

Urban Automata

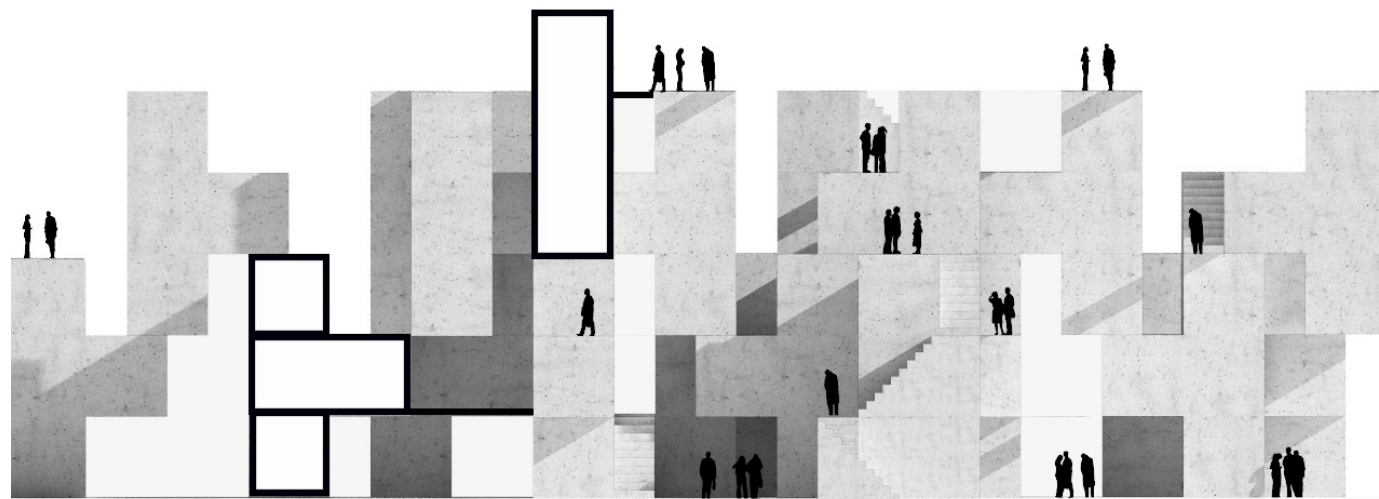
The Relationships between Interaction,
Generation and Design

Jens Lundin

Chalmers School of Architecture

Examiner: Morten Lund

Tutor: Kengo Skorick



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2017



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ABSTRACT

The goal of this thesis has been to study design processes and the relationship between the design system, user and designer as well as the qualities a method produces . Experiments with different approaches, both digital and analogue, have been made with the goal to analyze the relationship between the inherent logics or rule sets of systems and what spatial effects they generate. This is done in order to find new ways of planning urban areas as well as to try to find the best way to leverage the strengths of generative processes and human intellect together, and strike a balance between them. Looking at the architectural systems of modernist and vernacular architecture as well as city scapes, the spirit of those places are distilled translated and reconfigured. The aim is to design through selected spatial rules, which then are applied to contexts to reach a conclusion that embodies qualities of both. Another goal is to rethink the modern city and its predictable nature and try to capture the sense of surprise and exploration that is often found in vernacular urbanism and dense sprawling areas but is lost in typical contemporary urban planning.

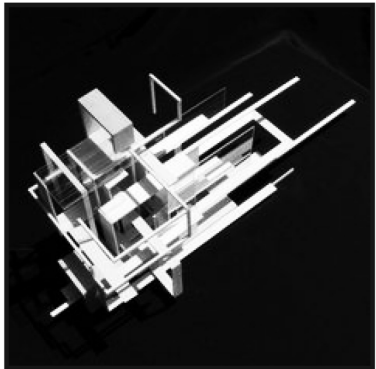
In the starting investigation the focused was on looking at existing design tools and design toys and games for the use in collaborative design processes and their inherent logics as well as their strengths and weaknesses, As well as explore the potential of new technological advances in virtual reality and augmented reality. Games and toys such as mine-craft and lego which as known to inspire creativity in both children and adults was compared to more tra-ditional. tools and methods of design iteration such as modeling software of conceptual modeling.

The amount of freedom varies greatly in the dif-ferent models , with the “game” types being more prone to have rules of building assigned to them. This limitations however just seem to increase the popularity of them and further the engagement of there users.

In comparing of the systems of Lego or Minecraft that has rigid rules inherent to them that dictates the way a user may interact with them some key differences was noticed. Physical based tools such as lego has an advantage in its tangibility and sense depth while virtual ones alow for a greater freedom of expression in the sense that it doesn’t constrain the user to real world physical laws.

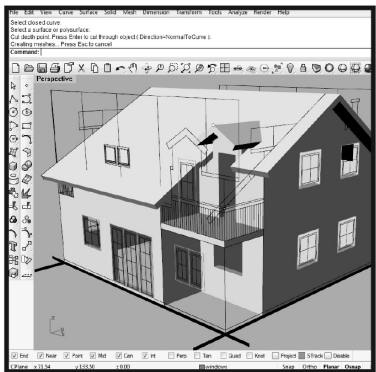
Another advantage a virtual environment has is the ability for the interaction with machine generated structures which can create a feedback between user and machine. For instance in the game minecraft the world is first generated by algorithms in the game which the player can then interact with, subtraction and then add to.

Conceptual models



- Creative freedom
- Depth perception
- Tangible
- Limited to material
- Only for physically present

3d modeling software



- Creative freedom
- Powerfull
- No limit to forms
- Hard to learn
- Inifficient for collaboration
- No depth , sense of scale

Lego , Bricks



- Playfull
- Intuitive
- Inviting
- Limiting
- Only for physically present
- No sense of scale

Minecraft, Games

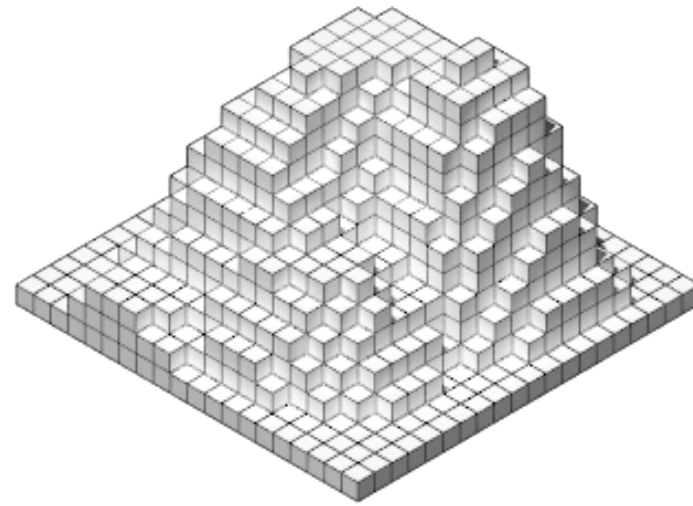


- Playfull
- Easy to learn, use
- Inviting
- Connected
- Limiting to rules
- No scale
- No depth , sense of scale

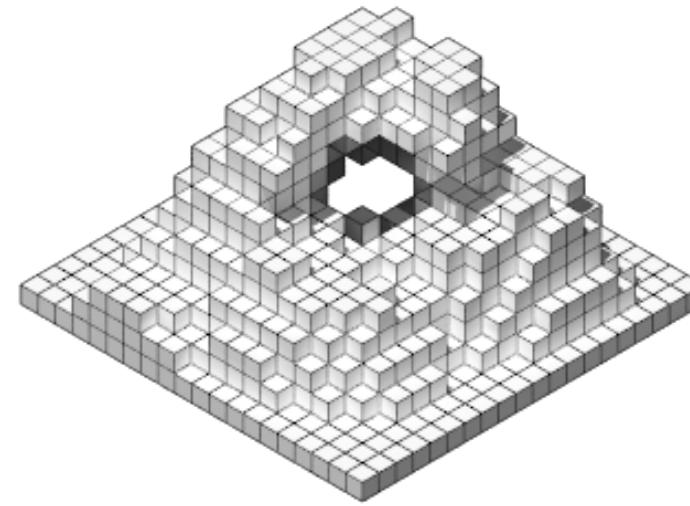
GENERATION



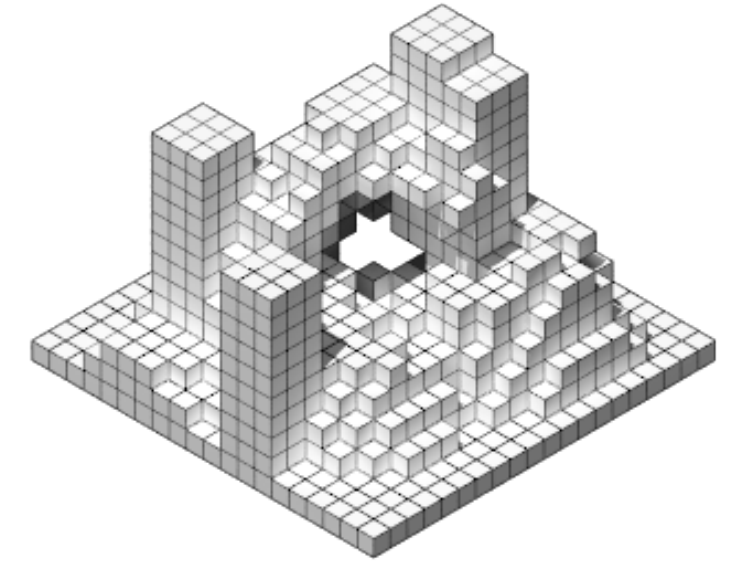
One base unit
configured in
many ways to
form structures



