

# IFC and gbXML, 2 Building Information Models for Building Performance Simulation

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# Workshop

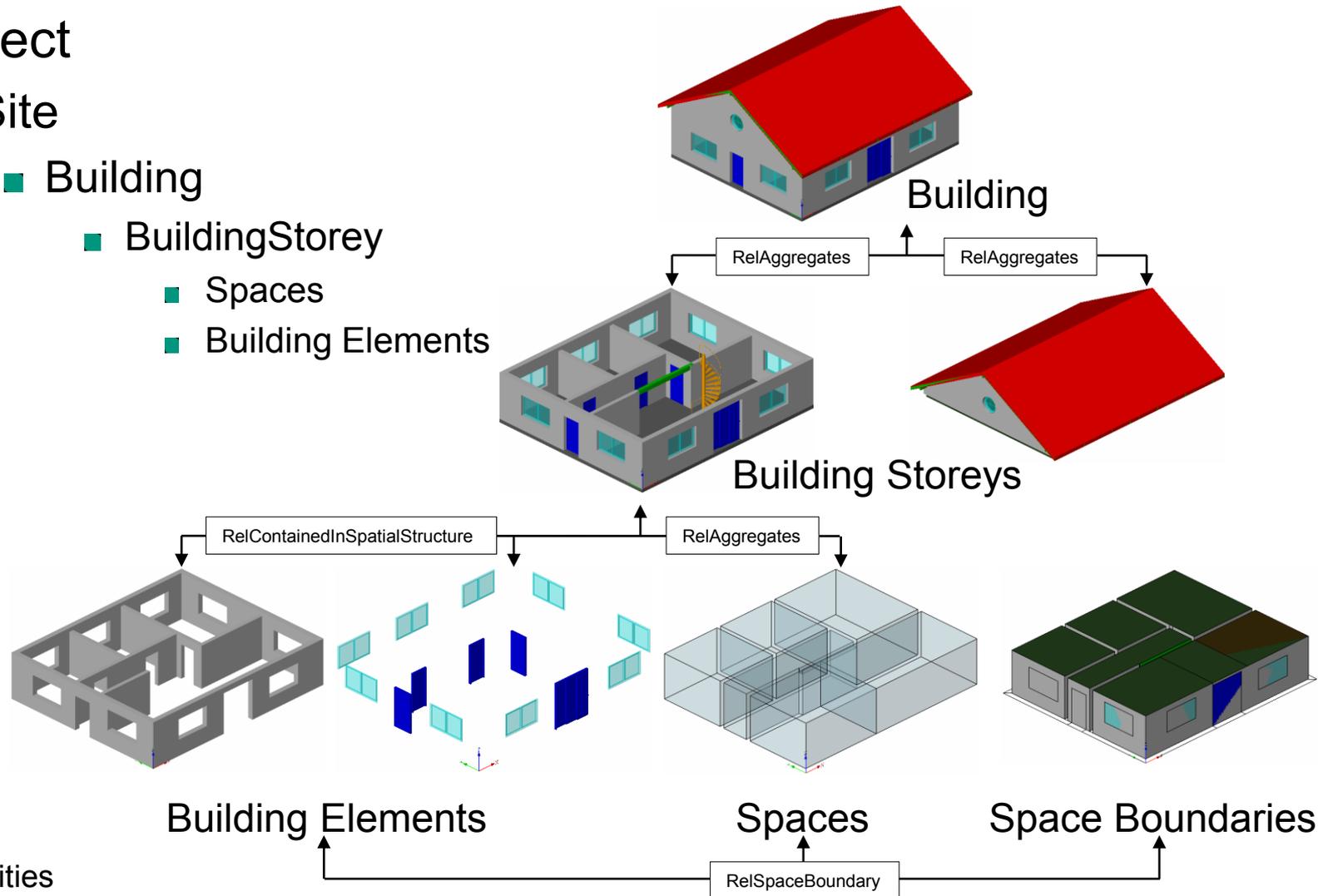
## ■ Models

- IFC – Industry Foundation Classes – buildingSMART
  - Geometry – General Properties – HVAC – Material Properties
- gbXML – Green Building XML –
  - Boundary Surfaces – HVAC - Control

