

The INSPIRE Building Model for Energy Applications

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**2nd Joint SIG 3D and OGC Workshop -
CityGML EnergyADE for building energy
calculation**

KIT, October 30th, 2014

- The INSPIRE Initiative
- Building Model: As-Is-Analysis
- Energy Use cases for buildings
- INSPIRE Building model
 - profiles
- Energy-related Metadata
- Energy-related Attributes
- Current Status of CityGML 3.0
- Conclusions

- **IN**frastructure for **SP**atial **InfoR**mation in **E**urope
- Aim: Building up a interoperable **Spatial Data Infrastructure** (SDI) for the European Union (EU)
- Directive of the European Commission (2007)
- Implemented by the member states
 - **Legally binding** Implementing Rules
 - Data has to be provided by **Geo Web Services**
- Fully Operable in 2019
- Focus: **environmental applications**
- Interoperability: Data Specifications **for 34 spatial themes**
- Focus of presentation: INSPIRE model for **Buildings**



- Analysis of **use cases** for building data
 - 70 use cases: Environment, Safety, Navigation, Map generation, Statistics, Energy, ...
 - Identification of requirements
- Analysis of **existing standards** in the context of buildings
 - national (e.g. the German AAA-Model)
 - international:
 - CityGML (3D City Models)
 - IFC (Building Information Models, BIM)
 - DGIWG
 -
- Analysis of **data availability** in EU member states

1. Energy / Sustainable buildings
2. Promoting the reduction of CO₂ emissions by buildings
3. Calculation of Sun exposure

1. Energy / Sustainable buildings

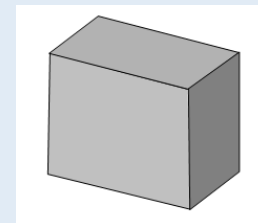
- Aim: promote the sustainability of buildings during their whole life-cycle
- Implementing the Energy Performance of Building Directive (Building is either new, rent or sold)
- Attributes needed:
 - size of building
 - classification (function/usage), to exclude e.g. religious buildings or industrial sites
 - age, no. of floors
- result: attribute engeryPerformance

2. Promoting the reduction of CO₂ emissions by buildings
 - Aim: assess energy demand of buildings and/or to detect houses with heat losses and to encourage owners to make insulation works
 - Attributes/features needed:
 - Area/no. of floors, building units, material of roof, material of façade, heating source, heating system
 - Analysis of more detailed data: 3D geometry with shape of roofs and openings
3. Calculation of Sun exposure
 - LoD2 Buildings
 - material of roof and/or roof type (suitability for solar panels)

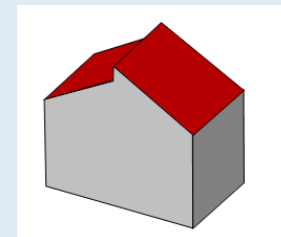
Profile	Normative	Geometry	Semantics
Core2D	Yes	2D/2.5D, polygon/point	features: Buildings, BuildingParts basic semantics: yearOfConstruction, name, usage, #storeys, ...
Core3D	Yes	3D, CityGML LoD1-3	same as Core2D
Extended2D	No	2D/2.5D, polygon/point	Core2D, plus features Constructions, Installations; rich semantics: materials of façade/roof, heating system, energy performance, ...
Extended3D	No	3D, CityGML LoD1-4	Extended2D, plus CityGML-features (Walls, Doors, Windows, Installations, Textures...), Materials for WallRoofSurfaces

Profile	Normative	Geometry	Semantics
Core2D	Yes	2D/2.5D, polygon/point	features: Building basic semantic name, ...
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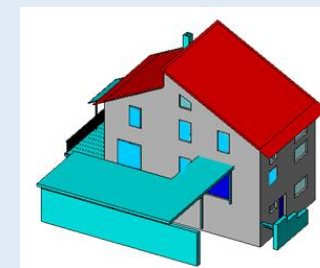
LoD1



LoD2



LoD3

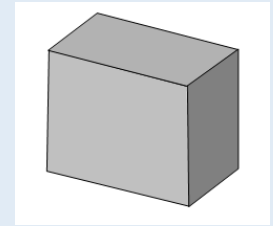


Images:: KIT Karlsruhe

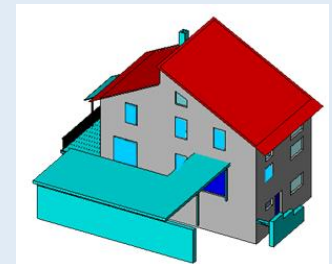
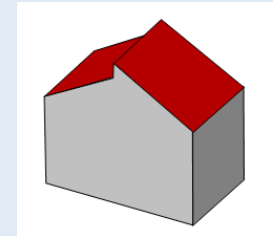
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Profile	Normative	Geometry	Semantics
Core2D	Yes	2D/2.5D, polygon/point	features: Building basic semantics: name, usage, #
Core3D	Yes	3D, CityGML LoD1-3	same as Core2D
Extended2D	No	2D/2.5D, polygon/point	Core2D, plus features: Installations: materials , systems
Extended3D	No	3D, CityGML LoD1-4	Extended2D (Walls, Doors, Windows, etc.) Installations, Technical details for WallRoofSurface

