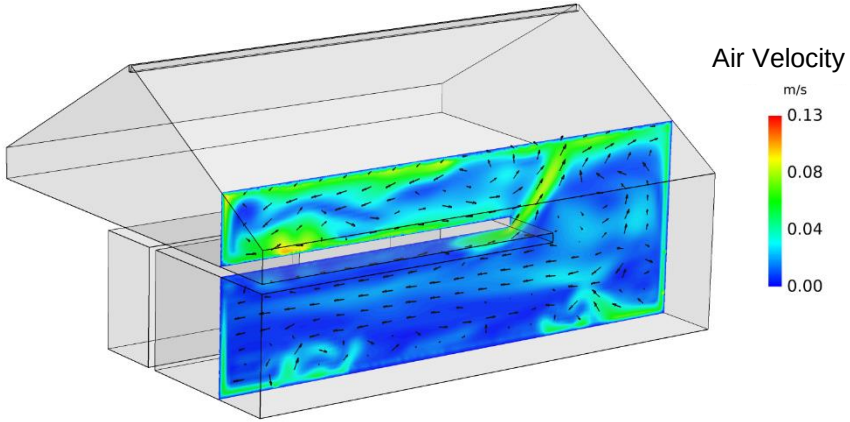
IDF-Viewer: OpenStudio V2.9.0

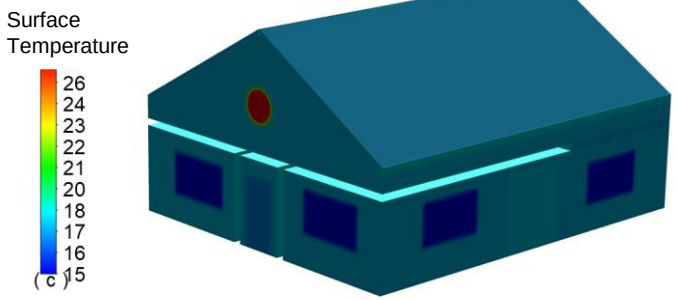
Use EnergyPlus Simulation Results as CFD Input



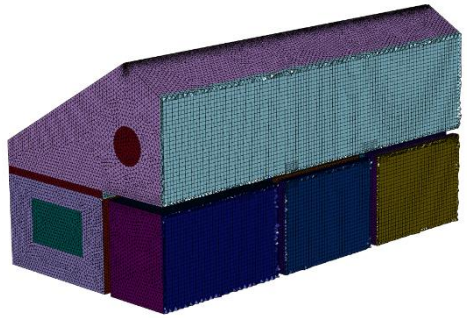
STL-Export from EnergyPlus Workflow

Fluent meshing (surface mesh)

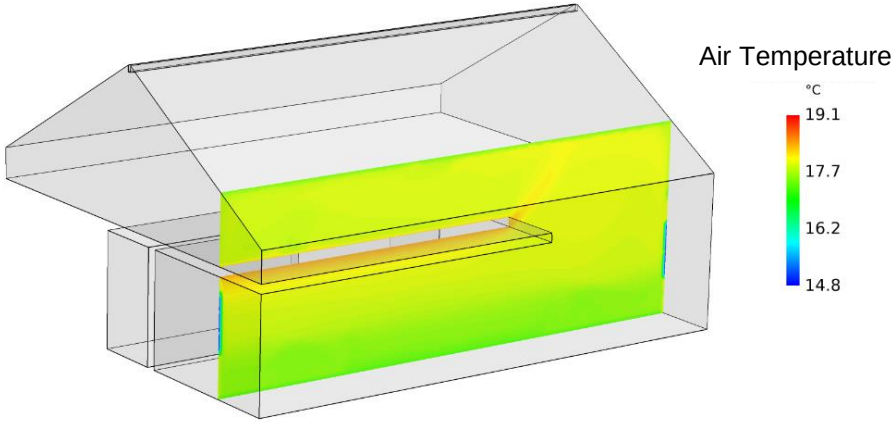




Surface Temperatures from EnergyPlus



Fluent meshing (volume mesh)



