
TU Delft

Automatic building feature detection and reconstruction in IFC models

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TU Delft

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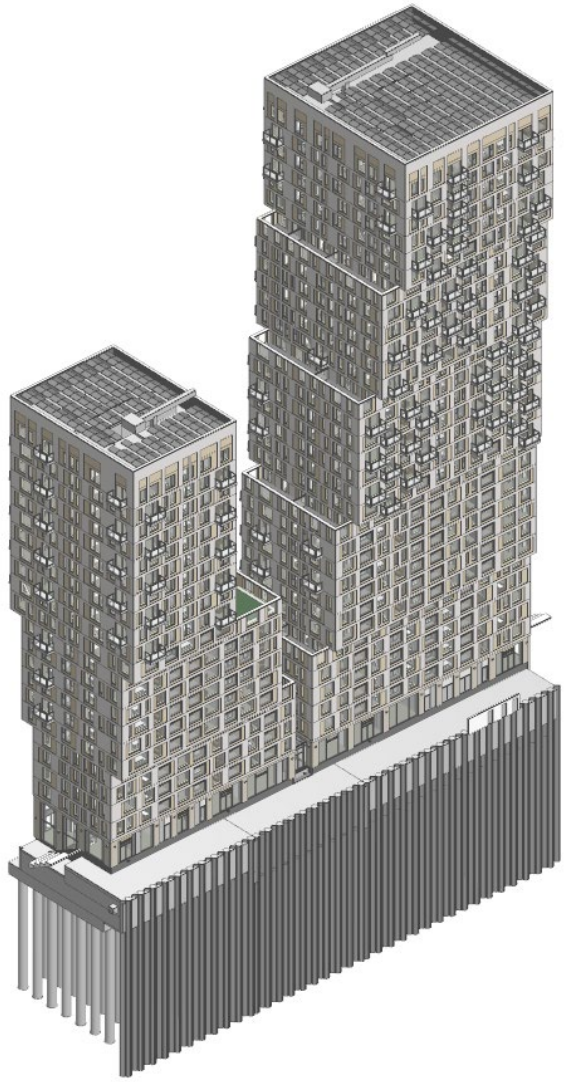
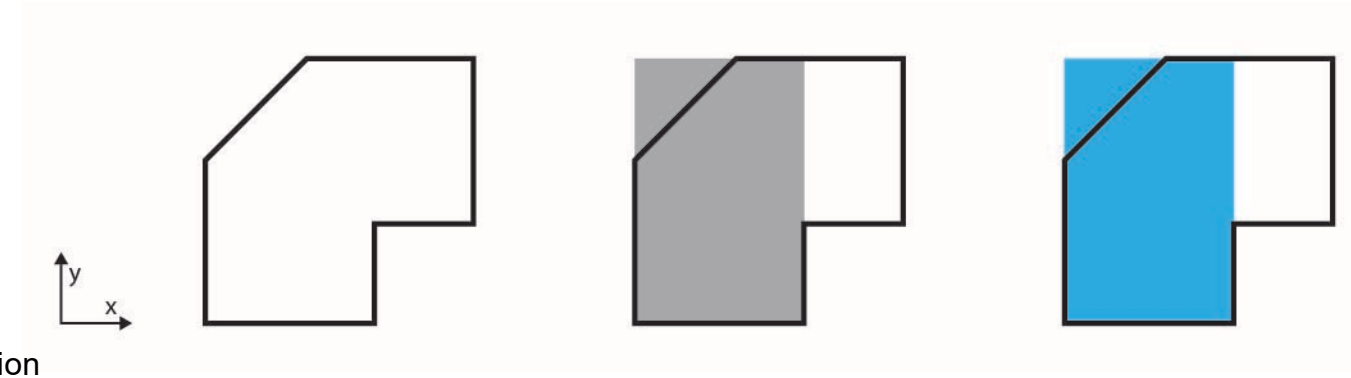
Introduction & Motivation

- IFC (Industry Foundation Classes) format
  - Central role AEC (Architecture, Engineering and Construction) industry
  - Flexible

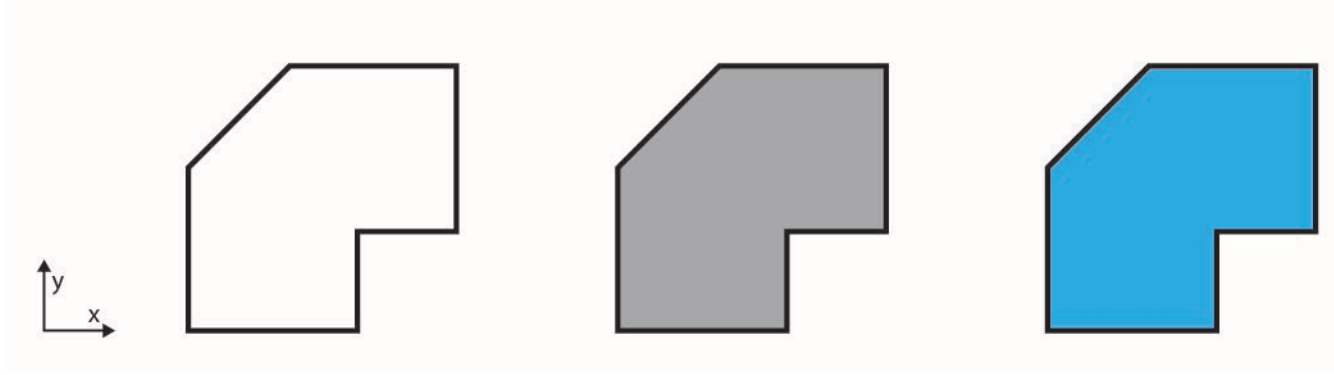
  - Error prone without warning
  - Unreliable
  - Hampers automation chances



Introduction & Motivation



1. Real situation



2. Desired situation

Wall

IfcSpace object

“New” geometry

Introduction & Motivation

- Research question:

  How can building features be automatically detected from an IFC file in a reliable manner?

Limited to:

- Storeys and their elevations
- Rooms
- Apartments

- Sub question:

  What data in an IFC file can be considered accurate and/or reliable and is the minimal needed data to base the reconstruction upon?

Methodology: Reliable data

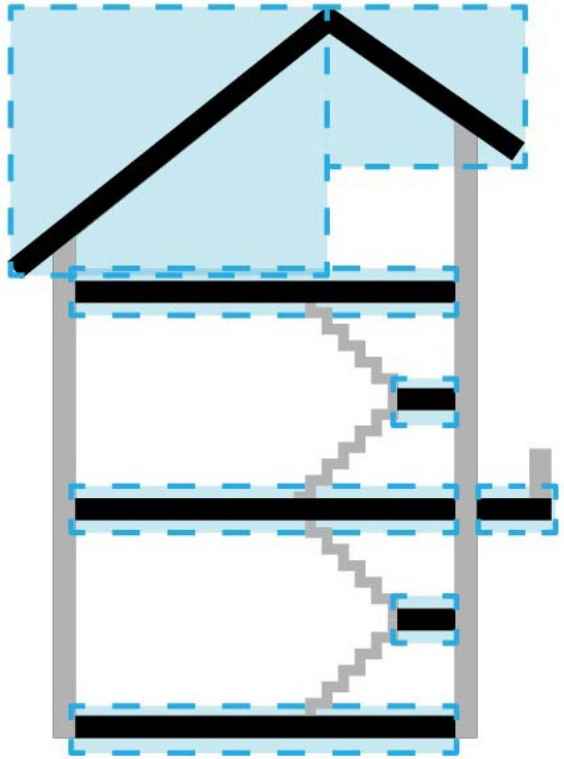
- Tangible geometry
  - Clearly visible
  - Central role for many involved parties
  - Implicitly stores a wealth of other data

