

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

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INSTITUT FÜR ANGEWANDTE INFORMATIK

Workshop

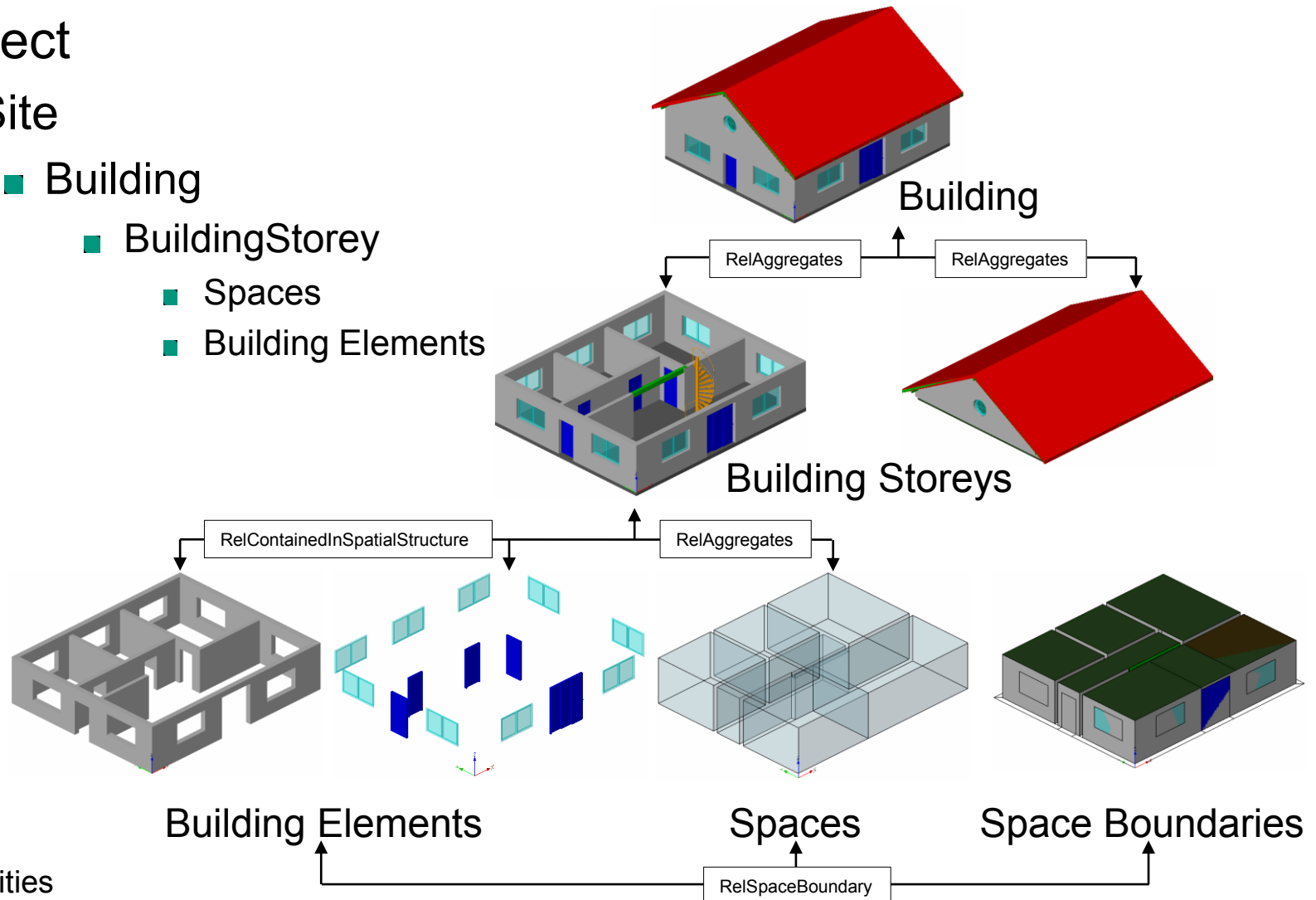
■ Models

- 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

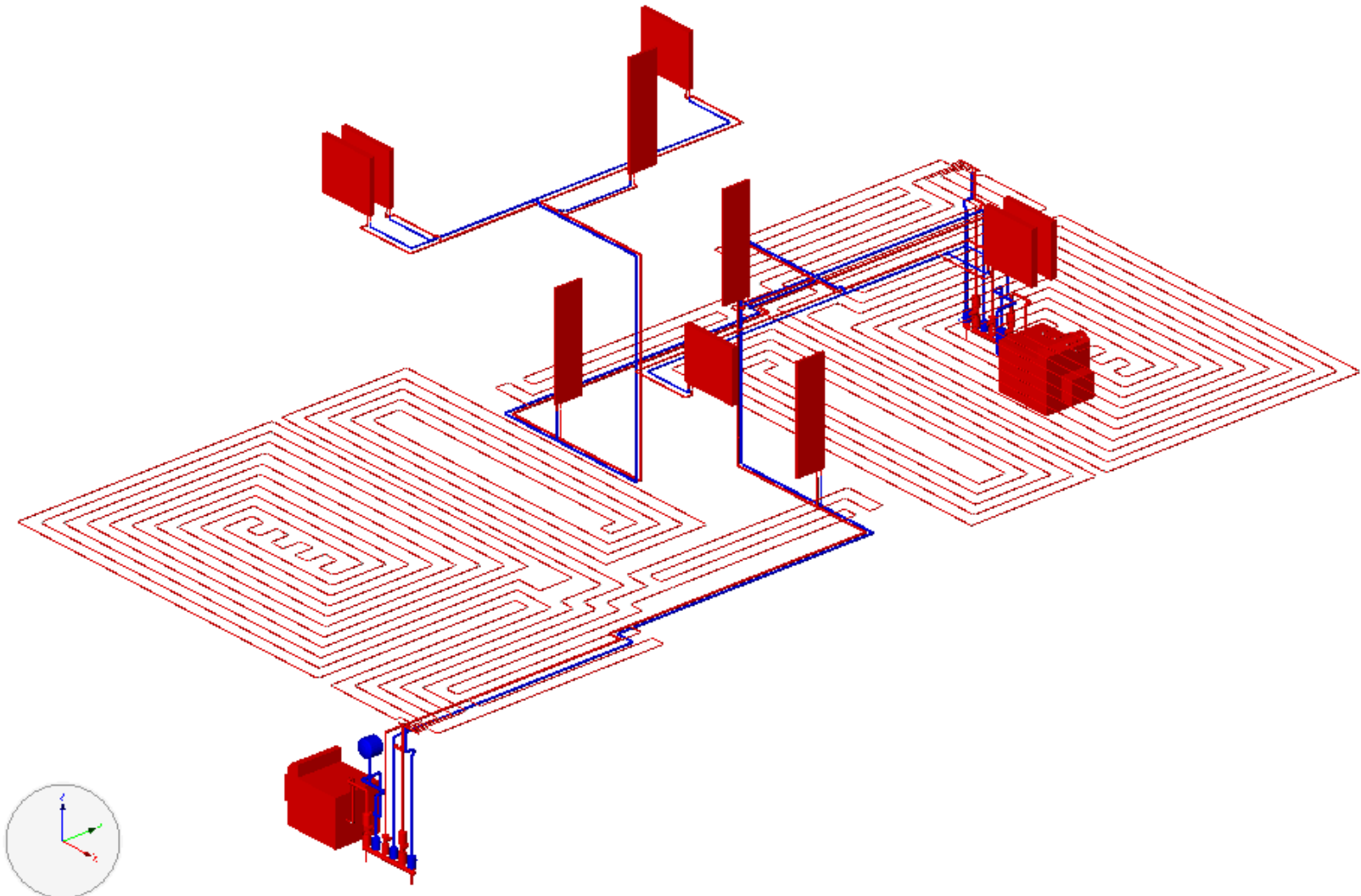


Space Boundary