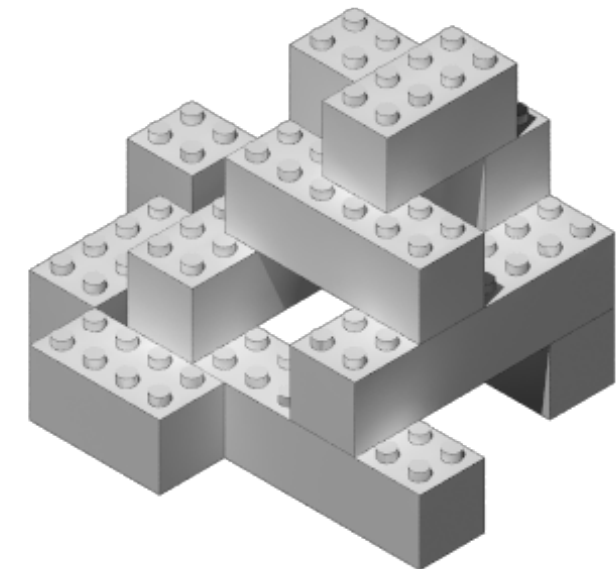
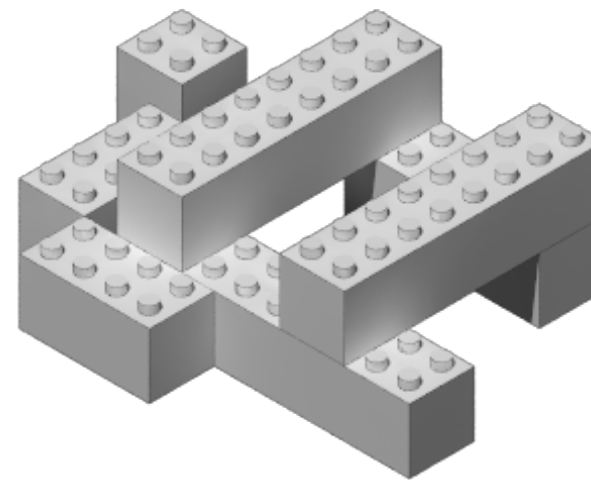
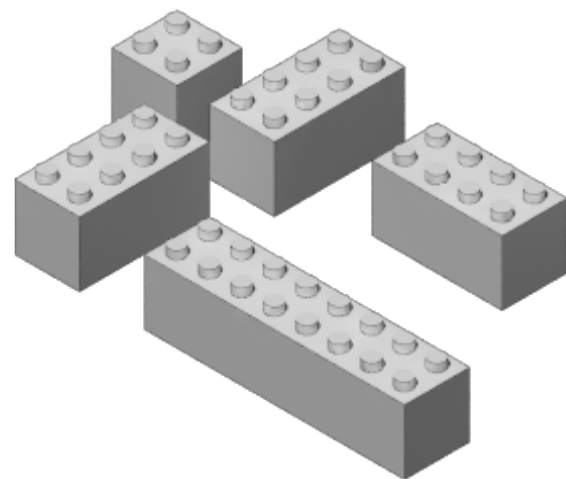
SUBTRACTION



ADDITION



Many base units
configurable
according to inher-
ent rules

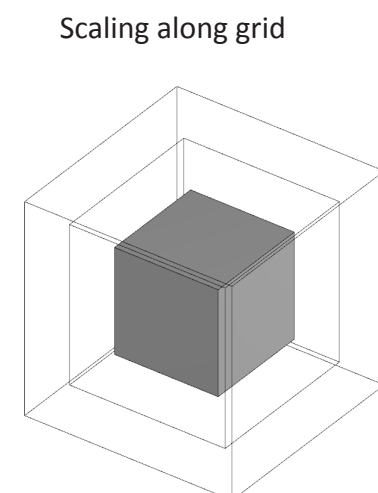
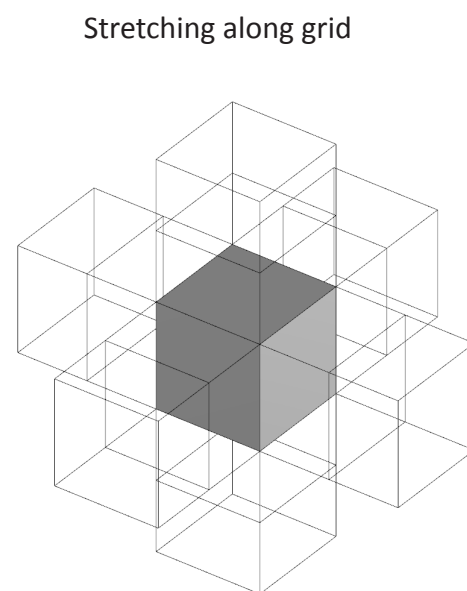
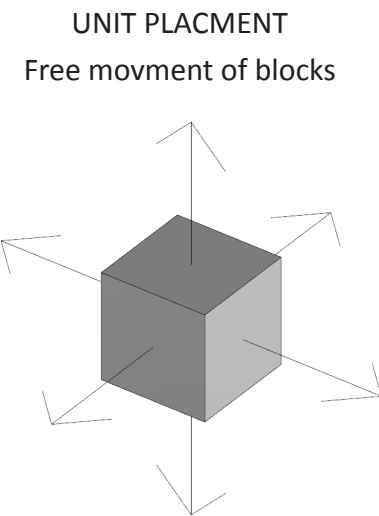


To explore this further, the intent was to develop a tool that encompassed key features of the different systems. This was done using Unreal Engine and coding in C++ to create an environment where users could move freely and place geometry. The user can place geometry free from rules or grids but the manipulation of the objects is tied to a grid.

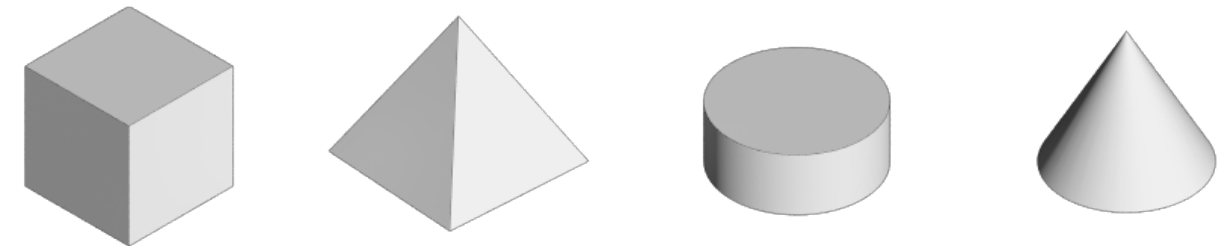
The tool can also be used in VR and online together with others to build conceptual models collaboratively in a simulated real world scale.

To build you press the mouse to bring out a "brush" object. I wanted this to work like a piece of clay you put into your model, that you can then stretch and mold to fit what you need. You can also give it different materiality and geometry.

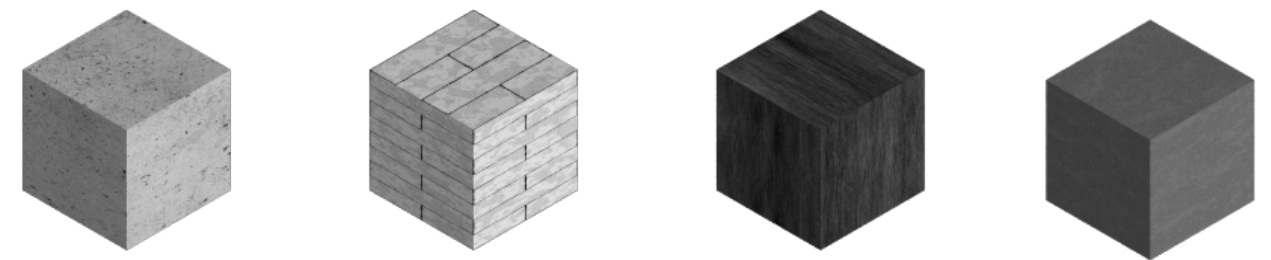
This first study revealed some interesting concepts of what can the chosen design system itself might drive both motivation and the direction of its users as well as the potential for digital tools to be used in aiding with immersing in the design process.