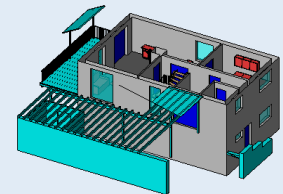
LoD1



LoD2

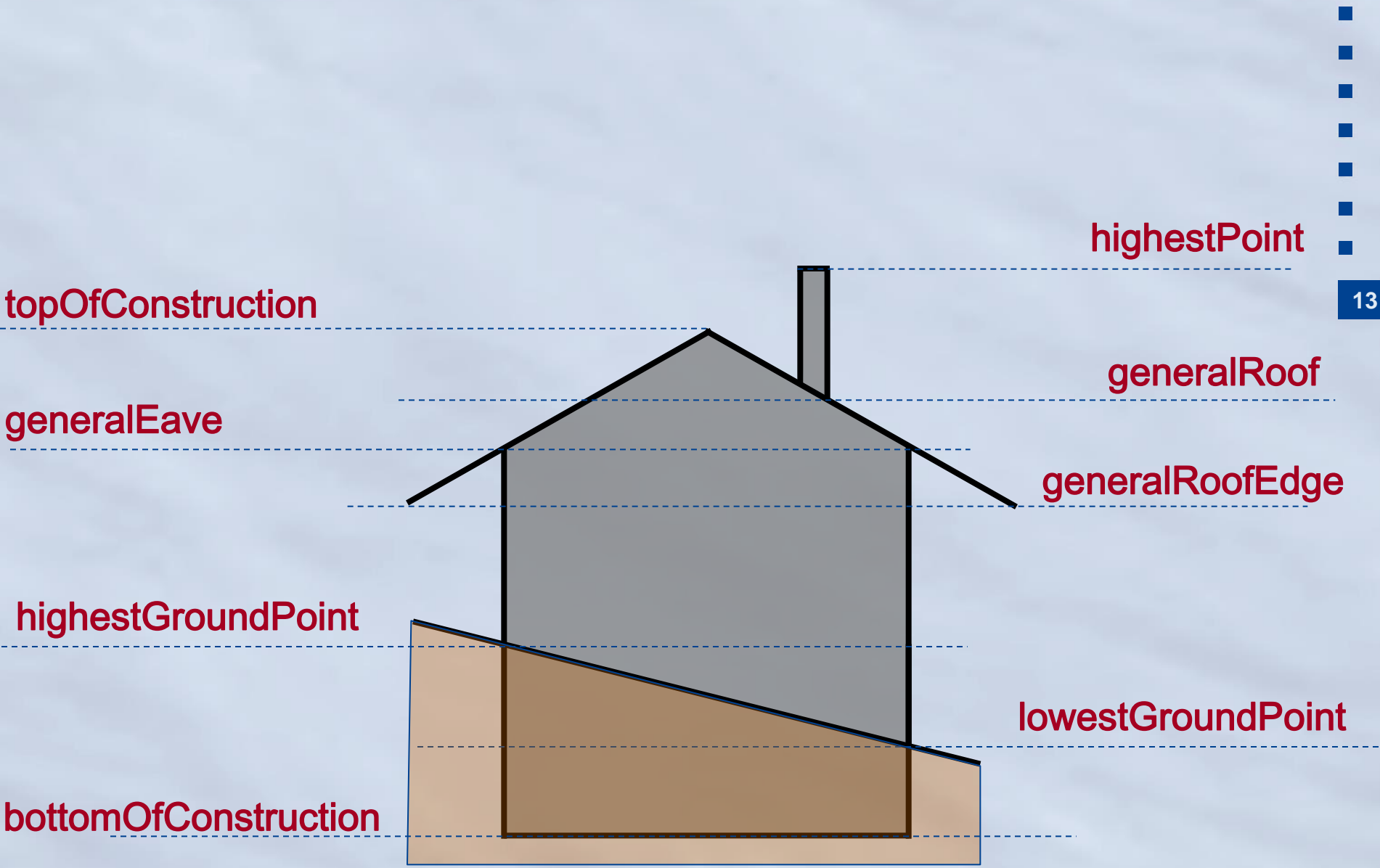


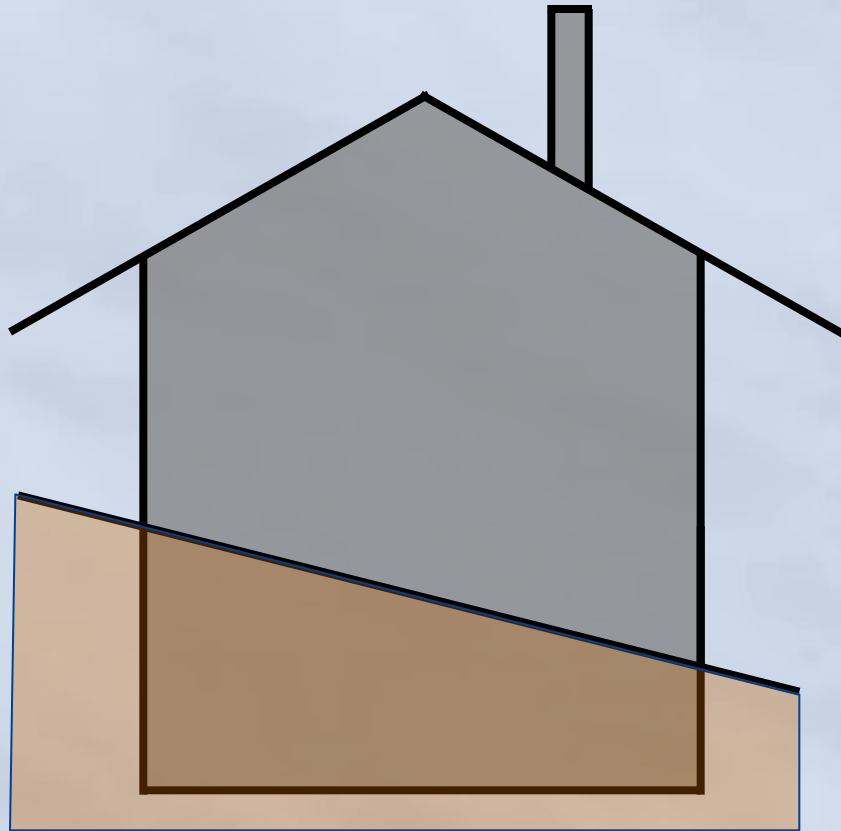
LoD4



Images:: KIT Karlsruhe

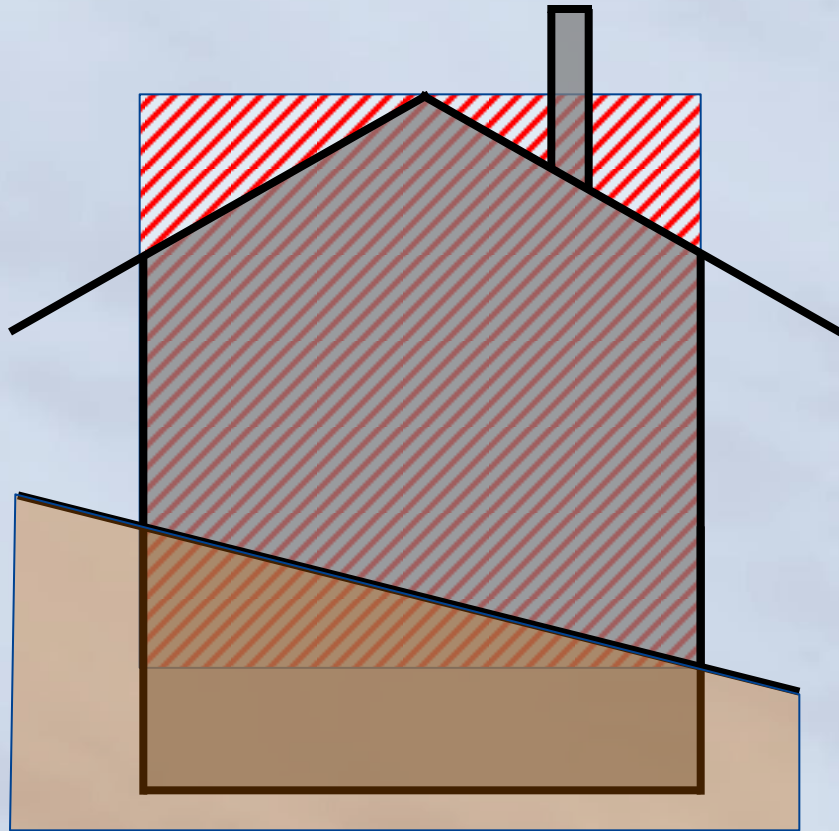
- Metadata allow for a more precise calculation of the volume of a LoD1 solid and of LoD2/LoD3 buildings (not provided in CityGML):
 - Reference for **top** of LoD1 block
 - ElevationReference (highestPoint, topOfConstr., ...)
 - LoD1 only (higher LoDs: actual roof shape)
 - Reference for **bottom** of geometries
 - ElevationReference (lowest/highestGroundPoint)
 - LoD1 – LoD3
 - Horizontal reference of the LoD1 or LoD2 geometry
 - Values: footprint, roof edge, ...