  - Is not 100% without errors

- Semantic data can **not** be completely discarded
- Topologic data can be completely discarded

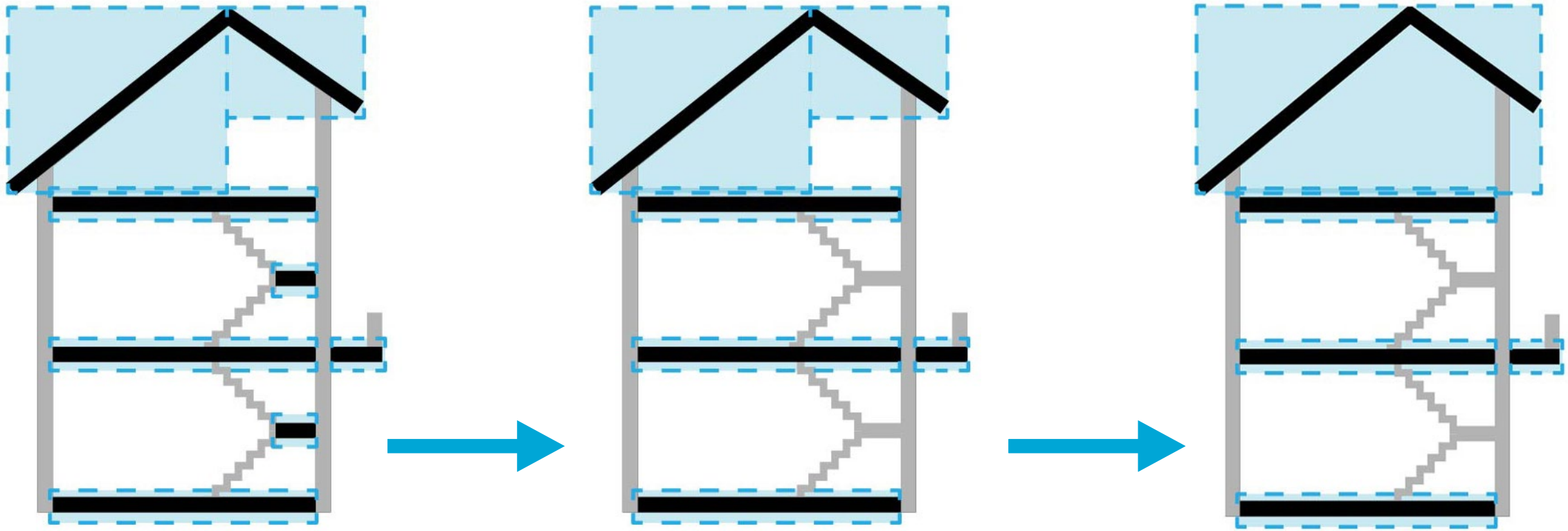
Methodology: **Storey detection** & object sorting

- Extracting the z-values of every object representing a floor or roof
  - IfcSlab & IfcRoof



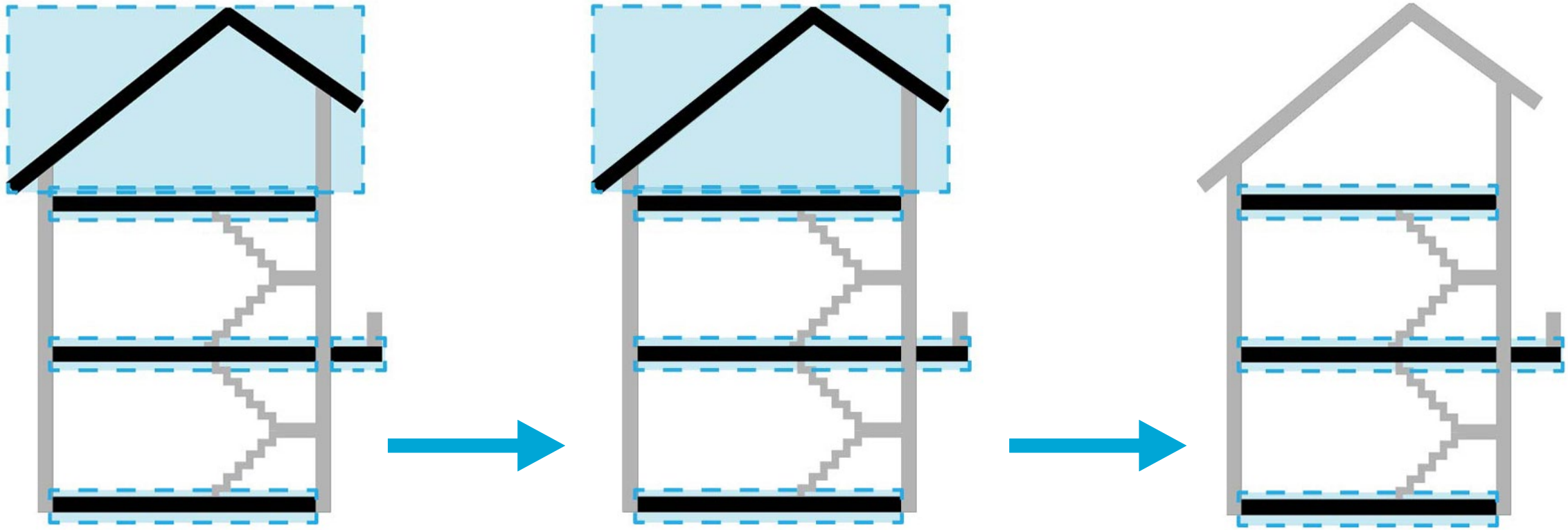
1.

Methodology: **Storey detection** & object sorting



1. 2. 3.