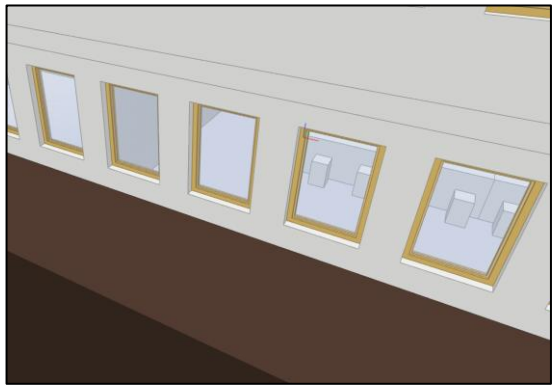
Discussion and Questions

Implementation Guide

- Latest version found is an amendment of 2010 for Ifc2x3
  (Implementation Guide: Space Boundaries for Energy Analysis)

Export to IFC

- Position of window/door boundaries within the wall having a hole?
- Distinction between types 2a and 2b. Best condition to define the building element „behind“
- Internal/External type: Fire/Water enumeration use cases
- External_Earth: Splitting faces, in case wall is intersected by ground level
- IfcBeams still shouldn‘t have SB?



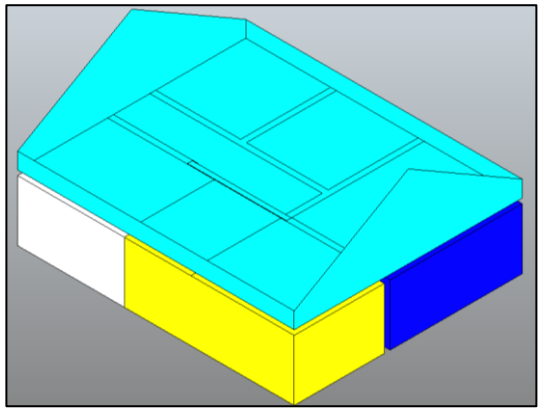
Discussion and Questions

EnergyPlus

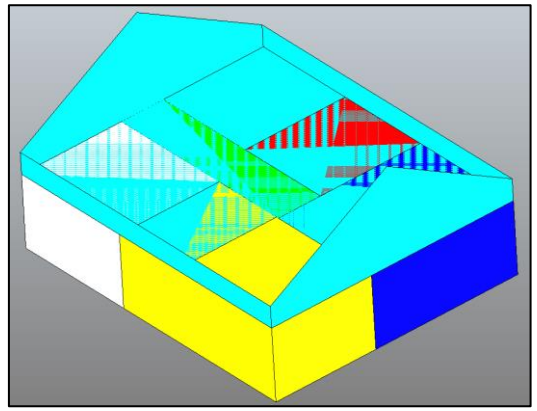
- For regular IFC files: How to handle incorrect/ missing SB data (e.g. 2b missing, internal/external, physical/virtual, …)
- Surface vs. centerline modeling
- Enrichment of simulation data (e.g. schedules, internal loads, …)
- epJSON interface for python

MVD

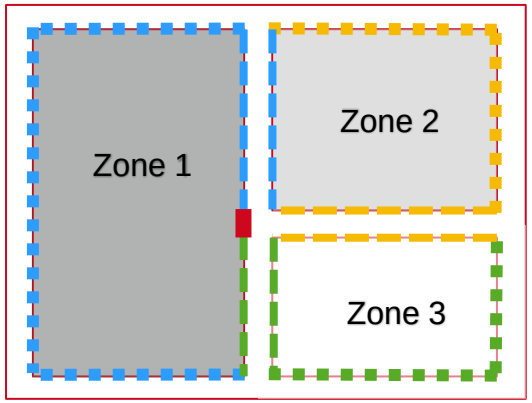
- Check correct syntax of sb information using mvdxml checked in FZKViewer (master thesis), what about KIT checking tool

