

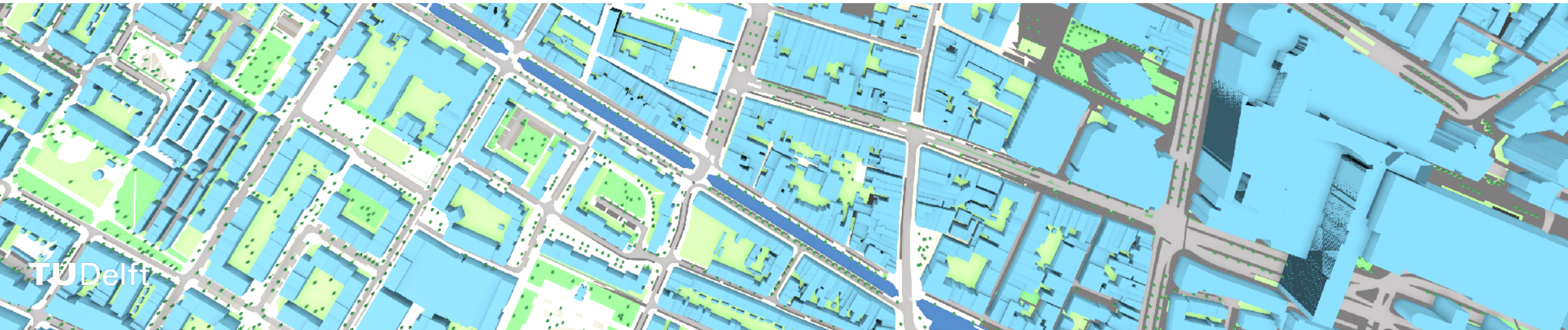


Exploring the 3D BAG

What is it and to what extent can it be automatically created with open data

E.J. Heeres

Supervisors: Jantien Stoter & Hugo Ledoux

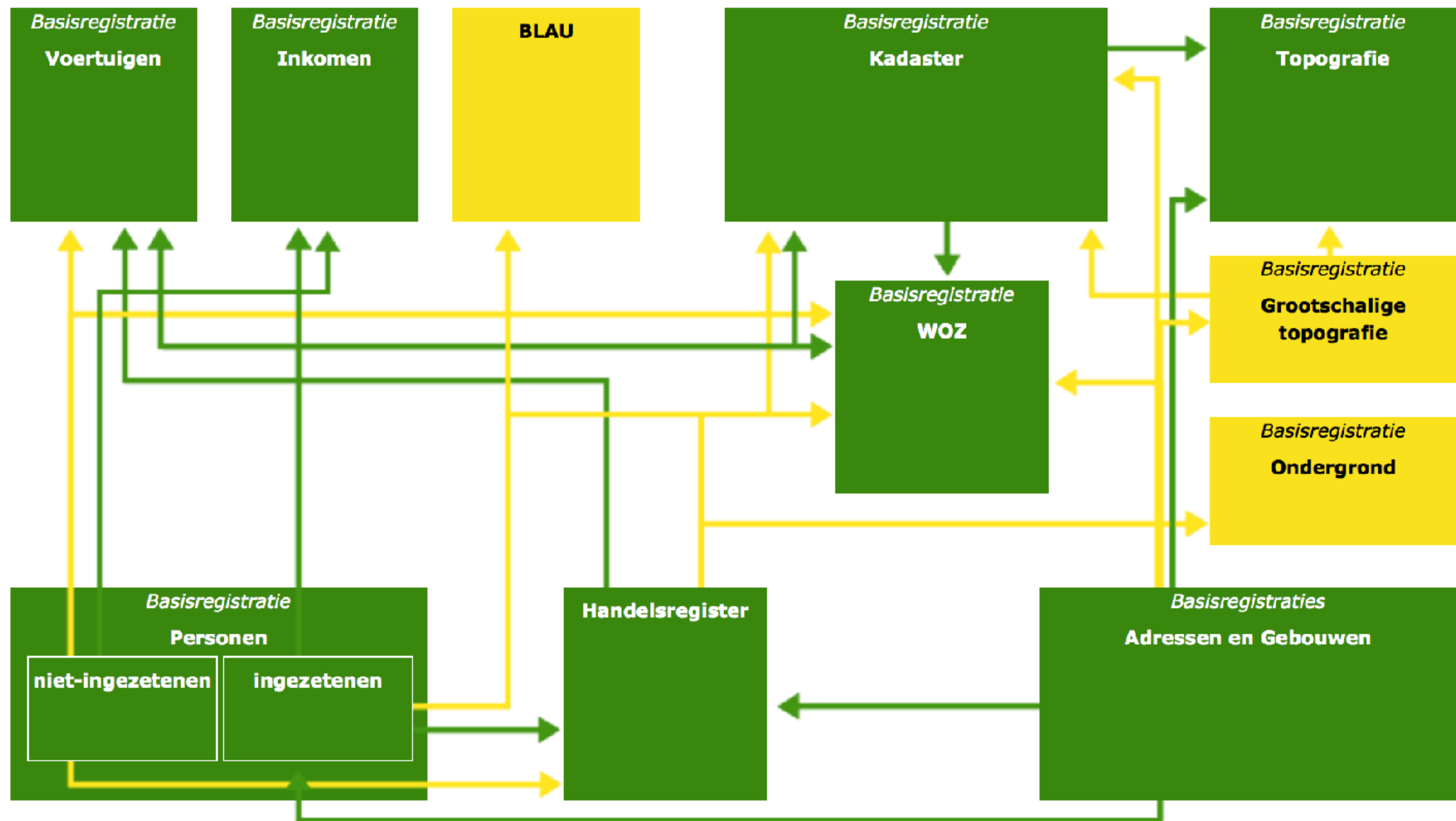


Introduction

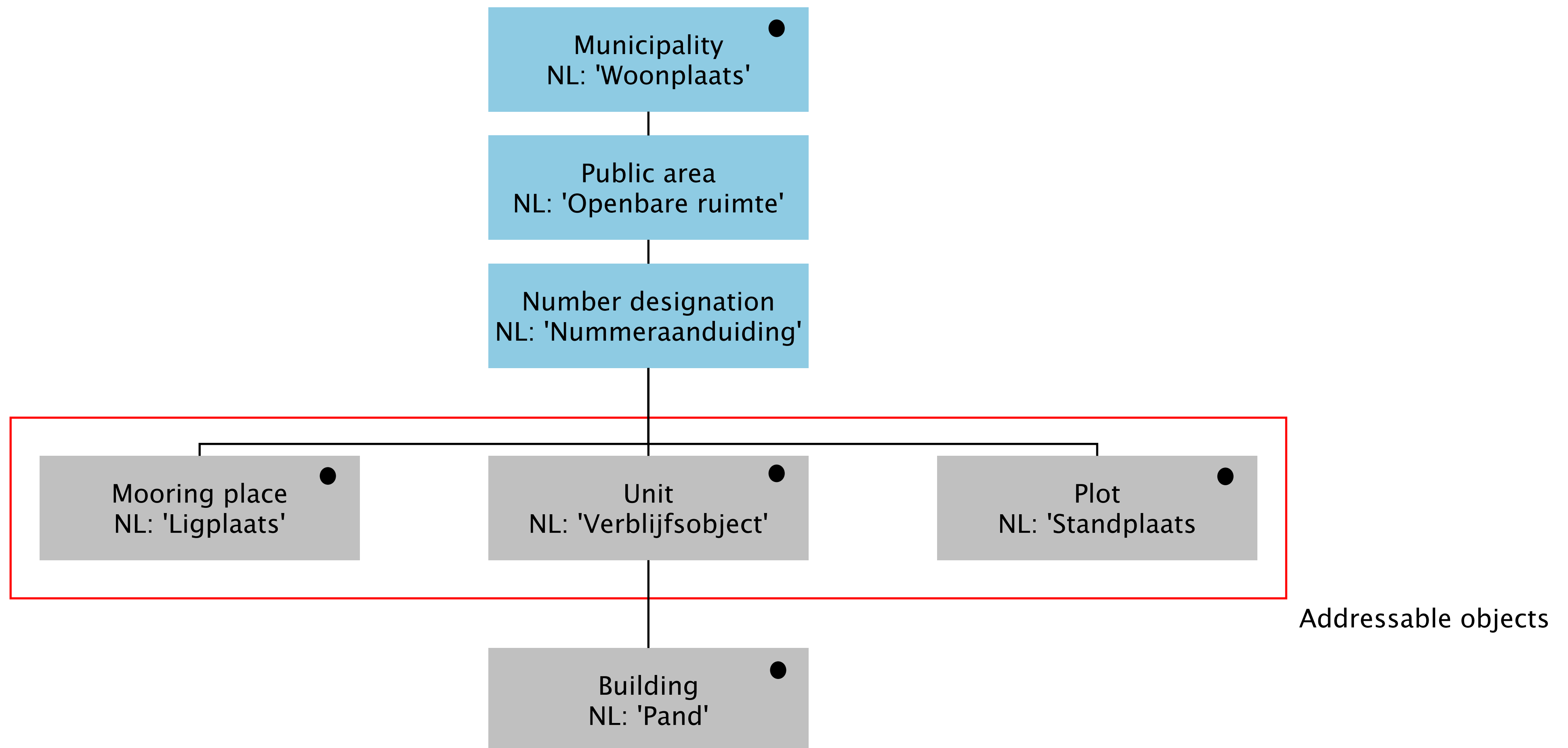
- The BAG
- Proposed model for the 3D BAG
- Methodology for creating a 3D BAG
- Implementation & Results
- Conclusions & Future work

The BAG

System of key registers



Relationship





Building

ID: 0518100000299505

Status: Pand in gebruik

Bouwjaar: 1926

....

Unit

ID: 0518010000734741

Status: Verblijfsobject in gebruik

- Gebruiksdoel: woonfunctie

Oppervlakte: 95 m2

....



Usage of BAG geometries

- Visualization - Real estate, municipalities
- Determine access routes - Emergency services
- Appreciation of real estate - Tax, real estate
- Analyses - Consultancy, geo-companies





Solution: move to 3D

- Solves uncertainties
- Emergency response
- Detect fraud (tax authorities)
- More detailed predictions (noise, flood, etc.)

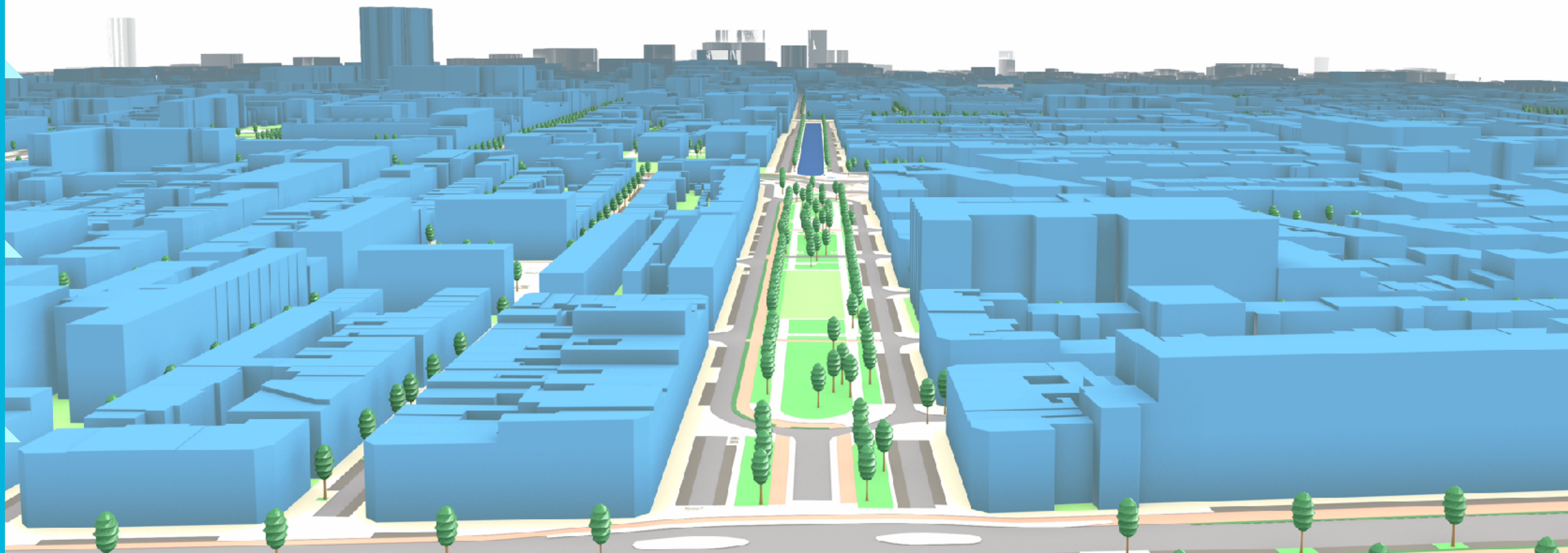
Research Question

“How to define the 3D BAG and to what extent can the current available open data be used to create 3D geometries of the BAG units?”

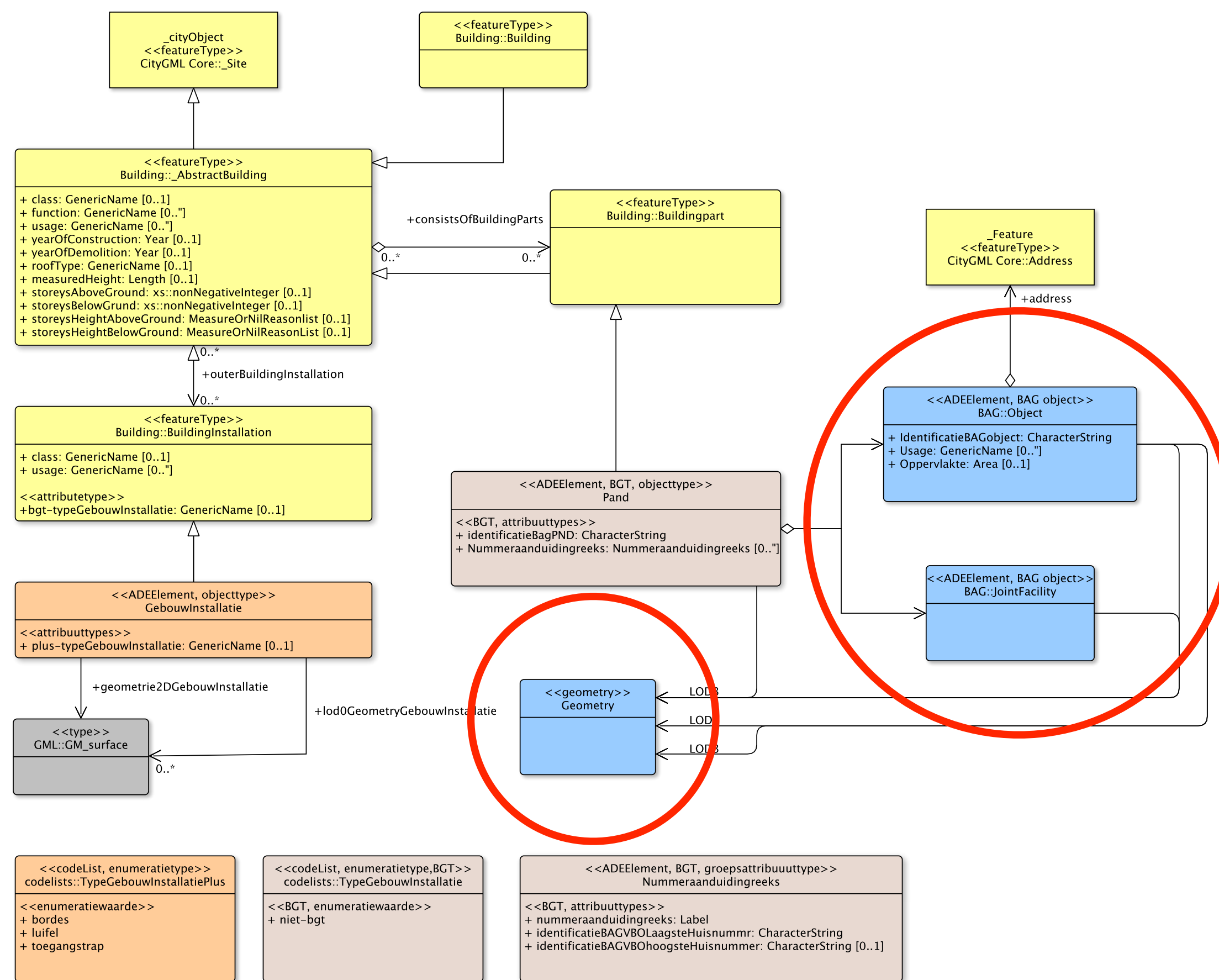
Proposed model

Proposed model

Combined model with geometry
from the key registers with spatial data (BGT-BAG)



CityGML IMGEO



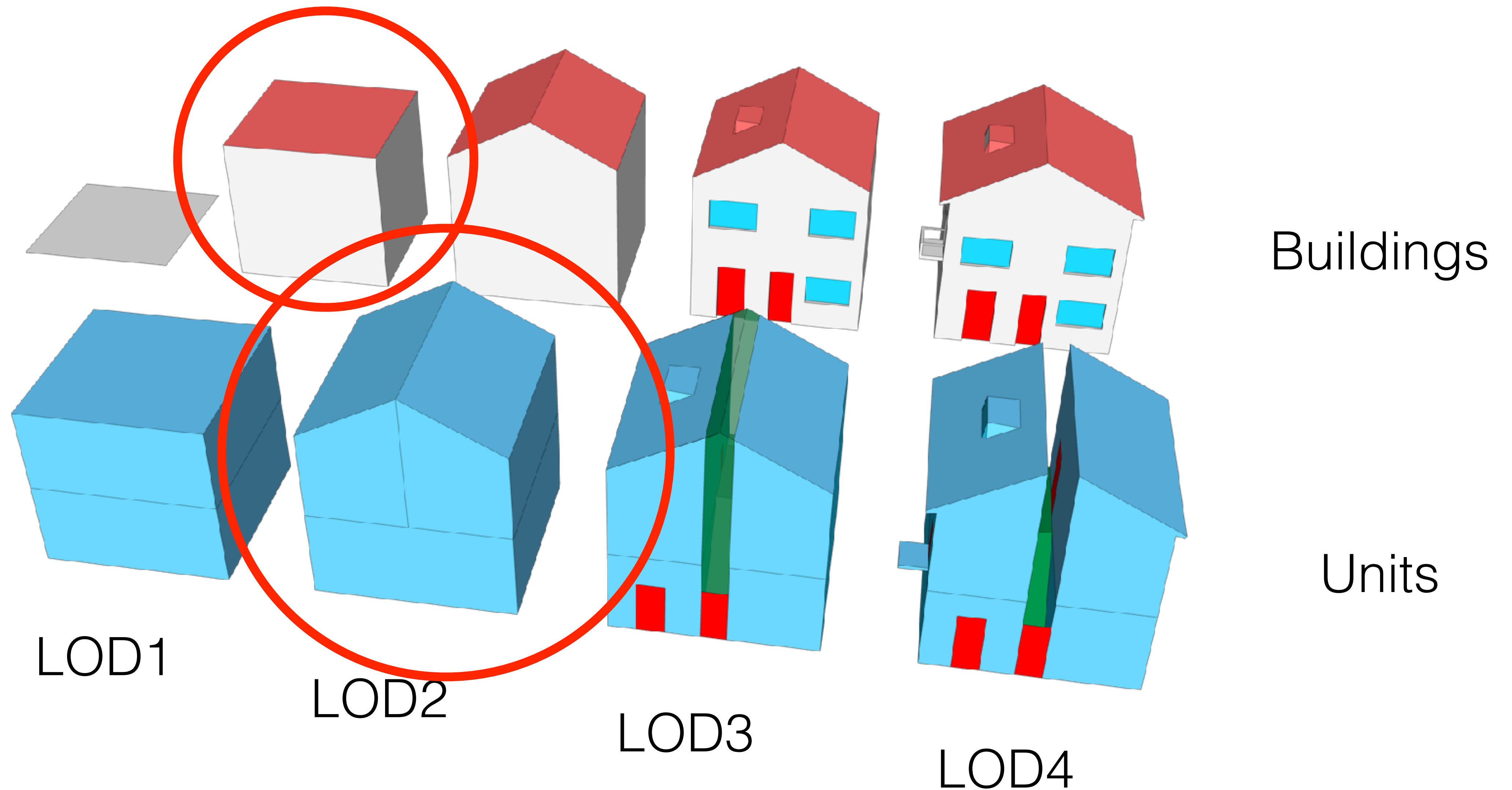
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<gml:upperCorner>442066.515734 111704.403033 17.249079</gml:upperCorner>
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Level of detail concept