Methodology: **Storey detection** & object sorting



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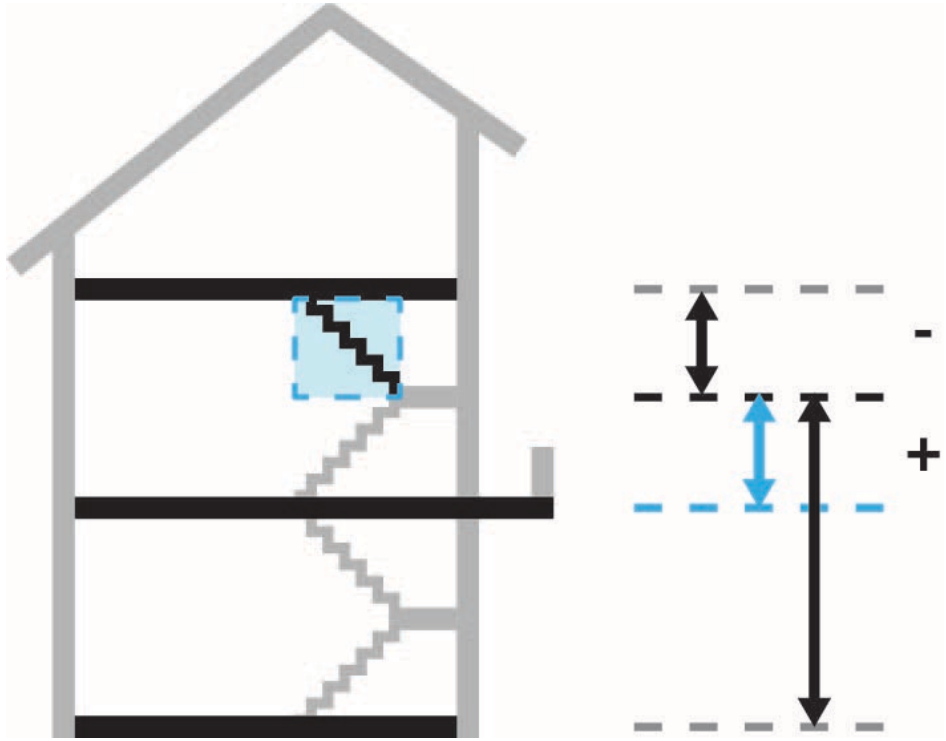
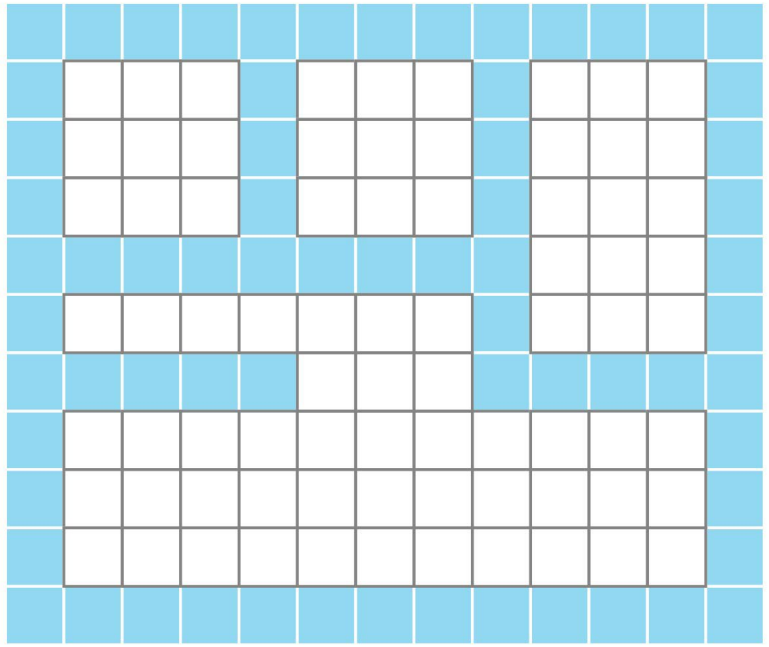
Methodology: Storey detection & **object sorting**



Methodology: Room detection/reconstruction

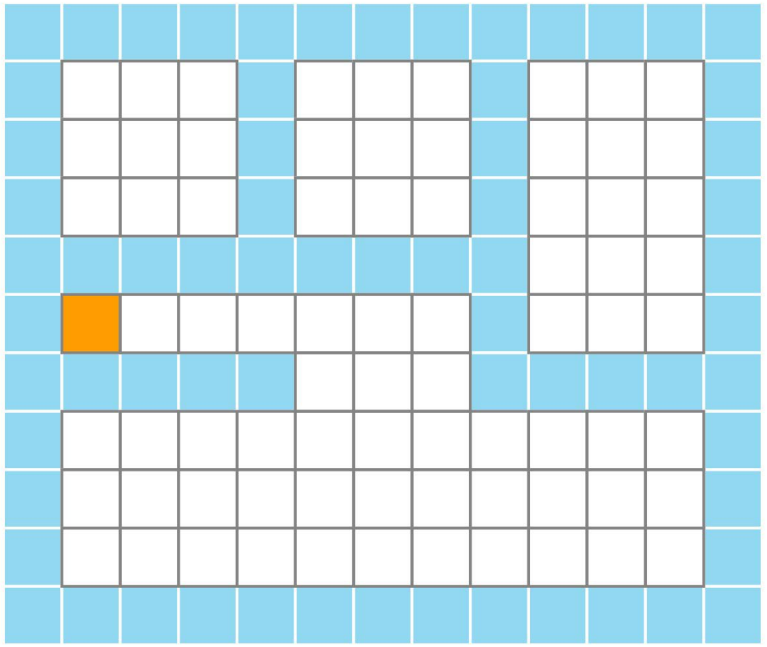
Original plan



Detection process

Methodology: Room detection/reconstruction

Original plan



Detection process

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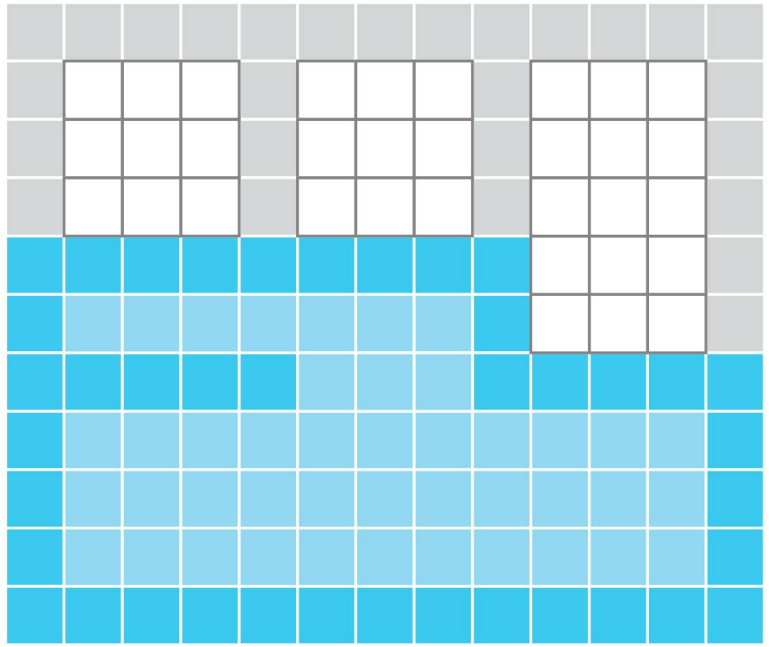

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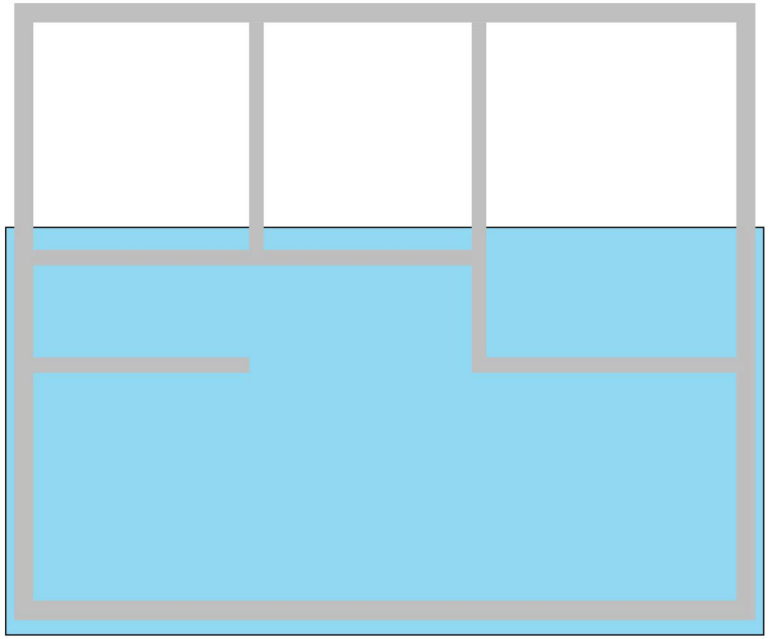