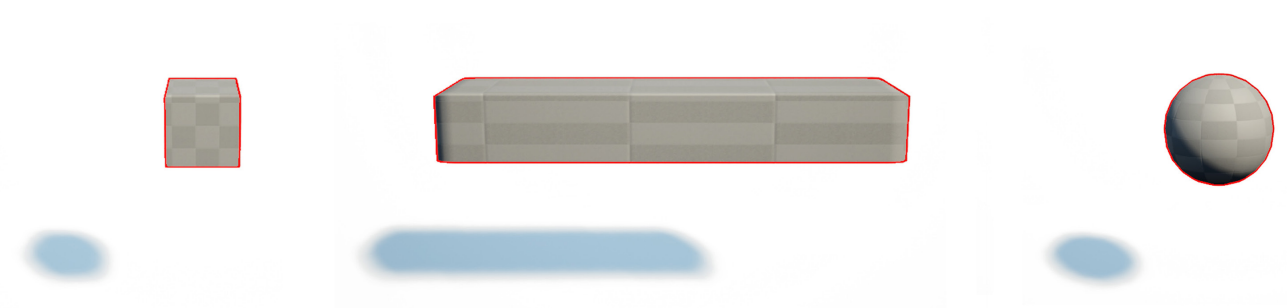
GEOMETRY PALETTE



MATERIAL PALETTE



BRUSH OBJECT

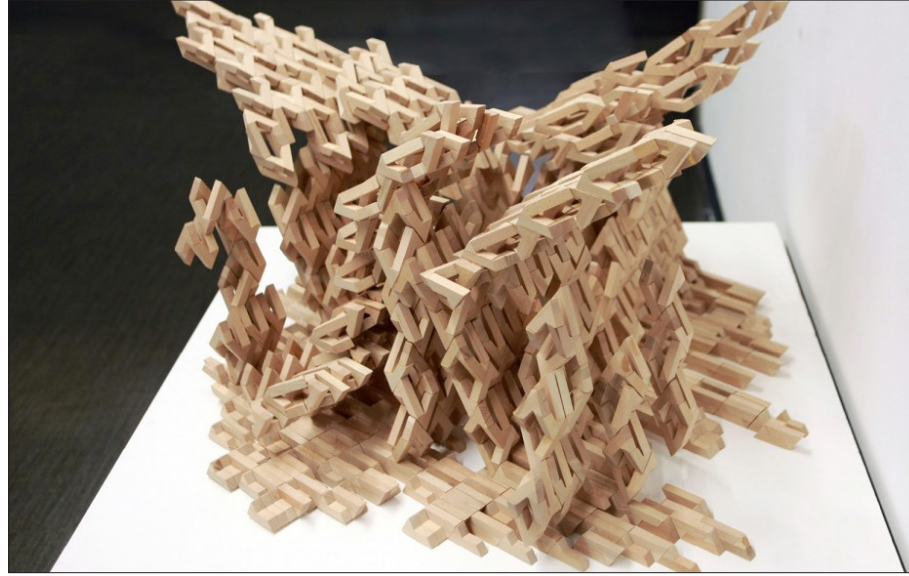


SAMPLE STRUKTURES BUILT IN APP

The program puts you in the environment as physical being, able to walk around and interact with the space, you have weight and will fall of ledges and you can not walk through structures that are built.

The reason for this is to make you see and interact with the world the way a person would if it existed in reality, while you design it.



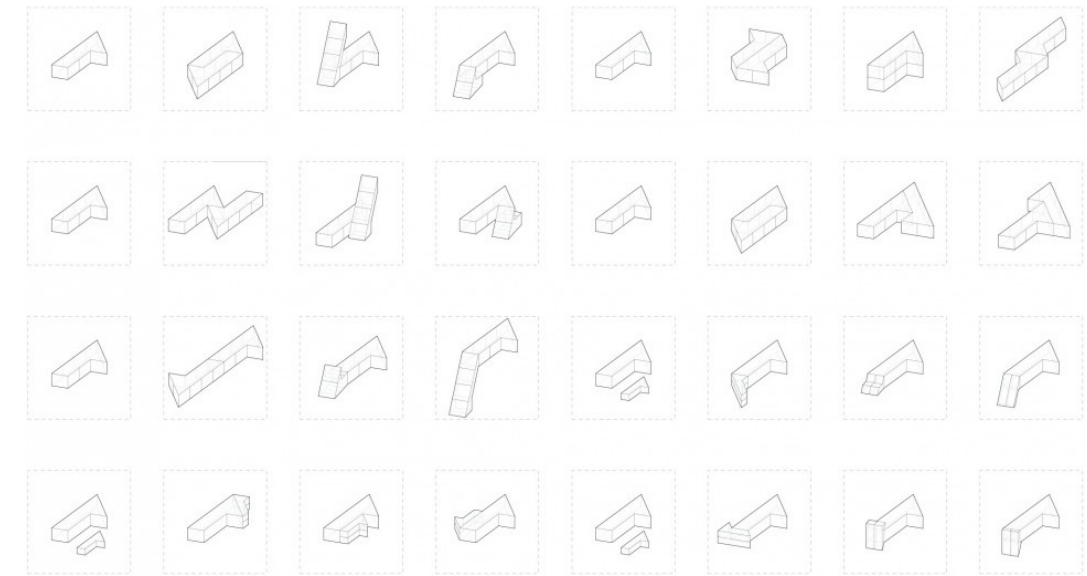


“Blockhuk” is a crowd-sourcing system, a sort of alternative to LEGO toys, made up of a massive population of individual wooden units. Users can participate in the design process in a bottom-up, open source construction process.

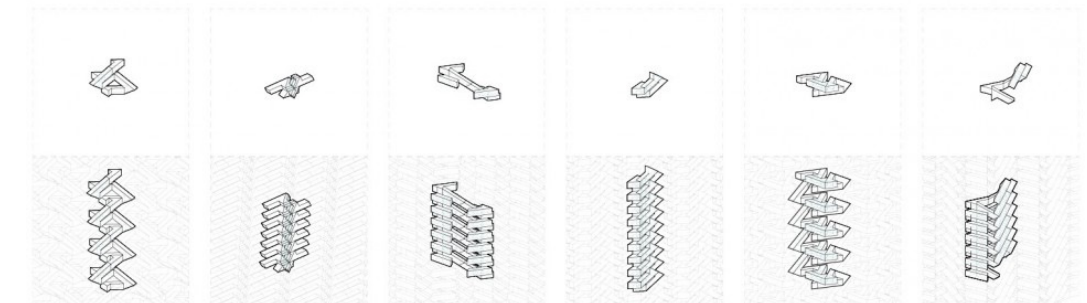


The geometrical properties of the unit allow them to hook up with each other to generate numerous types of aggregations, which Christopher Alexander would call “Pattern Language”: with the geometrical hierarchy of letters, words, sentences and paragraphs, developed by each user in the crowd-sourced community.

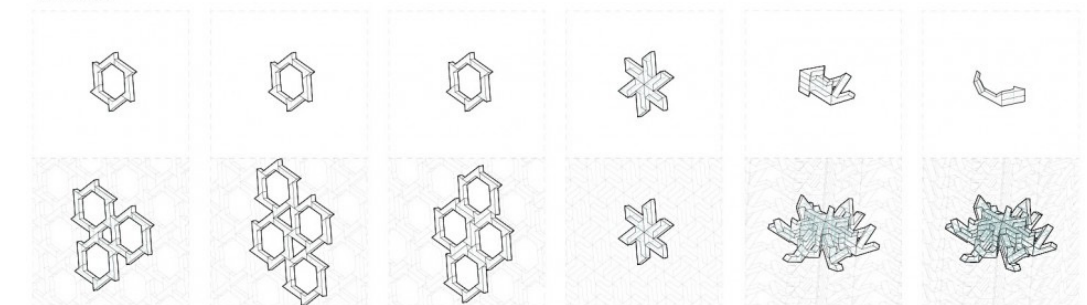
Also, the project further develops the system in the game engine “Unity3D”, where the algorithmic powers of both computers and human intuition can work together to simultaneously generate a huge amount of data in a very short amount of time, what J.C.R. would call “Man-Computer Symbiosis”.



