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SIG3D proposal for a revised CityGML LoD concept

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Former activities

- Until end 2012, SIG3D AG-Modellierung worked in the several areas to enhance CityGML 2.0
  - New LoD concept (WP03)
  - New Features *Storey* ard *BuildingUnit* in Building module (WP13)
  - Additional matadata for Building module according to INSPIRE (WP12)
- The new concept was further enhanced in publications of G. Gröger, M.O. Löwner, K.-H. Häfele und J. Benner

New LoD Concept– 1

- Elimination ofLoD4
- Independent modelling of the building's exterior shell and interior components
- All top-level features of the exterior shell(Building/ BuildingPart) and the building interior (Room) may occur in 4 different types of geometrical representation (Basic-LoD)
  - LoD0 - Representation of a specific two-dimensional view (e.g. the footprint of a building or of a room) of the modelled object by a 2.5 D surface.
  - LoD1 - Representation of a specific two-dimensional view (e.g. the footprint of a building or of a room) of the modelled object by a vertical extrusion solid.
  - LoD2 - Geometrically generalized representation of the real exterior shell of a building or room, respectively.
  - LoD3 - Geometrically exact representation of the real exterior shell of a building or room, respectively.

New LoD Concept– 2

- From LoD2, all top-level features may occur with different semantical structuring (Semantic Level):
  - S0 - No further semantic structuring of the features
  - S1 - Semantic structuring by BoundarySurfaces
  - S2 - Semantic structuring by BoundarySurfaces and special features
  - S3 - Semantic structuring by BoundarySurfaces with Doors or Windows and special features
- The geometric and semantic modelling depth of a **complete Building object** is explicitly indicated by a structured label
- Up to now, the new concept does not take into account the new features *Storey* and *BuildingUnit*

Basic LoD

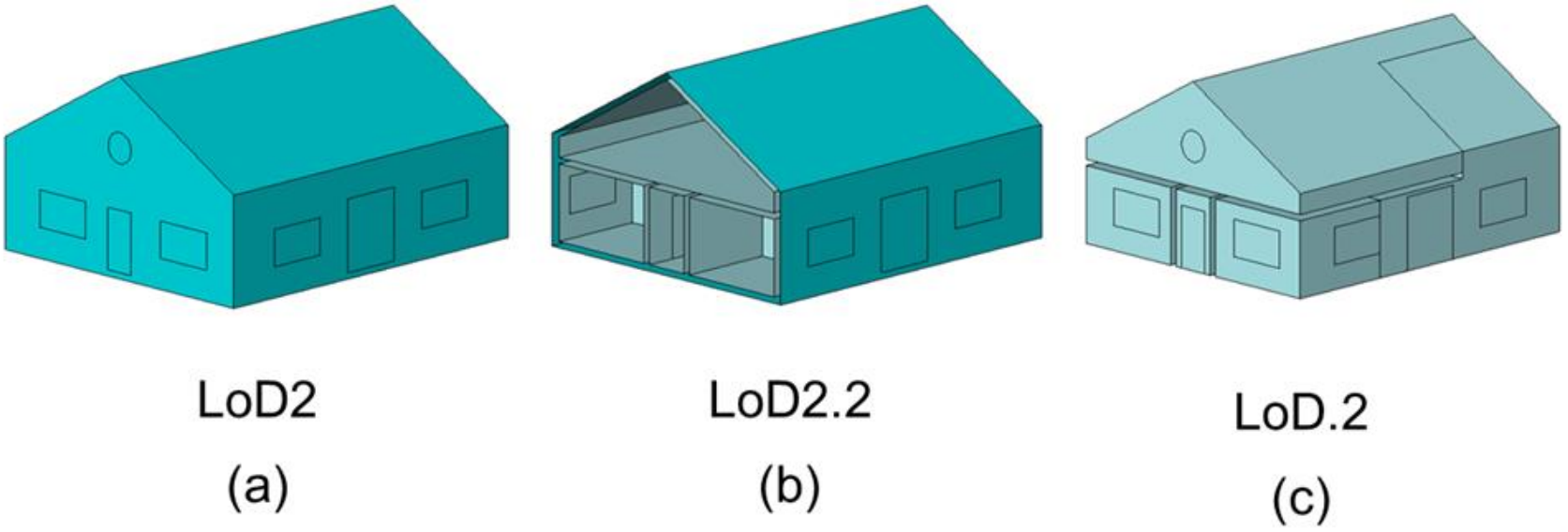


Figure 4: Basic LoD labelling examples: (a) LoD2 exterior shell without interior structure; (b) LoD2 exterior shell with LoD2 rooms; (c) LoD2 rooms without exterior shell (source: Karlsruhe Institute of Technology)