## ■ Practical Experience

# IFC – Building Information Model

- Project
  - Site
    - Building
      - BuildingStorey
        - Spaces
        - Building Elements



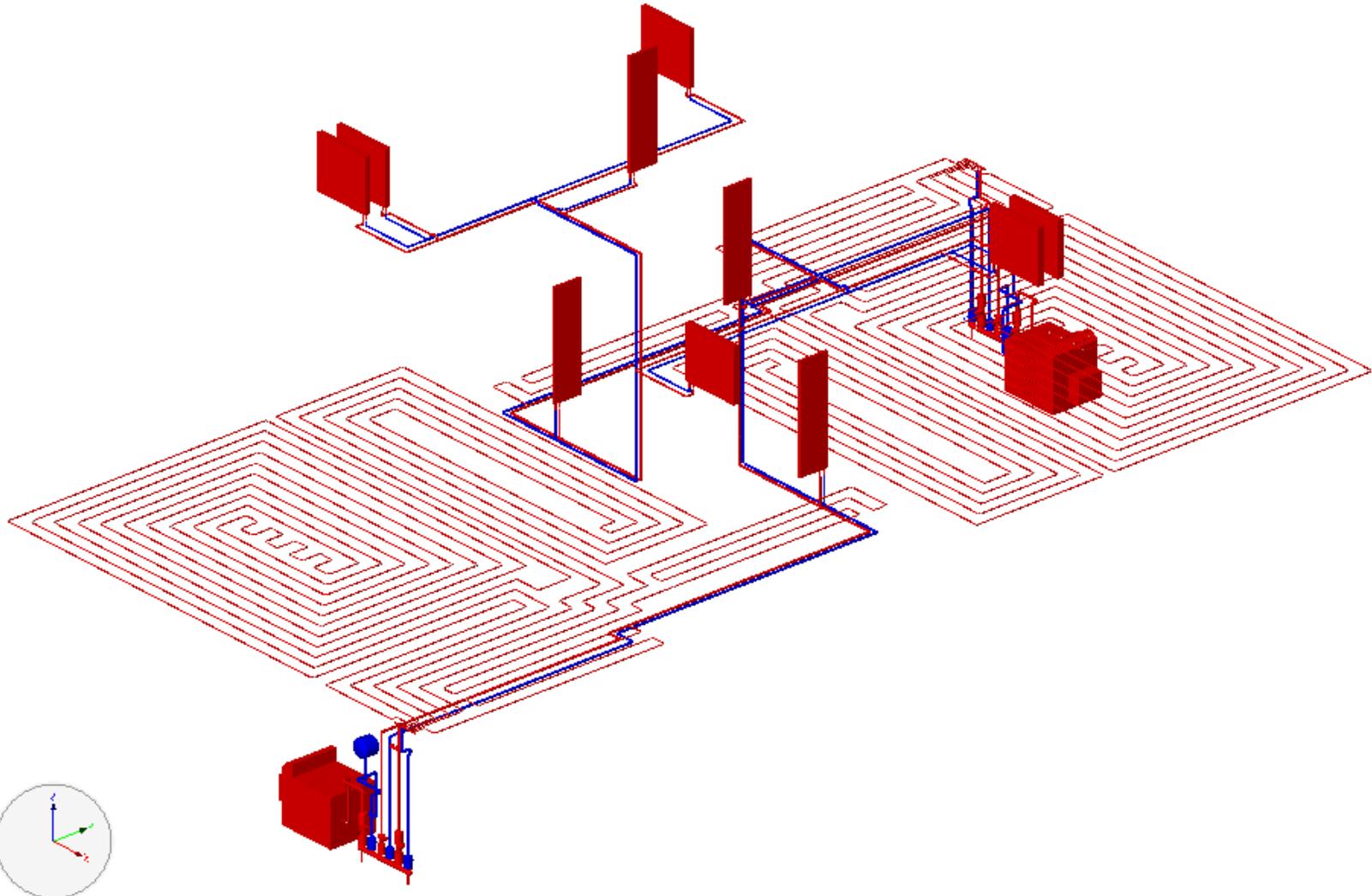
653 IFC Entities

# Space Boundary

- Relation between Spaces and enclosing Building Elements
  - Connecting geometry
  - PhysicalOrVirtualBoundary
  - InternalOrExternalBoundary

# General Properties

- All other Information are taken from:
  - Building (Pset\_BuildingCommon)
  - Site (longitude, latitude)
  - Representation Context (north direction)
  - Space (e.g. Pset\_SpaceThermalRequirements, OccupancyRequirements, LightingRequirements...)
  - Building Element (e.g. Pset\_WallCommon)
    - Material, Material Layer, Material List (IfcThermalMaterialProperties)
    - Connectivity



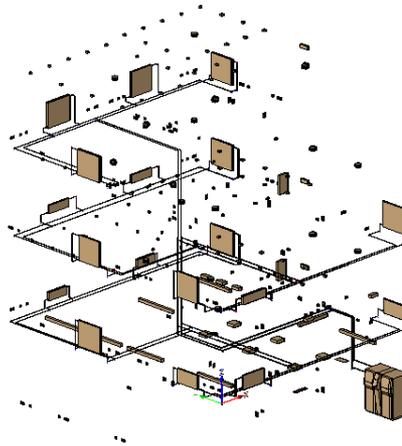
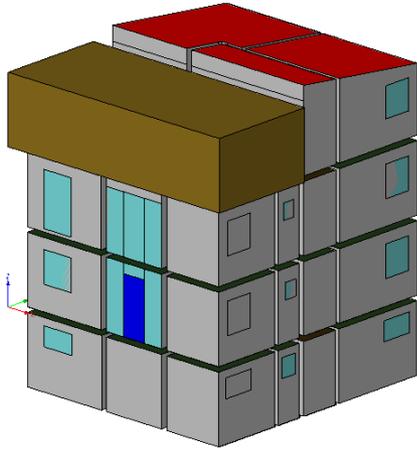
# Material Properties

- Material
  - IfcMechanicalMaterialProperties
    - e.g. ThermalExpansionCoefficient
  - IfcThermalMaterialProperties
    - e.g. SpecificHeatCapacity
    - e.g. ThermalConductivity
  - IfcHygroscopicMaterialProperties
    - e.g. MoistureDiffusivity
  - IfcGeneralMaterialProperties
    - e.g. MassDensity
  - IfcOpticalMaterialProperties
    - e.g. SolarTransmittance
    - e.g. SolarReflectanceFront

## Additional Information

- Costs (items, schedules, values)
- Schedules (all time related information)
- Consumptions (Pset\_UtilityConsumption, time series)
- Weather (Pset\_OutsideDesignCriteria)
- Performances History (HVAC components)
- Owner History

# Summary IFC



## Model

- Volumetric Building Elements
- Space Boundaries

## HVAC

- Components
- Port connections
- Systems including flow directions

## HVAC and User Control

- Schedules
- Performance
- History
- Controls
- Weather

653 entities (IFC2x3) → 329 entities in the Coordination View → 388 entities at IAI