Detection process

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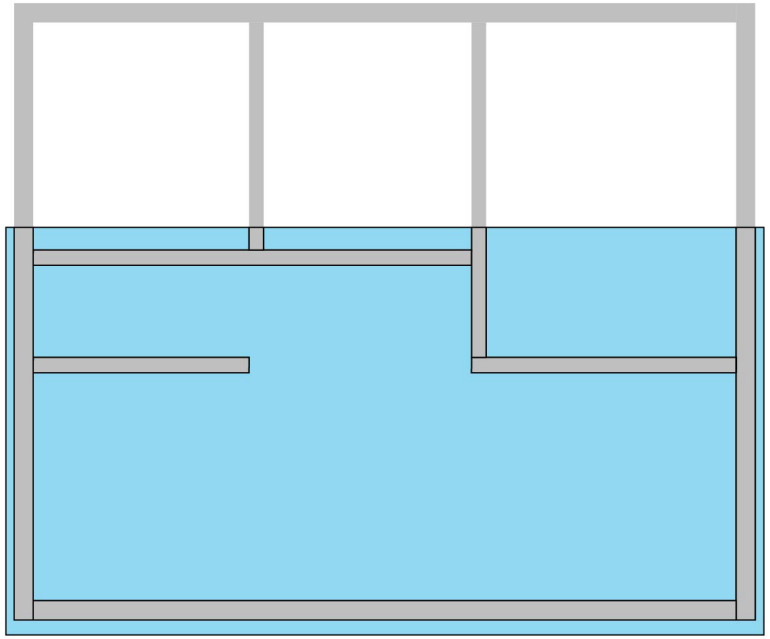
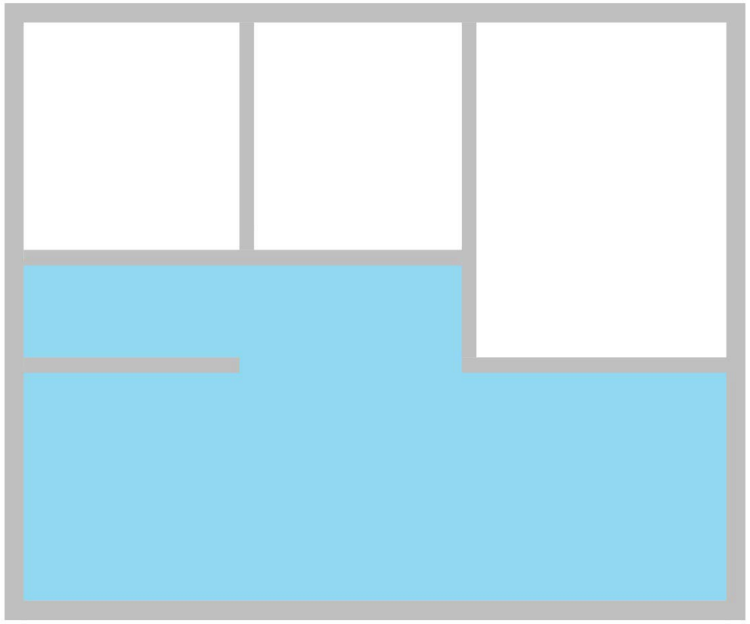


Detection process

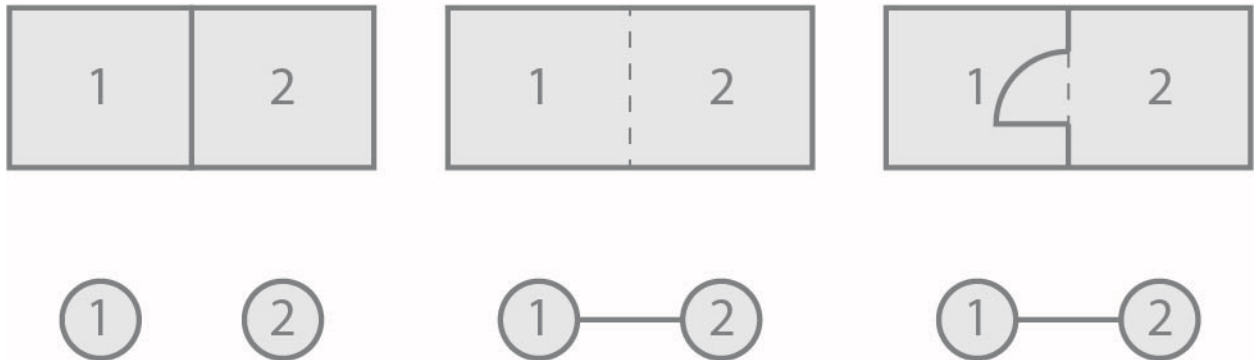
Methodology: Room detection/reconstruction