Semantic Level

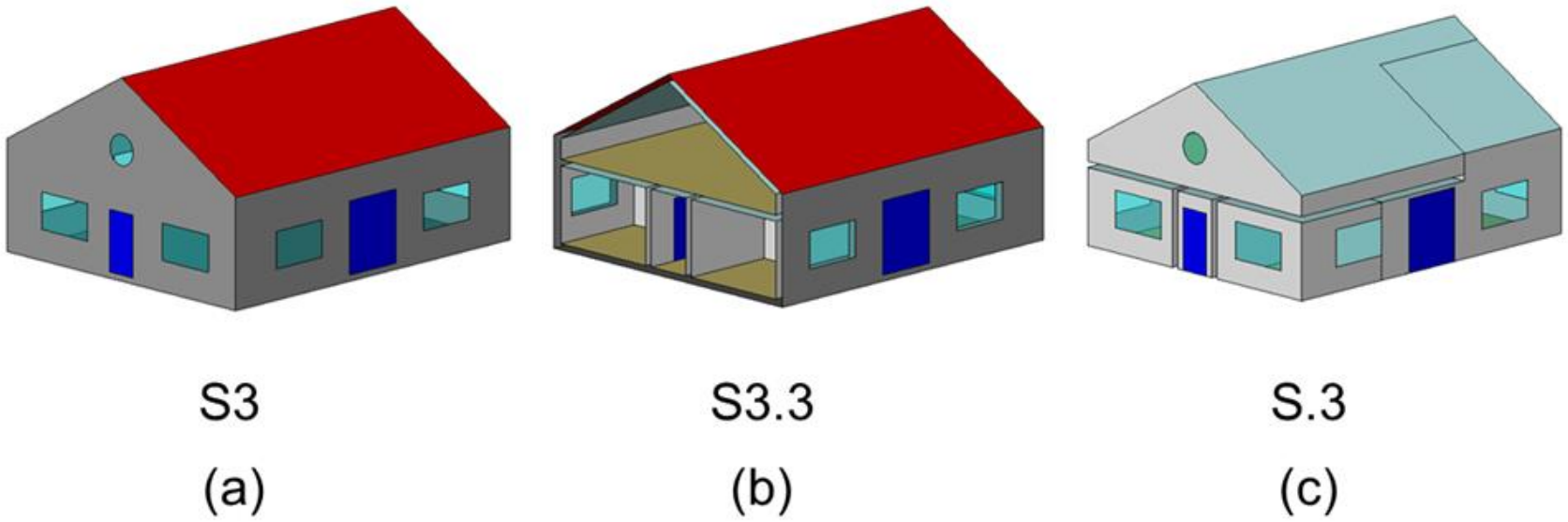
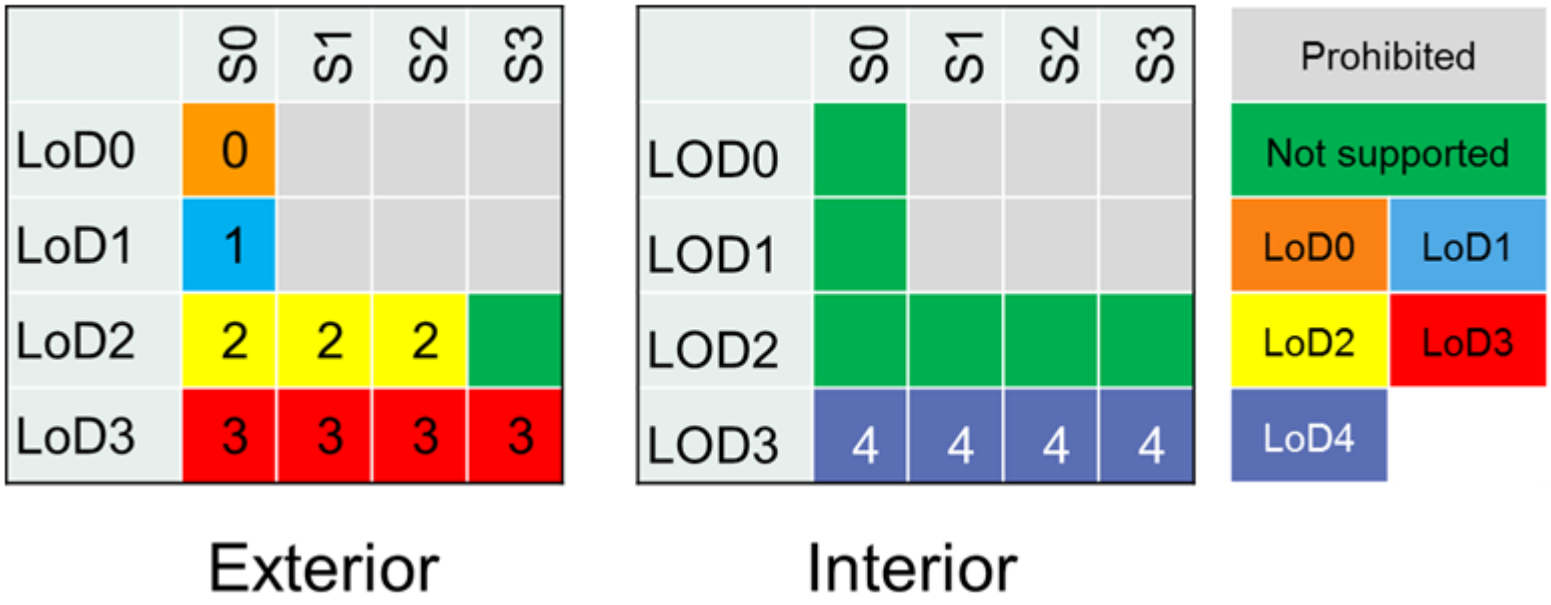