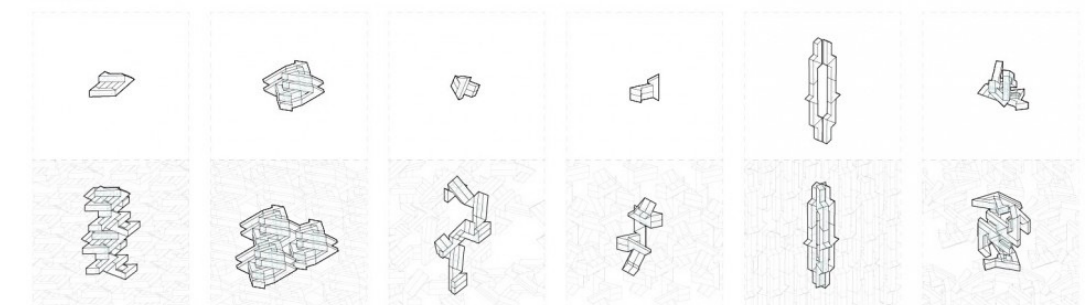
Periodic



Circular



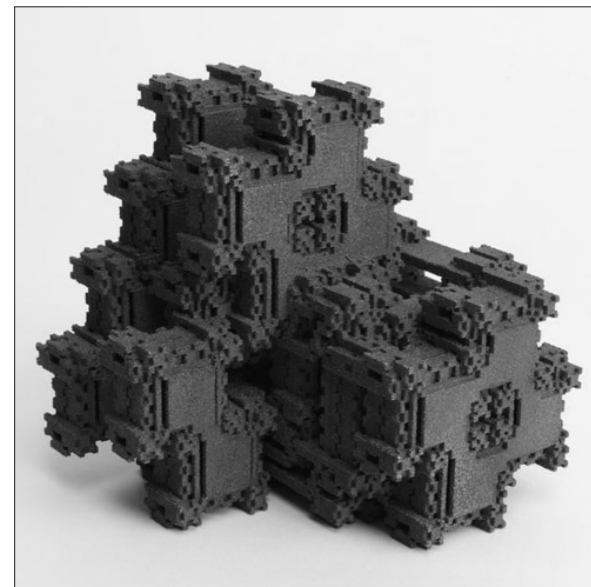
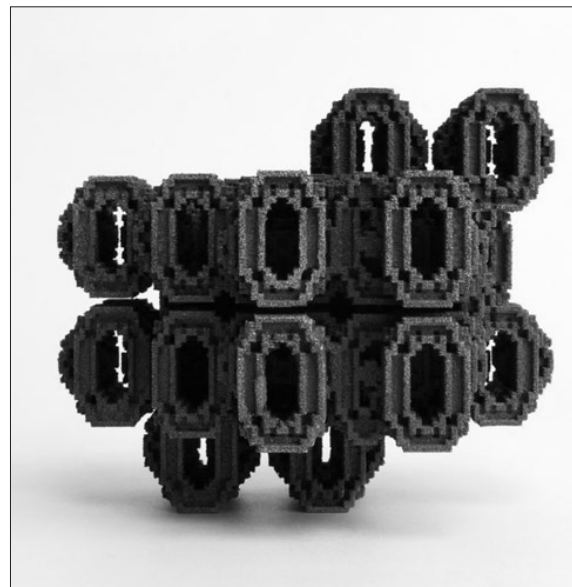
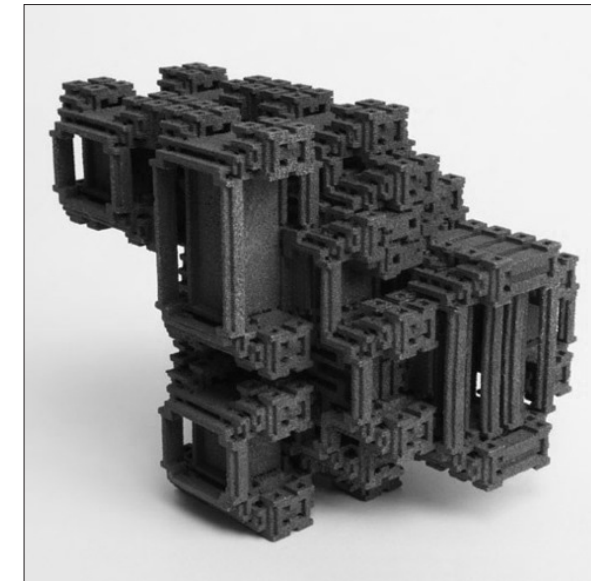
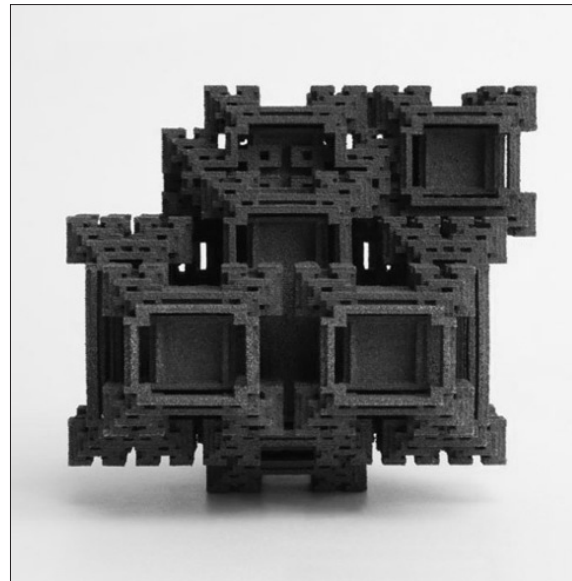
Others

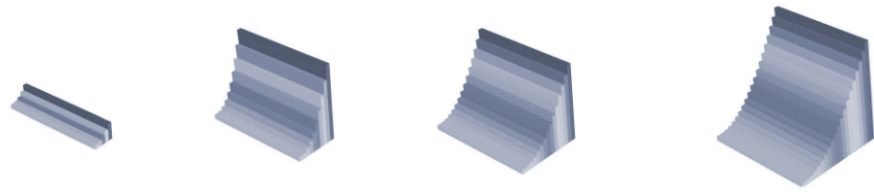
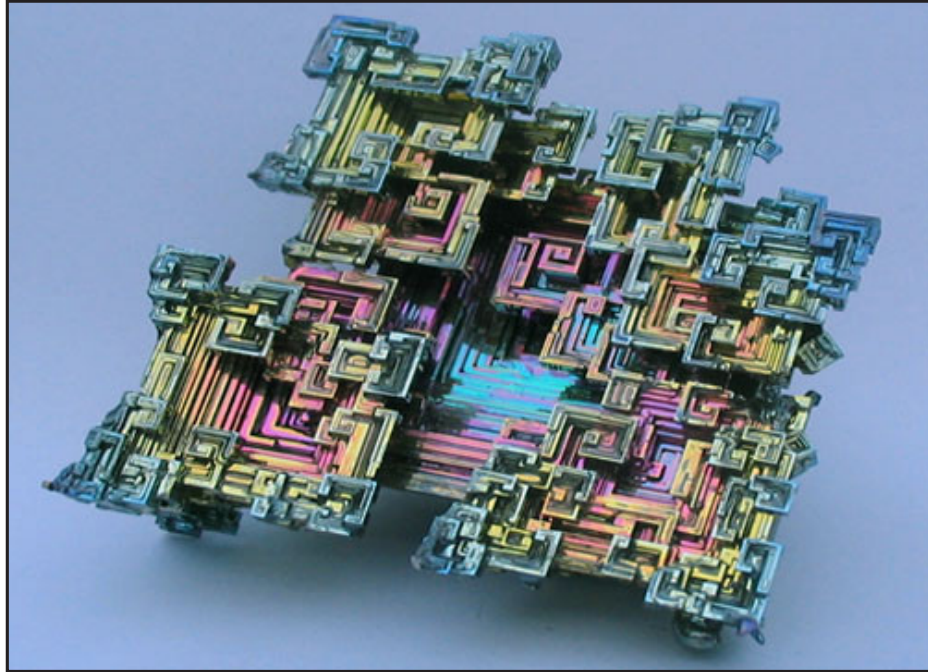


'One initial cell, a cube, engenders throughout successive stages of cell division a complex, multi-cellular "body". Morphogenetic rules determine how the division of a cell occurs, dependent on its situation between the cells surrounding it. Every potential situation has a separate rule, so a cell surrounded on all sides by other cells may divide differently from a cell that only has a neighbour on the left and underneath, or a cell with nothing at all in the vicinity, etc'

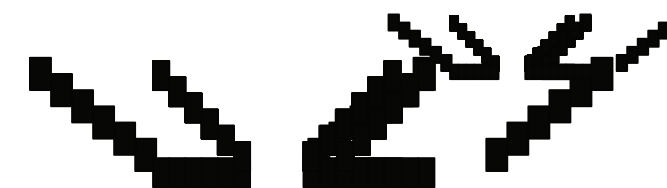
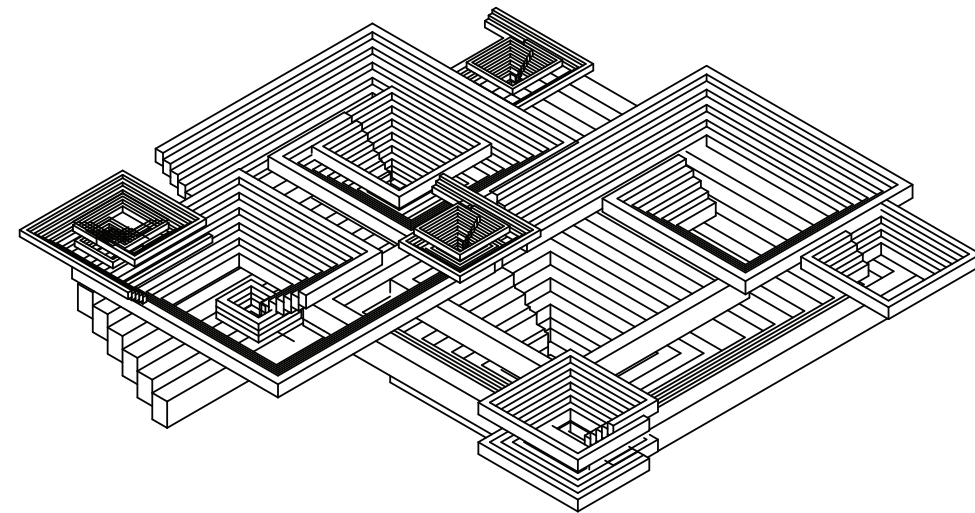
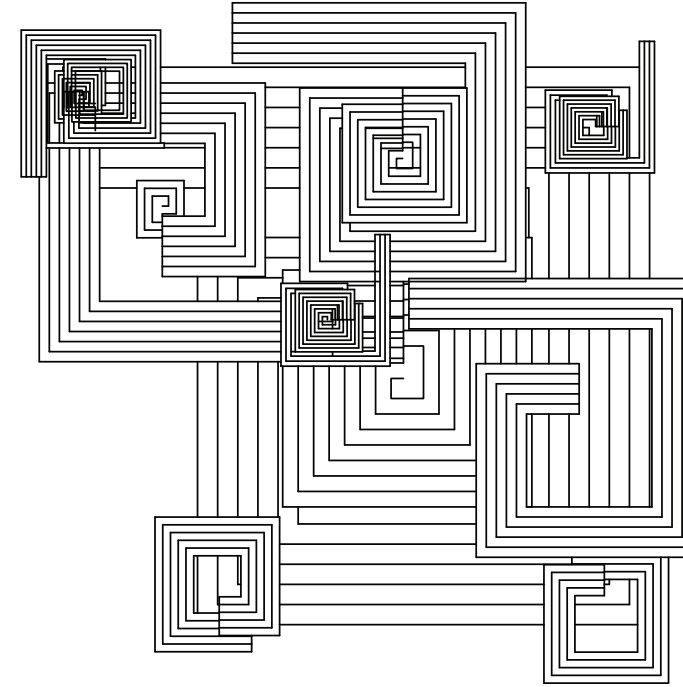
An interesting post procedural aspect to the creation of the sculptural lattices is the ability to search for shape "coherence" in order to find "fitter" models, i.e. models that would not collapse under the effect of gravity in the real world:

'The simplest method (two-membered evolution strategy) is already effective: take a randomly composed genotype as base, generate the phenotype and test it for fitness; mutate the base genotype, generate the phenotype and test it for fitness; compare both results with each other, and take the result with the highest fitness as the new base. Repeat the mutations until the result satisfies the stated requirements'





The spiral, stair-stepped structure of bismuth crystals is the result of a higher growth rate around the outside edges than on the inside edges. The variations in the thickness of the oxide layer that forms on the surface of the crystal causes different wavelengths of light to interfere upon reflection, thus displaying a rainbow of colors.