- 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



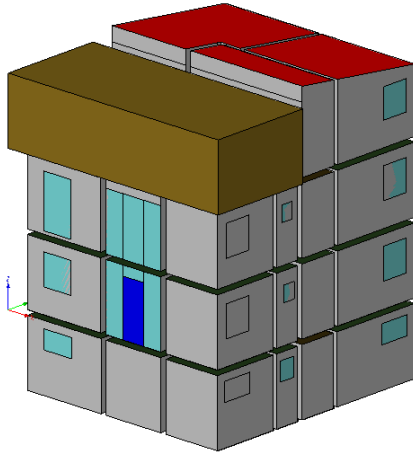
Material Properties

- 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

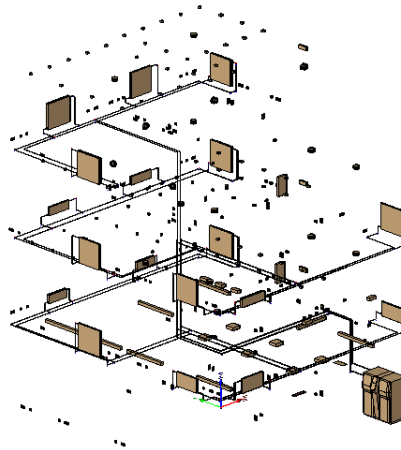
- Costs (items, schedules, values)
- Schedules (all time related information)
- Consumptions (Pset_UtilityConsumption, time series)
- Weather (Pset_OutsideDesignCriteria)