Figure 5: Examples for the labelling of Semantic Levels: (a) S3 exterior shell without interior structure; (b) S3 exterior shell with S3 rooms; (c) S3 rooms without exterior shell (source: Karlsruhe Institute of Technology)

Combination Basic LoD – Semantic Level

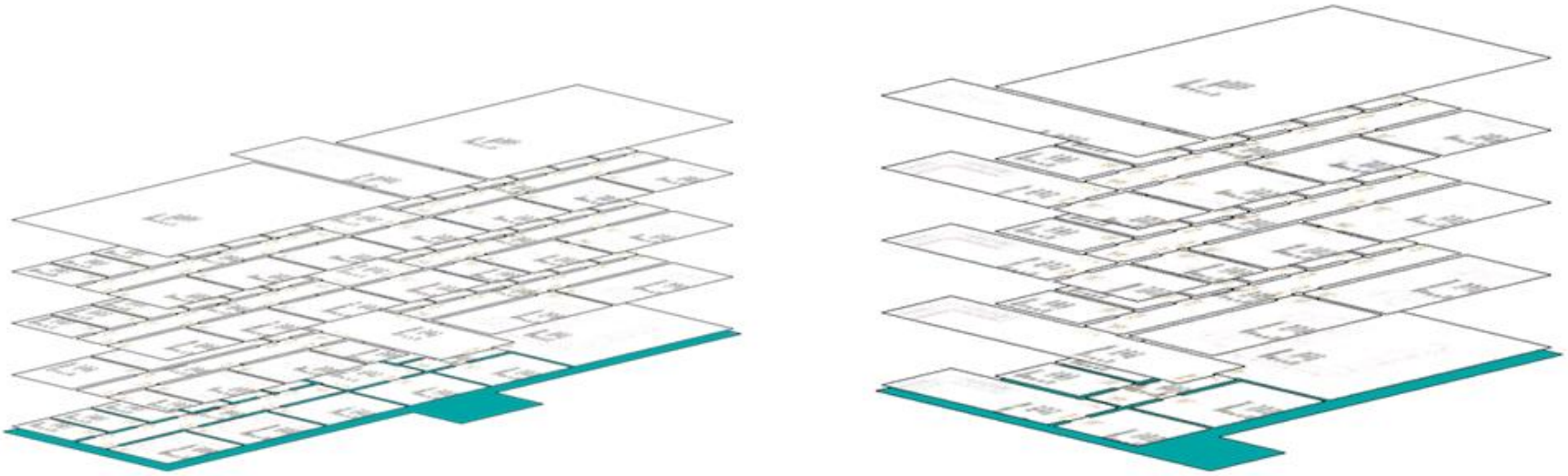


The restrictions of LoD0 and LoD1 could be canceled
if there are use cases for the corresponding model types