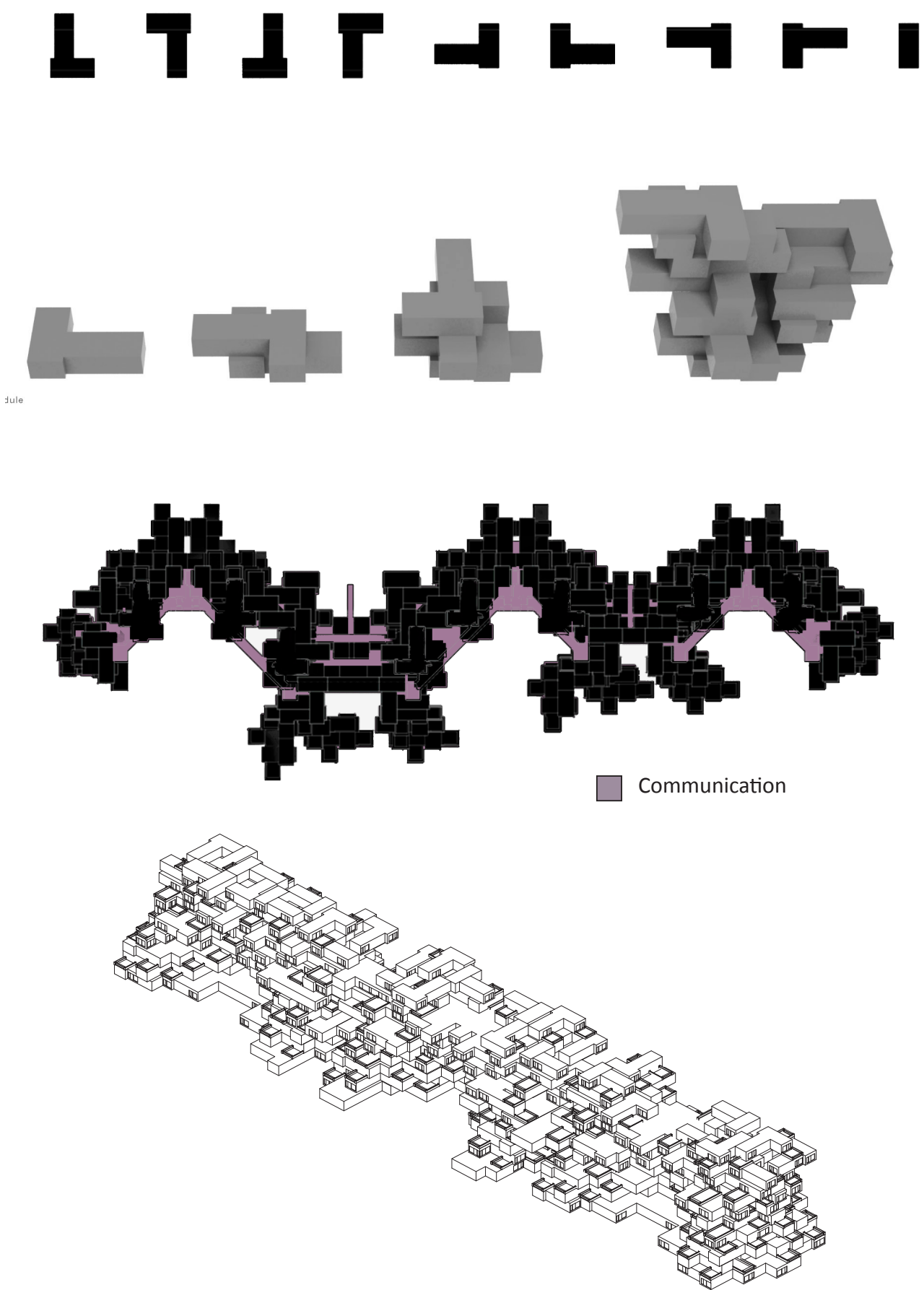


REFERENCE STUDY: Clustering system of HABITAT 67

Habitat 67 is an attempt by architect Moshe Safdie to create a unique spaces and living situations using prefabricated units arranged according to predefined rules. Where each unit is placed to both allow for communication and terracing space. The result was an apartment complex that embodies a sense of geometrical complexity usually not found in prefabricated apartment structures.



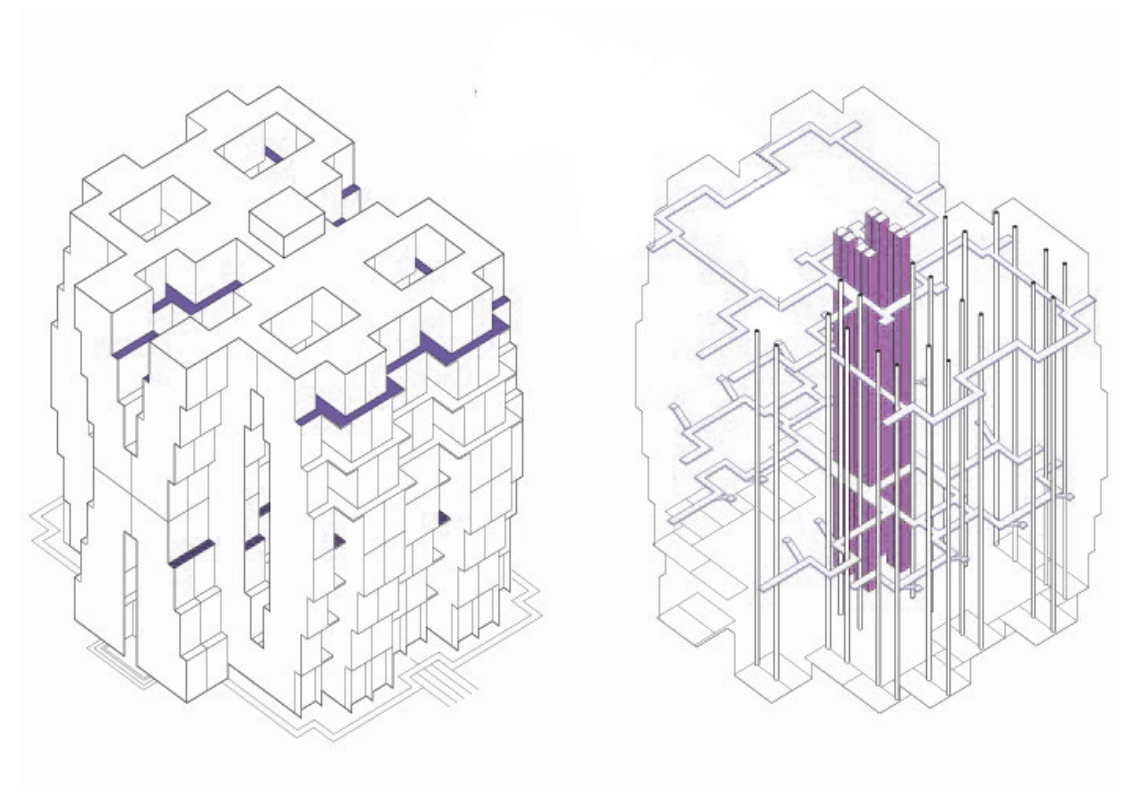
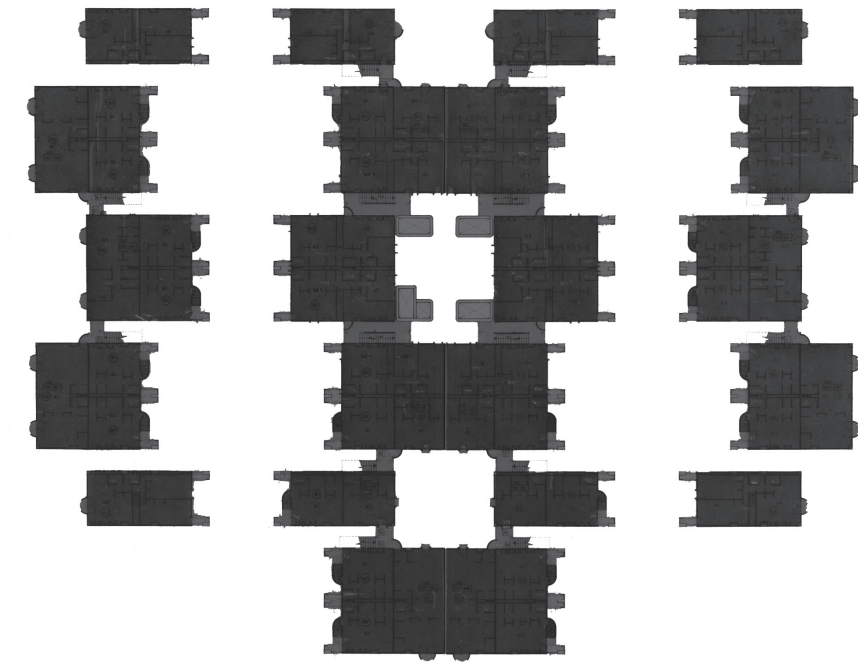
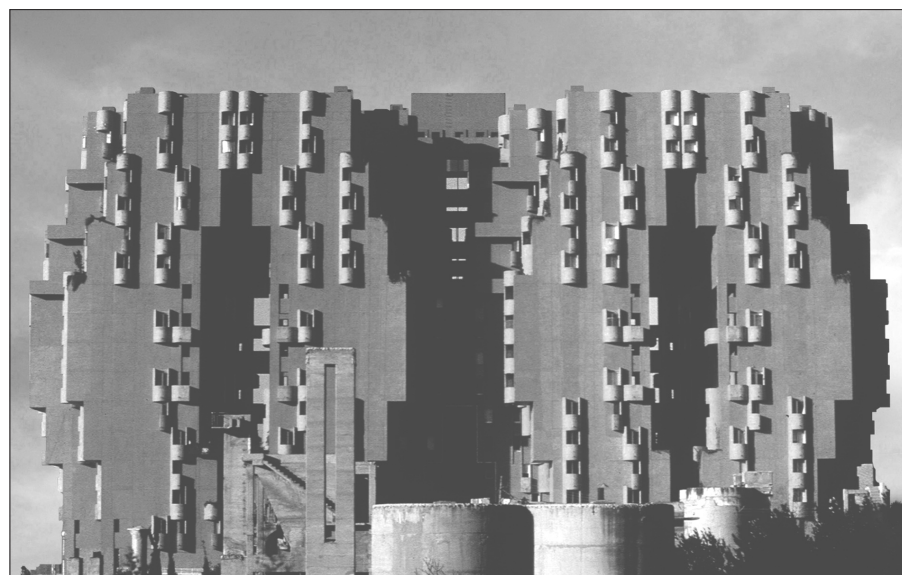
Formation