# gbXML

- Campus

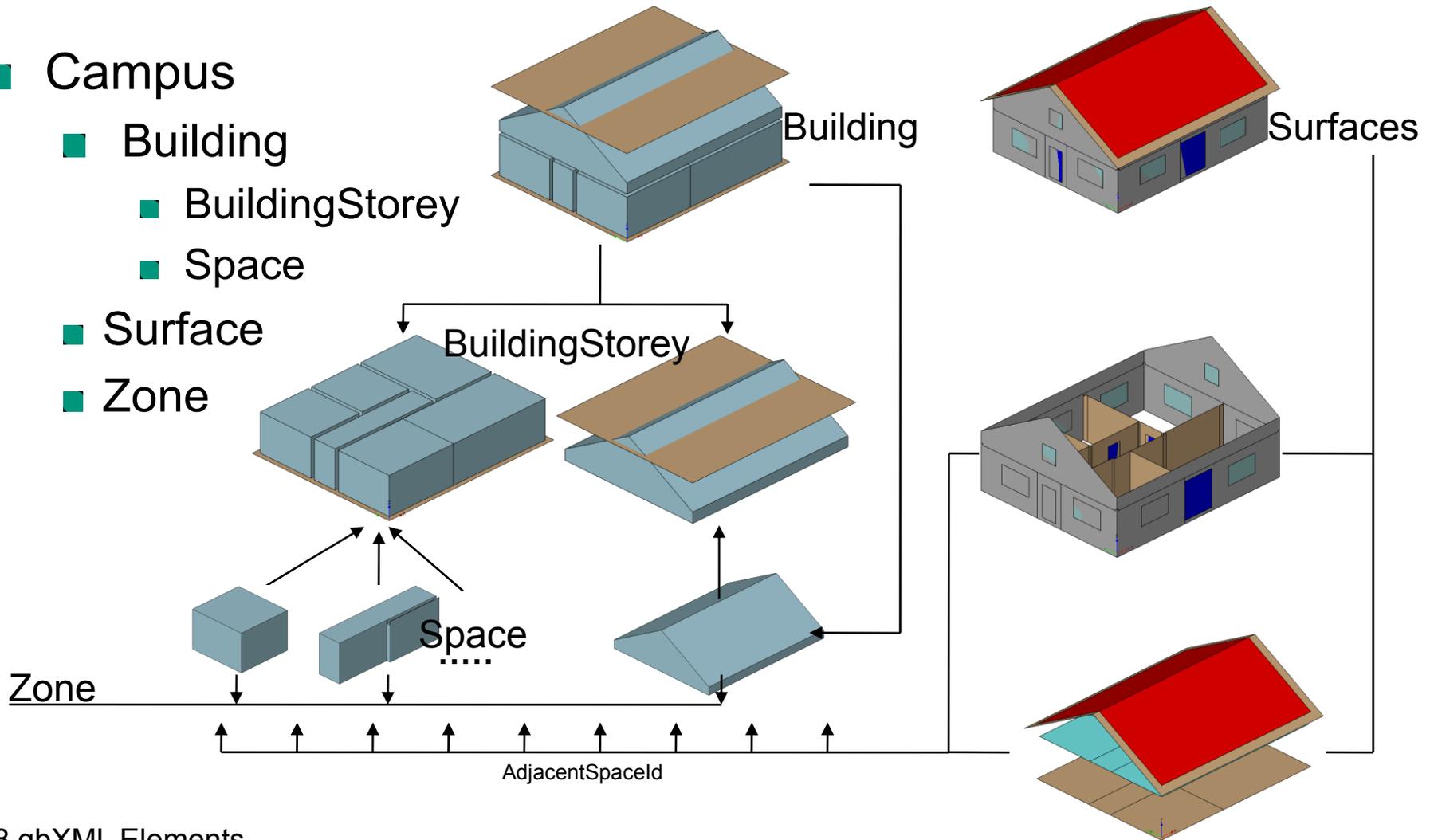
- Building

- BuildingStorey

- Space

- Surface

- Zone



288 gbXML Elements

# Boundary Surfaces

- InteriorWall
- ExteriorWall
- Roof
- InteriorFloor
- Shade
- UndergroundWall
- UndergroundSlab
- Ceiling
- Air
- UndergroundCeiling
- RaisedFloor
- SlabOnGrade
- FreestandingColumn
- EmbeddedColumn
- Opening
  - FixedWindow
  - OperableWindow
  - FixedSkylight
  - OperableSkylight
  - SlidingDoor
  - NonSlidingDoor
  - Air