Proposed model

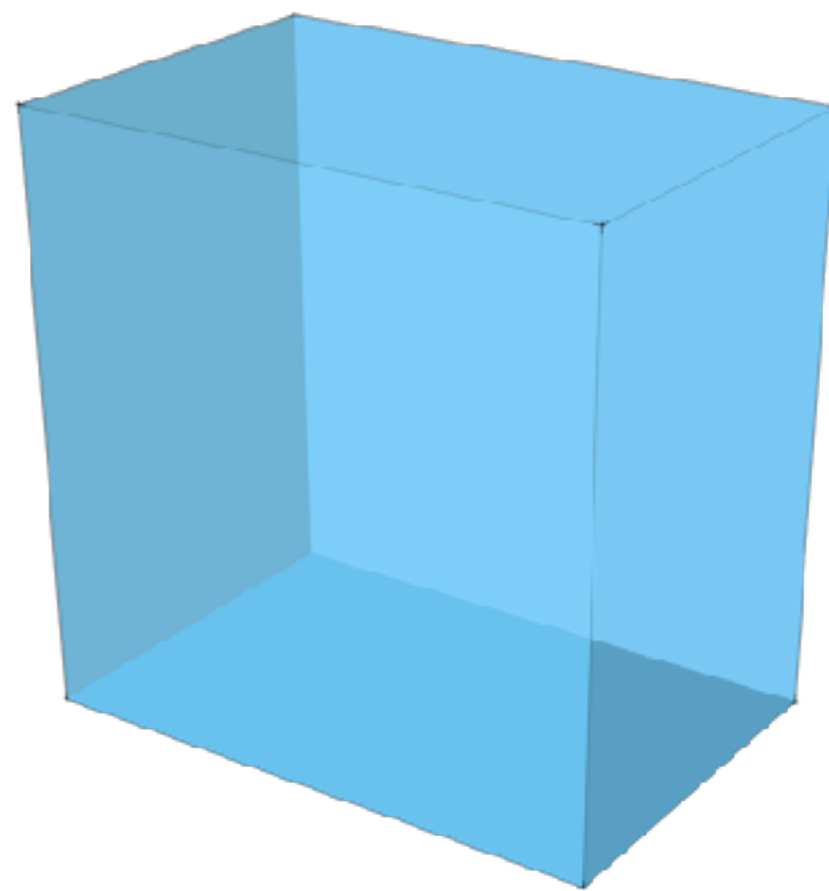


Methodology

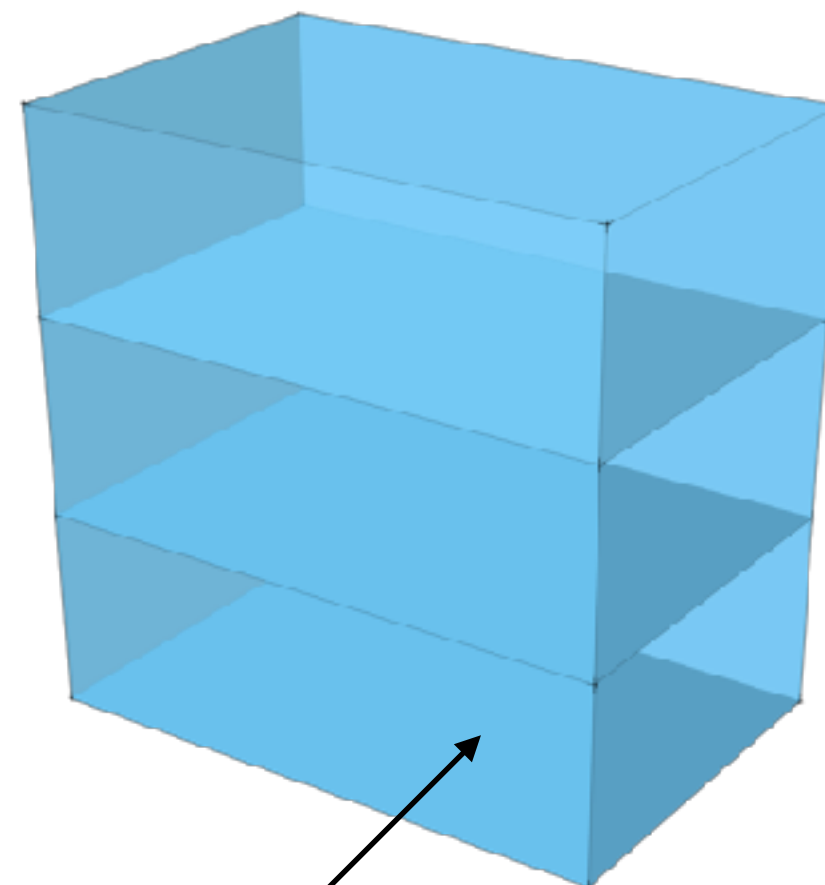
My methodology for creating a 3D BAG

Methodology

Location and Height

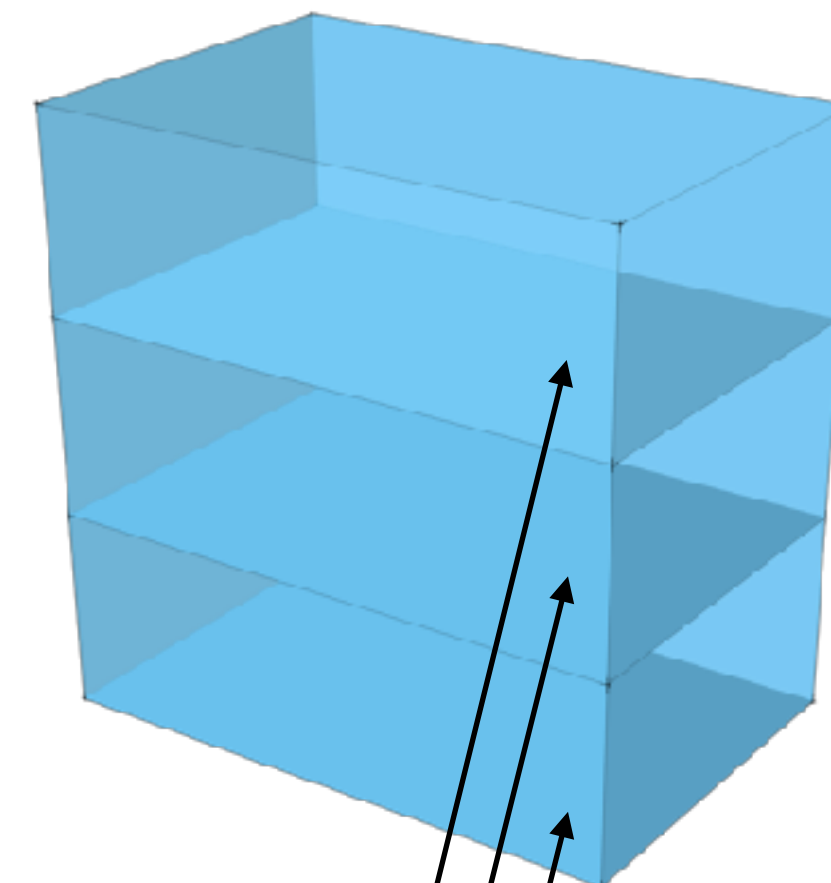


Calculate Storeys



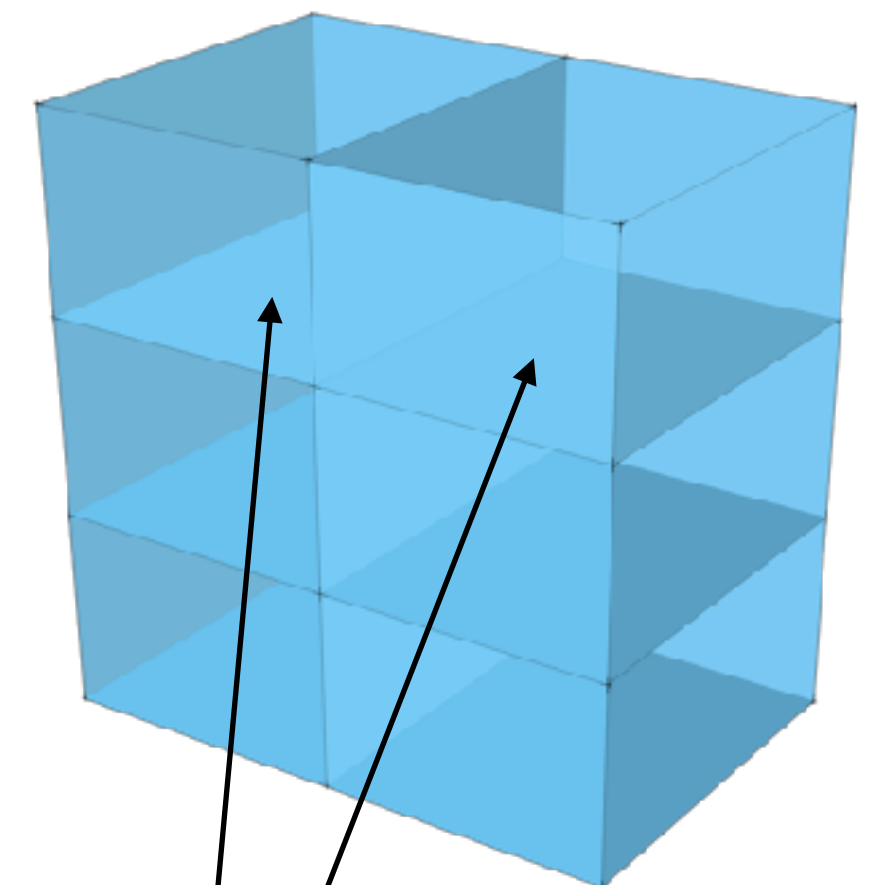
Area: polygon (m2)*storeys

Place Units



Unit 1: ratio * area
Unit 2: ratio * area
Unit 3: ratio * area
Unit 4: ratio * area
Unit 5: ratio * area
Unit 6: ratio * area

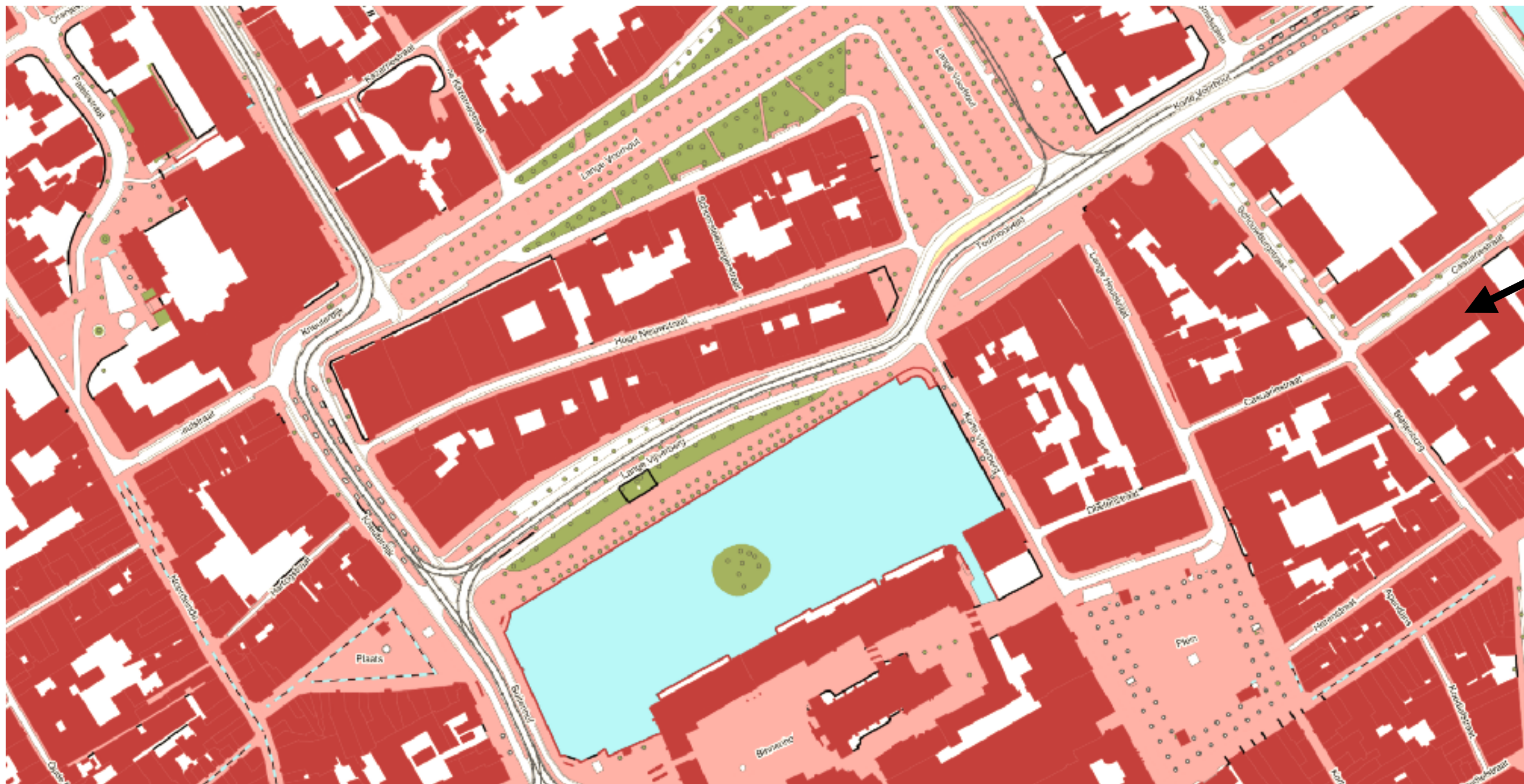
Divide Storeys



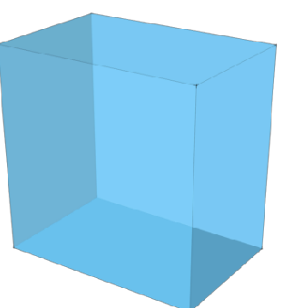
Unit 1: 1/2 storey
Unit 2: 1/2 storey

Underground: BGT (1.1)

Methodology

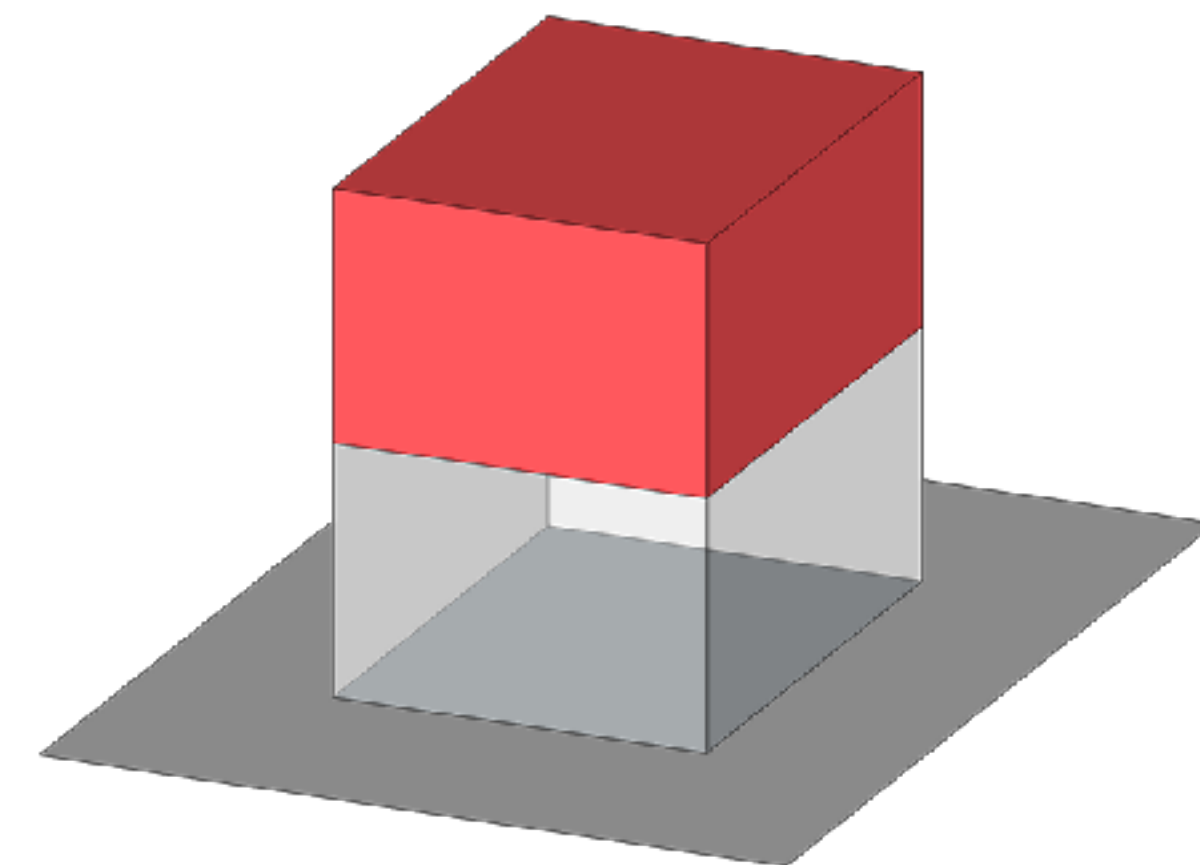
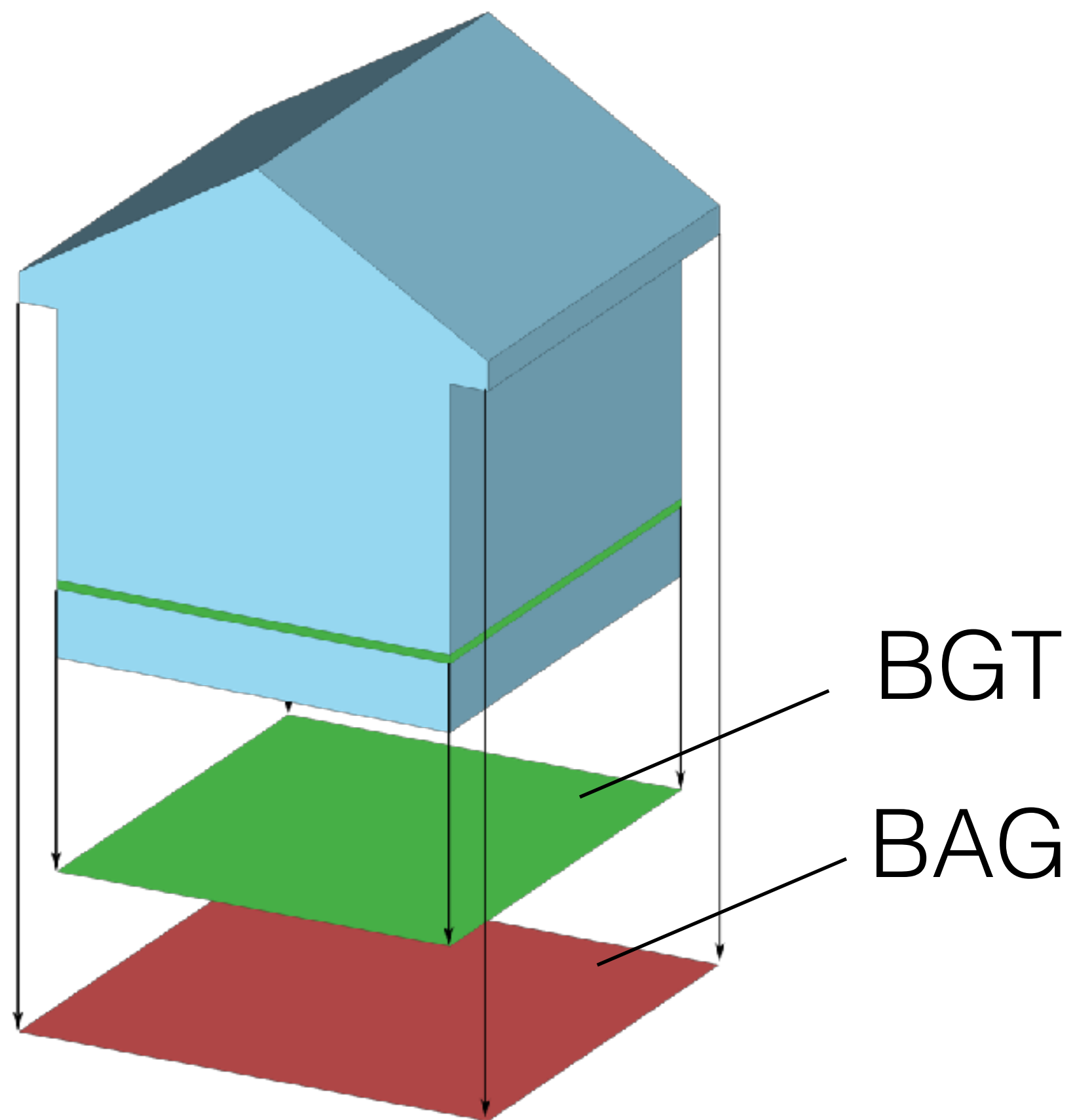


BAG ID

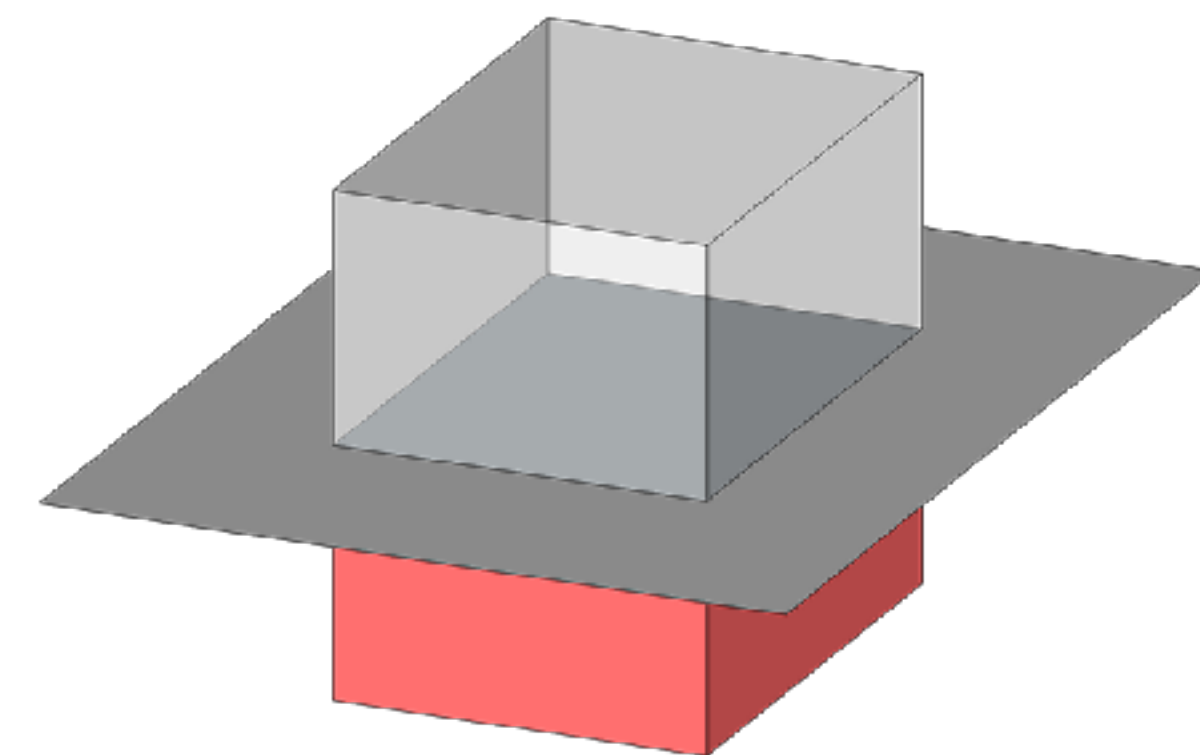


Underground: BGT (1.2)

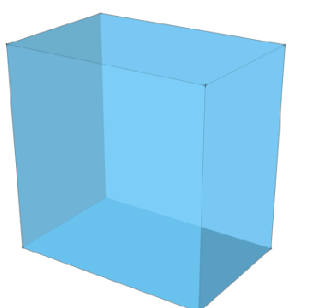
Methodology



Above?



Under?