Combination "Interior components" and "Exterior shell"

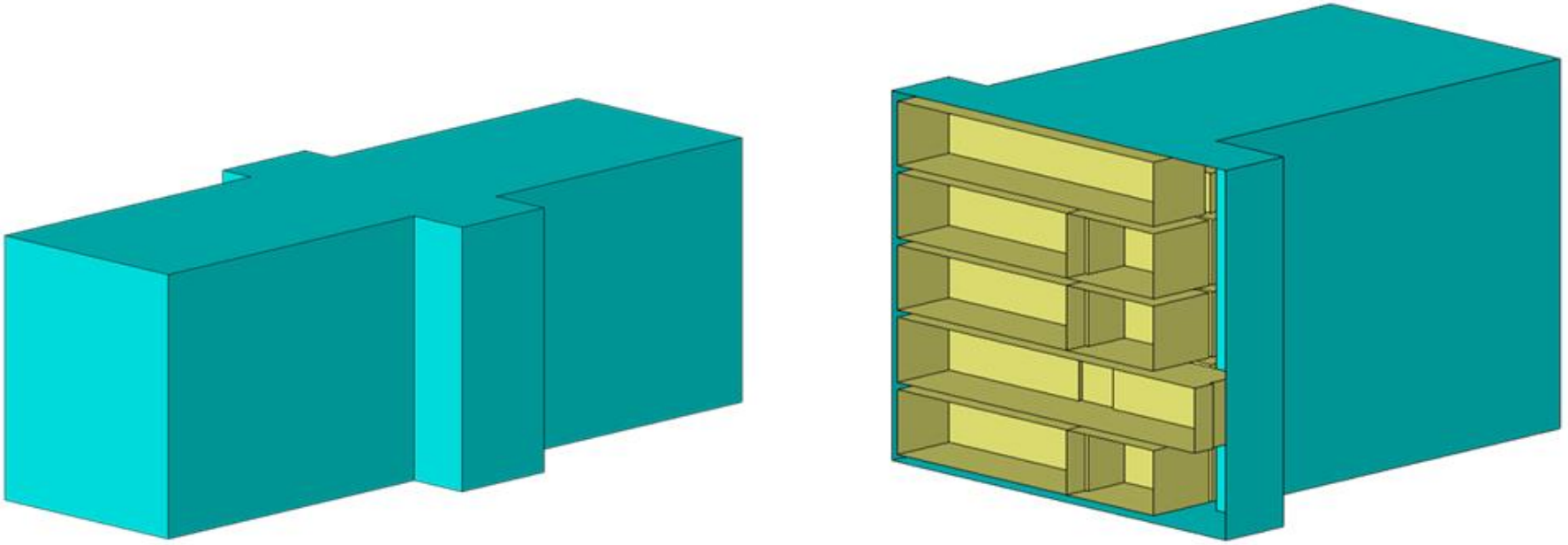
		Exterior shell									
		Not modeled	LoD0/S0	LoD1/S0	LoD2/S0	LoD2/S1	LoD2/S2	LoD2/S3	LoD3/S0	LoD3/S1	LoD3/S2	LoD3/S3
	Not modeled		0 (S0)	1 (S0)	2 (S0)	2 (S1)	2 (S2)	2 (S3)	3 (S0)	3 (S1)	3 (S2)	3 (S3)
Interior components	LoD0/S0	.0 (S.0)	0.0 (S0.0)	1.0 (S0.0)	2.0 (S0.0)	2.0 (S1.0)	2.0 (S2.0)	2.0 (S3.0)	3.0 (S0.0)	3.0 (S1.0)	3.0 (S2.0)	3.0 (S3.0)
	LoD1/S0	.1 (S.0)	0.1 (S0.0)	1.1 (S0.0)	2.1 (S0.0)	2.1 (S1.0)	2.1 (S2.0)	2.1 (S3.0)	3.1 (S0.0)	3.1 (S1.0)	3.1 (S2.0)	3.1 (S3.0)
	LoD2/S0	.2 (S.0)	0.2 (S0.0)	1.2 (S0.0)	2.2 (S0.0)	2.2 (S1.0)	2.2 (S2.0)	2.2 (S3.0)	3.2 (S0.0)	3.2 (S1.0)	3.2 (S2.0)	3.2 (S3.0)
	LoD2/S1	.2 (S.1)	0.2 (S0.1)	1.2 (S0.1)	2.2 (S0.1)	2.2 (S1.1)	2.2 (S2.1)	2.2 (S3.1)	3.2 (S0.1)	3.2 (S1.1)	3.2 (S2.1)	3.2 (S3.1)
	LoD2/S2	.2 (S.2)	0.2 (S0.2)	1.2 (S0.2)	2.2 (S0.2)	2.2 (S1.2)	2.2 (S2.2)	2.2 (S3.2)	3.2 (S0.2)	3.2 (S1.2)	3.2 (S2.2)	3.2 (S3.2)
	LoD2/S3	.2 (S.3)	0.2 (S0.3)	1.2 (S0.3)	2.2 (S0.3)	2.2 (S1.3)	2.2 (S2.3)	2.2 (S3.3)	3.2 (S0.3)	3.2 (S1.3)	3.2 (S2.3)	3.2 (S3.3)
	LoD3/S0	.3 (S.0)	0.3 (S0.0)	1.3 (S0.0)	2.3 (S0.0)	2.3 (S1.0)	2.3 (S2.0)	2.3 (S3.0)	3.3 (S0.0)	3.3 (S1.0)	3.3 (S2.0)	3.3 (S3.0)
	LoD3/S1	.3 (S.1)	0.3 (S0.1)	1.3 (S0.1)	2.3 (S0.1)	2.3 (S1.1)	2.3 (S2.1)	2.3 (S3.1)	3.3 (S0.1)	3.3 (S1.1)	3.3 (S2.1)	3.3 (S3.1)
	LoD3/S2	.3 (S.2)	0.3 (S0.2)	1.3 (S0.2)	2.3 (S0.2)	2.3 (S1.2)	2.3 (S2.2)	2.3 (S2.3)	3.3 (S0.2)	3.3 (S1.2)	3.3 (S2.2)	3.3 (S3.2)
	LoD3/S3	.3 (S.3)	0.3 (S0.3)	1.3 (S0.3)	2.3 (S0.3)	2.3 (S1.3)	2.3 (S2.3)	2.3 (S3.3)	3.3 (S0.3)	3.3 (S1.3)	3.3 (S2.3)	3.3 (S3.3)