# General Properties

Query Location

Address Type	
Name	Brandenburg an der Havel
Description	
PostalCode	
Longitude	12.55
Latitude	52.4167
Elevation	
CADModelAzimuth	1.5708

OK

- Costs (15 cost types)
- Weather ( ca. 40 parameter)
- Schedules (YearSchedule, WeekSchedule, DaySchedule)
- Controls (FlowControl, TemperaturControl, LightingControl)
- Lighting
- Space (People, Airflow, HeatGain etc.)
- Document History

# Construction

Construction information

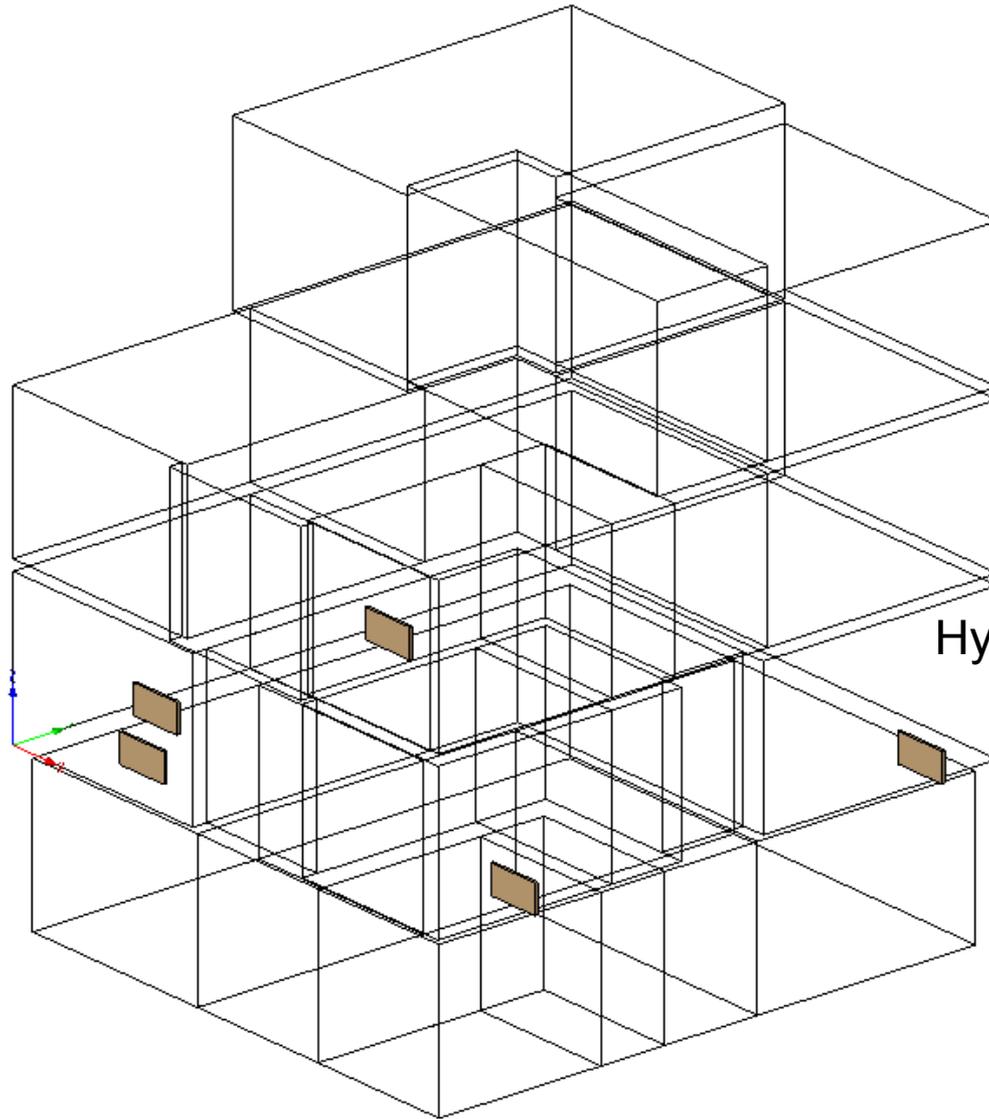
Construction	Variable	Value	Unit	Type
[-] GK - 3-lagig beplankt	uValue	0.16	WPerSquareMeterK	
[-] Gipskartonplatte				
Gips	Thickness	0.0125		
[-] Gipskartonplatte				
Gips	Thickness	0.0125		
[-] Gipskartonplatte				
Gips	Thickness	0.0125		
[-] Dämmung				
Dämmung, weich, Sch	Thickness	0.1		
[-] Gipskartonplatte				
Gips	Thickness	0.0125		
[-] Gipskartonplatte				
Gips	Thickness	0.0125		
[-] Gipskartonplatte				
Gips	Thickness	0.0125		
[-] Bodenaufbau 2	uValue	0.18	WPerSquareMeterK	
[-] lay13				
Beton, unbewehrt	Thickness	0.06		
[-] lay14				
Dämmung, hart	Thickness	0.04		
[-] Dachaufbau 2	uValue	0.2	WPerSquareMeterK	
[-] lay15				
Kies 2, großer Maßstab	Thickness	0.02		
[-] lay16				
Dämmung, hart	Thickness	0.15		
[-] lay17				
Beton, Stahlbeton	Thickness	0.2		

