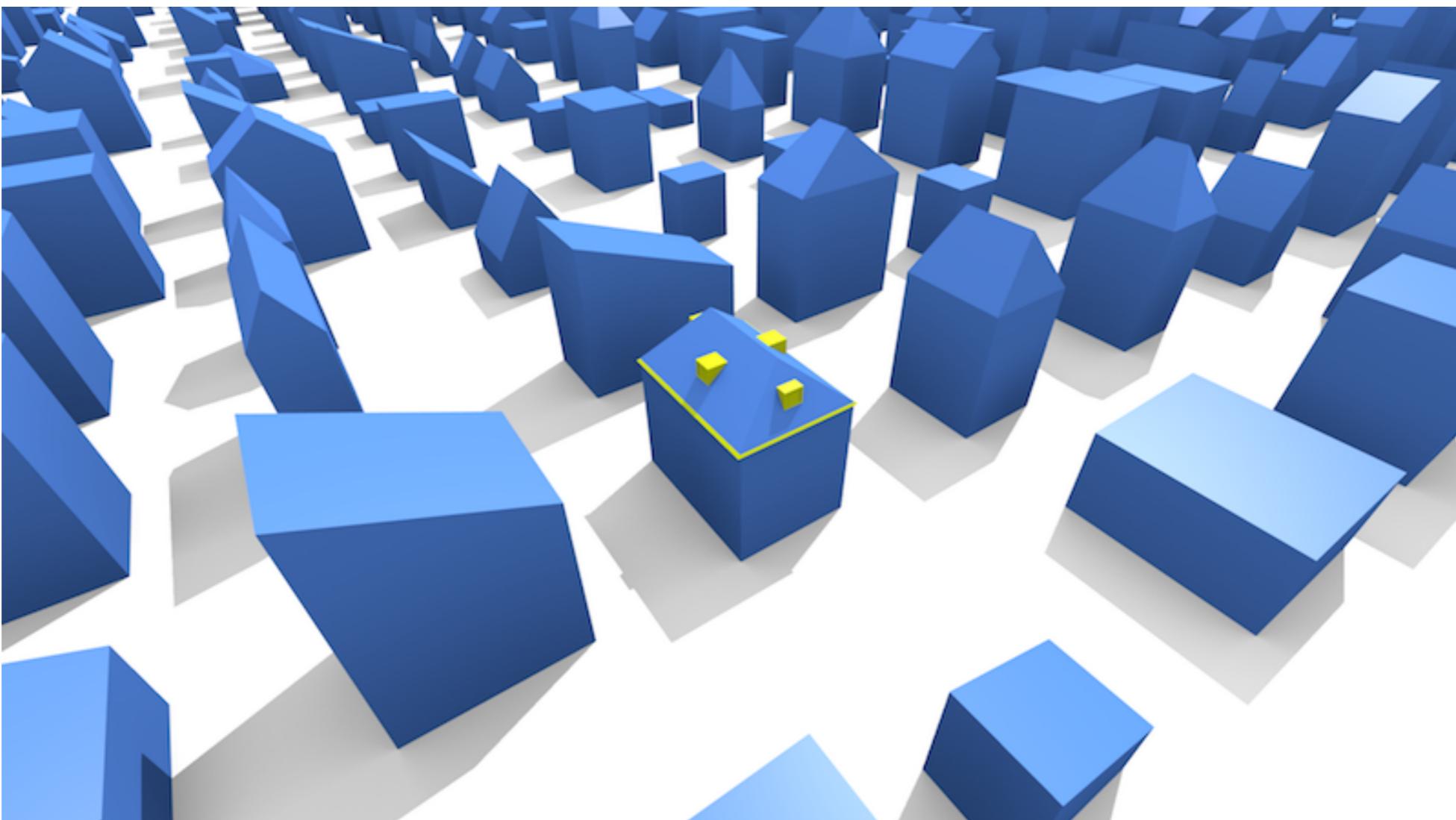


# Importance of specifying the geometric complexity

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Filip Biljecki, TU Delft



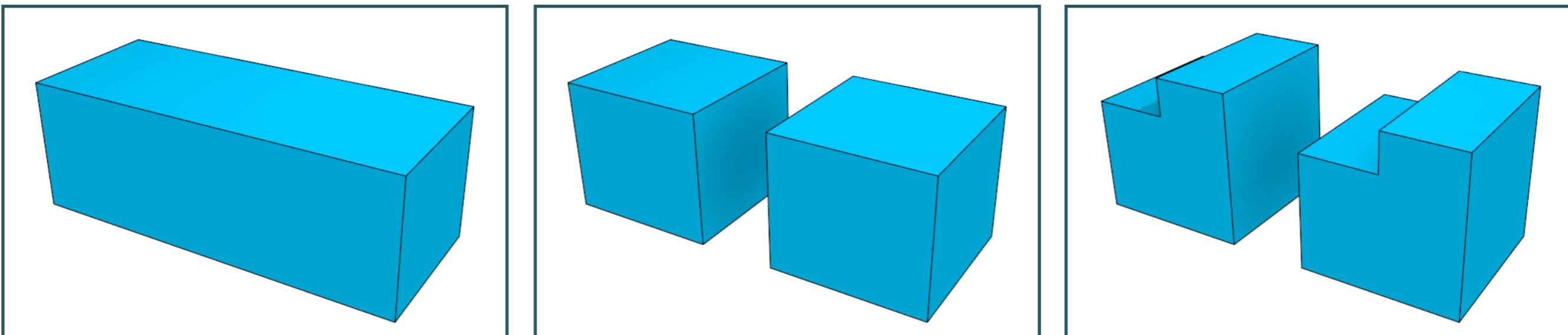
# Background and facts

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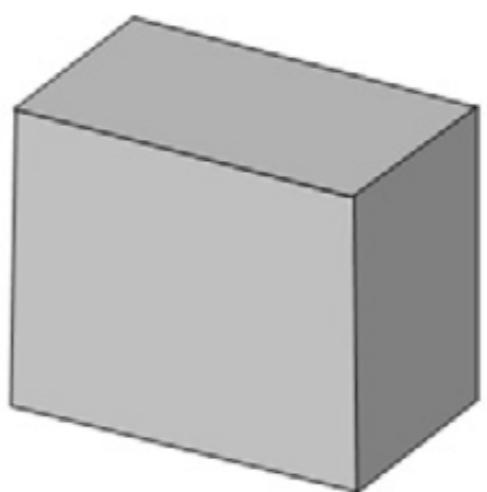
- More or less compatible with other proposals
  - My opinion is that the geometric aspect (which is orthogonal to the semantics) is overlooked in the WP3 discussions
1. Practitioners refer to the CityGML level of detail concept to express the geometric complexity of a model
    - This is the case even when the data will not be stored in CityGML
    - They don't care that much about semantics
  2. Too much ambiguity in CityGML when it comes to the description of the complexity of the geometric representation. What is exactly an LOD2?

# LOD1 – multiple variants

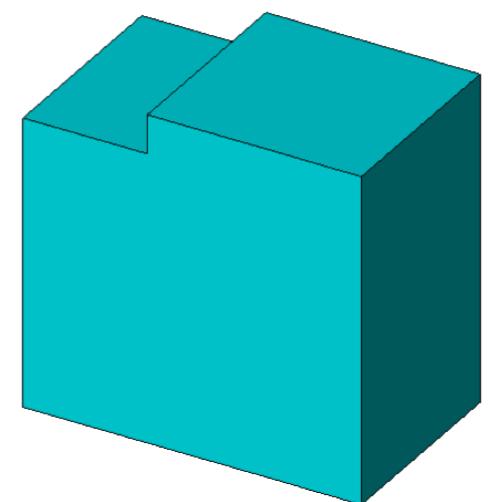
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**LoD 1**