Underground: LIDAR (2.1)

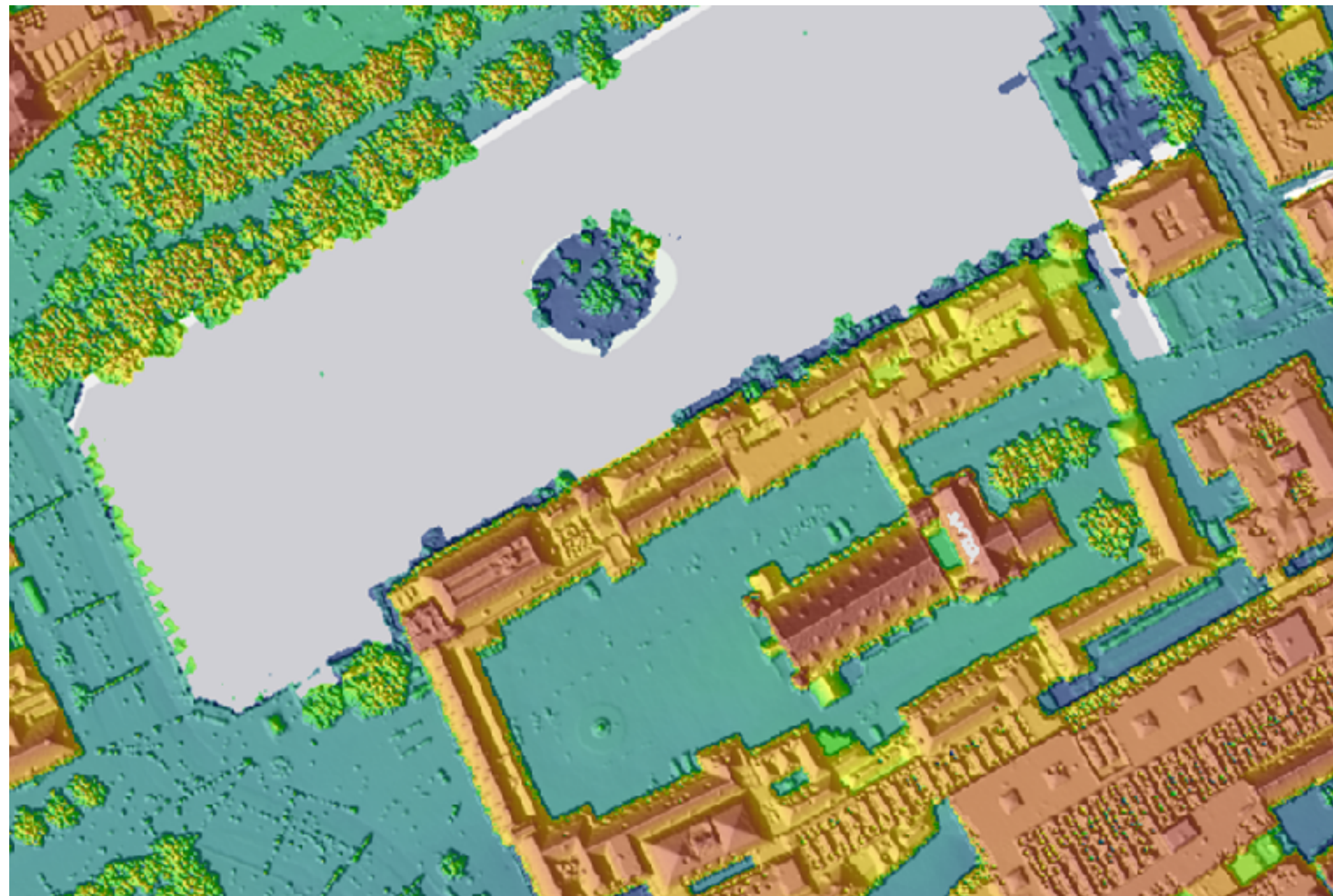
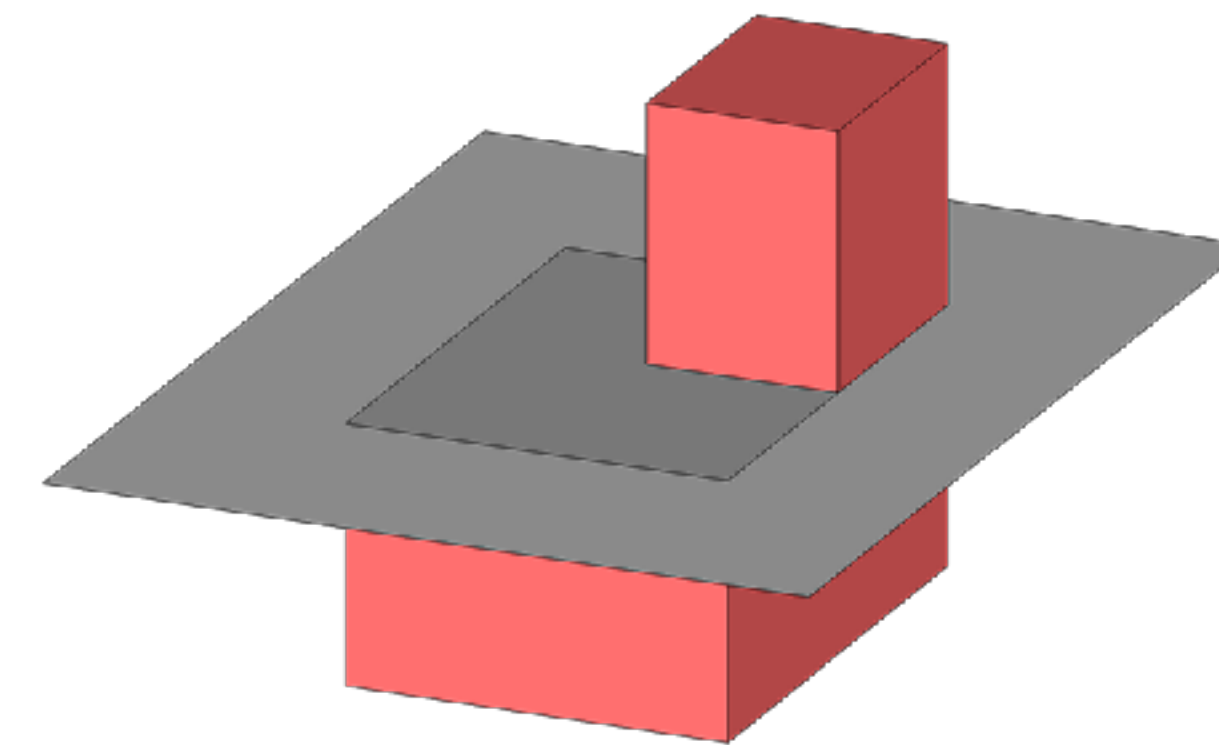
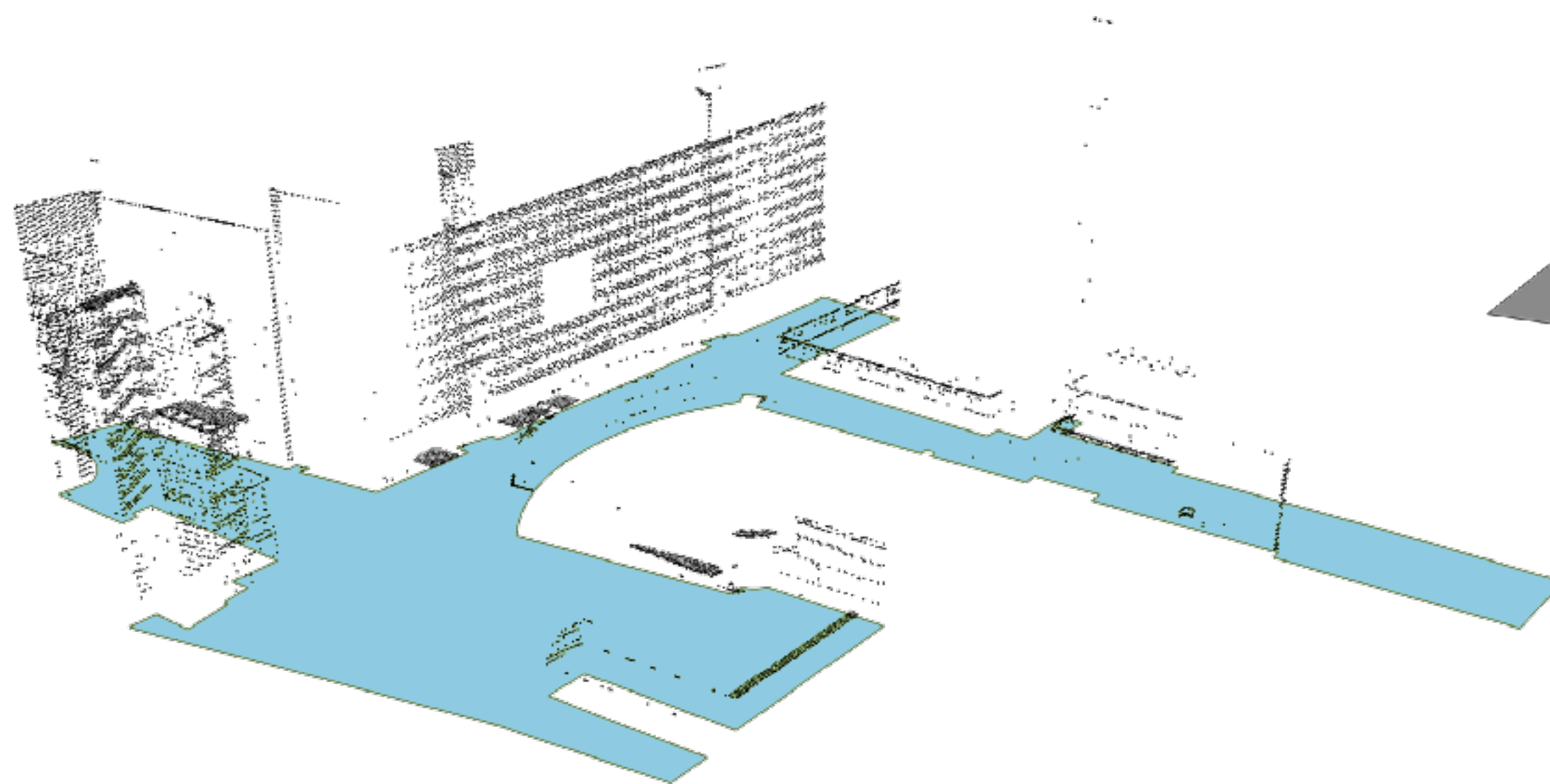


Image from <http://www.ahn.nl/>

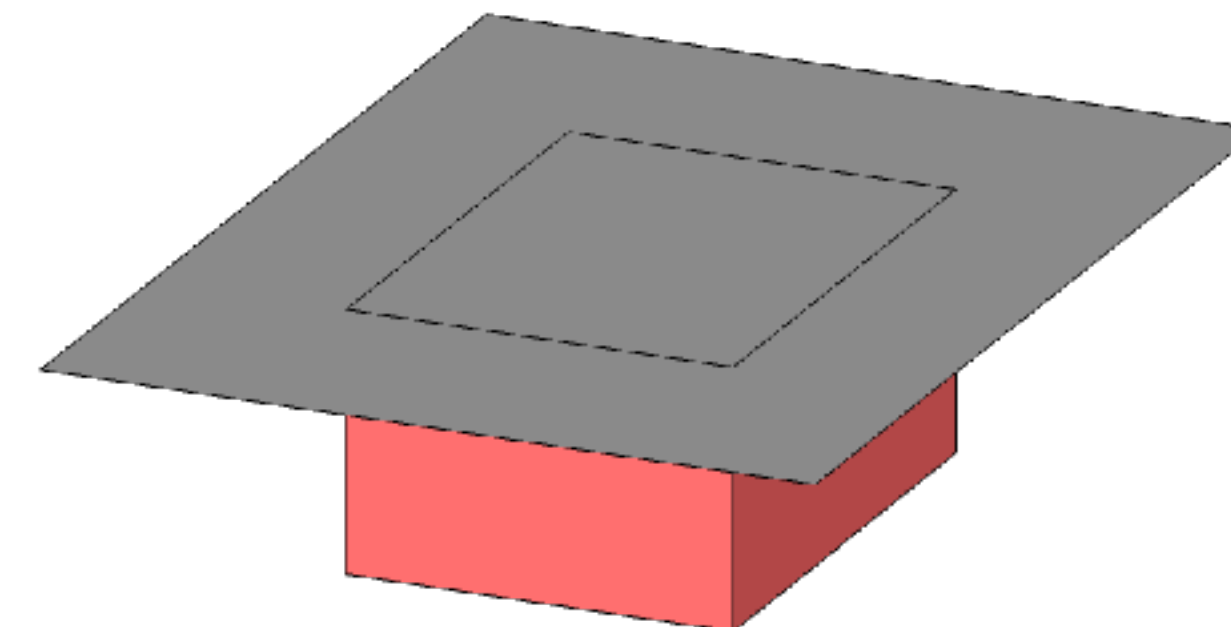
Classification Value (bits 0:4)	Meaning
0	Created, never classified
1	Unclassified ¹
2	Ground
3	Low Vegetation
4	Medium Vegetation
5	High Vegetation
6	Building
7	Low Point (noise)
8	Model Key-point (mass point)
9	Water
10	<i>Reserved for ASPRS Definition</i>
11	<i>Reserved for ASPRS Definition</i>
12	Overlap Points ²
13-31	<i>Reserved for ASPRS Definition</i>

Underground: LIDAR (2.2)

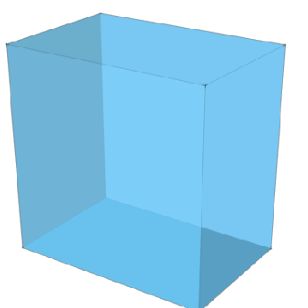
Methodology



Mostly under?



Under?



Number of storeys

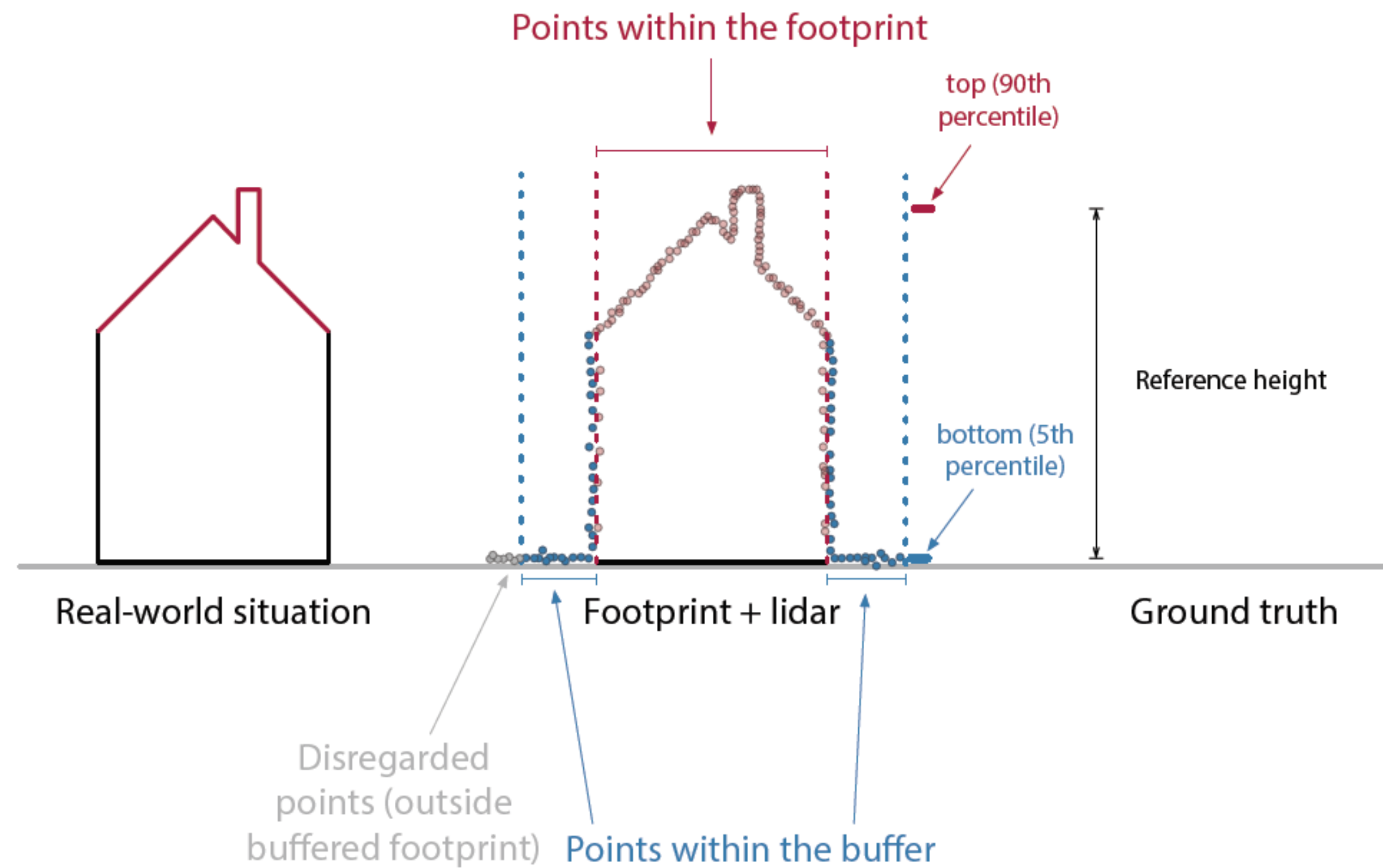
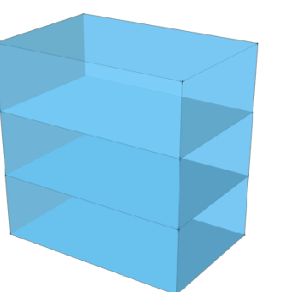
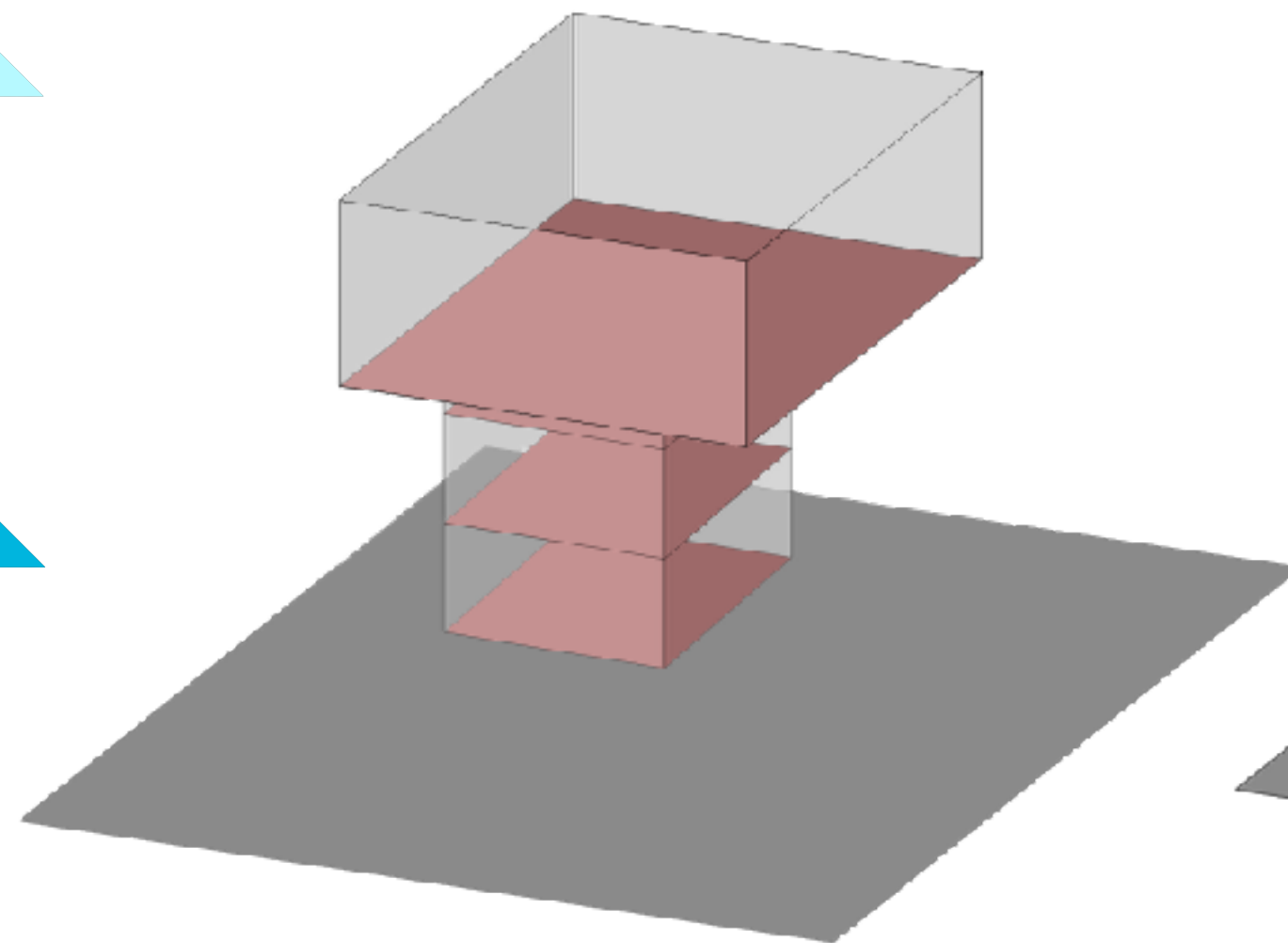


Image by Biljecki, F., Ledoux, H., & Stoter, J. (2017). Generating 3D city models without elevation data. Computers, Environment and Urban Systems, Under review