Original plan



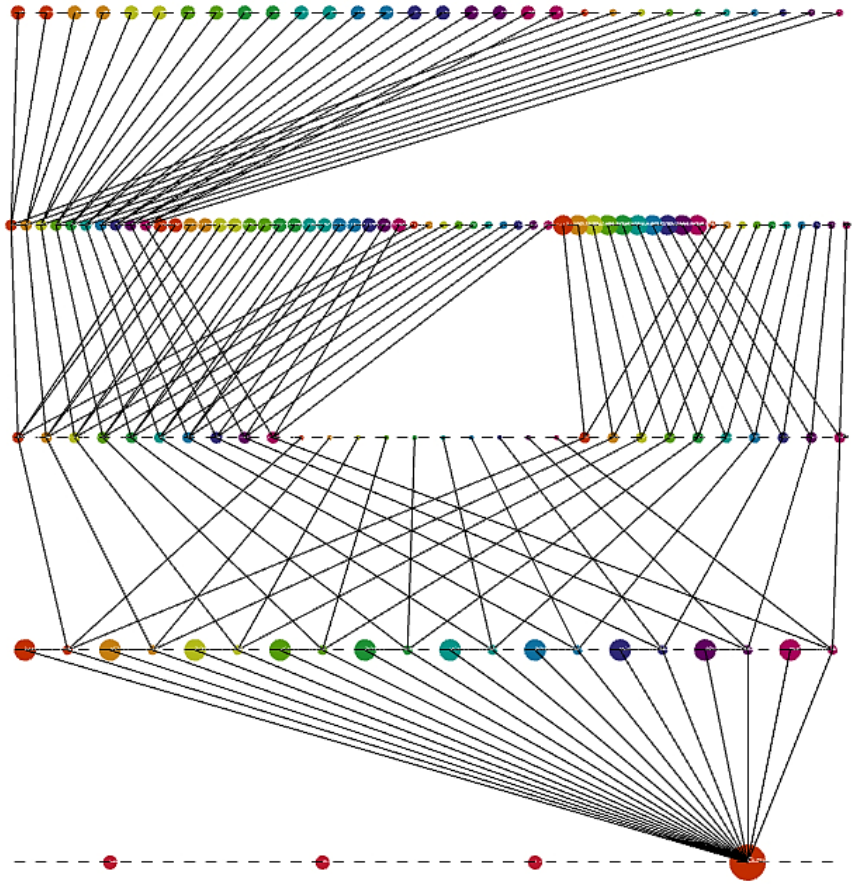
Final result

Methodology: Apartments



- Room connecting objects:
  - IfcDoor
  - IfcStaircase

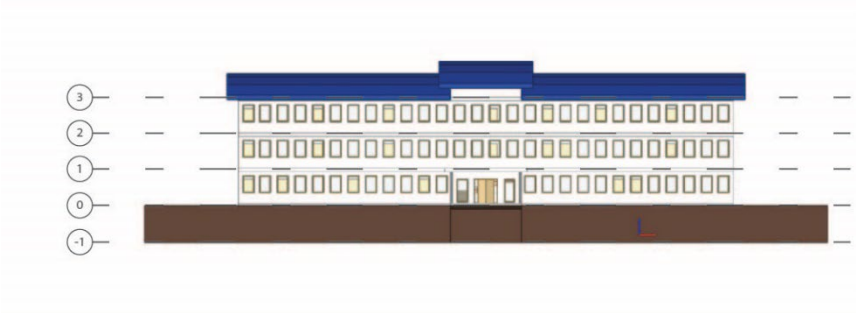
Methodology: Apartments

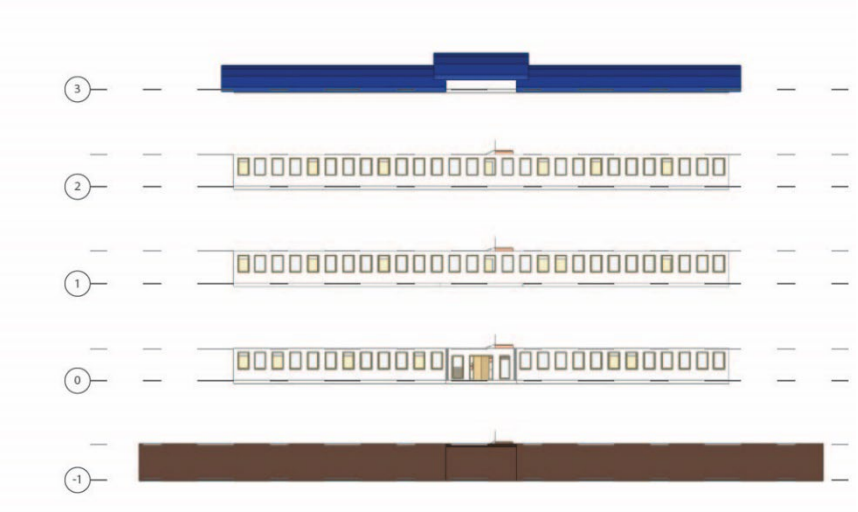


Methodology: Apartments

- Rules:
  - Connections to the outside are splitting points.
  - An apartment/section has to minimally consist out of two rooms.
  - An apartment/section has to have at least one room with a singular connection.
  - An apartment/section has to minimally have a floor area of 22 square meters.
  - A hallway/connection space can be a splitting point when it has five or more door connections to it.

Results & Discussion





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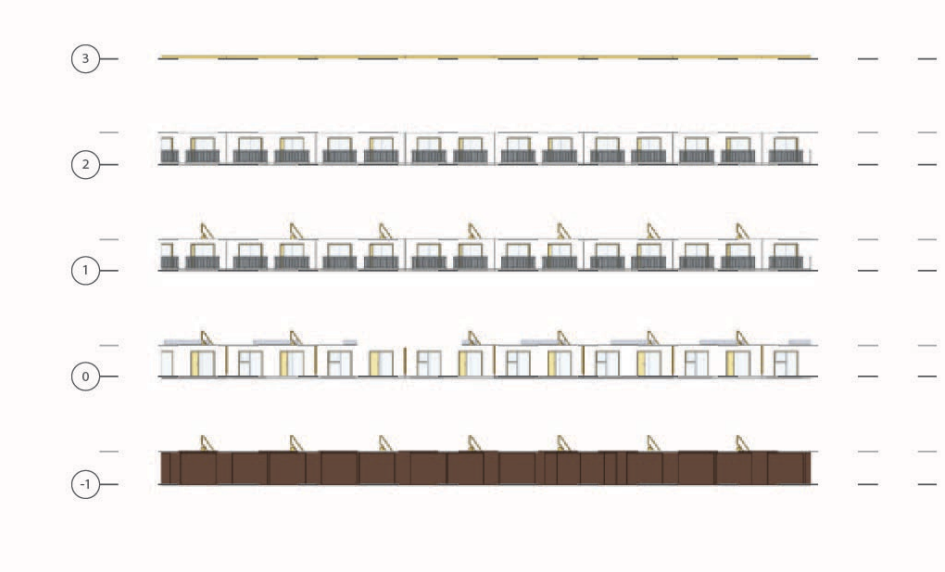
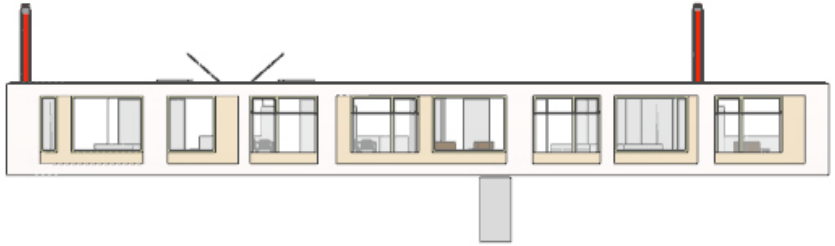
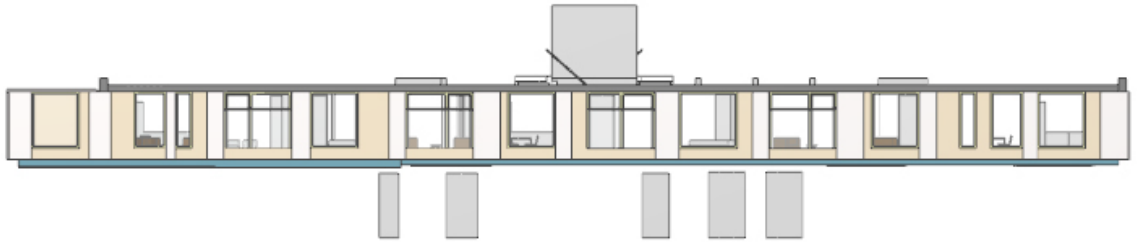


2.

Results & Discussion





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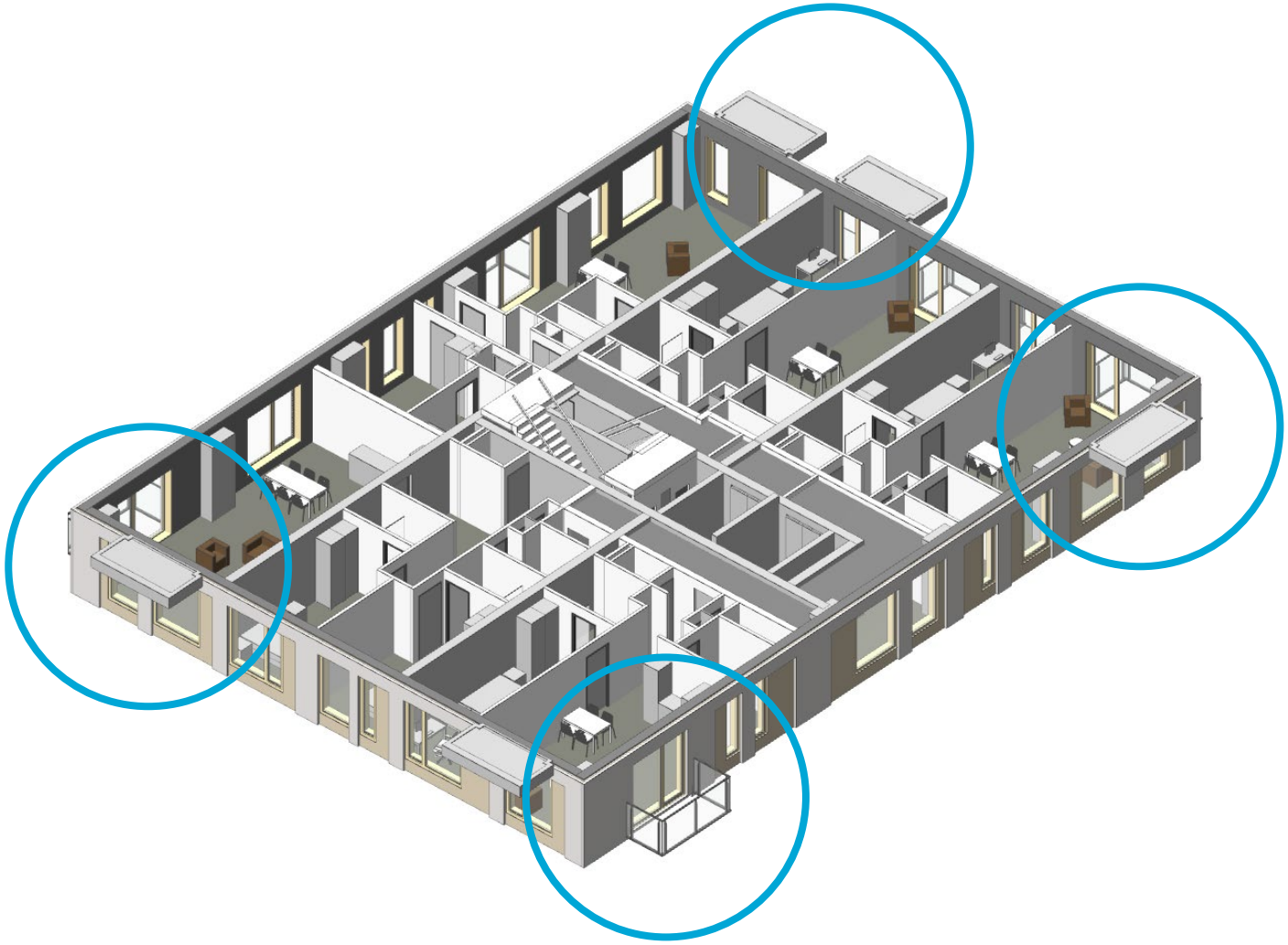
Results & Discussion