Example LoD Label – 1



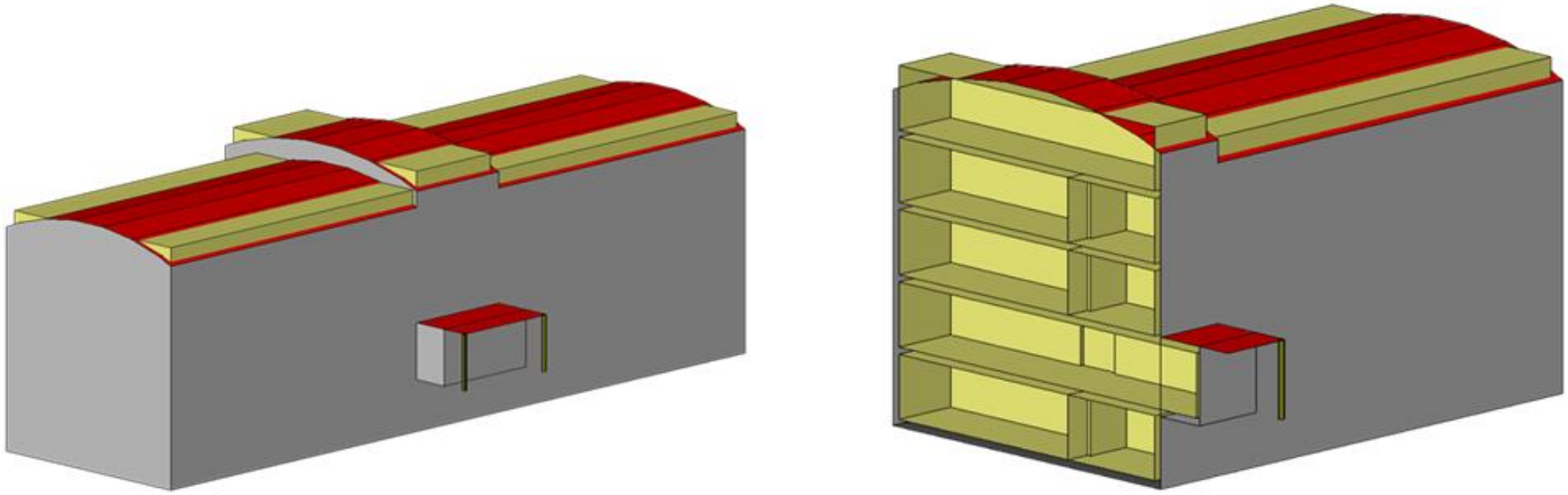
LoD0.0(S0.0)