REFERENCE STUDY Clustering and organisational system of Walden 7

Ricardo Bofill is another architect known for creating immersing environments through the use of repeating geometries is .

Walden 7 is composed of 18 towers which are displaced from their base, forming a curve and coming into contact with the neighbouring towers. The result is a vertical labyrinth with seven interconnecting interior courtyards. The simple geometry of the project arranged in repeating patterns creates large interior spaces within the structure and gives a spatial sense akin to cliffs or caverns.

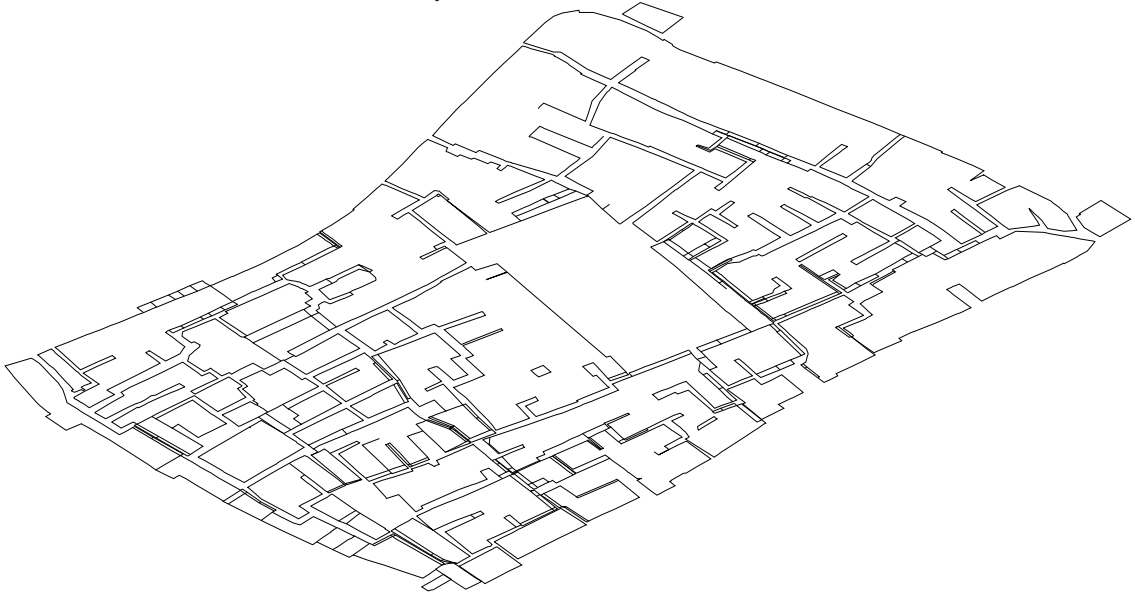
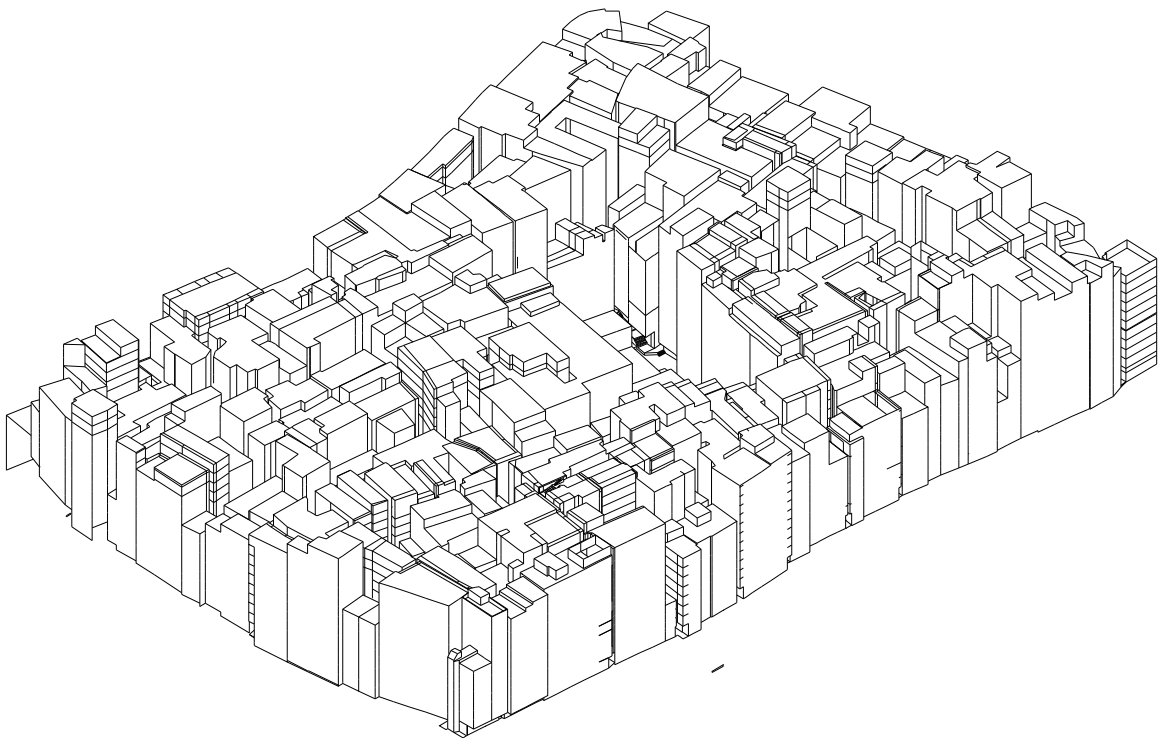
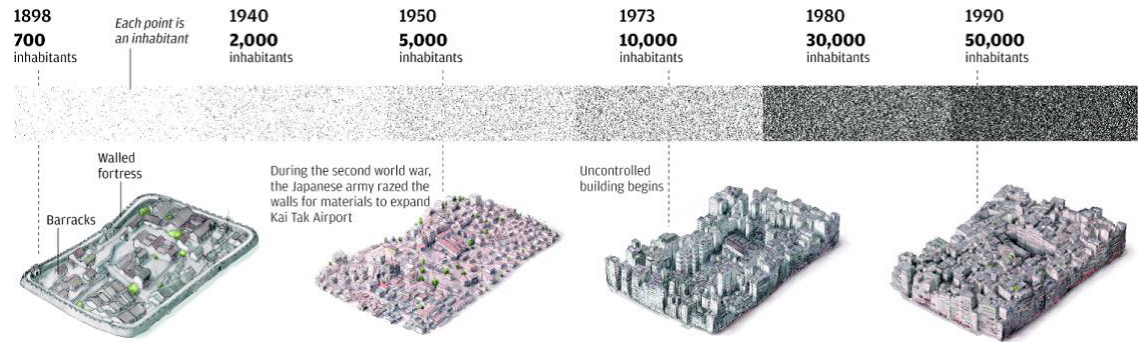