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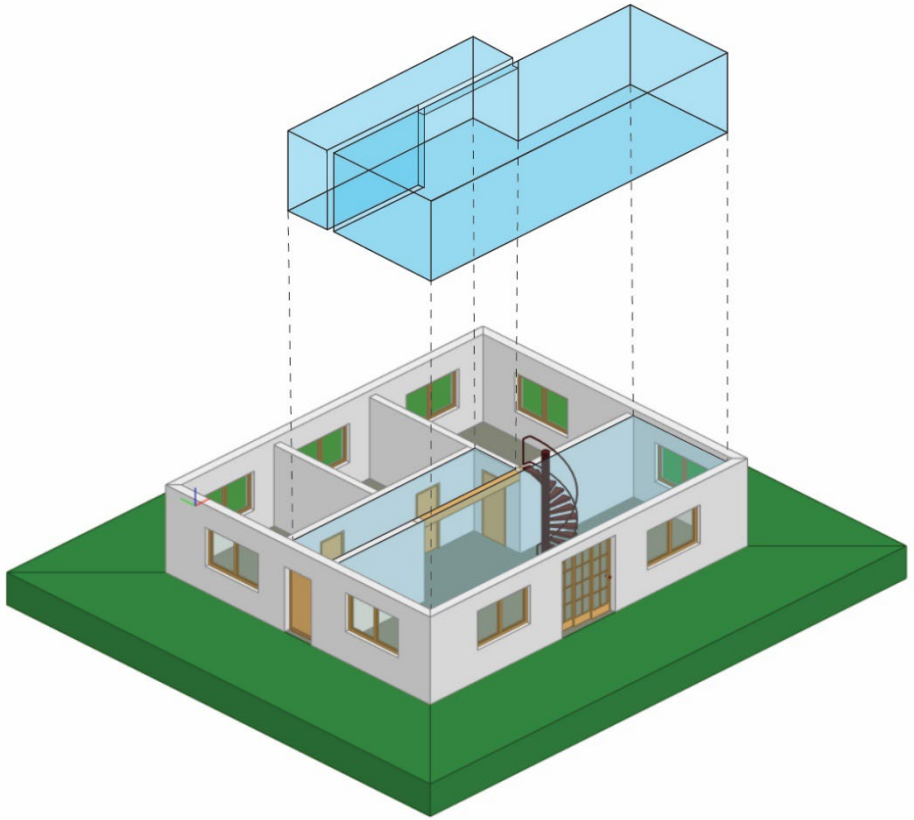

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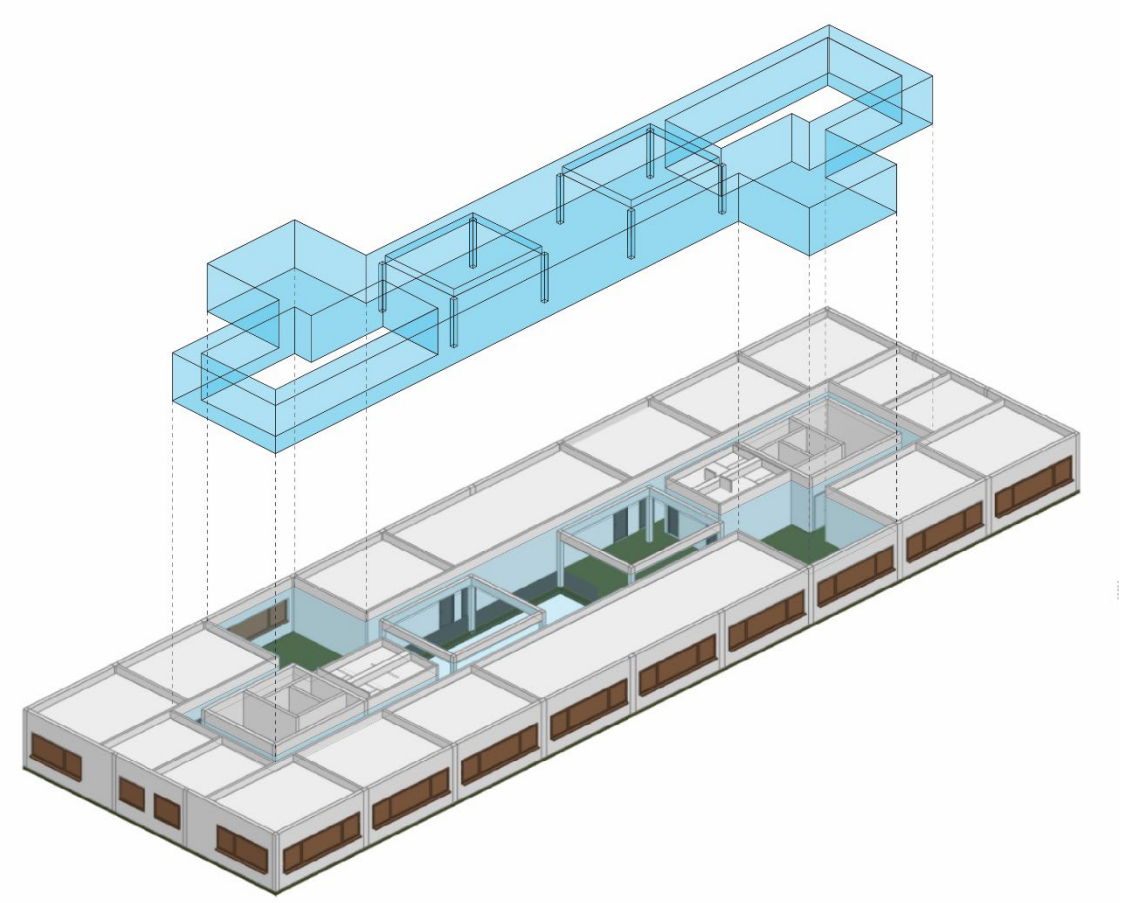