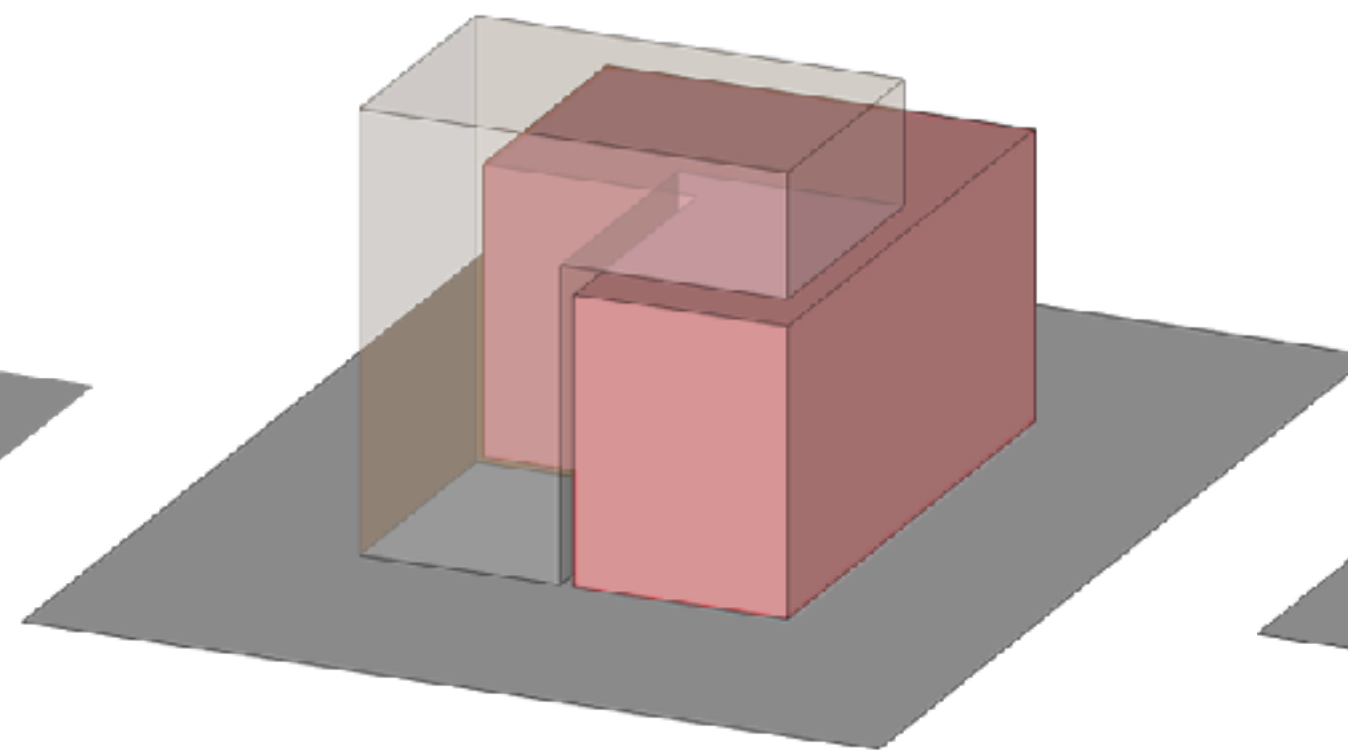


Uncertainties

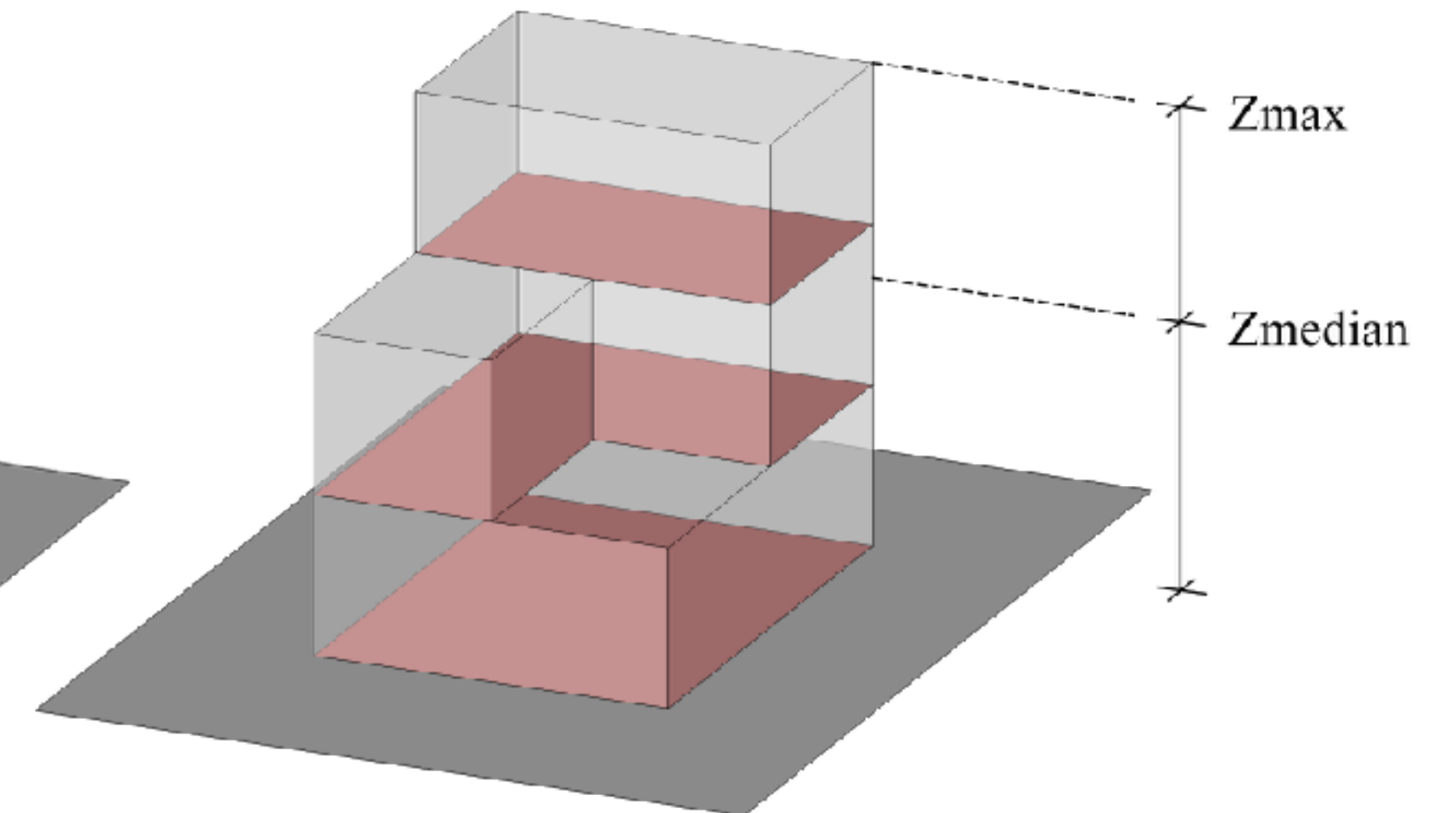
Methodology



BGT/BAG test



Overlap test



Zmax/Zmedian test

Divide units over buildings

Unit

ID: 0518010000734741
Oppervlakte: 120 m2
Gerelateerd pand: 518100000299505
....

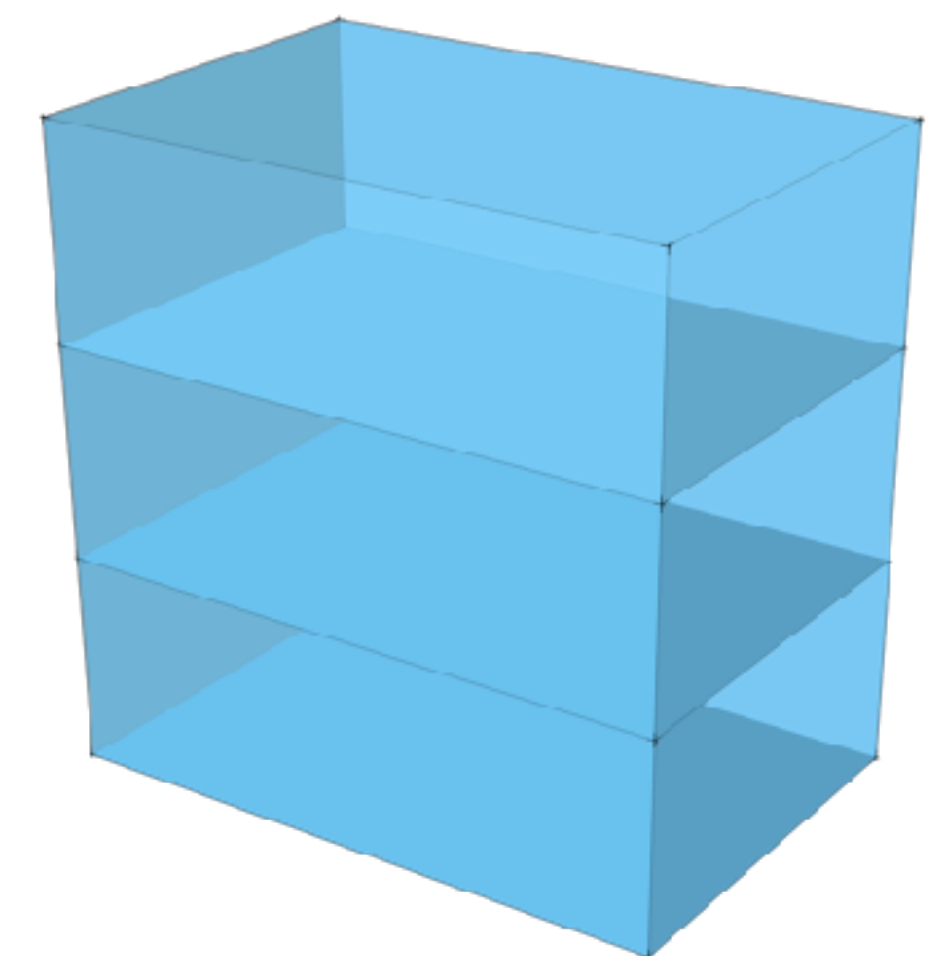
$$120/360 * 3 = 1.0$$



Unit

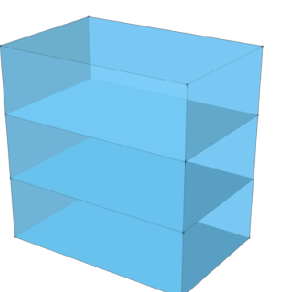
ID: 518010000600386
Oppervlakte: 240 m2
Gerelateerd pand: 518100000299505
....

$$240/360 * 3 = 2.0$$



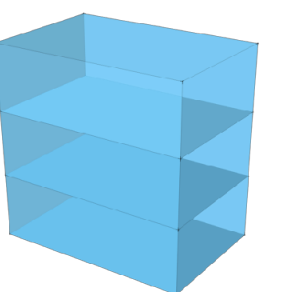
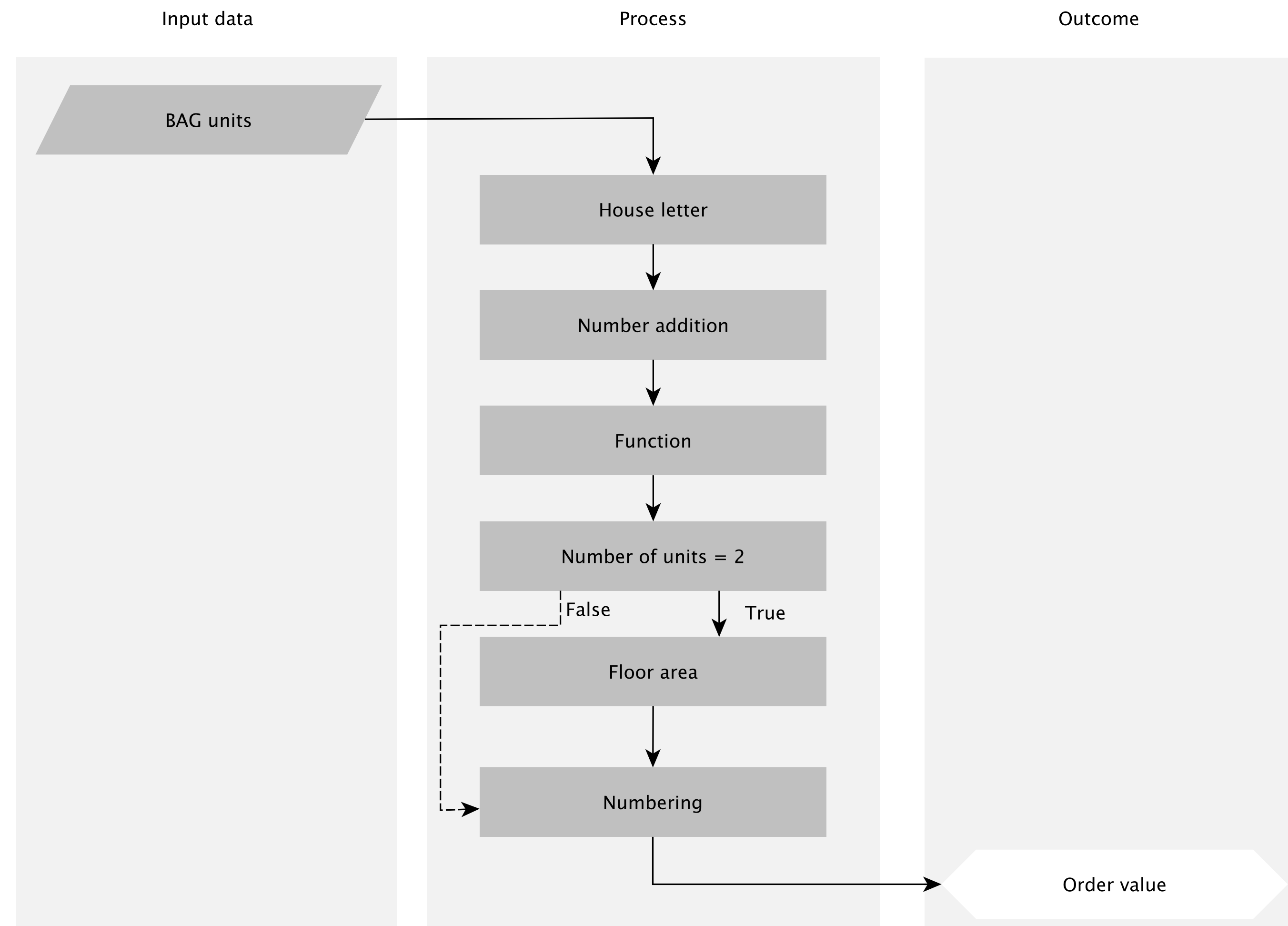
Total gross area: 400 m2

Total nett area: 360 m2



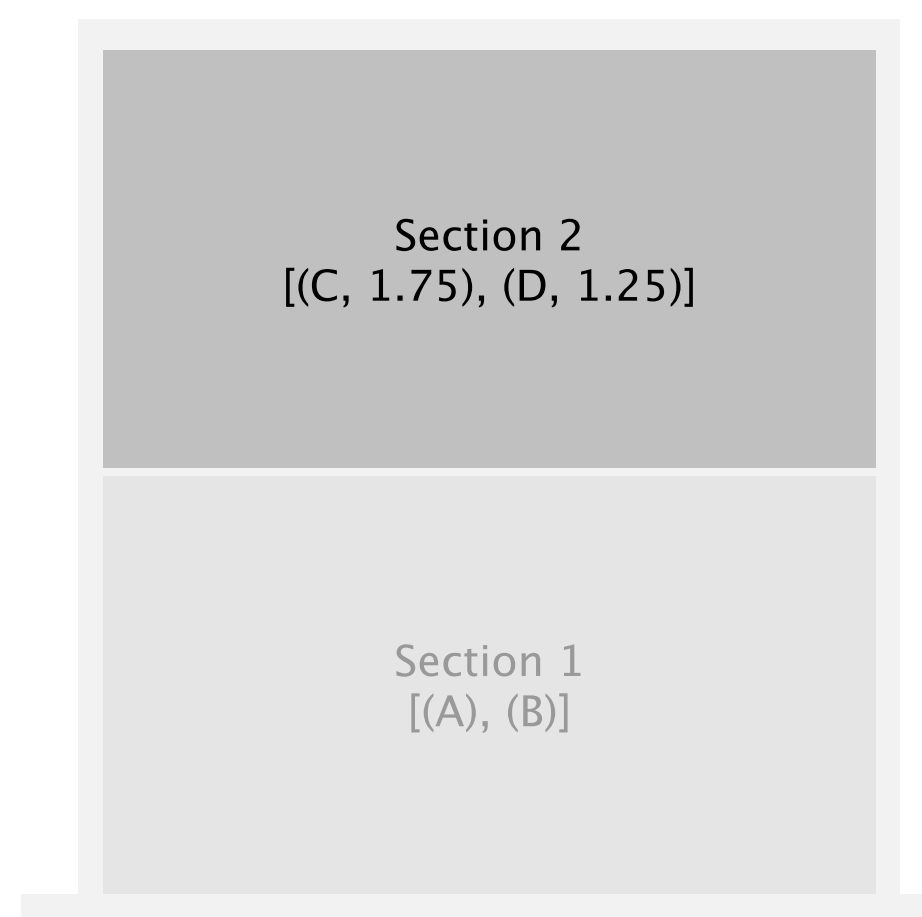
Place Units

Divide units over storeys (1)

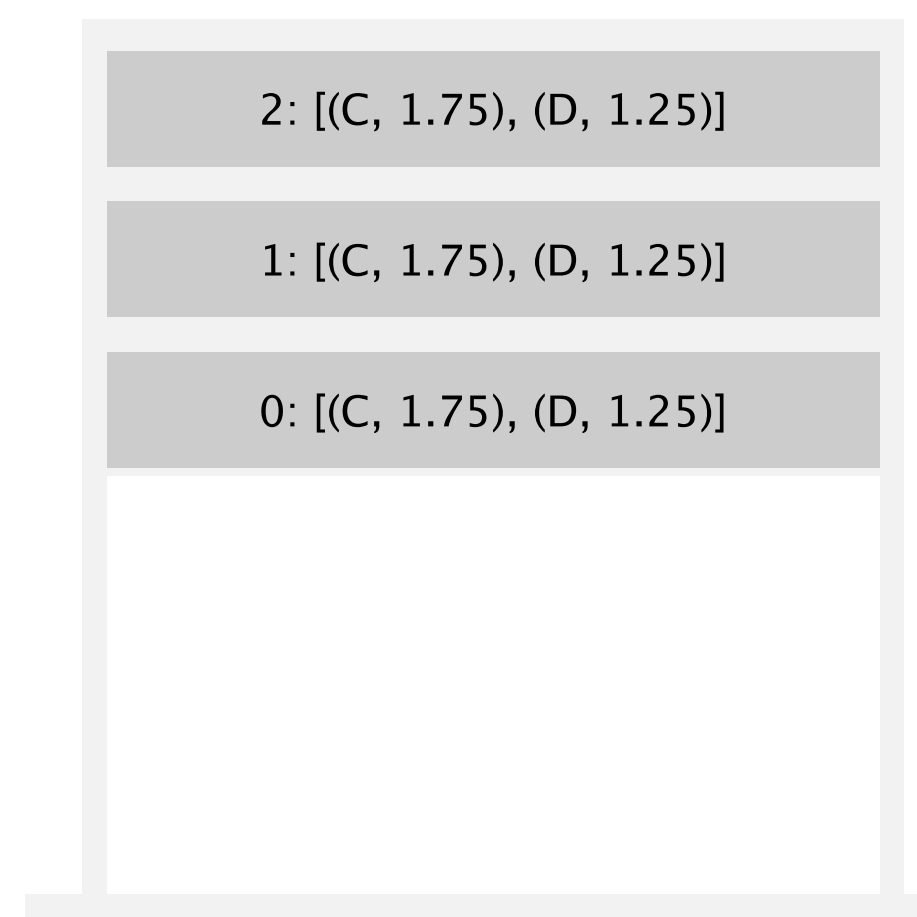


Divide units over storeys (2)