- Performances History (HVAC components)
- Owner History

Summary IFC



Model

- Volumetric Building Elements
- Space Boundaries



HVAC

- Components
- Port connections
- Systems including flow directions

HVAC and User Control

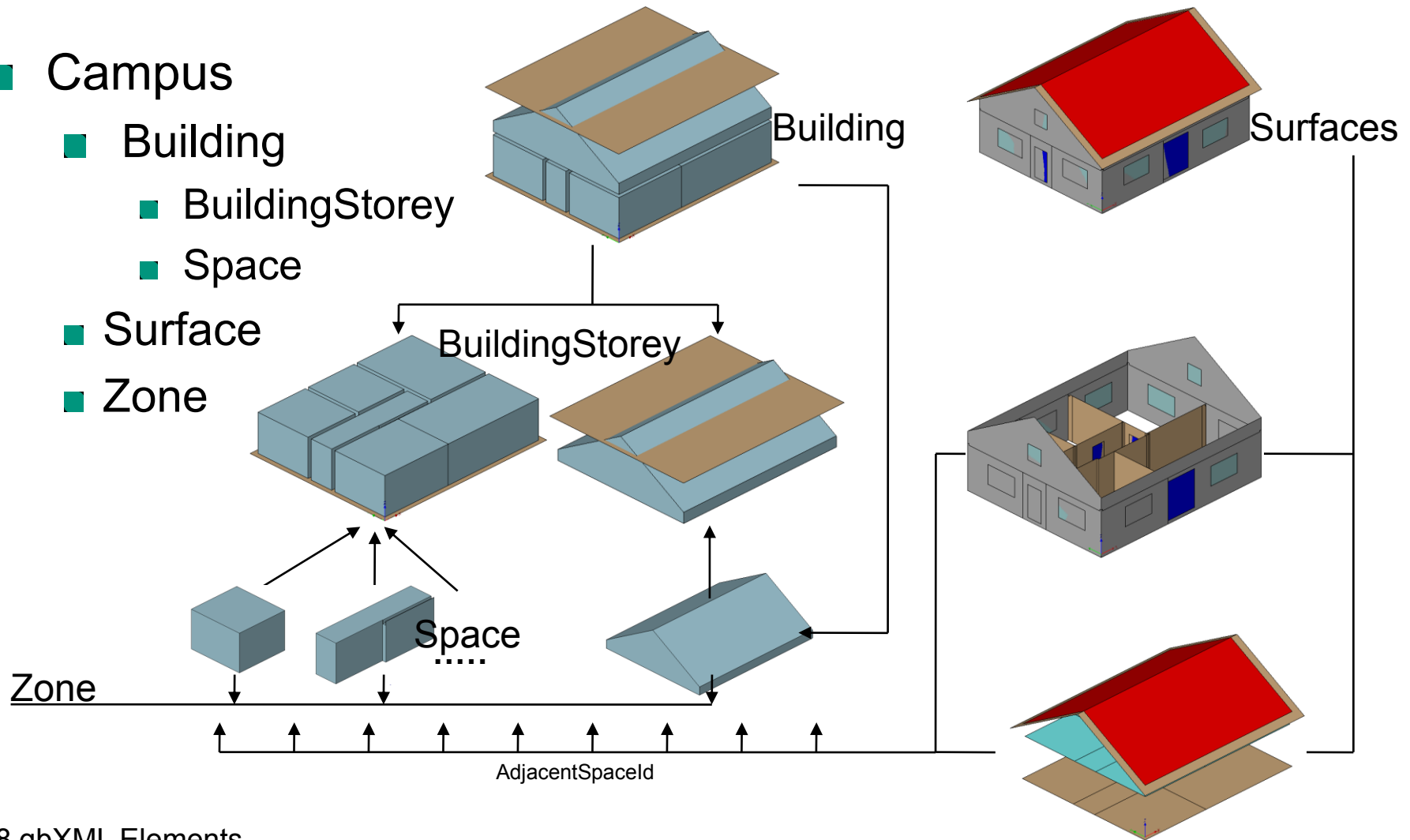
- Schedules
- Performance
- History
- Controls
- Weather