Communication

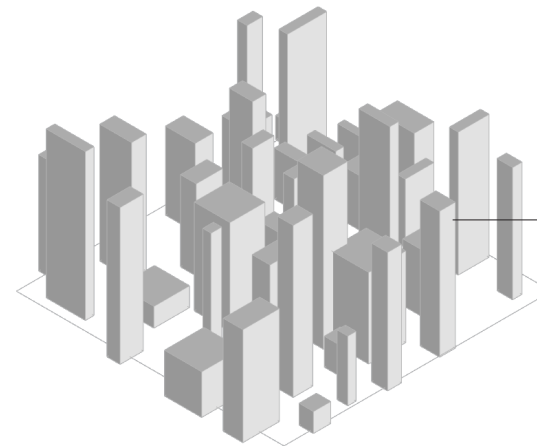
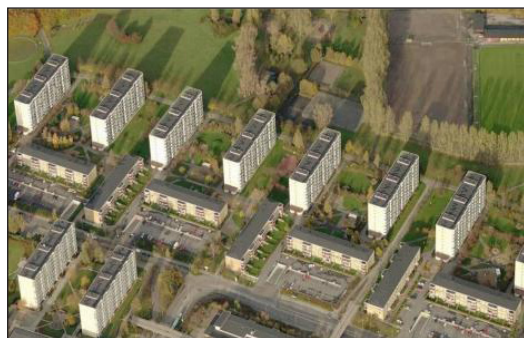
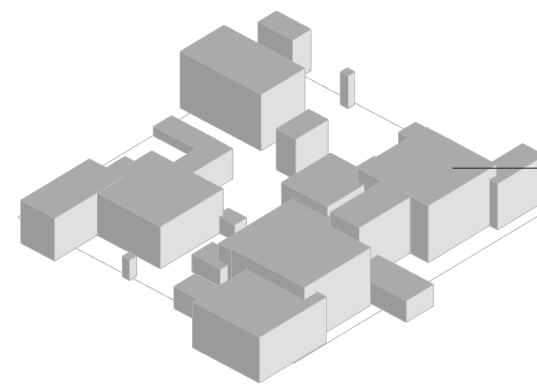
Complex spaces emerging from urban growth.

Kowloon walled city is a urban landscape that is know through out the world for both the poverty of its habitants and as an example of what happens when city develop-ment is left un checked. Yet it is also the source of much fascination and awe. What is it about this super dense structure that captivates so many? Maybe one thing is it's organic unpredictable nature. You never know what to expect around the next corner.

Is ther a way to capture this sense of unpredictability and adventure of kowloon and use it in planned urban projects? Maybe one can use regulated planning in a way that gener-ates unpredictable geometry that enstills the same sense for the visitor.

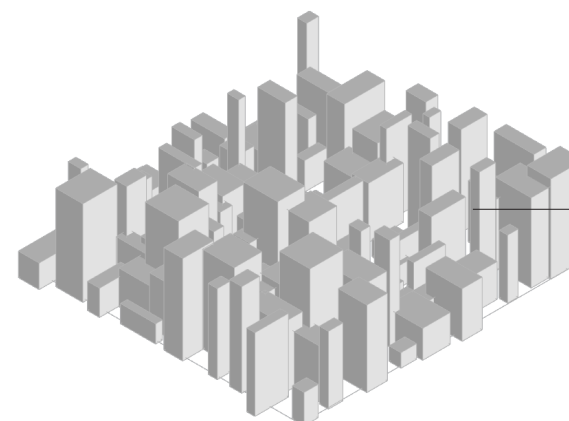


For the larger urban scale intention of the project a less rigid system consisting of blocks configured in different base units was chosen. The systems in the precedence had too much of an inherent geometry to them to be used in this context. The simple block shape allows for many variations of base units in the experimentation and can represent objects or buildings of many sizes. One of the main goals in the experiments was to apply different rulesets to the block systems and measure the spatial qualities and density of the resulting morphologies.



Modern urban spaces and structures are usually planned in regular predictable patterns that are engaging and dull. You always know what to expect around the corner since the geometry is easy to read and follows a repeating pattern.