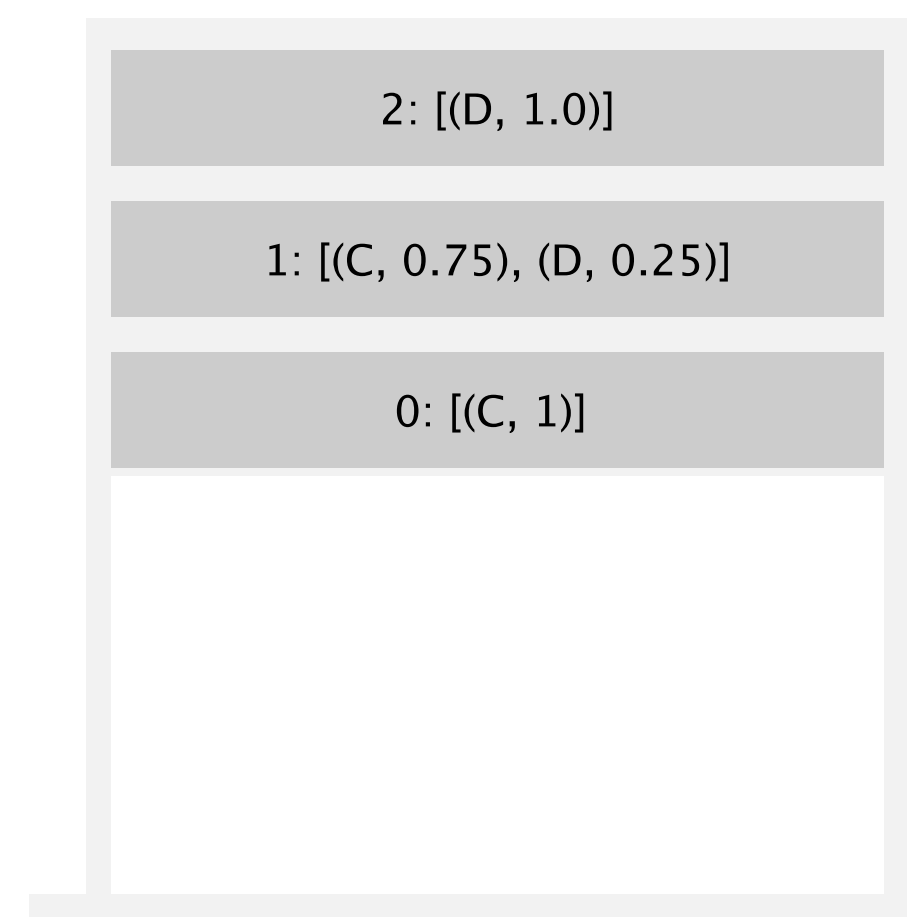
Methodology



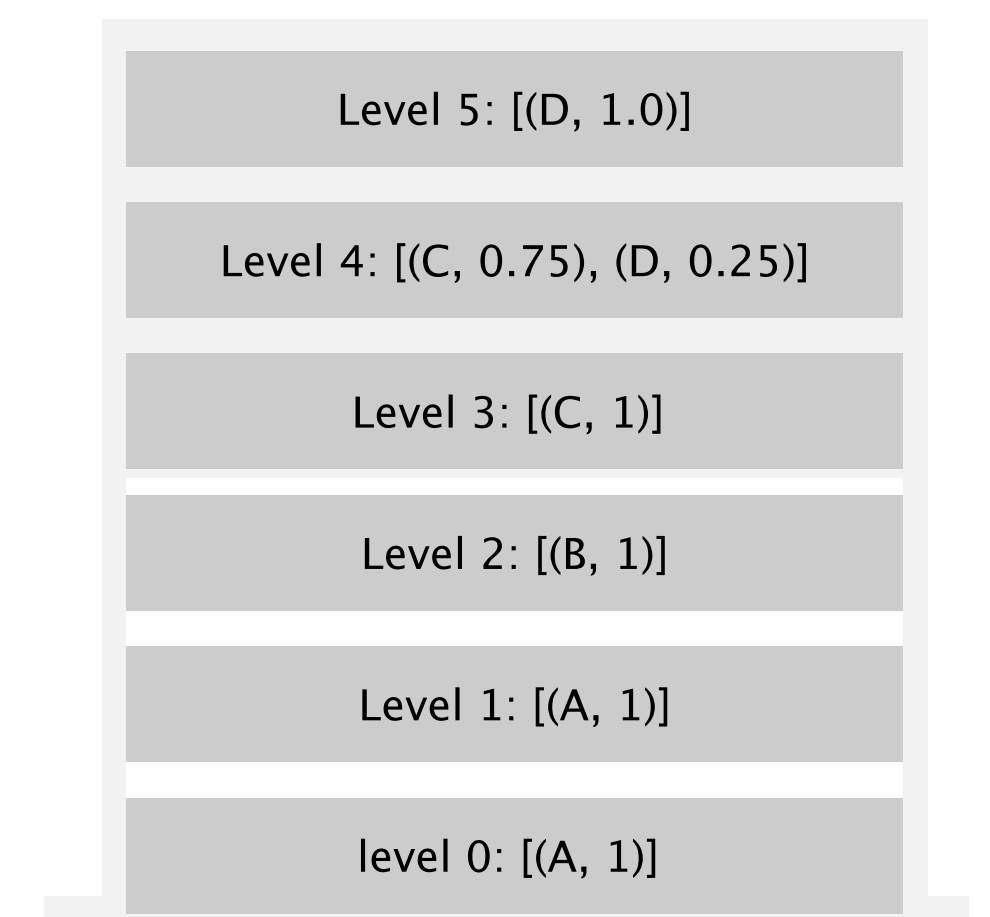
Sections



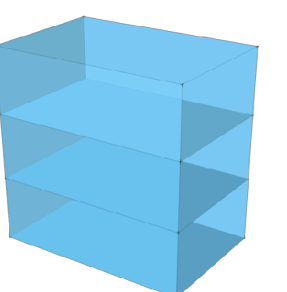
Section-storeys



Set storey

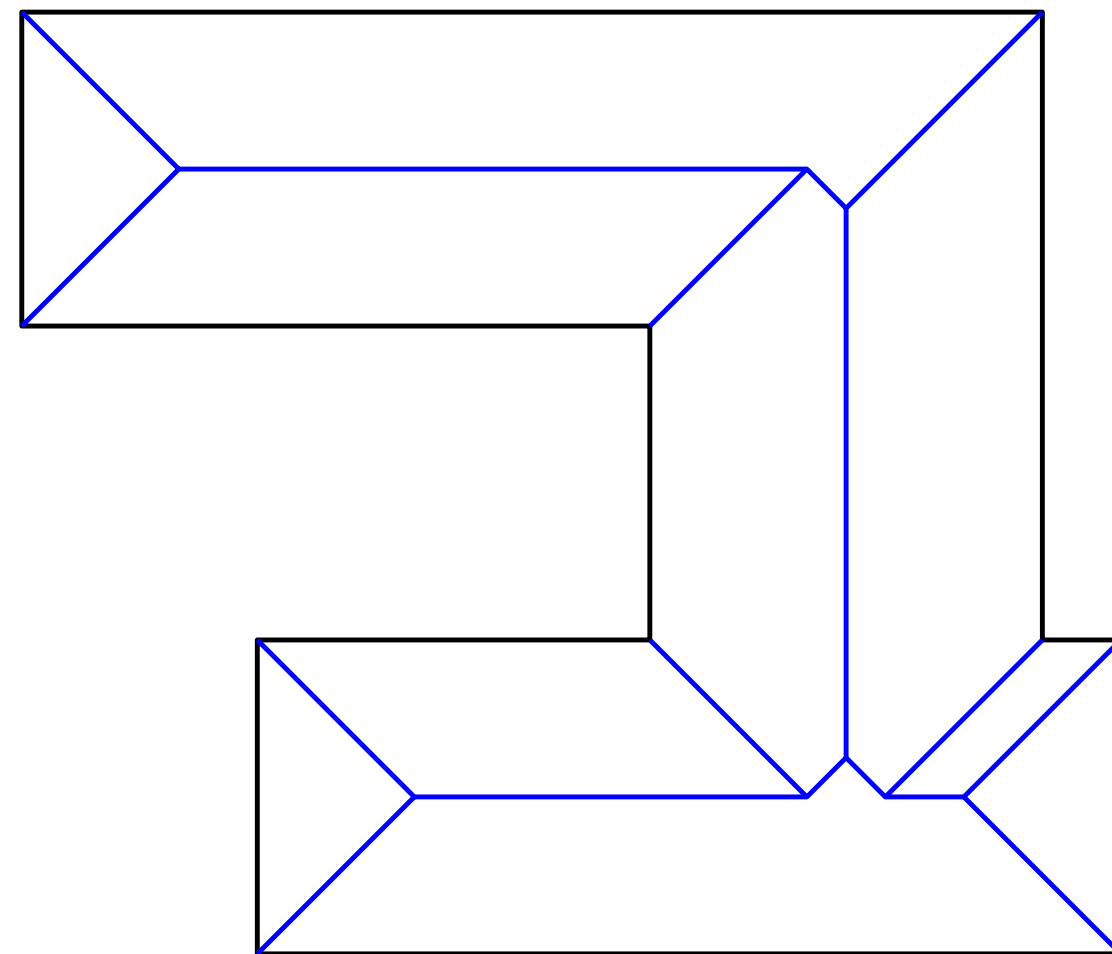


Set floor number

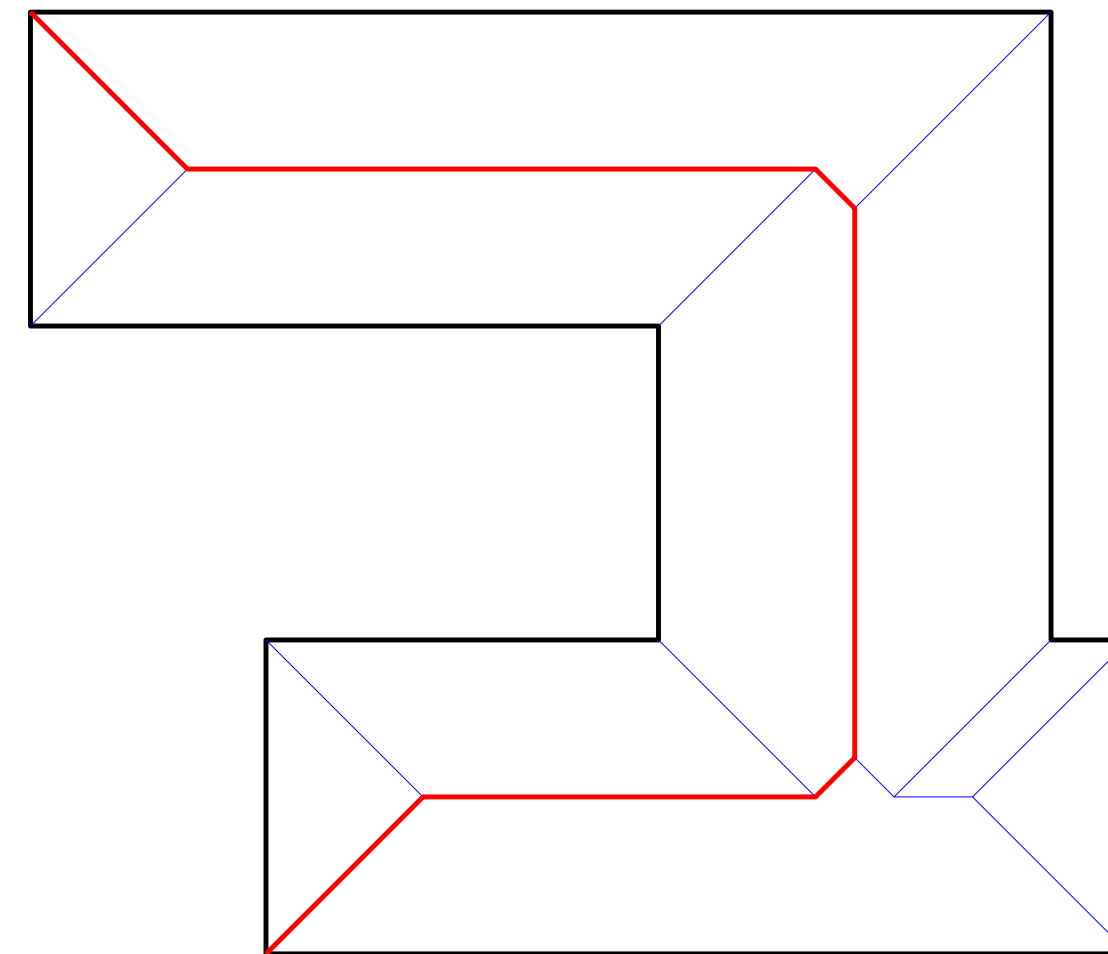


Divide storeys (1)

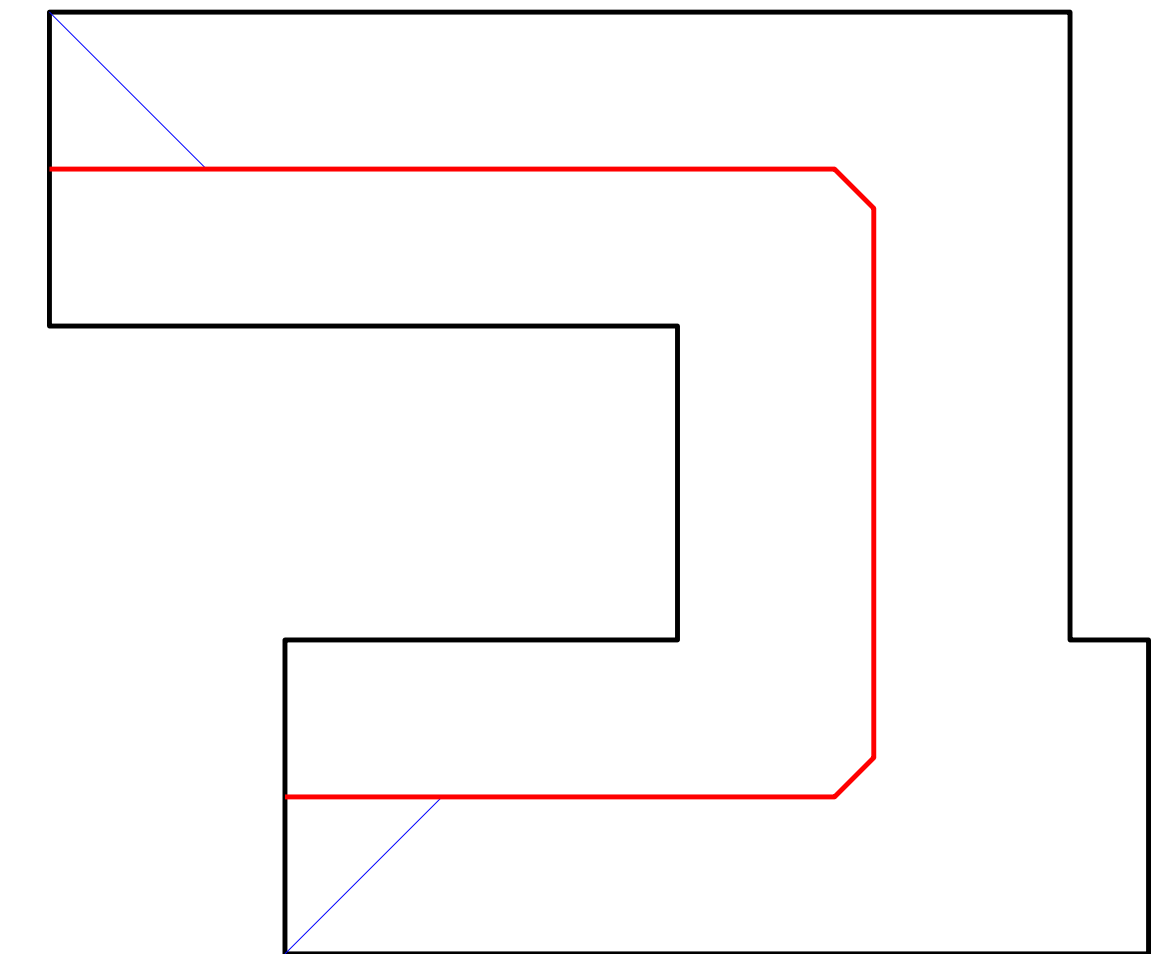
Methodology



Straight Skeleton

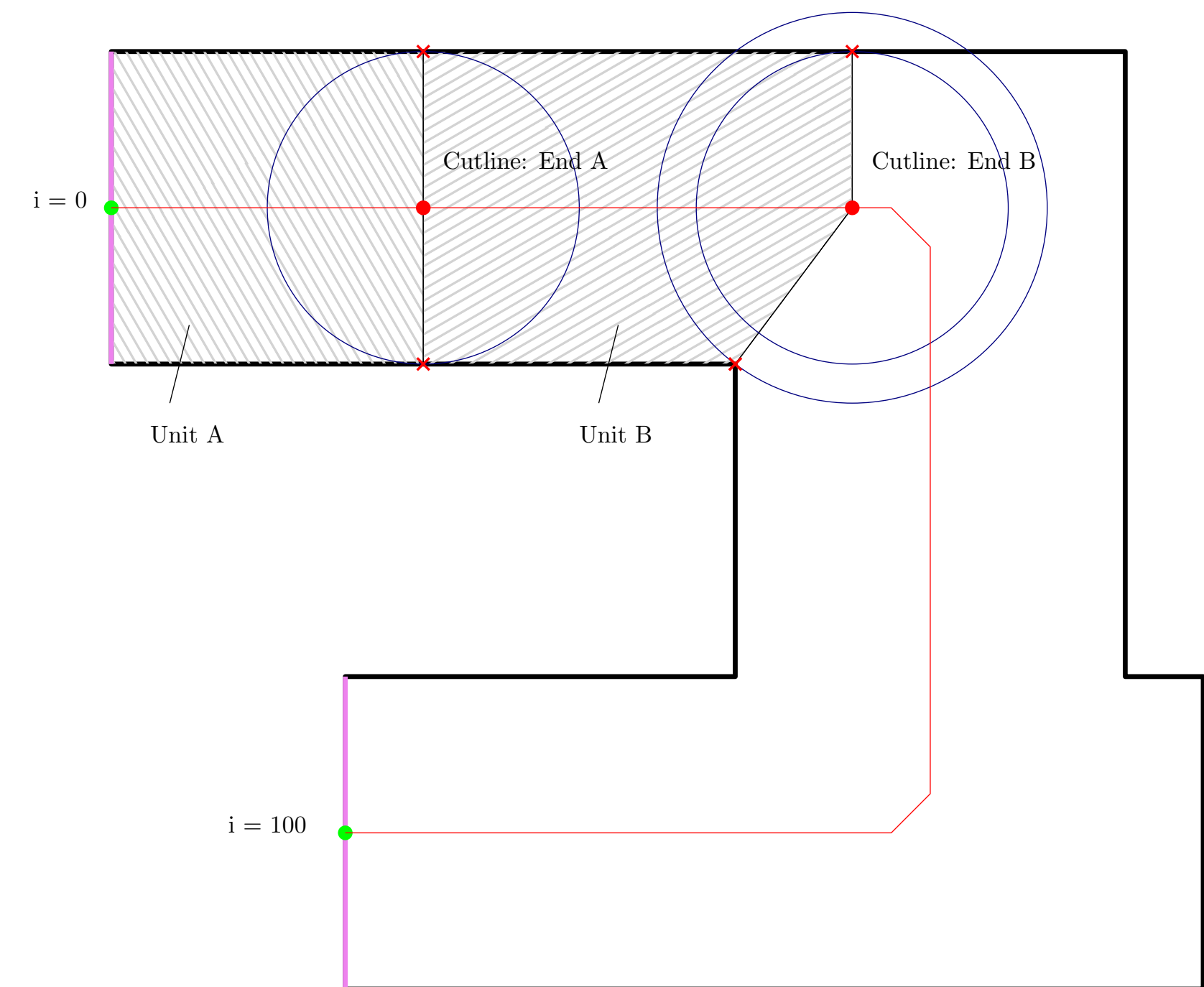
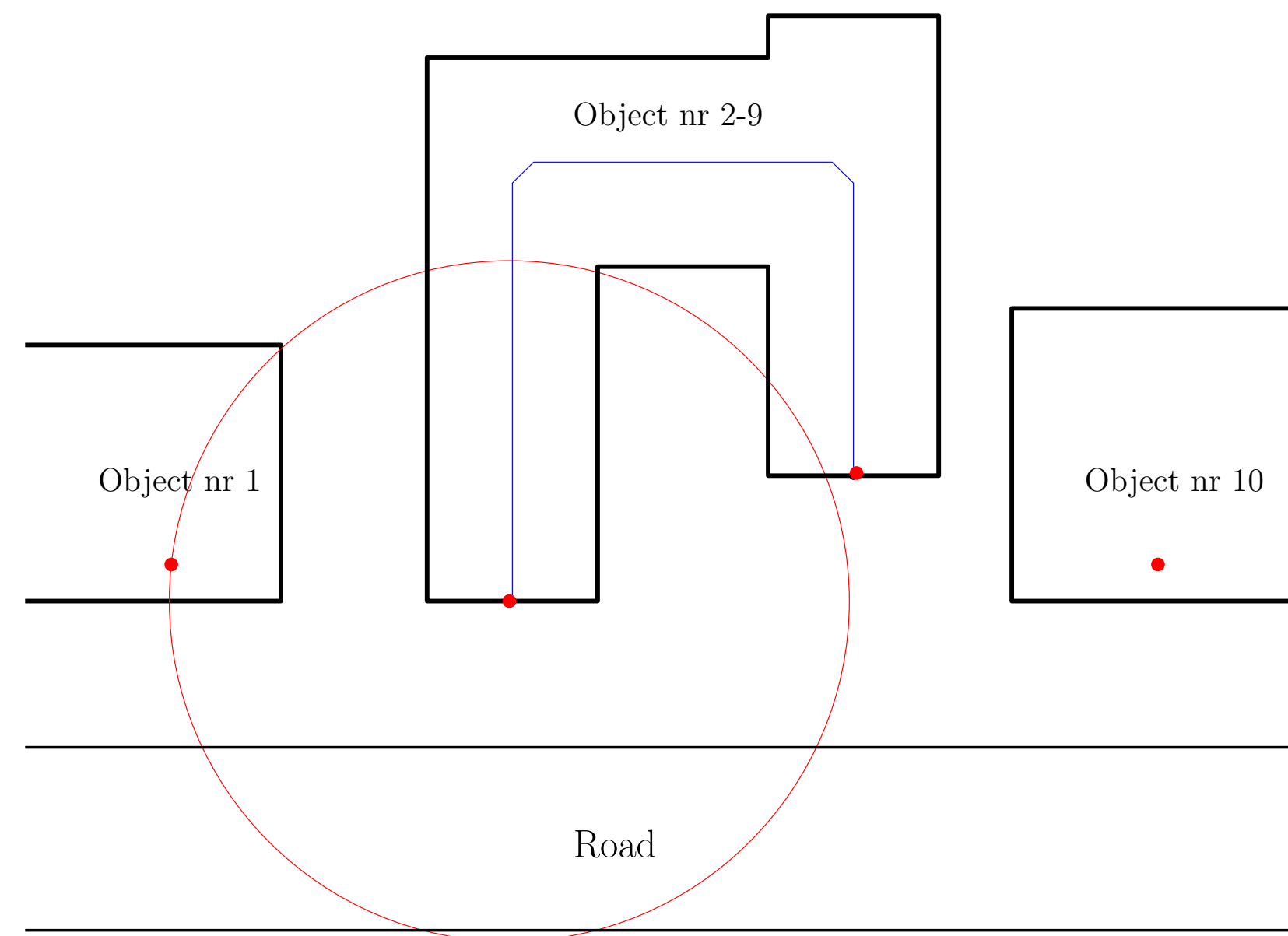