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

■ Campus

- # Building

Surfaces



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

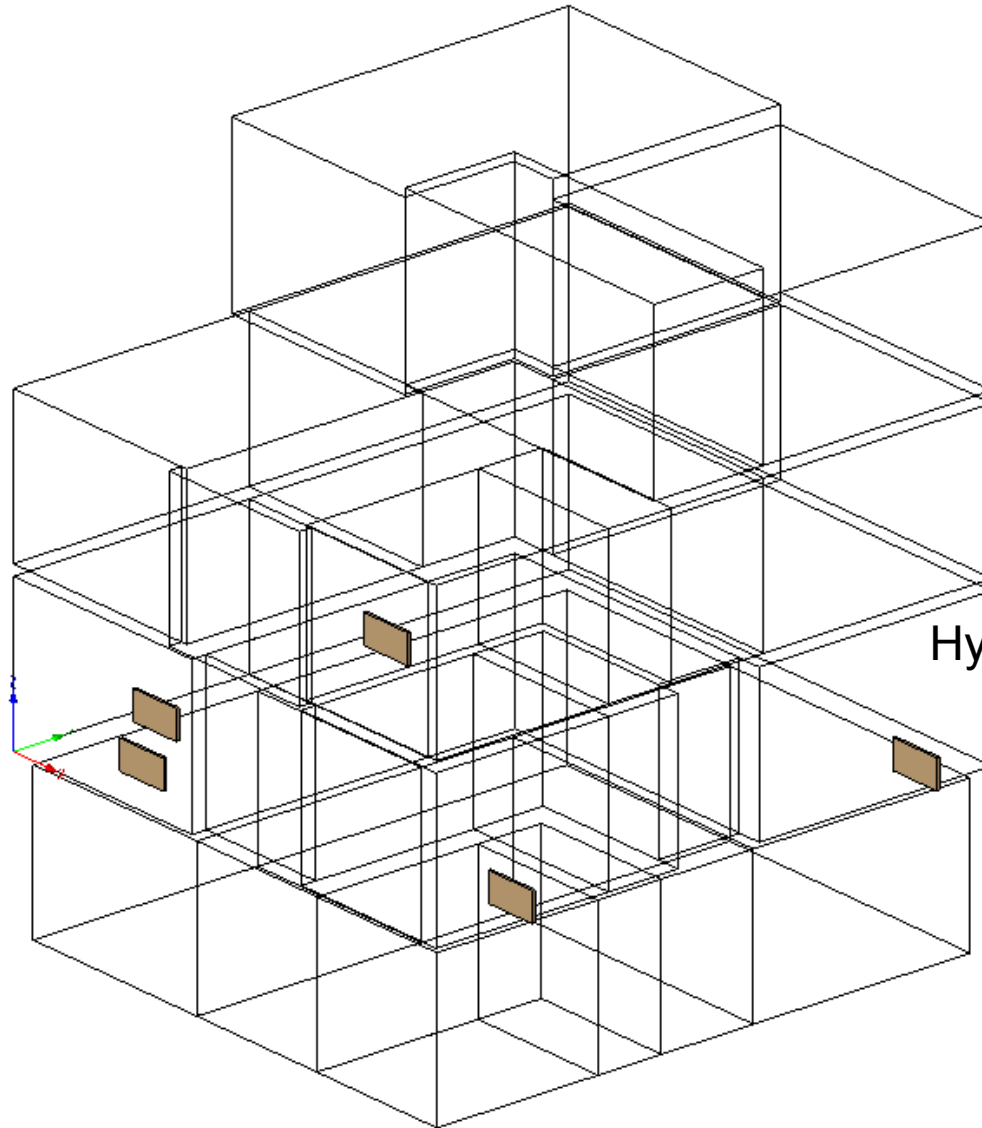
Construction information

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

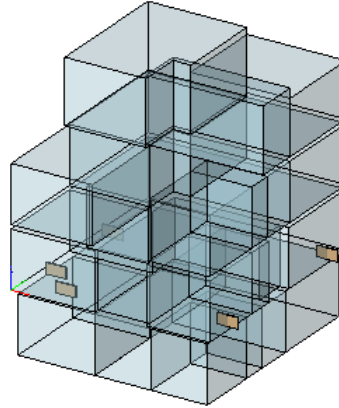
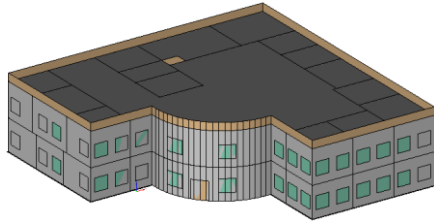
Construction
15 properties

Material
16 properties



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

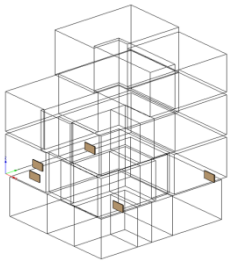
- ETU
- EnergyPlus
- IES
- REVIT, ACA, ArchiCAD, Bentley, EliteCAD, DDS