**LoD1**

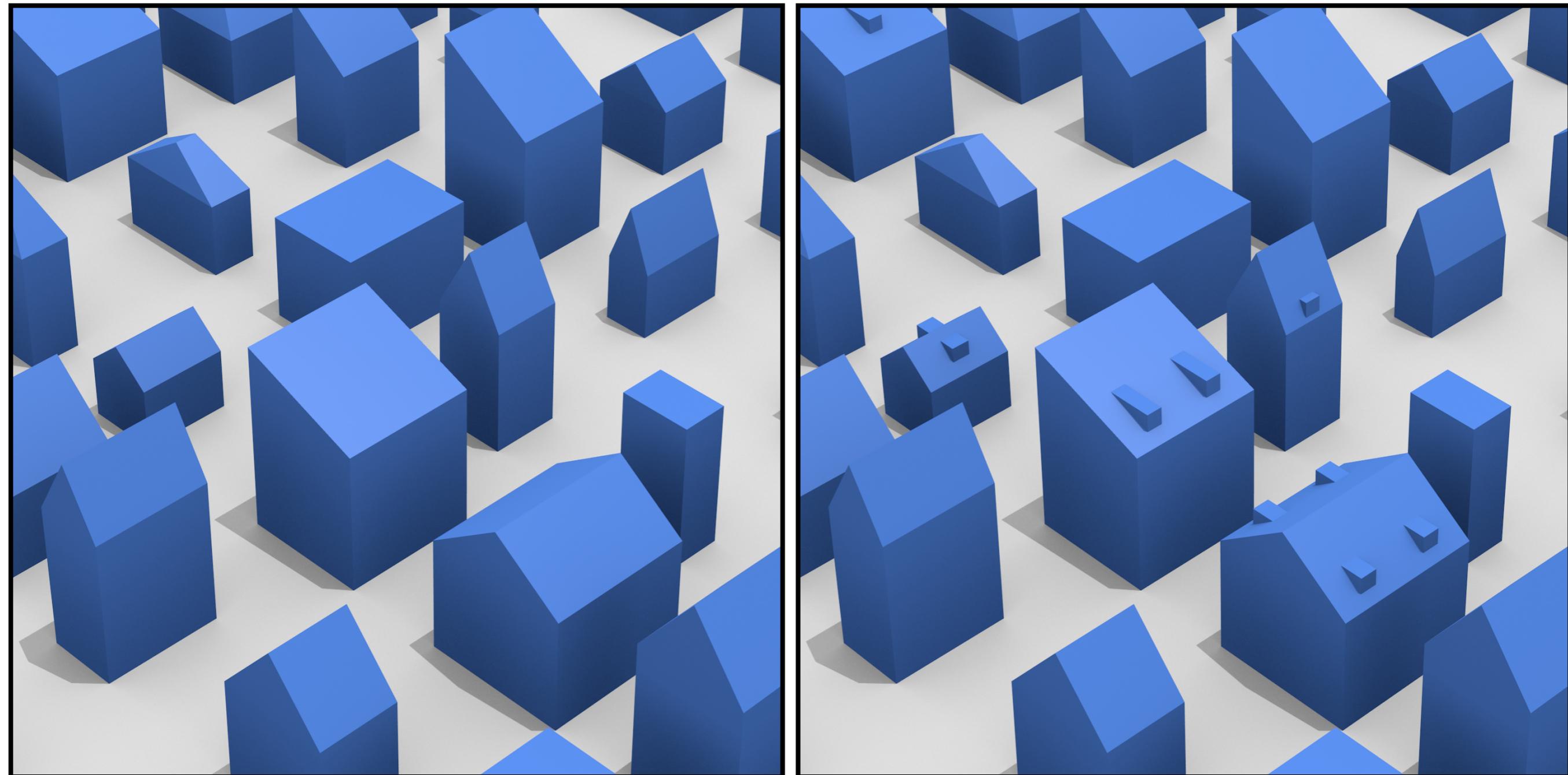


Gröger et al. (2012)

Häfele (2011)