Find longest path

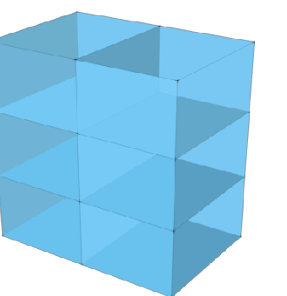
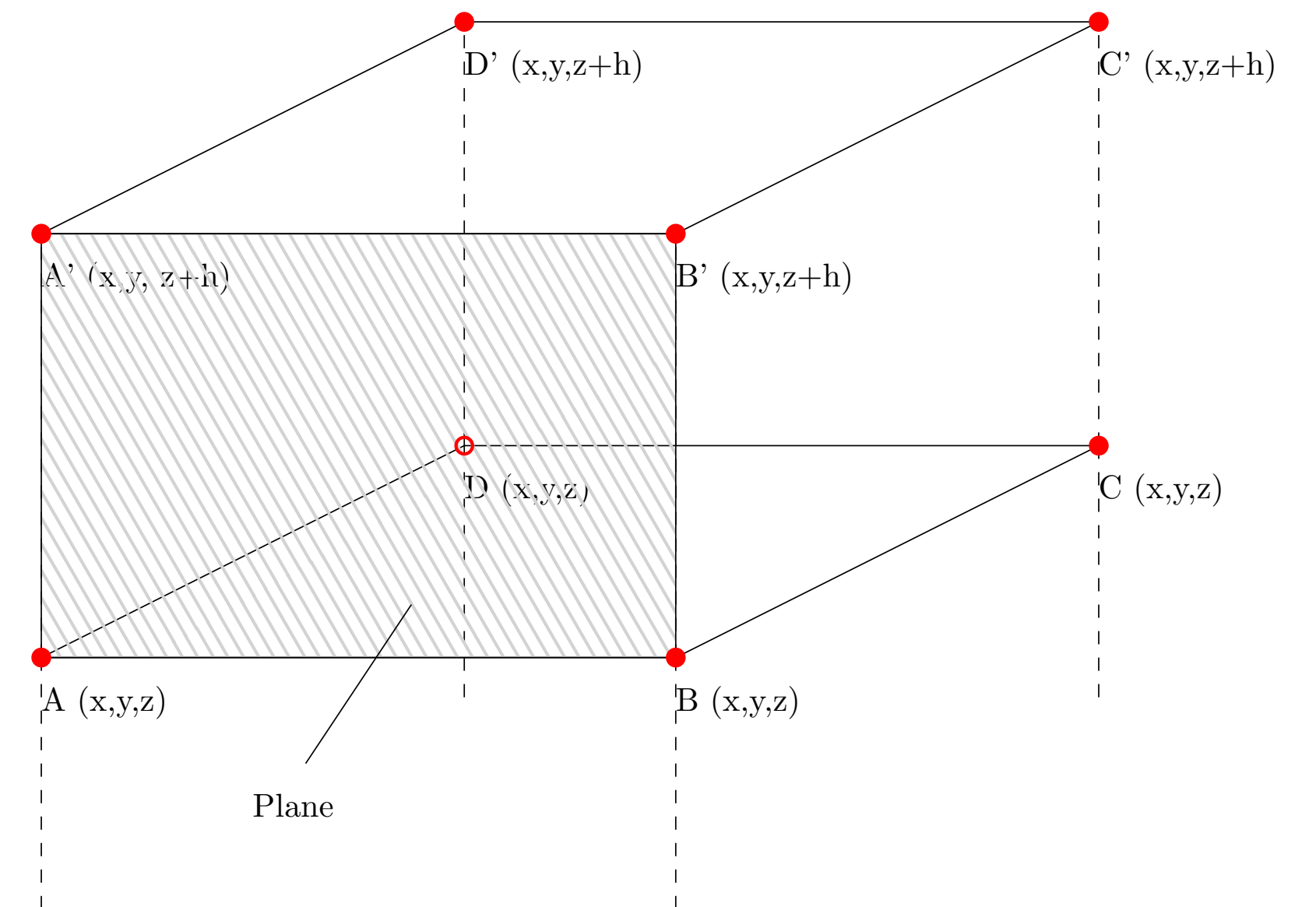
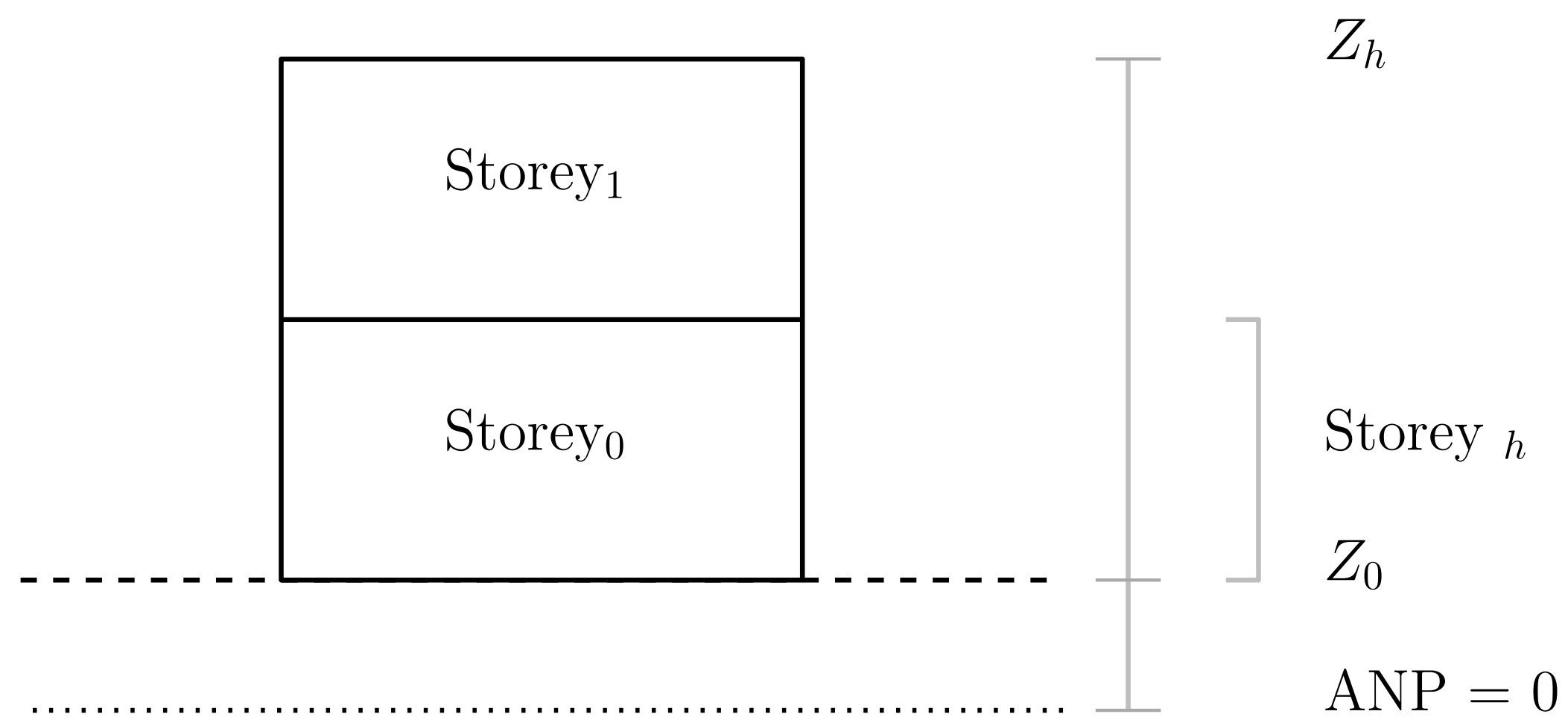


Extend

Divide storeys (2)

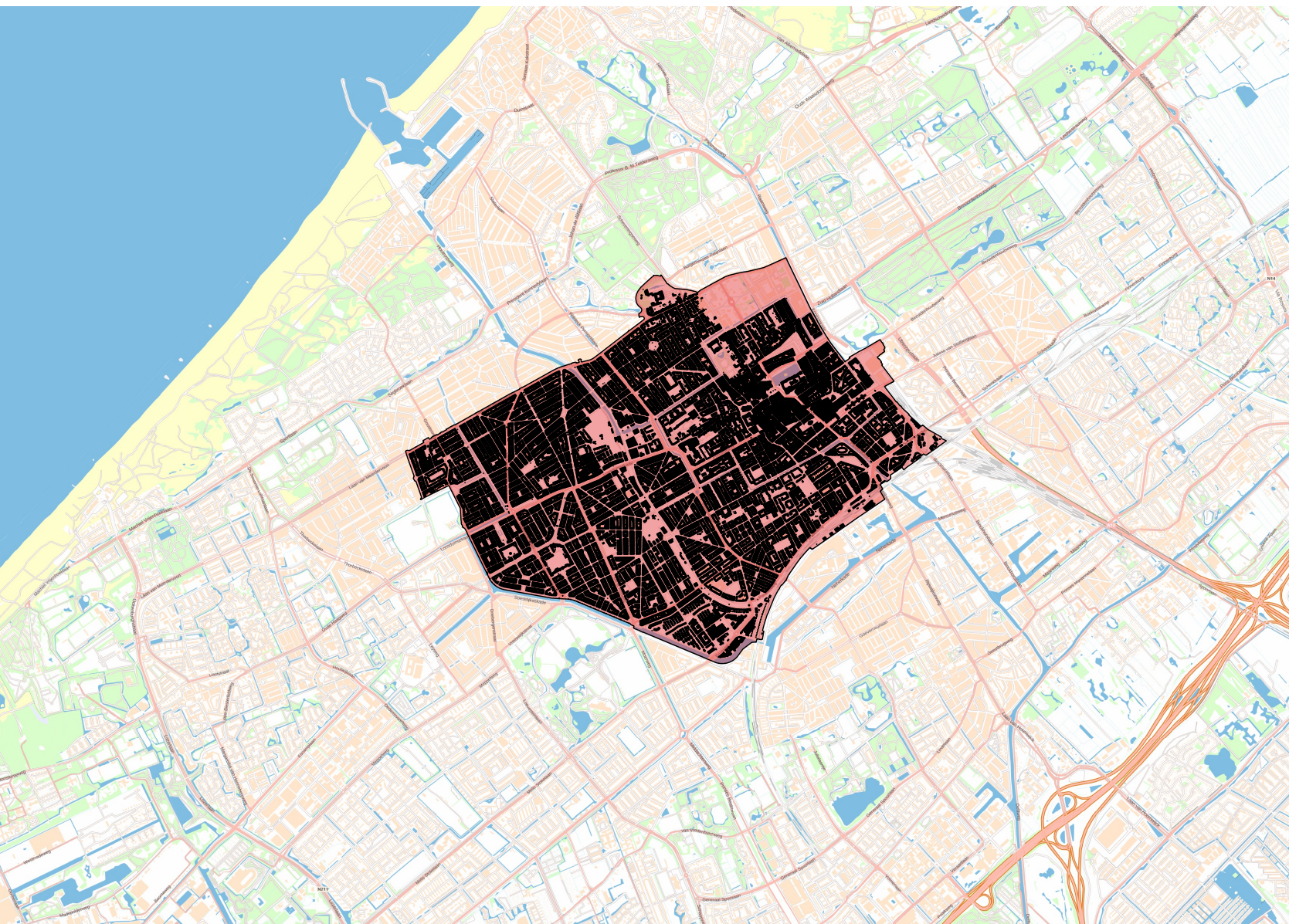


Create 3D

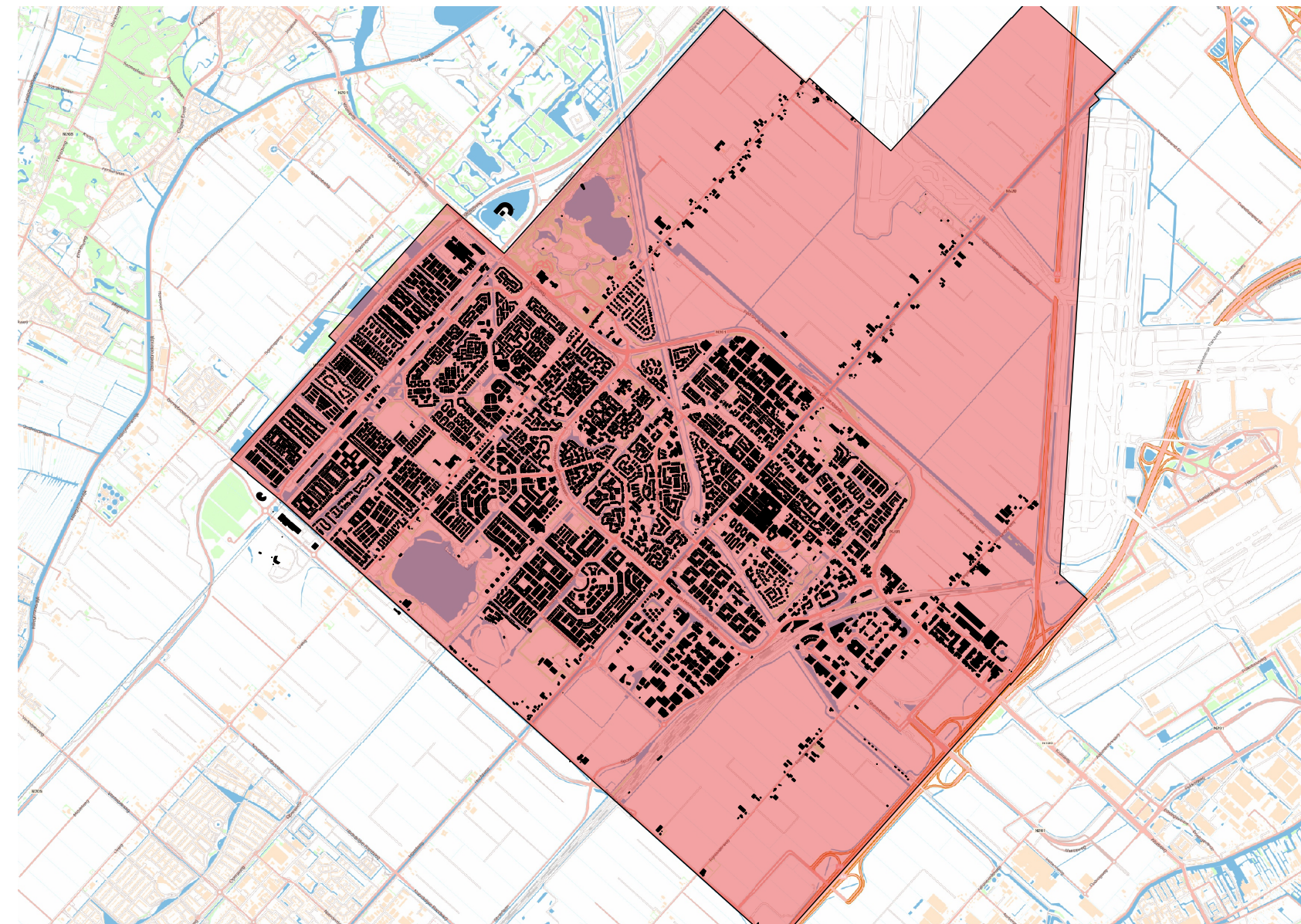


Implementation & Results

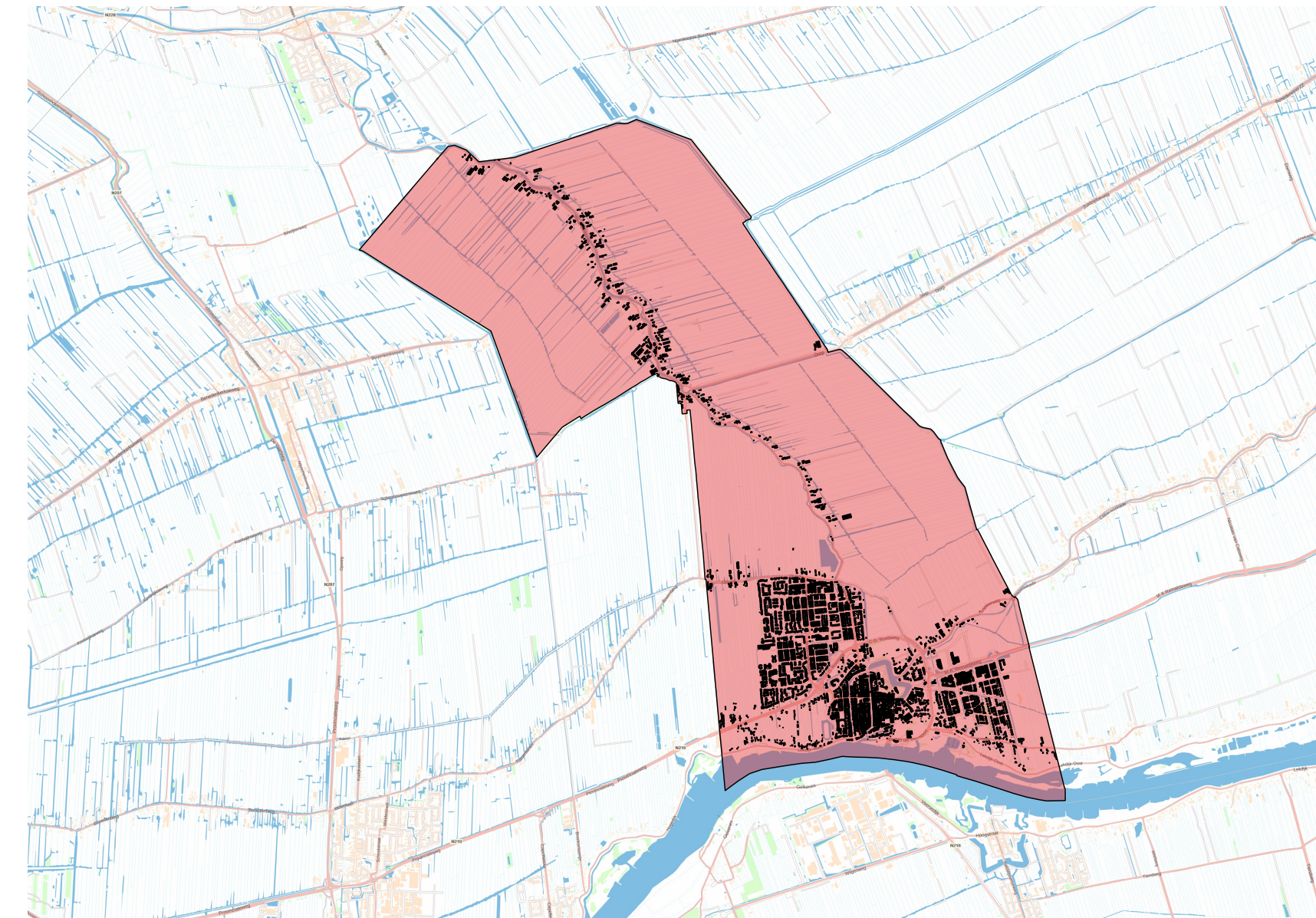
Test areas



Den Haag

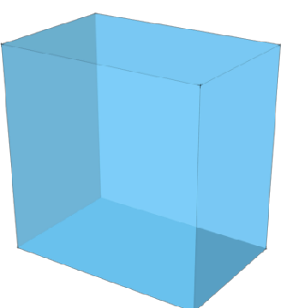
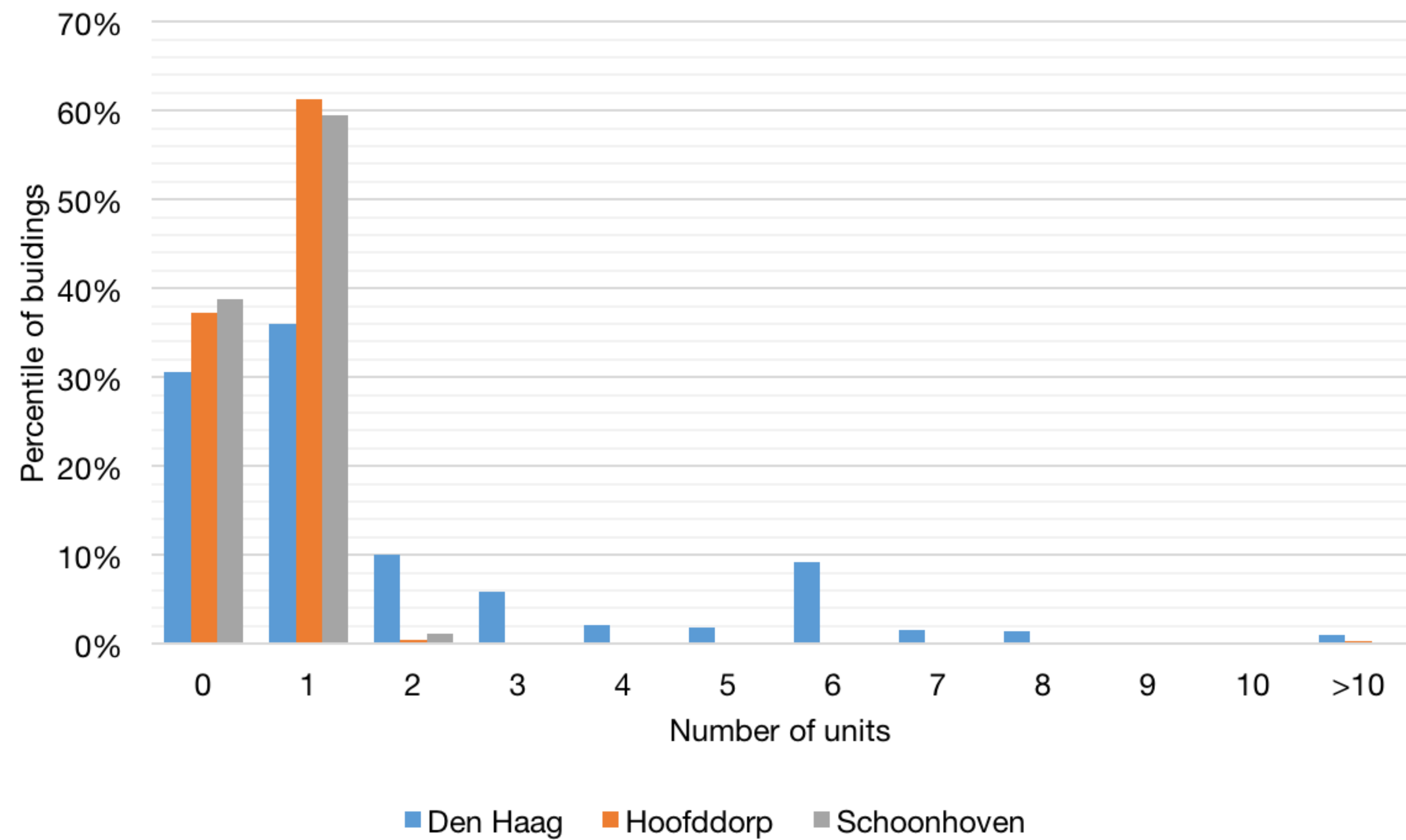


Hoofddorp

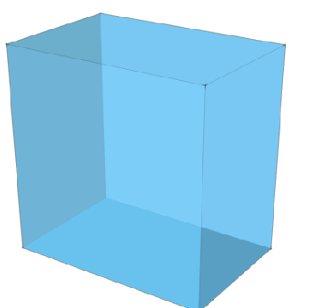
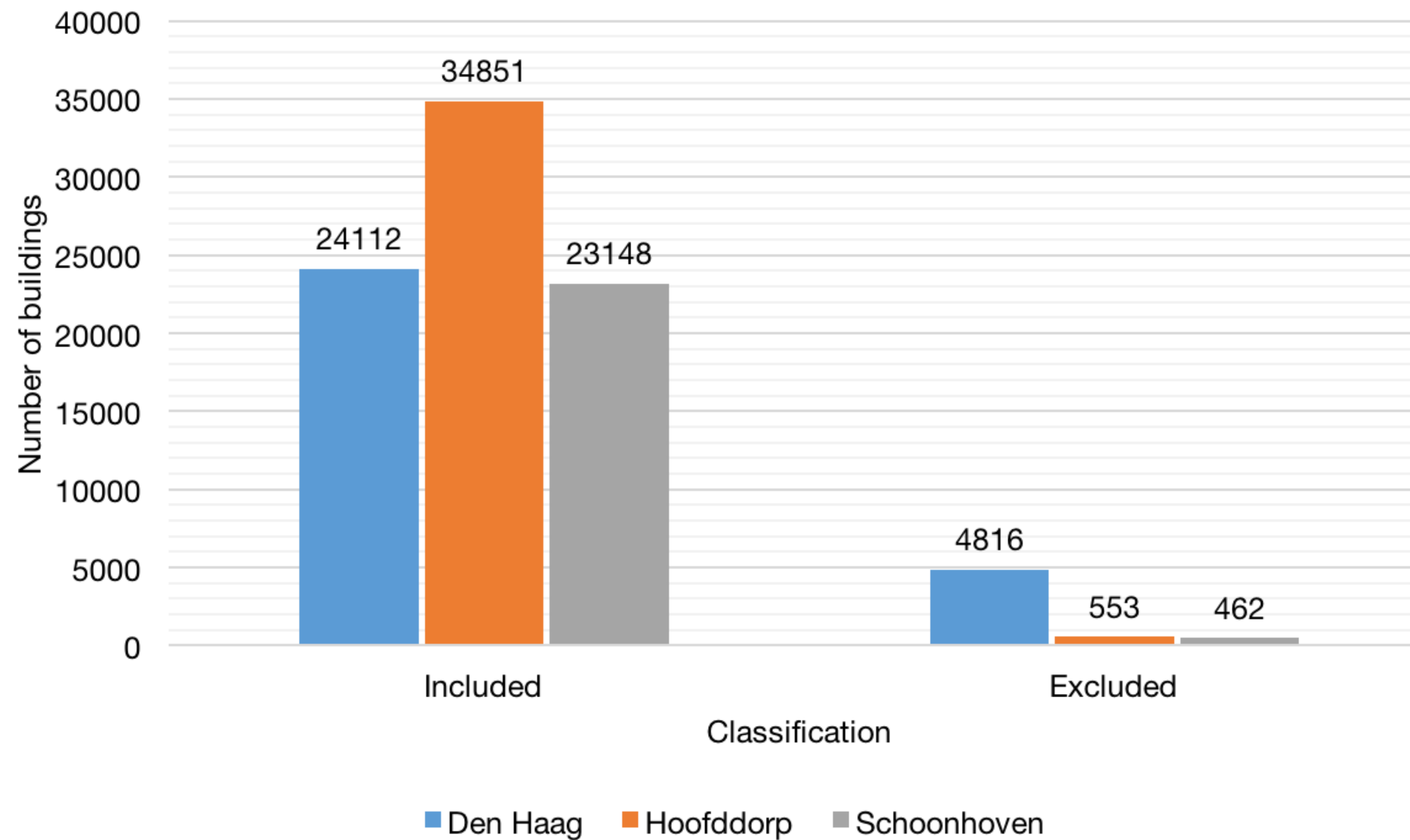