■ gbXML

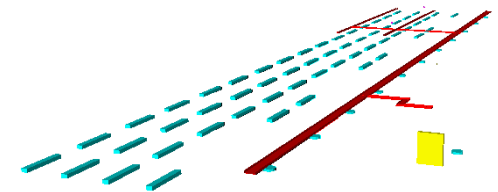
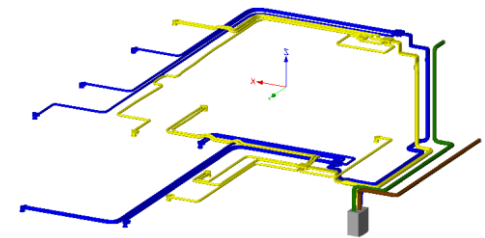
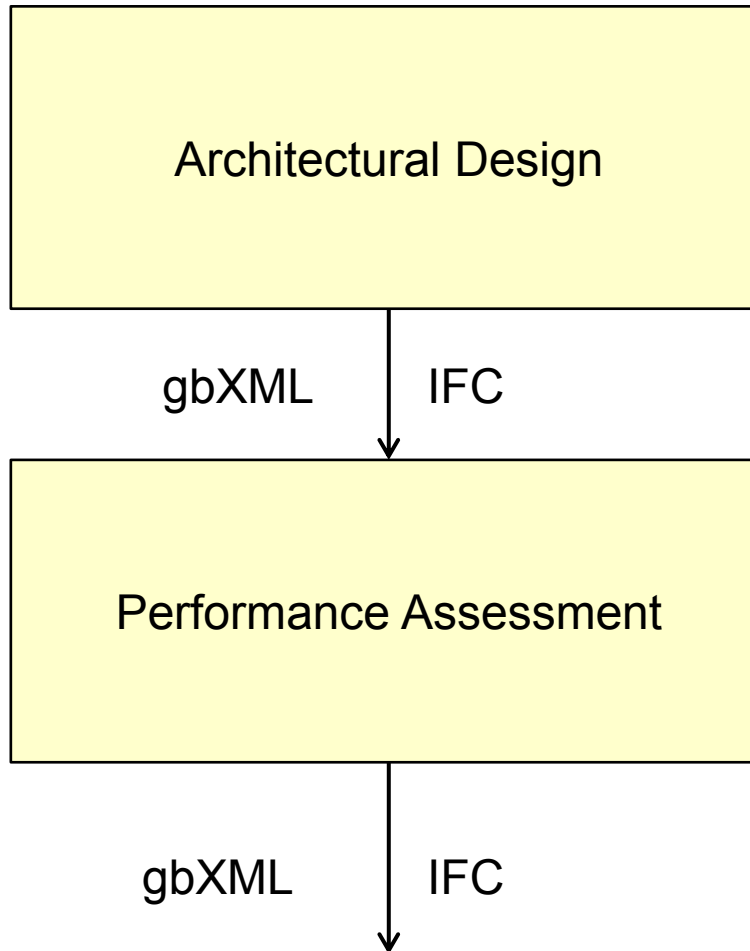
- CROSSEY ENGINEERING LTD.
- DDS
- Solar Computer
- REVIT, ACA, ArchiCAD, Bentley
- IES