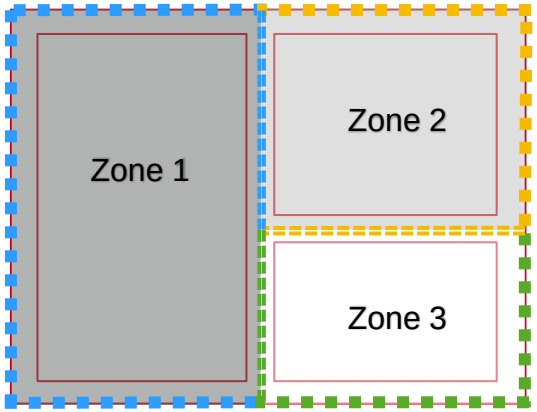


Surface modeling



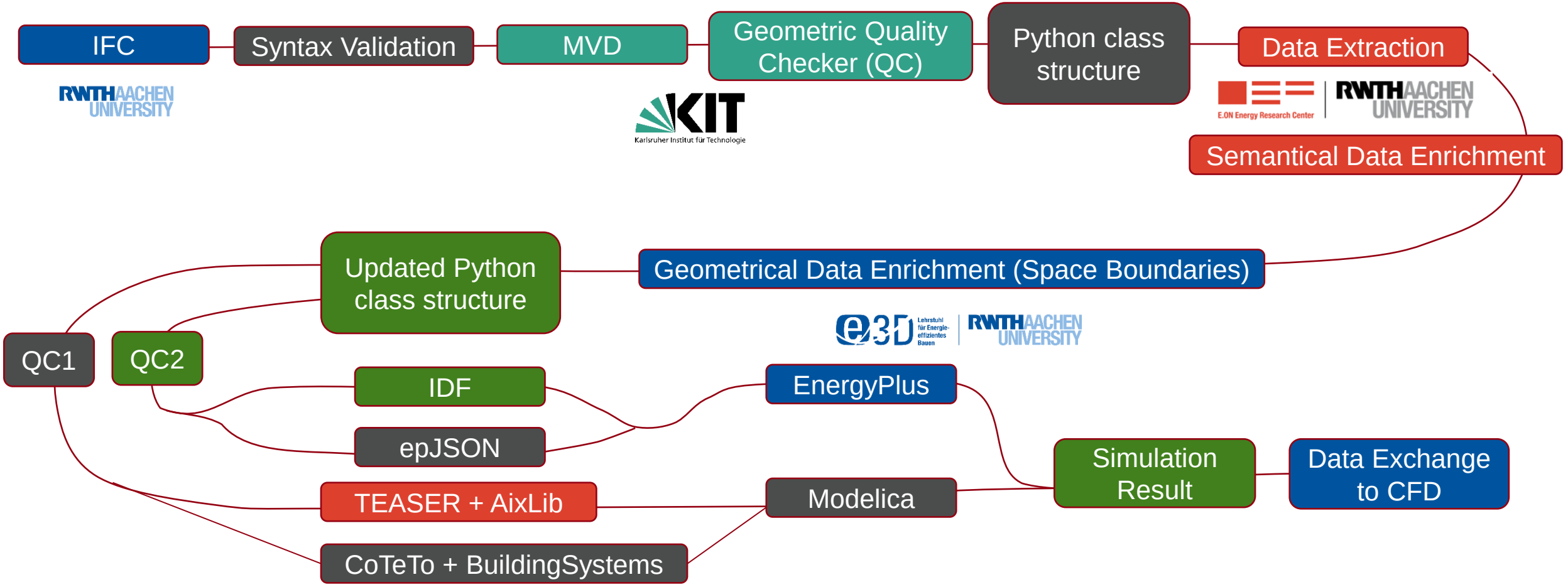
Centerline modeling





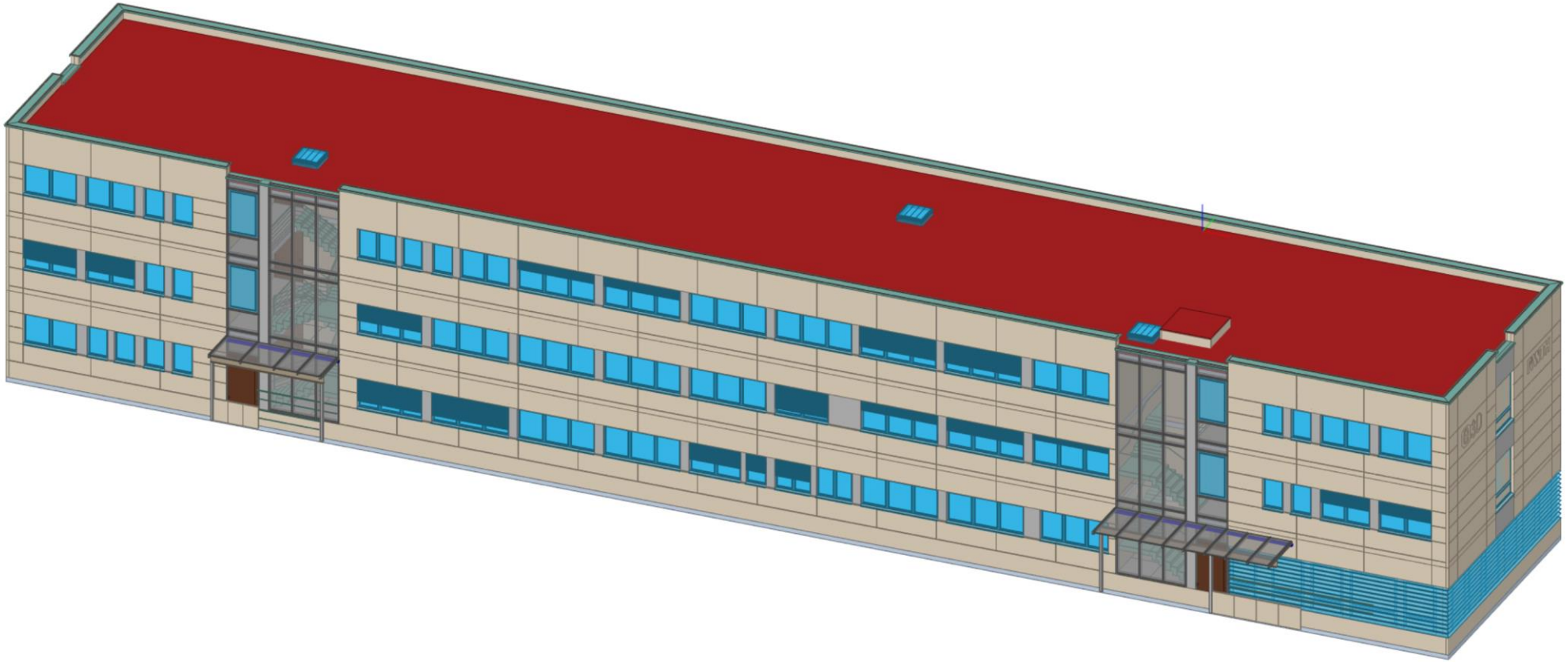
Application Case

- Subprocesses for simulation model preparation with focus on data enrichment



Application Case

- Example IFC4 building, e.g. E3D institute or KIT institute, proposals welcome



BimSurfer Integration

- Tasks of code are visualized in GUI
- Elements for the different decisions will be highlighted to support decisions
- User and project based database
- Django for Backend
- VueJS for Fronend
- Usage of BimSurfer2 for visualization of IFCs
- IFCs are converted to .gltf and .xml