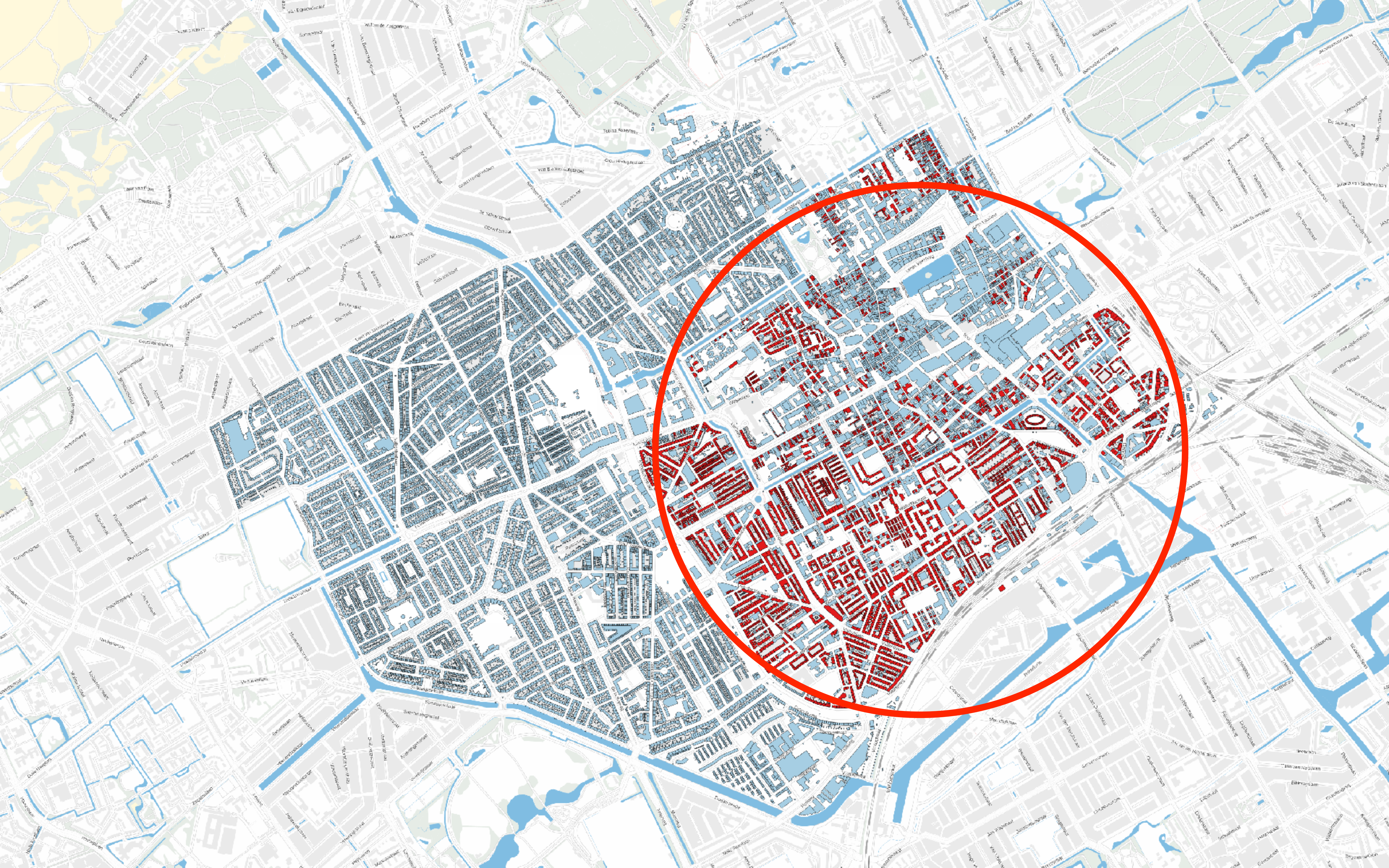
Schoonhoven

Units per building

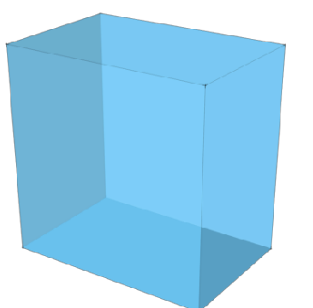
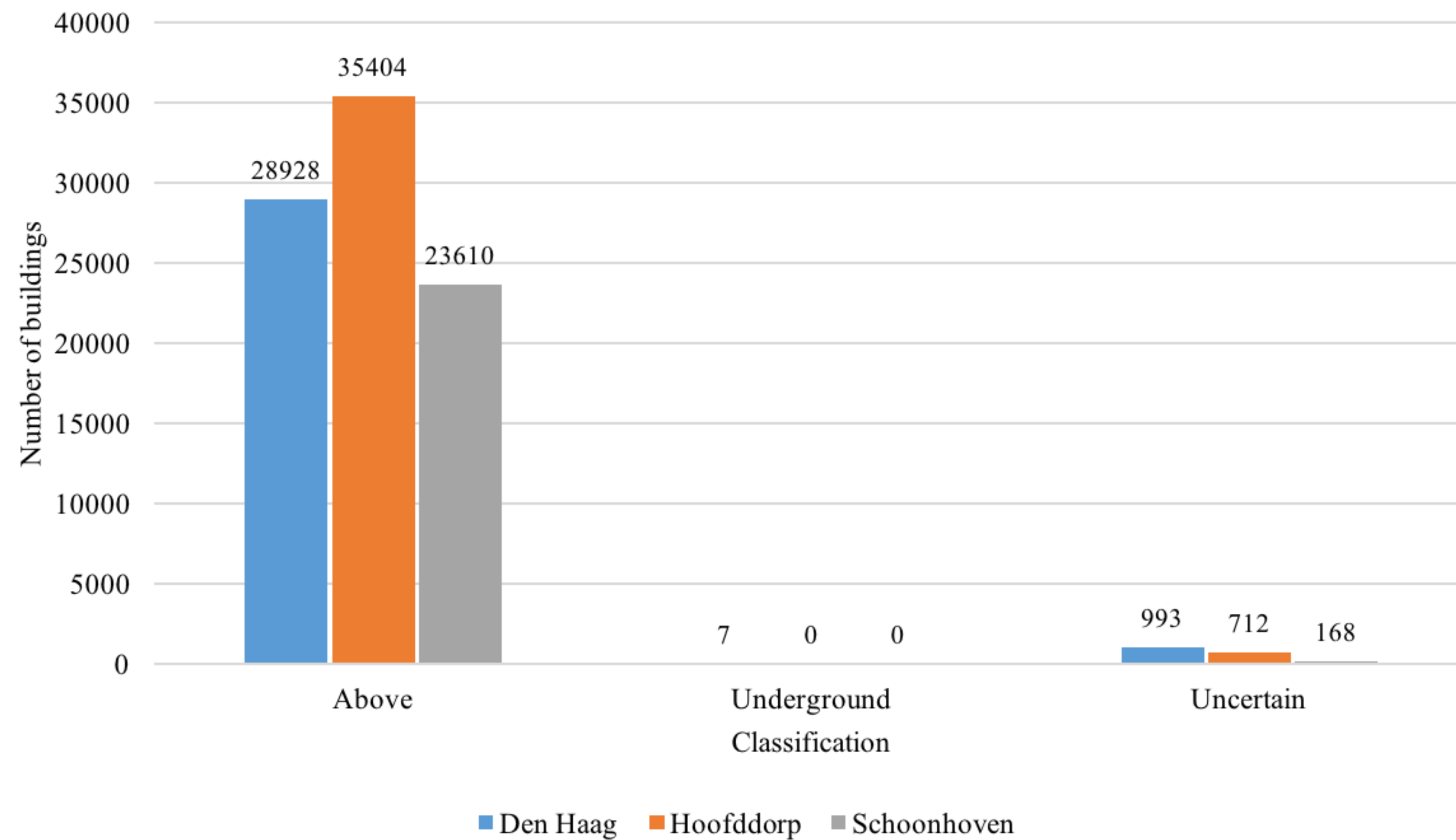


Excluded

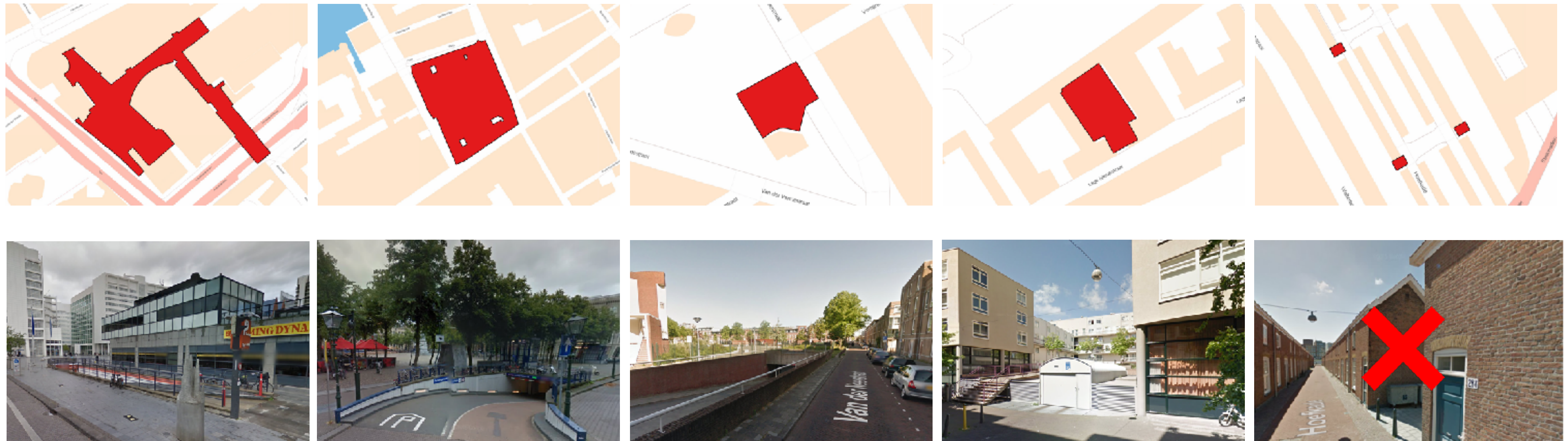


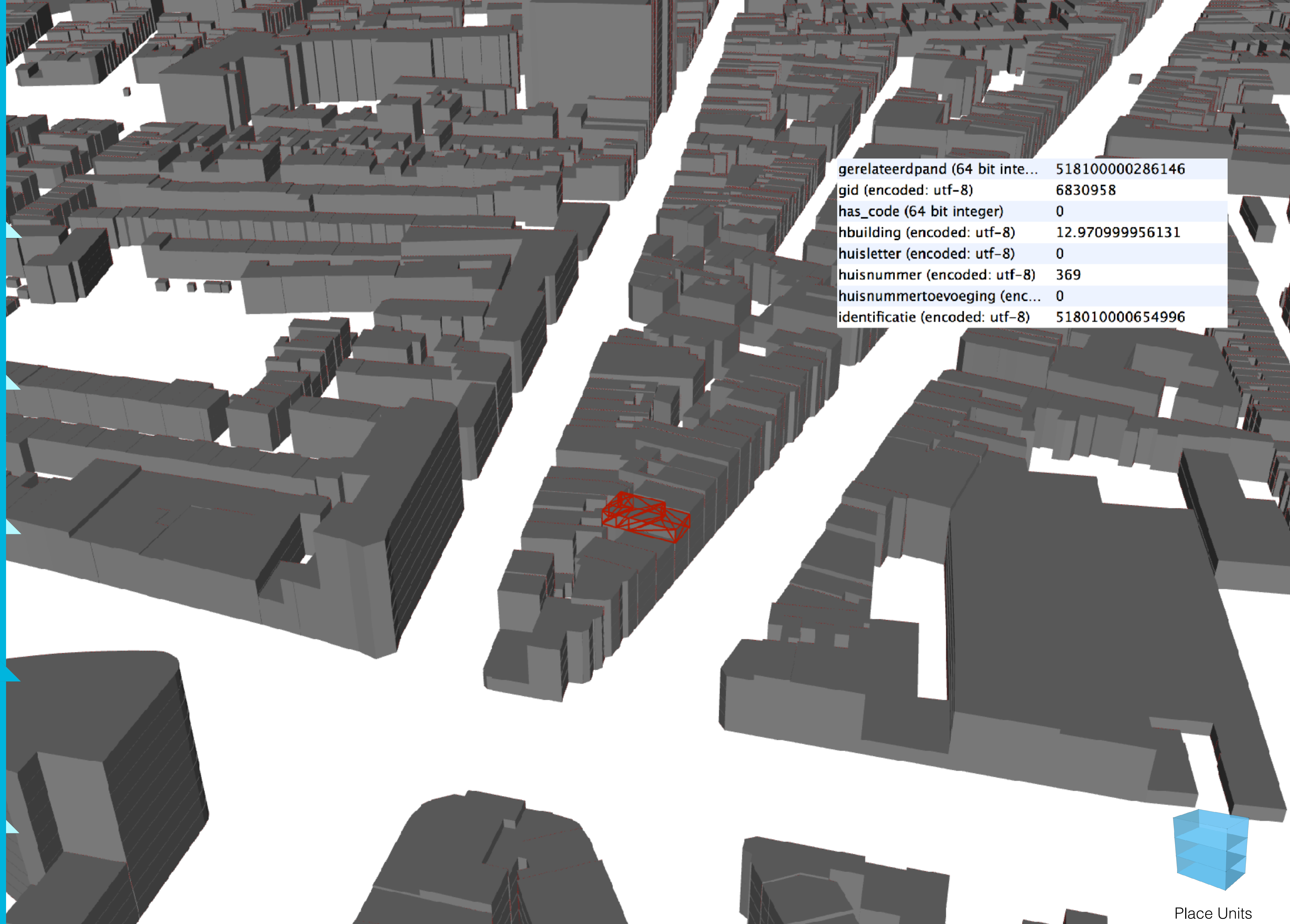


Underground



Underground

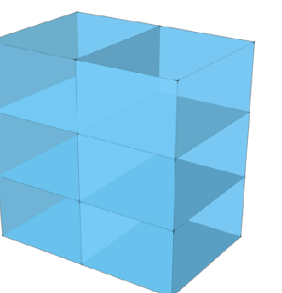
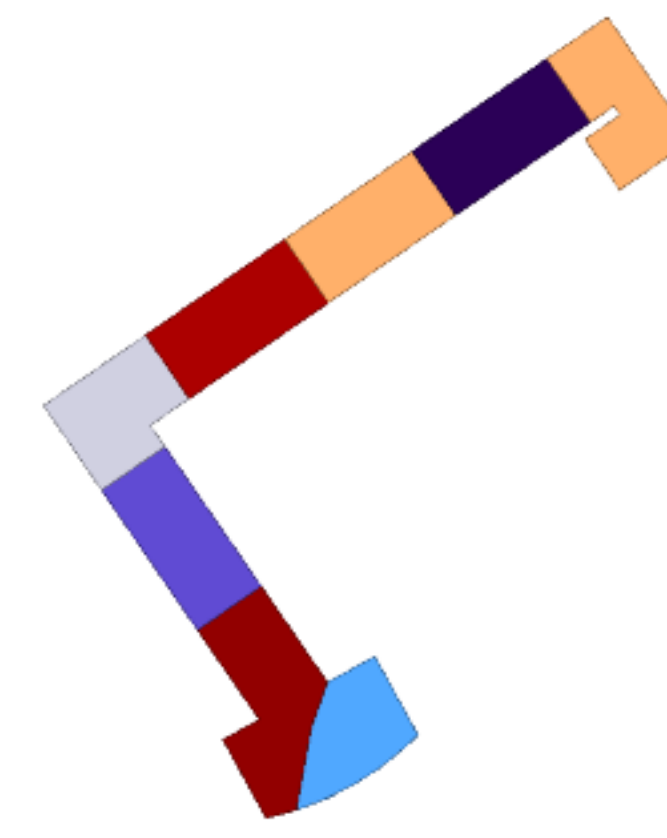
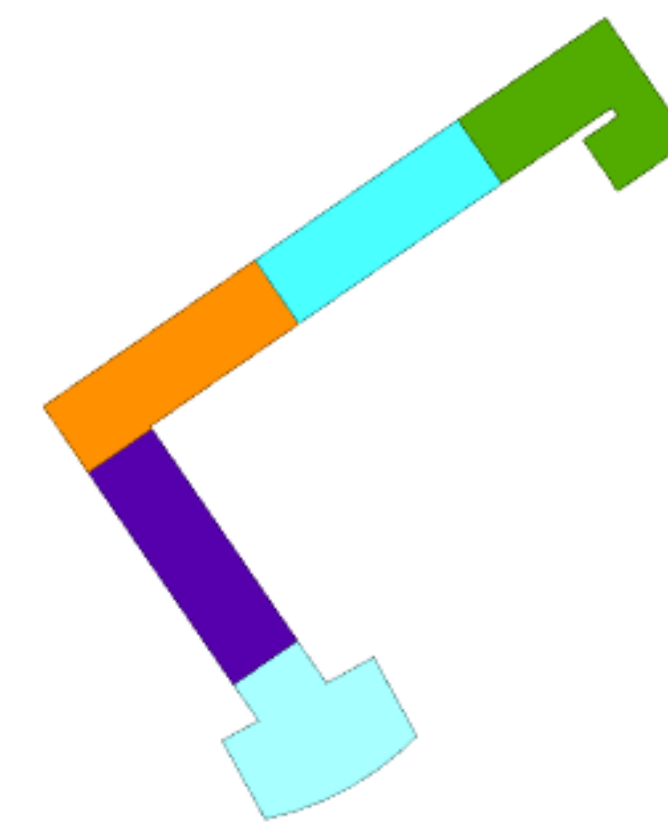
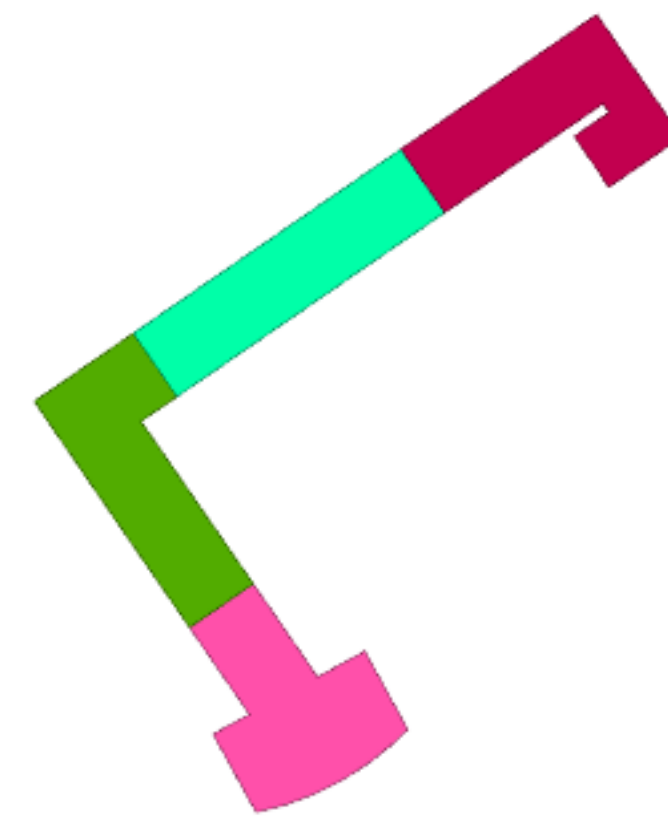
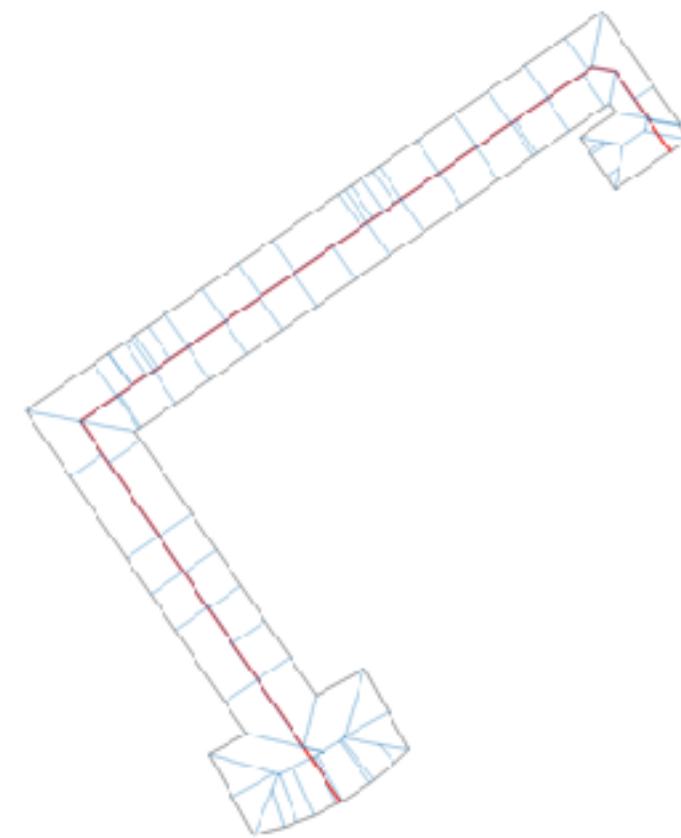
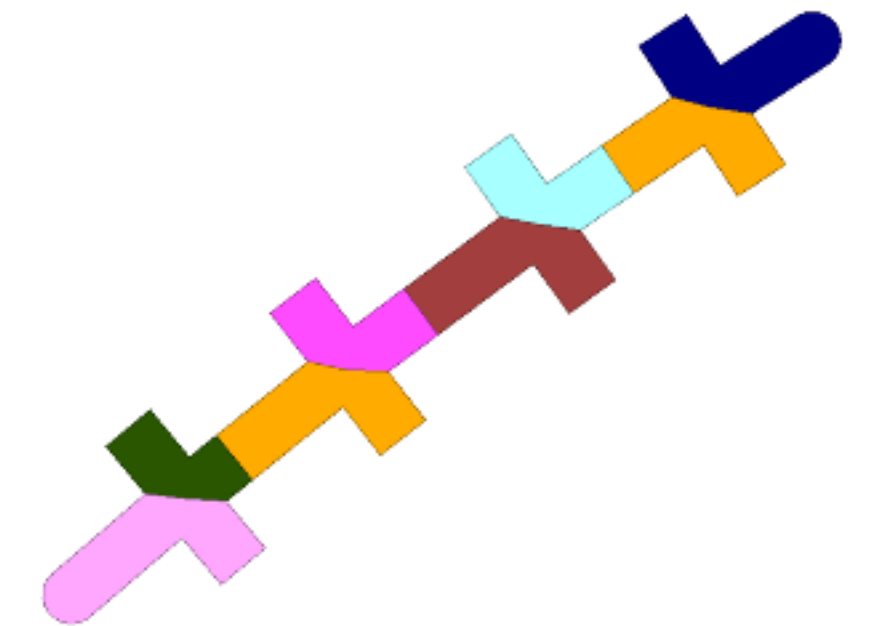
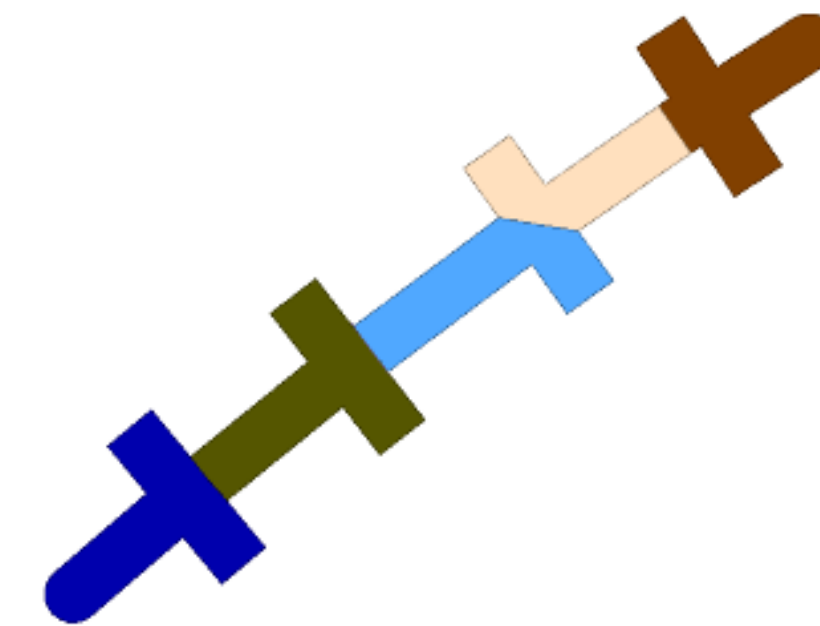
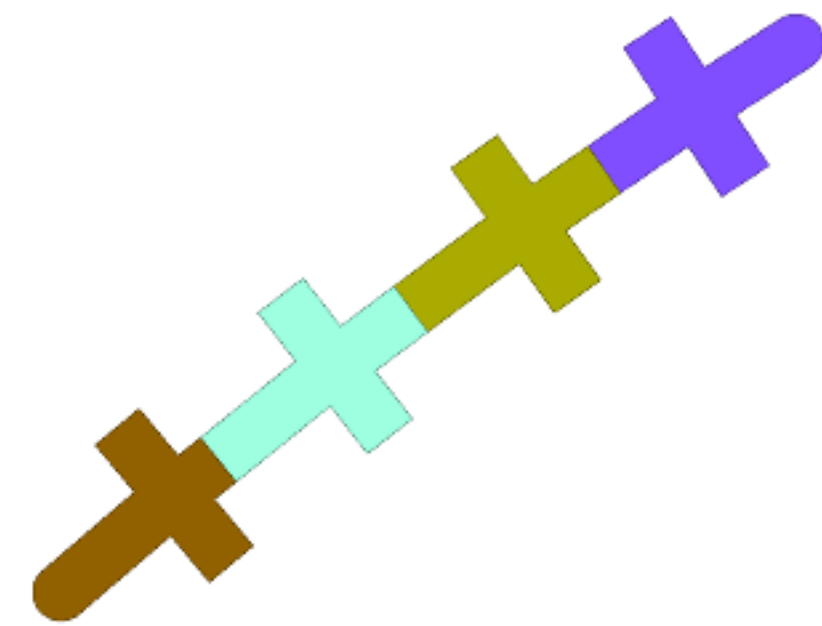
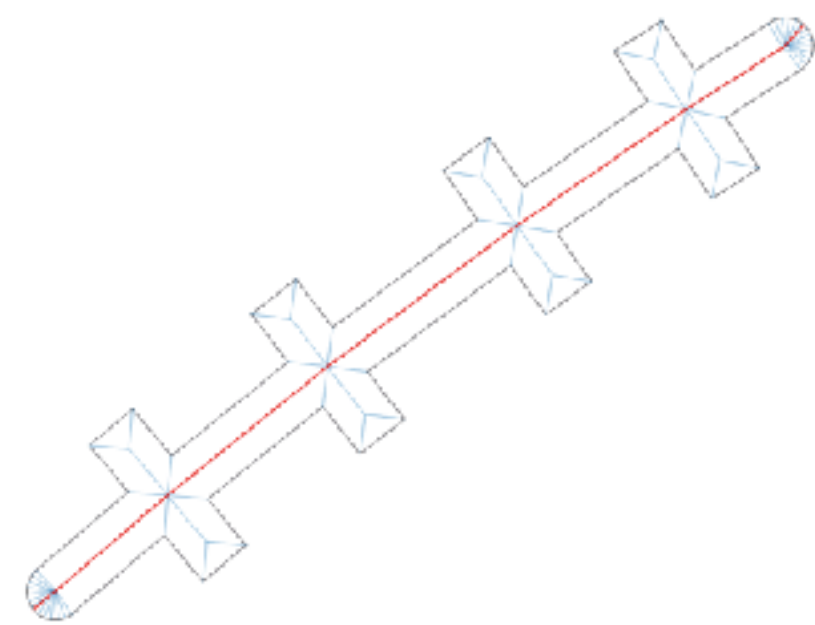