OK

Construction  
15 properties

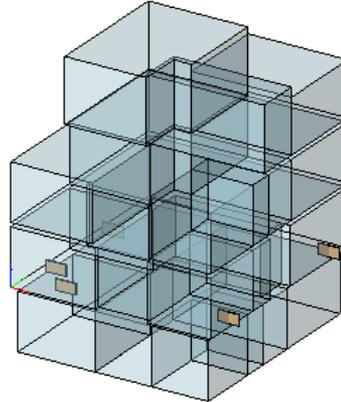
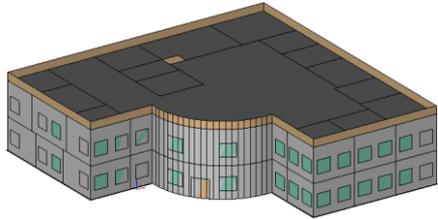
Material  
16 properties

# HVAC



HydronicLoopEquipment  
(30 properties)

# Summary gbXML



```
<Schedule id="schdl-1"
type="Fraction">
<Name>
Common Office Occupancy - 8 AM to 5
PM
</Name>
<YearSchedule id="yr-schdl-1">
<BeginDate>
2012-01-01
</BeginDate>
<EndDate>
2012-12-31
</EndDate>
<WeekScheduleId
weekScheduleIdRef="wk-schdl-1"/>
</YearSchedule>
</Schedule>
```

## Model

- Spaces
- Boundary Surfaces
- Shading

## HVAC

- Int- and Ex Equipment
- Air- and Hydronic loop
- Lighting

## HVAC and User Control

- Schedules
- Controls
- Weather

288 gbXML elements → 70 elements

# Practical Experiences

## ■ IFC

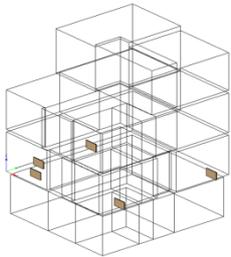
- ETU
- EnergyPlus
- IES
- REVIT, ACA, ArchiCAD, Bentley, EliteCAD, DDS

## ■ gbXML

- CROSSEY ENGINEERING LTD.
- DDS
- Solar Computer
- REVIT, ACA, ArchiCAD, Bentley
- IES