Workflow

Geometry, topology,
material properties



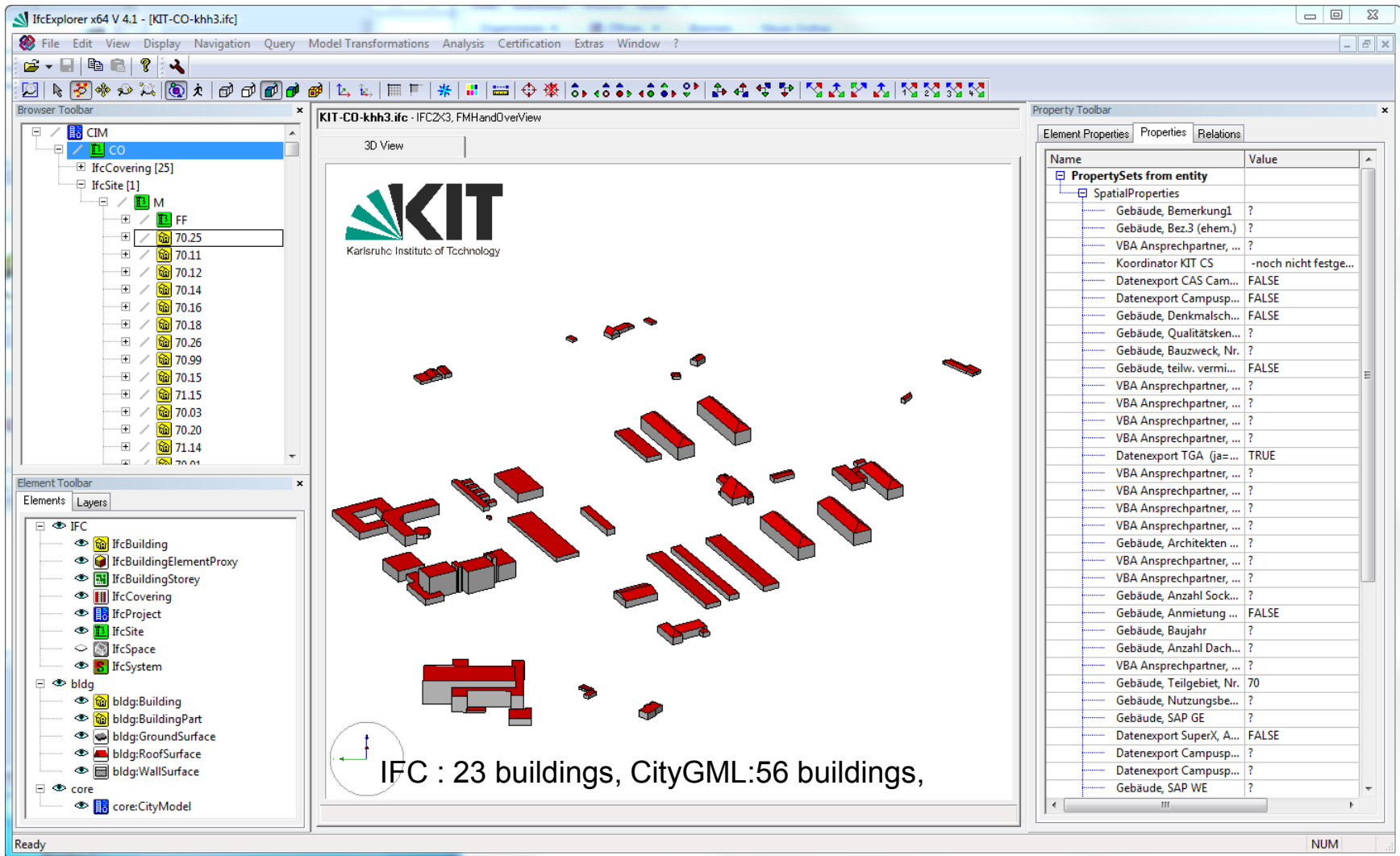
Space properties,
assessment results,
HVAC design



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 main window displays a 3D view of a building model with red roofs and grey walls. The left sidebar contains a 'Browser Toolbar' with a tree view showing the IFC hierarchy: CIM, CO, IfcCovering [25], IfcSite [1], M, FF, and a list of rooms (70.01 to 70.25). Below this is an 'Element Toolbar' with 'Elements' and 'Layers' tabs, showing a list of IFC entities like IfcBuilding, IfcBuildingElementProxy, IfcBuildingStorey, IfcCovering, IfcProject, IfcSite, IfcSpace, IfcSystem, bldg, bldg:Building, bldg:BuildingPart, bldg:GroundSurface, bldg:RoofSurface, bldg:WallSurface, core, and core:CityModel.

The right sidebar contains a 'Property Toolbar' with 'Element Properties', 'Properties', and 'Relations' tabs. The 'Properties' tab is active, showing a table of properties for the selected entity.

Name	Value
PropertySets from entity	
SpatialProperties	
Gebäude, Bemerkung1	?
Gebäude, Bez.3 (ehem.)	?
VBA Ansprechpartner, ...	?
Koordinator KIT CS	-noch nicht festge...
Datenexport CAS Cam...	FALSE
Datenexport Campusp...	FALSE
Gebäude, Denkmalsch...	FALSE
Gebäude, Qualitätsken...	?
Gebäude, Bauzweck, Nr.	?
Gebäude, teilw. vermi...	FALSE
VBA Ansprechpartner, ...	?
VBA Ansprechpartner, ...	?
VBA Ansprechpartner, ...	?
VBA Ansprechpartner, ...	?
Datenexport TGA (ja=...	TRUE
VBA Ansprechpartner, ...	?
VBA Ansprechpartner, ...	?
VBA Ansprechpartner, ...	?
VBA Ansprechpartner, ...	?
Gebäude, Architekten	?
VBA Ansprechpartner, ...	?
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	?

IFC : 23 buildings, CityGML:56 buildings,

Challenge II