Example LoD Label – 2



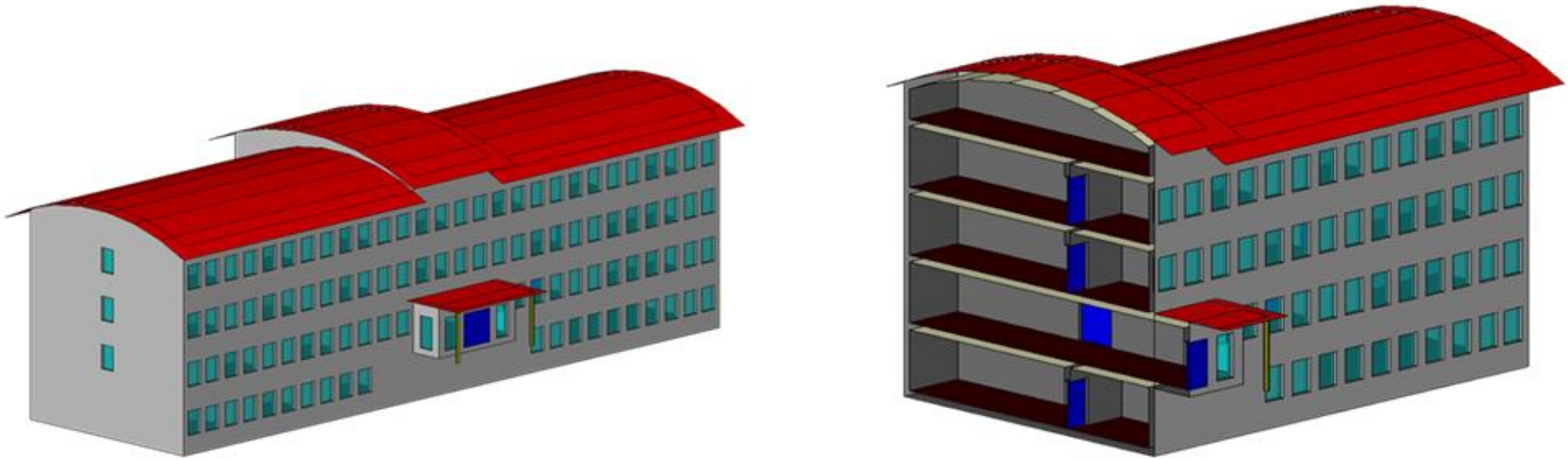
LoD1.1(S0.0)

Example LoD Label – 3



LoD2.1(S2.0)

Example LoD Label – 4



LoD3.3(S3.3)

Comparison with the LoD proposal of Claus Nagel

- Conceptionally, the SIG 3D proposal is not far away from the proposal of Claus. The only differences are some (debatable) restrictions on the allowed representations of secondary features like, e.g., BoundarySurfaces, Openings or BuildingInstallations
- The central difference lies in the understanding of the LoD property
  - For Claus, the LoD is simply the name of a geometry property of a CityGML feature
  - For us, the LoD is a property, indicating with which geometric and semantic quality a building (or other city objects like bridges, water bodies, traffic objects, ..) are represented in CityGML.

Some general remarks to the proposal of Claus

- Claus frequently addresses the "simplicity" of a data model without precisely defining how "simplicity" or "complexity" of a data model is defined or measured.
- If we define complexity as the total number of feature types and (geometrical) properties, his proposal is far more complex than the existing CityGML.
- Simplicity has not an absolute value, "simple" solutions often have the most severe (negative) consequences.
- A central use-case of CityGML should be to support the **interoperability** of different applications. Concerning this aspect, a totally general data model without any restrictions is highly counterproductive.
- The IFC experiences show that a totally unrestricted data model is useless. Therefore, in the IFC area exist a huge number of "model view definitions" and "implementer agreements" for making IFC practicable and implementable.

LOD Concepts - Complexity