# LOD2

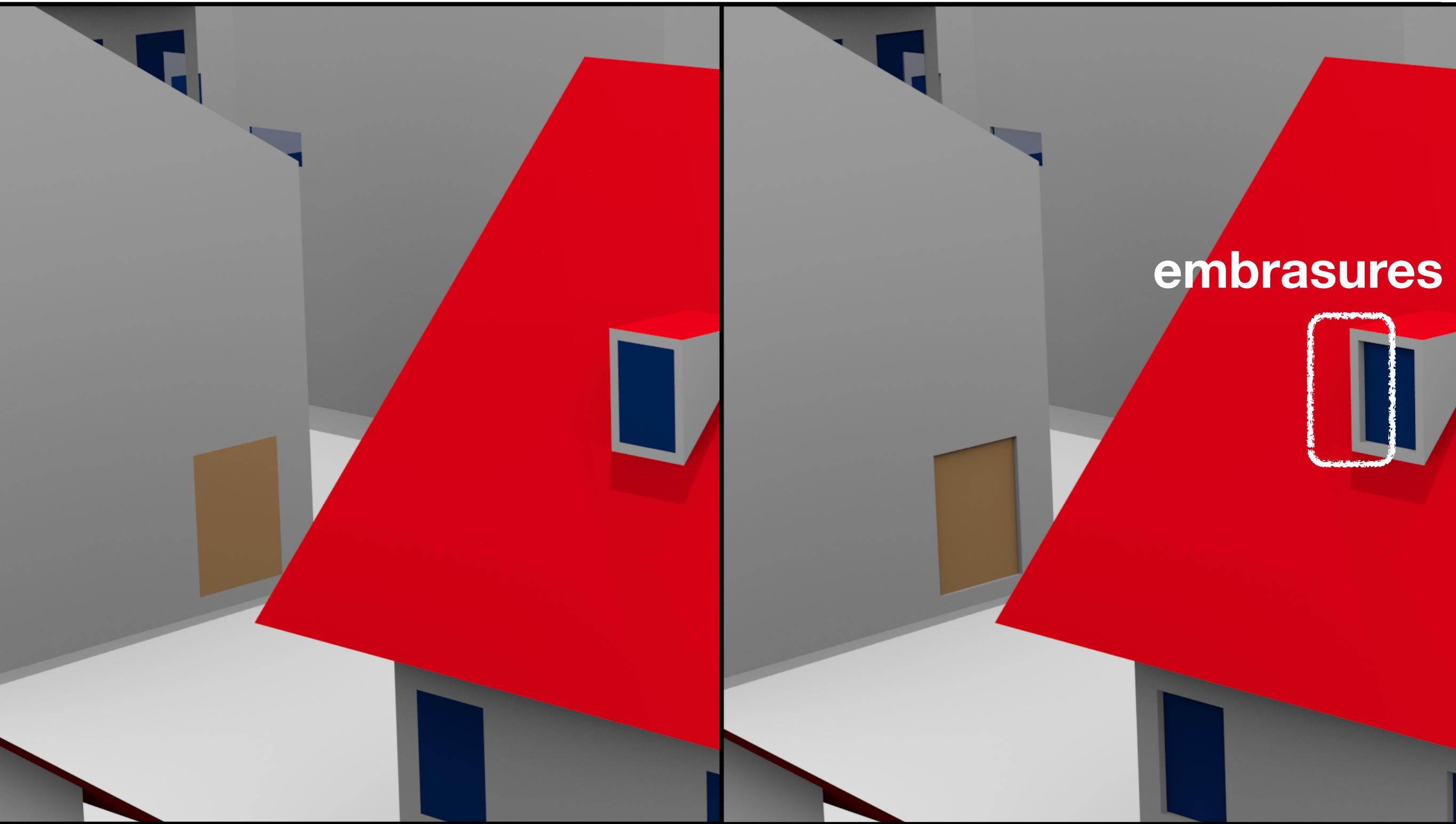
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Should dormers and overhangs be acquired?