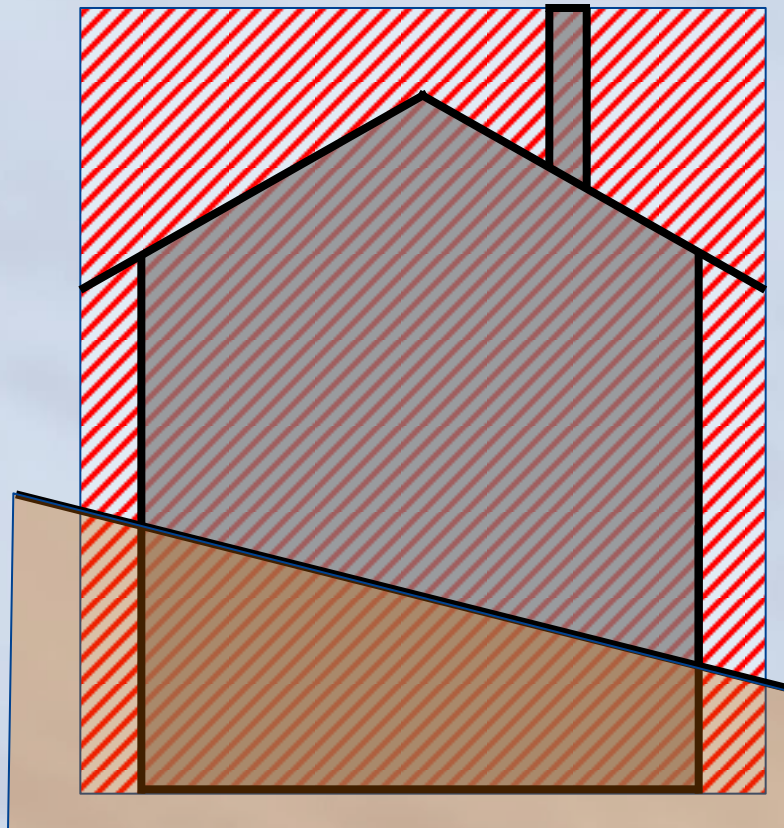


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- Top Reference: topOfConstruction
- Bottom Reference: lowestGroundPoint
- Horizontal reference: footPrint



- Top Reference: highestPoint
- Bottom Reference: bottomOfConstruction
- Horizontal reference: roofEdge



- Building/BuildingPart
 - connectionToElectricity/Gas/Water/Sewage (boolean)
 - heatingSource
 - values: biogas, electricity, liquidFuels, naturalGas, solidFuels, straw, warmWaterOrStream
 - heatingSystem
 - values: centralHeating, districtHeating, electricRaditors, heatPump, portableGasHeating, solarHeating, stove
 - energyPerformance
 - values: A, B, C, D, E, F, G
 - dateOfAssessment
 - assessmentMethod

- Building/BuildingPart (cont')
 - materialOfRoof/ Facade /Structure
 - values: adobe, asbestos, ceramicTiles, composite, concrete, glass, limestone, ...
 - FloorDescription
 - areaOfOpenings (doors, windows, open space) on the facade of the building, related to this given floor
 - floorArea
- Wall-/Roof Surfaces
 - materialOfRoof/Facade
 - Values: asbestos, ceramicTile, clayTile, composition, concreteTile, corrugatedSheet, glass, hotMoppedAsphalt, ...

- Standard INSPIRE **encoding**: automatically deriving XML schemas from UML diagrams
- Standard encoding is different to CityGML encoding
- Alternative encoding for INSPIRE Building model as CityGML **Application Domain Extension** (ADE)
- INSPIRE CityGML ADE enables the use of **CityGML tools** (visualization, editing, representation, conversion, ...) for INSPIRE buildings
- Currently for the Core3D profile, Extended3D in preparation
- INSPIRE ADE is developed by TWG BU and the TU Munich (Prof. Kolbe)

- Preparation of Changes: 14 Working Packages/Groups
- Work in progress (until 2016)
- Energy-relevant changes (more or less agreed on):
 - Indoor features (Rooms, ...) in all LoD (LoD0 – 3)
 - Openings and BoundarySurfaces in all LoD (LoD1 – 3)
 - Stories in the Building module
 - INSPIRE Metadata (reference for top, bottom, horizontal reference) will be included

- INSPIRE Building Model: **flexible model** (4 profiles, 2D and 3D)
- Influenced by **CityGML**, extends CityGML
- Profile extended3D provides many attributes relevant for energy applications
- Discussion to add INSPIRE concepts to CityGML
→ **Harmonization** between INSPIRE and CityGML

Thank you for your
attention