# Workflow

Geometry, topology,  
material properties

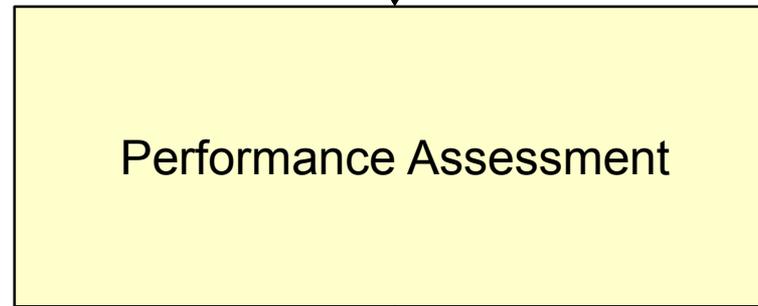


Space properties,  
assessment results,  
HVAC design



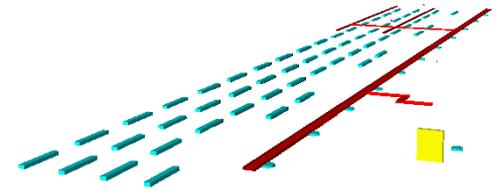
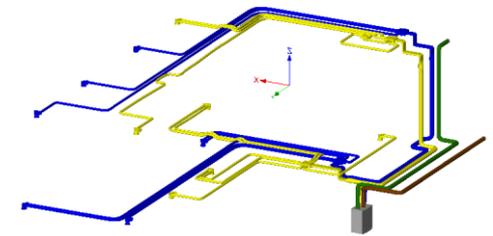
gbXML