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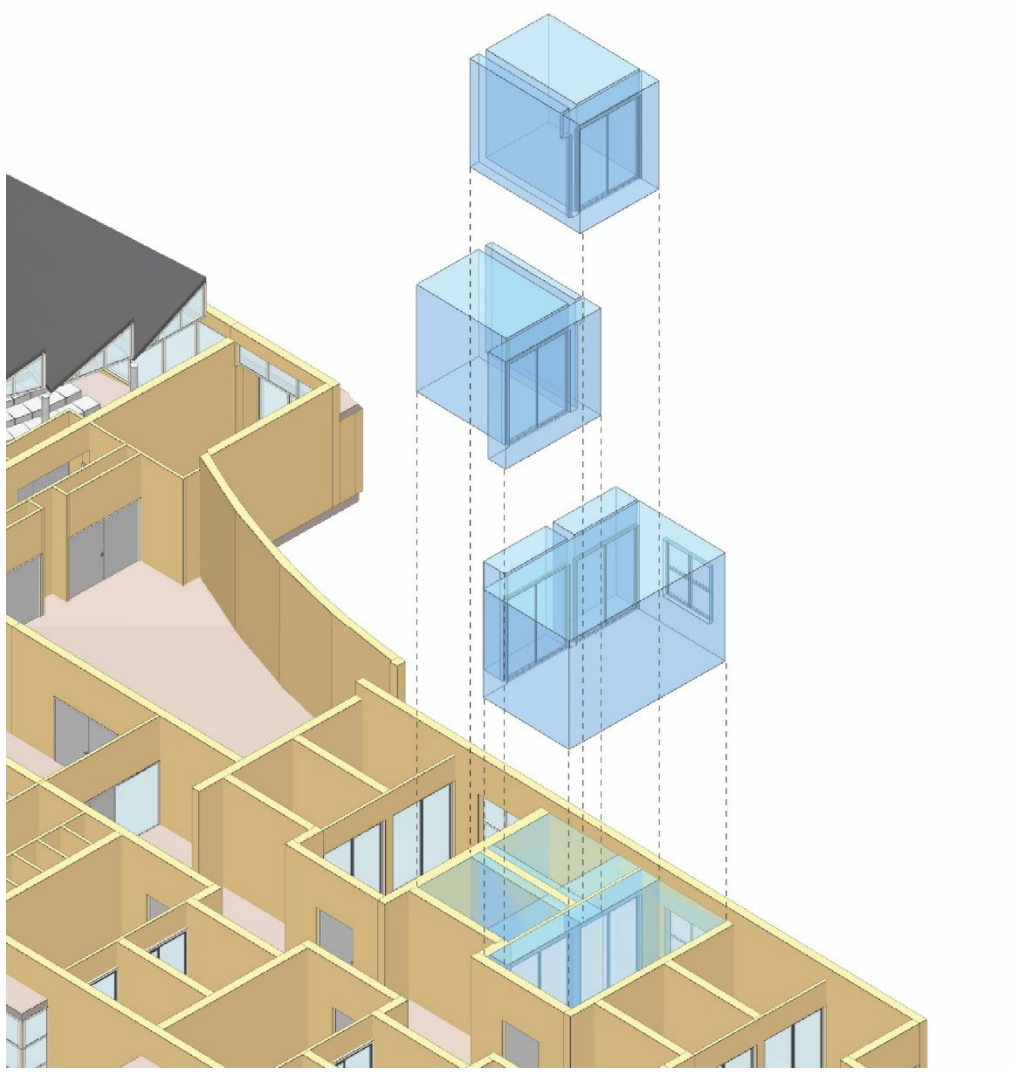

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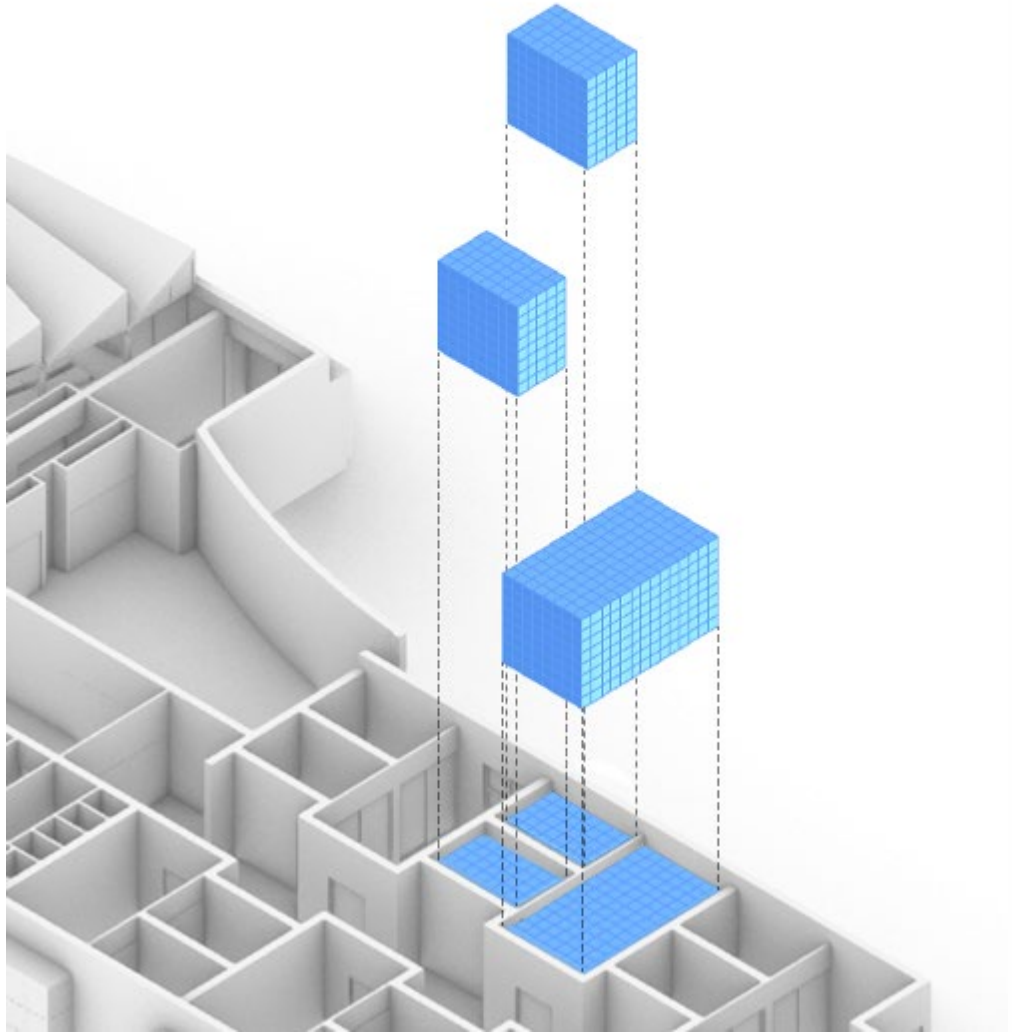