# LOD3

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# Consequences

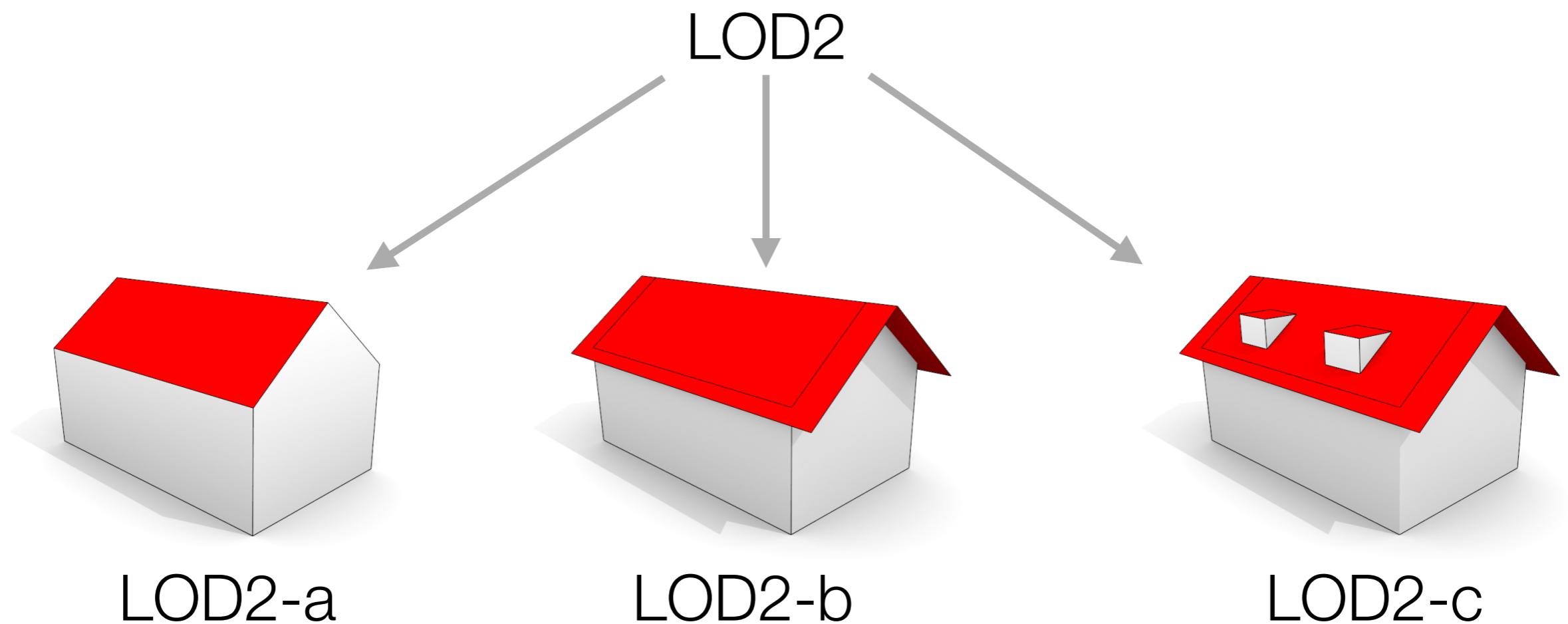
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- Ambiguity: Multiple possible variations within the same LOD which significantly differ in their complexity, acquisition effort, price, end results of the application of the data (e.g. shadow estimation), etc.
- Acquisition techniques are not regarded
  - e.g. overhangs in LOD2 cannot be acquired with aerial photogrammetry or LiDAR which are the most common techniques for deriving an LOD2 (footprints usually not visible, and not available from cadastre)
- Technically, a simple block model can be considered as LOD3 because there are no minimum requirements
- Not possible to store two variants of LOD2 simultaneously
- **Need to distinguish the multiple geometric variants**

# Solution

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- Retain the current concept for general guidelines
  - e.g. “LOD2 is a simple model containing standard roof structures”
- but refine them into multiple geometric representations (sub-LODs) with less ambiguous definitions and regard them in the metadata. Only as guidelines.



# Specifications

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- Should be realised through two main aspects that regard the actual industry practices:
  - List of features to be acquired (e.g. chimneys, windows on walls)
  - Minimum size of these features to be mapped (e.g. 2 m)

Case of dormers, LOD2 acquisition from an orthophoto of GSD 8cm



Courtesy of Geofoto, Zagreb (Croatia)

# Specifications (example)

LOD2	Acquire...	Min. size	Suited for techniques
LOD2-a	Only simple roof shapes	2 m	Aerial LiDAR or photog.
LOD2-b	Simple roof shapes with explicit roof overhangs	0.5 m	Terrestrial LiDAR or cadastre + aerial LiDAR combination
LOD2-c	Roofs with their main constructions and overhangs	0.5 m	High resolution LiDAR/ph. + cadastre

# Conclusion

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- LOD0, LOD1, LOD2, LOD3 fully retained
- Their general geometric description should be, however, enhanced with more details and minimum requirements
- Refinement of each LOD, to be described as modelling guidelines in the standard, rather than a major change in the UML. Such information should be noted in the metadata.
- Less ambiguity and freedom of modelling

# Implementation

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- Early implementation in my procedural modelling engine Random3Dcity (synthetic CityGML data in multiple LODs)
- Around 10 LODs so far—real data already available!
- I will submit a publication in a few weeks