IFC



gbXML

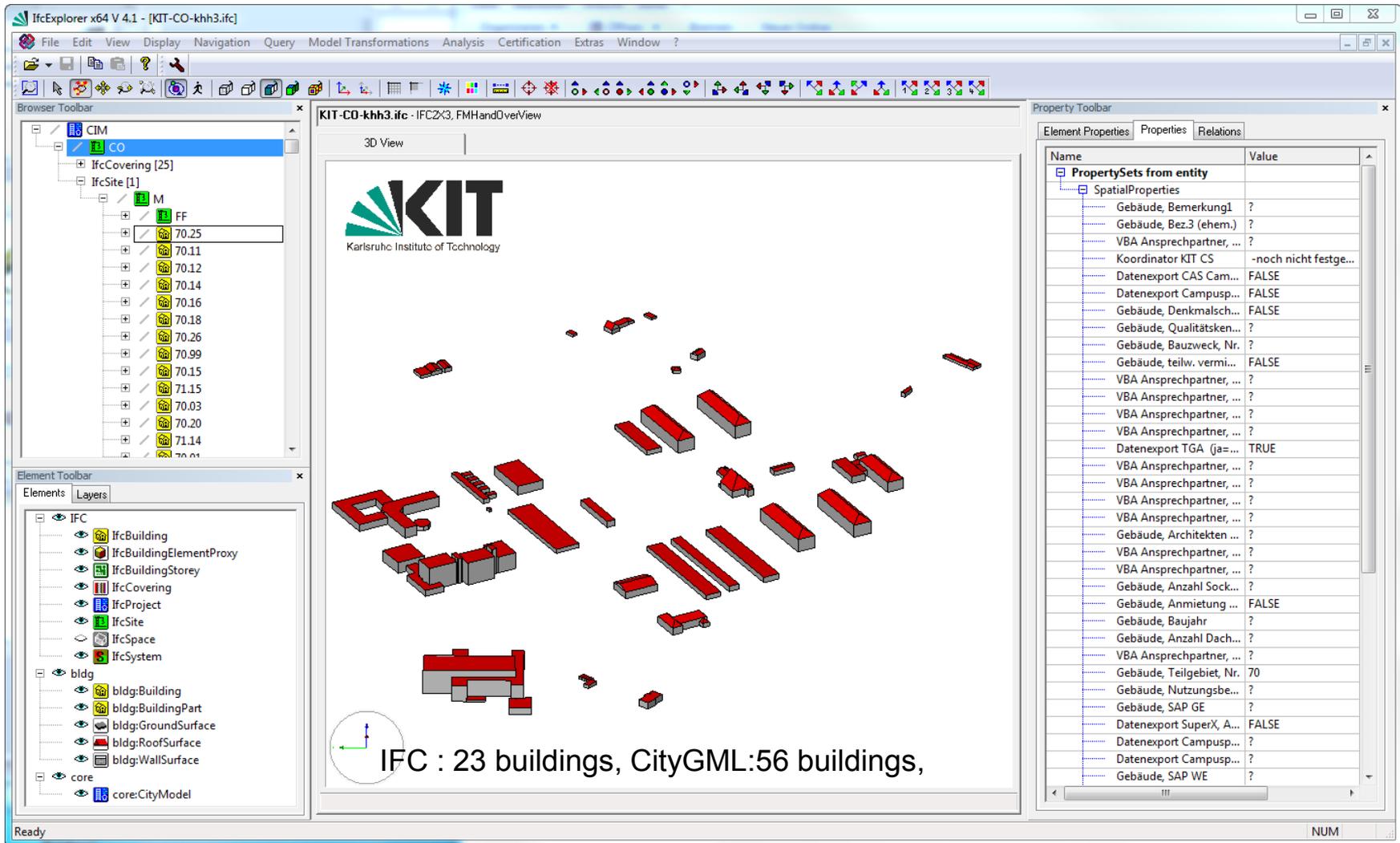
IFC



# Conclusion

- IFC – Building Information Model for all phases in the building live cycle
- gbXML – Building Information Model for performance assessment
- Both models are comprehensive. Only parts of the models are in use
- Remarks:
  - IFC: Header and OwnerHistory; gbXML DocumentHistory for identification
  - gbXML: CADModelId and CADObjectId as cross reference to “BIM”
  - IFC: “type” concept; gbXML: “construction” concept
  - Both: multi material layers possible
  - gbXML: properties can be used with different units (PeopleNumber → NumberOfPeople, SquareFtPerPerson, SquareMPerPerson)
  - Both: online feature catalogues available

# Challenge I



The screenshot shows the IfcExplorer x64 V 4.1 interface. The central 3D View displays a model of buildings with red roofs and grey walls. The left side contains a Browser Toolbar with a tree view of the model's structure, including 'CIM', 'CO', 'IfcCovering [25]', and 'IfcSite [1]'. Below it is the Element Toolbar with a list of IFC and bldg classes. The right side features a Property Toolbar with a table of property sets.

**IFC : 23 buildings, CityGML:56 buildings,**

Name	Value
<b>PropertySets from entity</b>	
SpatialProperties	
Gebäude, Bemerkung1	?
Gebäude, Bez.3 (ehem.)	?
VBA Ansprechpartner, ...	-noch nicht festge...
Koordinator KIT CS	
Datenexport CAS Cam...	FALSE
Datenexport Campusp...	FALSE
Gebäude, Denkmalsch...	FALSE
Gebäude, Qualitätsken...	?
Gebäude, Bauzweck, Nr.	?
Gebäude, teilw. vermi...	FALSE
VBA Ansprechpartner, ...	?
Datenexport TGA (ja=...	TRUE
VBA Ansprechpartner, ...	?
Gebäude, Anzahl Sock...	?
Gebäude, Anmietung ...	FALSE
Gebäude, Baujahr	?
Gebäude, Anzahl Dach...	?
VBA Ansprechpartner, ...	?
Gebäude, Teilgebiet, Nr.	70
Gebäude, Nutzungsbe...	?
Gebäude, SAP GE	?
Datenexport SuperX, A...	FALSE
Datenexport Campusp...	?
Datenexport Campusp...	?
Gebäude, SAP WE	?

# Challenge II