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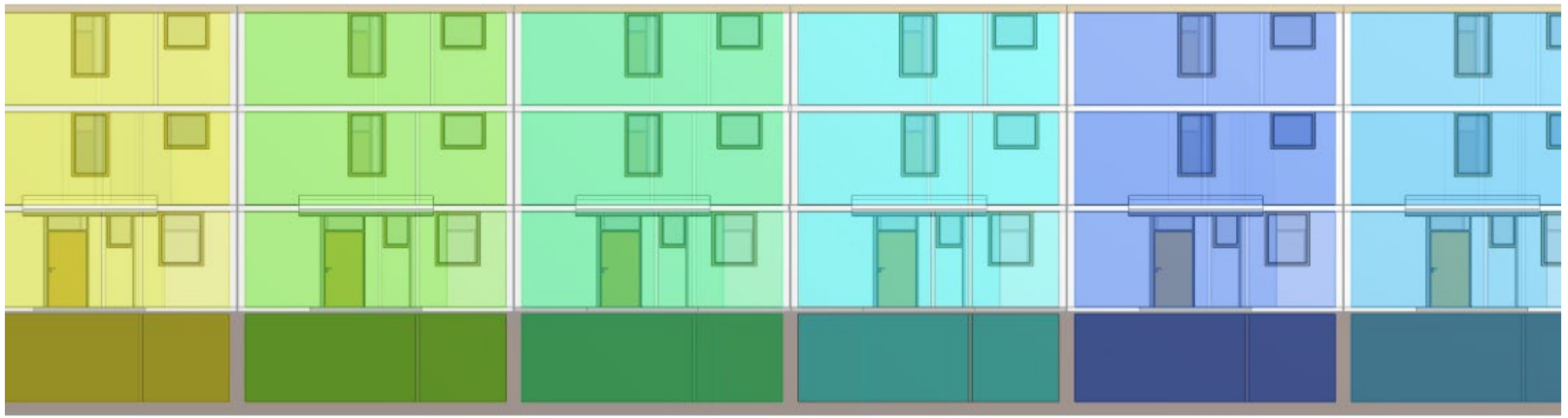

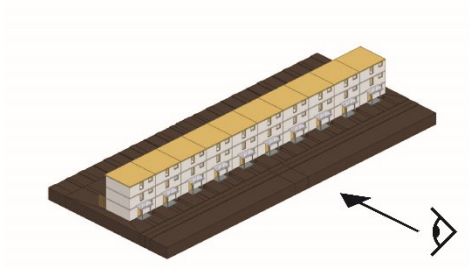

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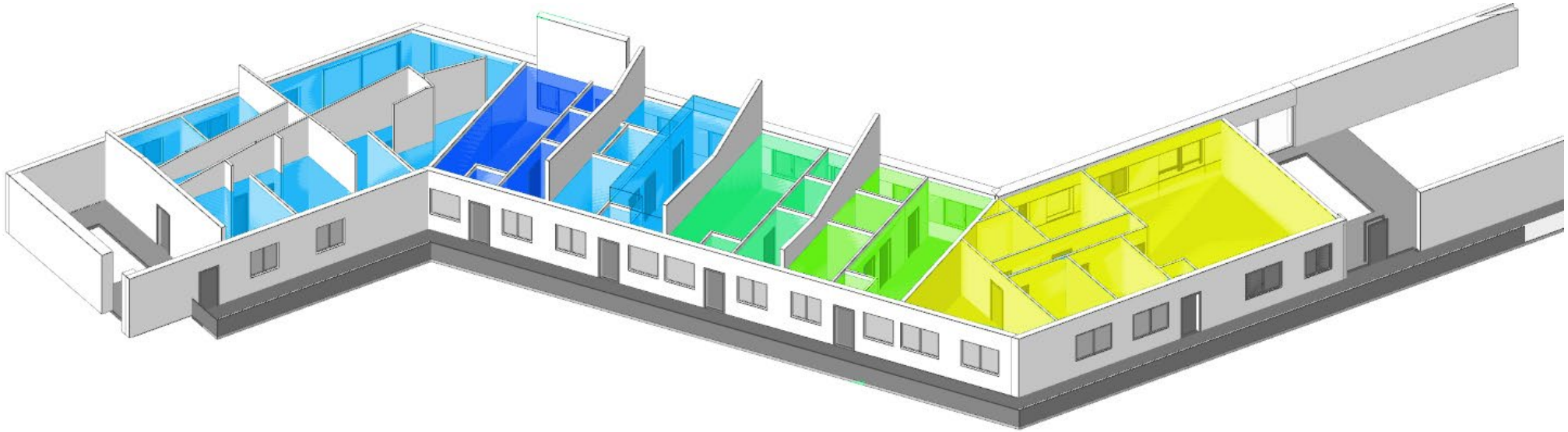

Results & Discussion

Model name	# expected apartments	# of correct apartments/-sections	# incorrect apartments/-sections	# missing apartments/-sections
FZK-Haus	1	1	0	0
Institute-Var-2	1	1	0	0
Smiley-West-10	10	10	0	0
RAC-sample-project	1	0	2	0
DigitalHub	1	1	0	0
ON4 Building	20	16	4	0
CUVO Building	1	0	4	0
Projekt Golden Nugget	8	0	11	0

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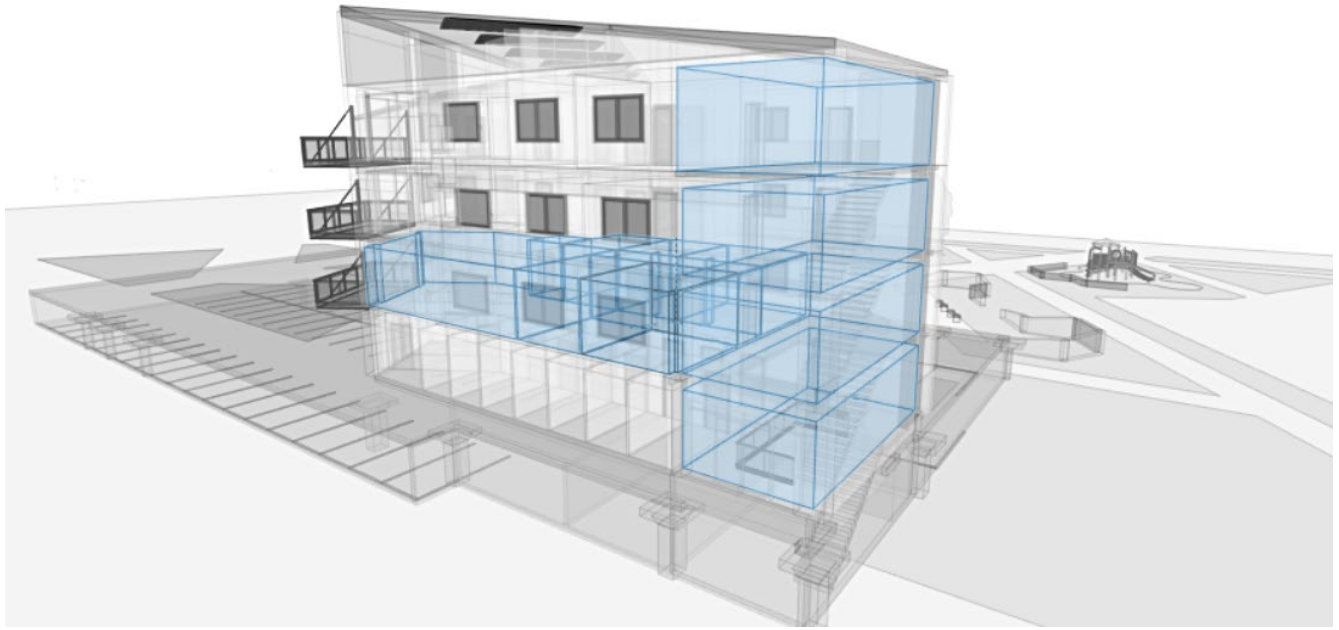

Conclusion

- What data in an IFC file can be considered accurate and/or reliable and is the minimal needed data to base the reconstruction upon?
  - Tangible geometry considered reliable
  - Subset of semantic data has to be relied upon

Conclusion

- How can building features be automatically detected from an IFC file in a reliable manner?

- Storeys:
  - Grouping and extraction of z-values

- Rooms
  - Voxelization followed by Boolean refinement

- Apartments
  - Graph construction and splitting based on rules

Automatic building feature detection and reconstruction in IFC models

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