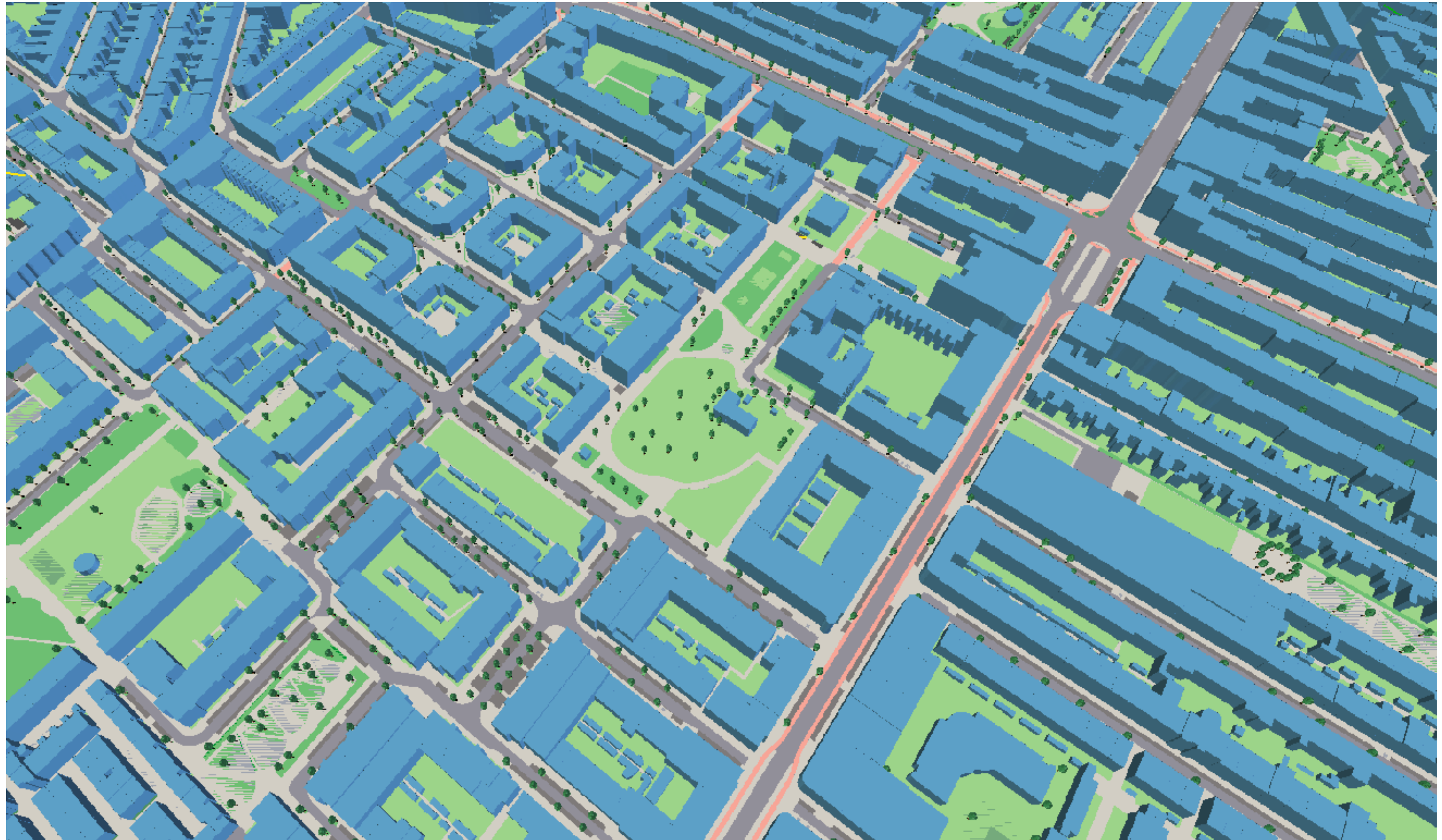
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Partitioning

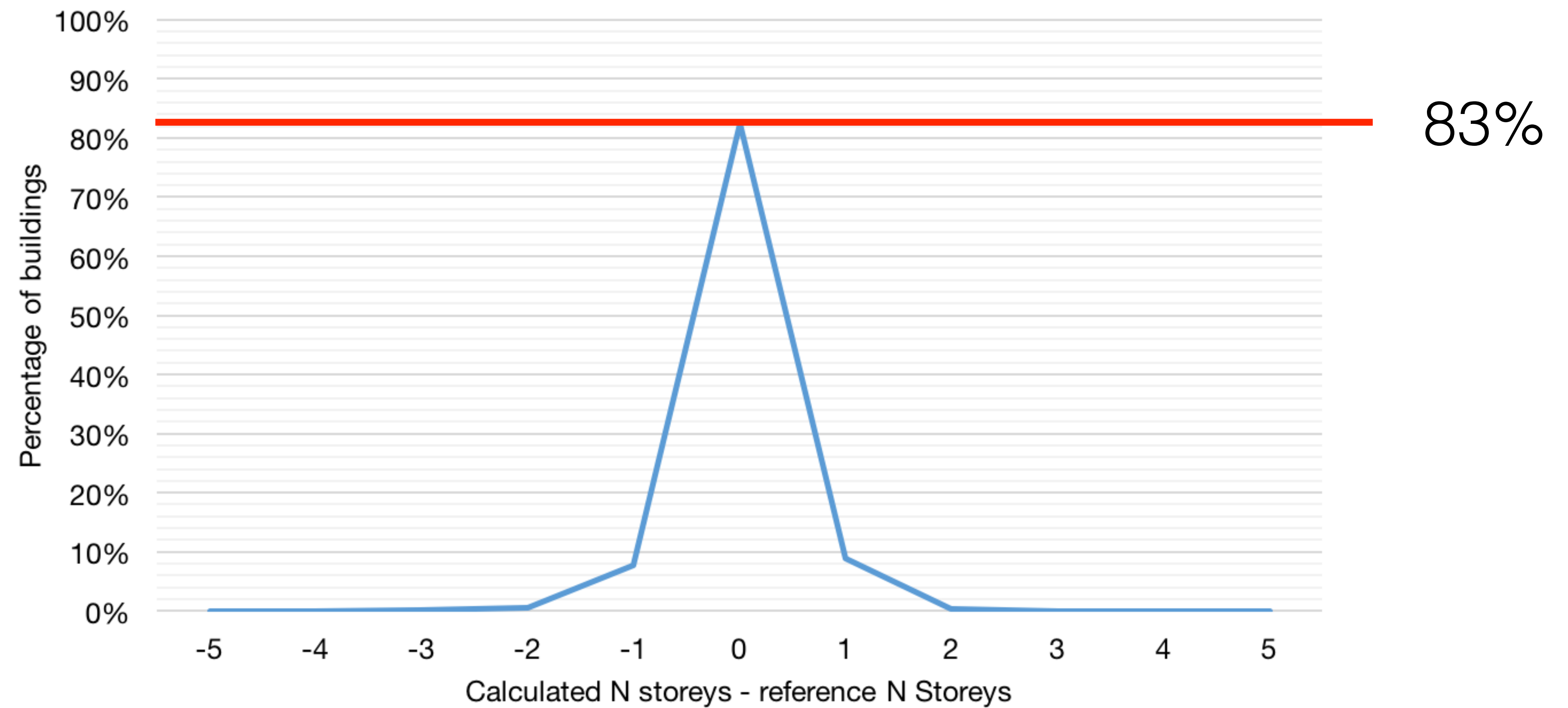
Implementation & Results



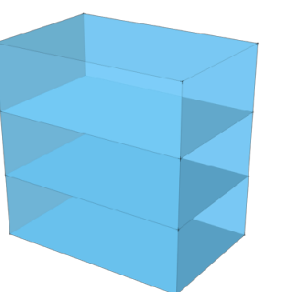
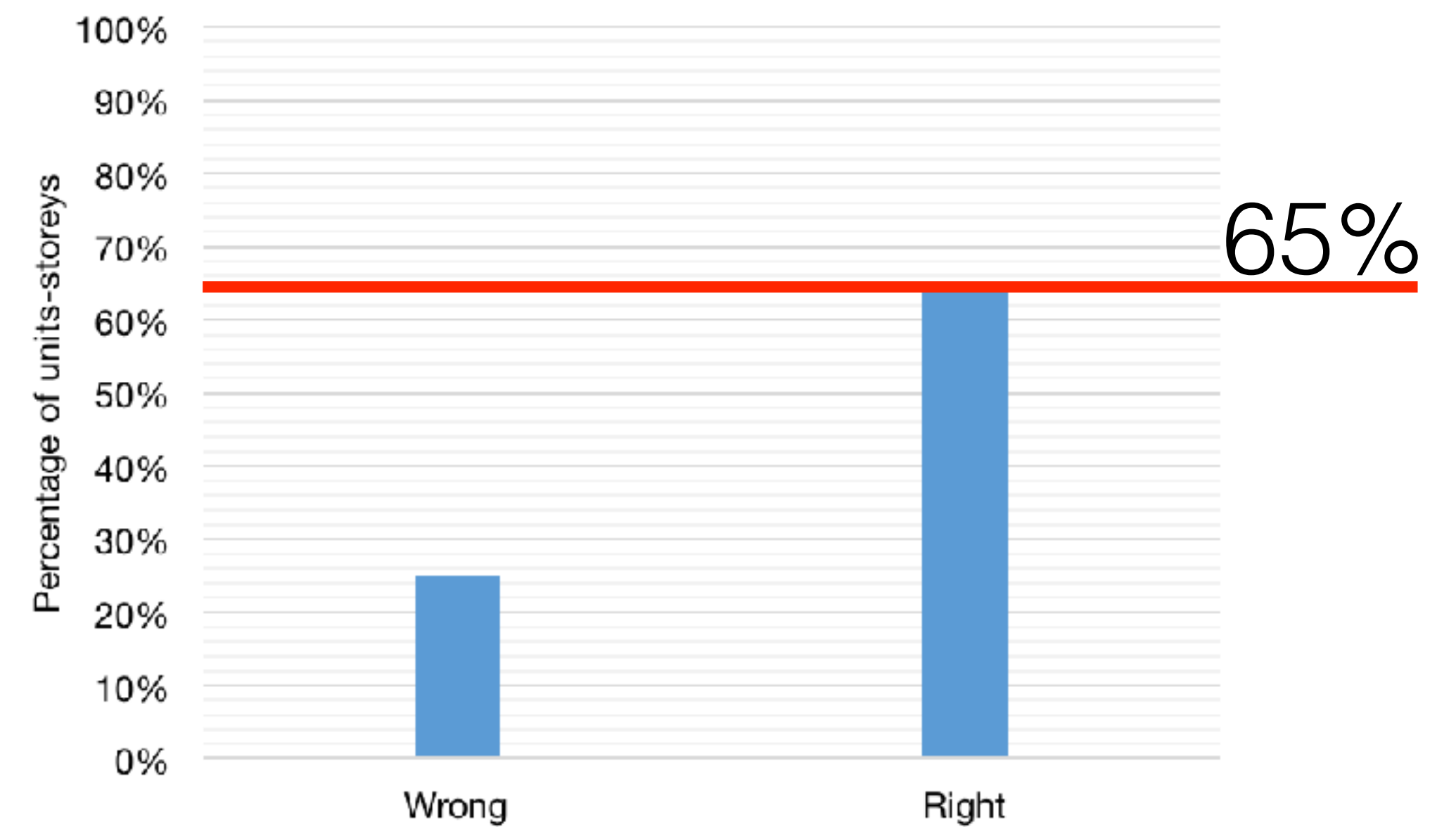
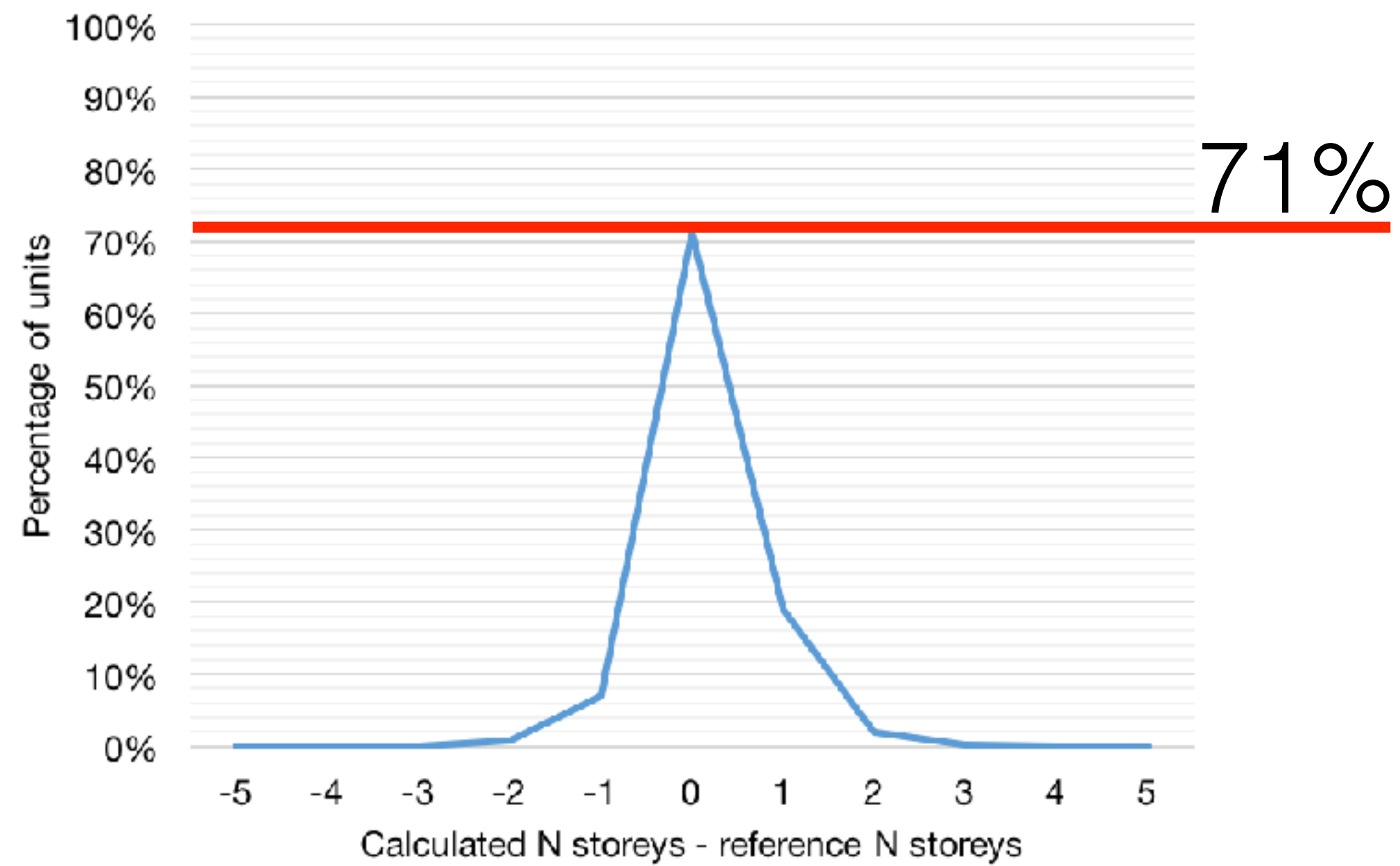
BGT & BAG



Storeys per building



Unit-storeys



Conclusions & Future work

Conclusion

- Proposed a model for the 3D BAG
- A lot of uncertainties in the BAG
- Every step adds new inaccuracies
- Even without interior information it is possible to create an approximate model of the 3D BAG

Future work

- Storey height based on parameters
- Improve level of detail of buildings
- Improve partitioning method
- Combine more data sources

Acknowledgement

Tu Delft



Hugo Ledoux

Jantien Stoter

Martijn Meijer

Municipalities of

The Hague and Rotterdam

Timo Erinkveld

Patrick Schmidt