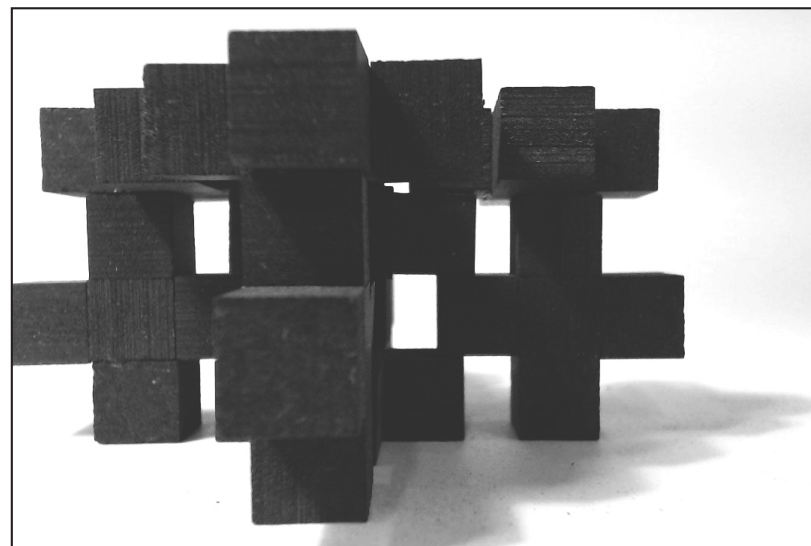
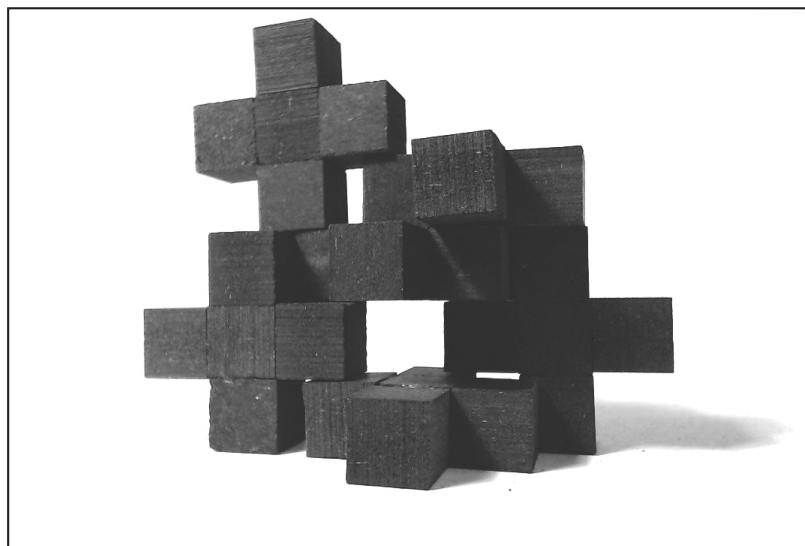
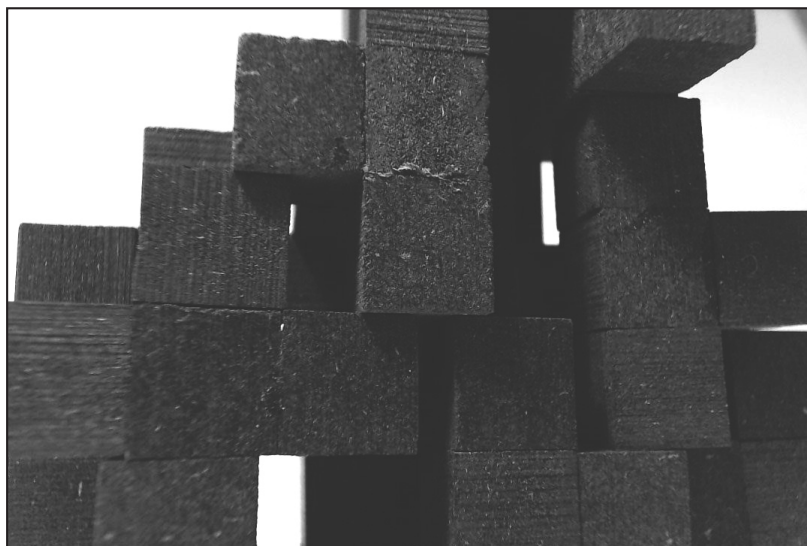
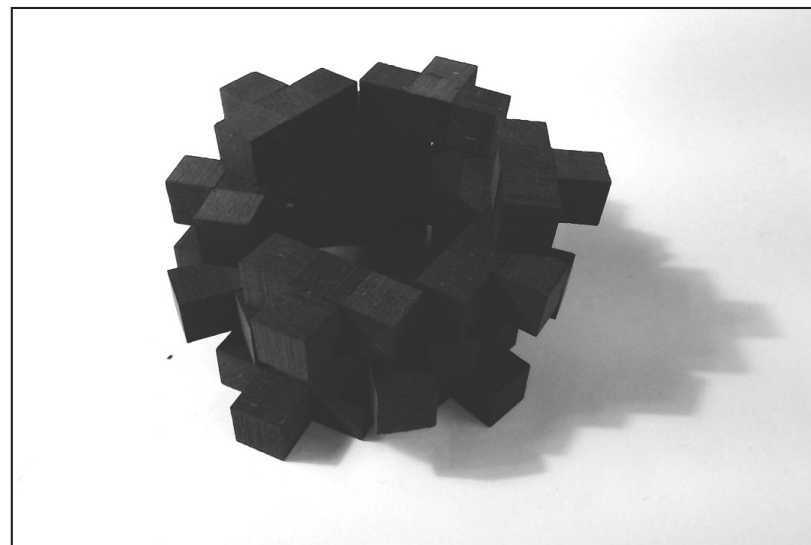
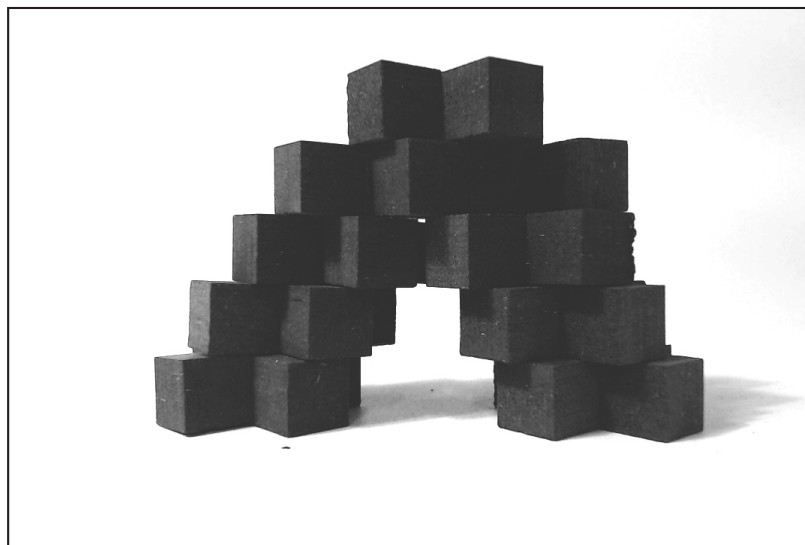
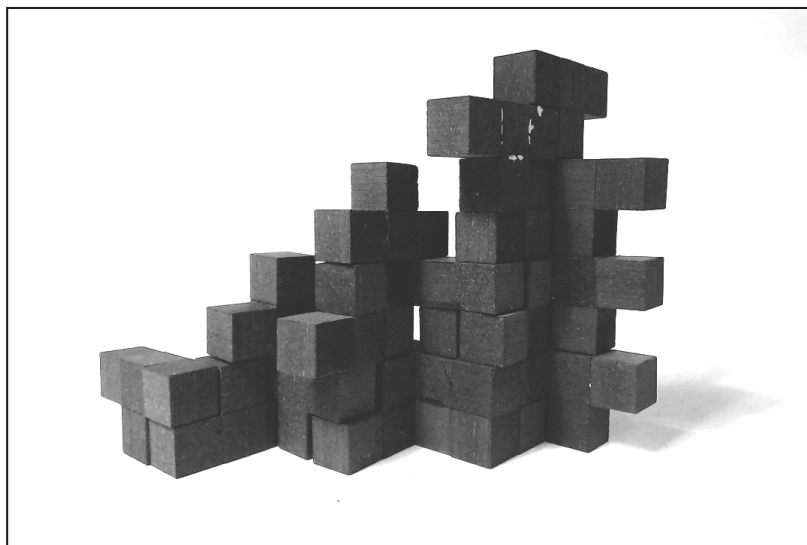
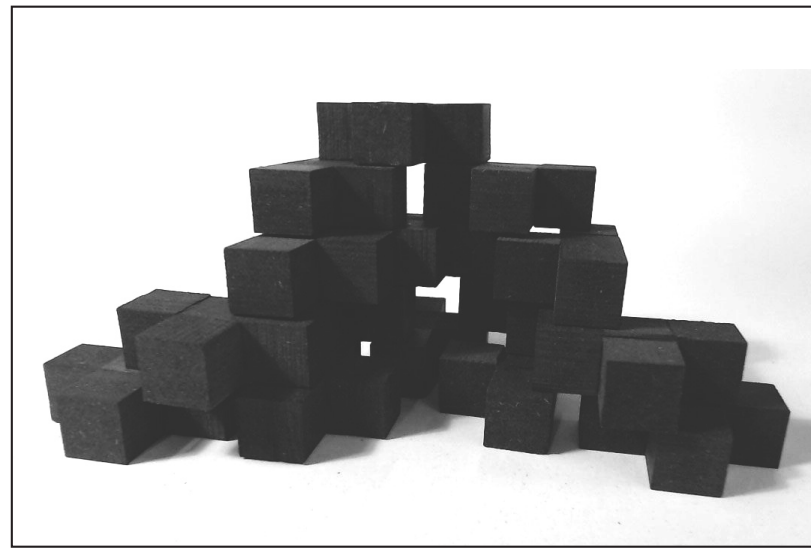
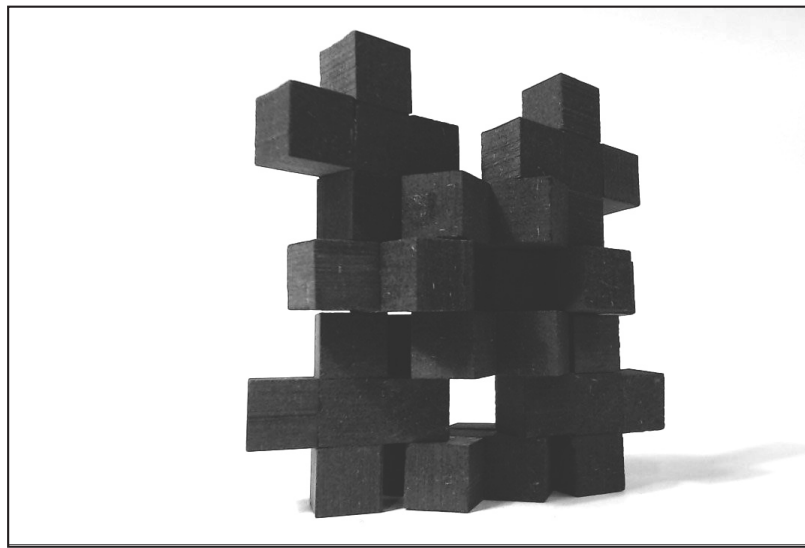
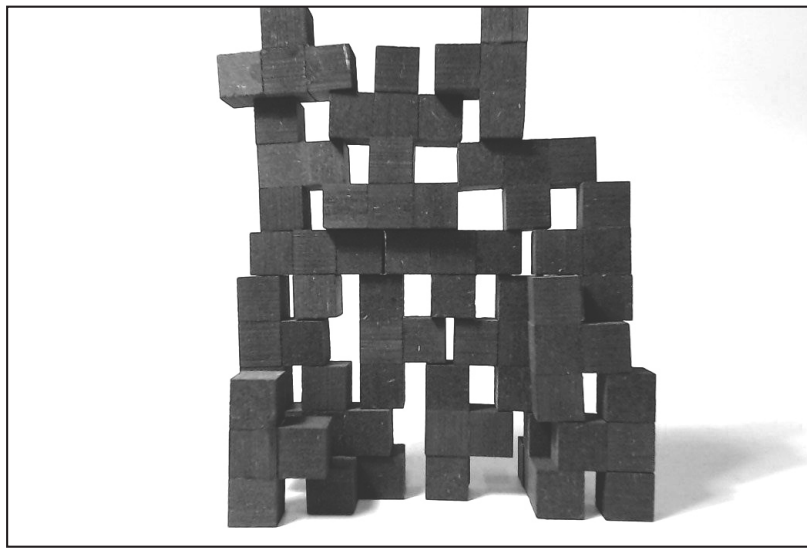
Vernacular morphology often has a more of an element of surprise inherent to it due to the more sporadic nature of its competition, often more being the result of limitations and contextual factors. The overarching design doesn't dominate.

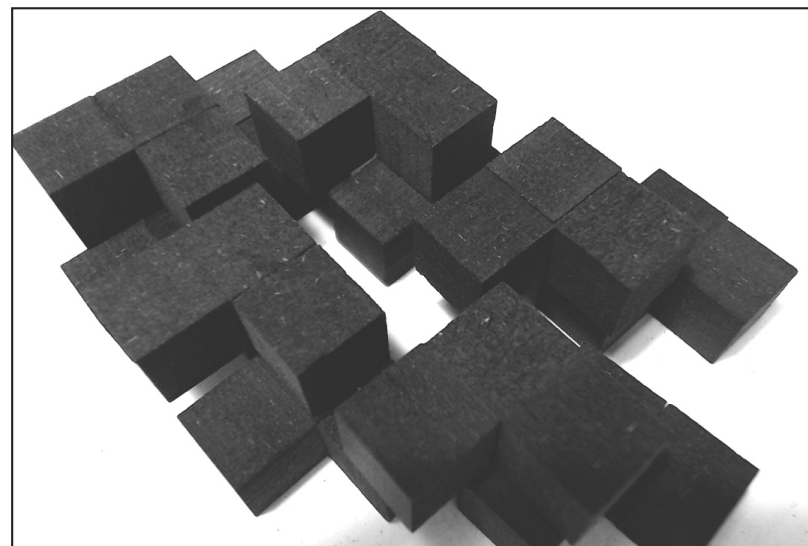
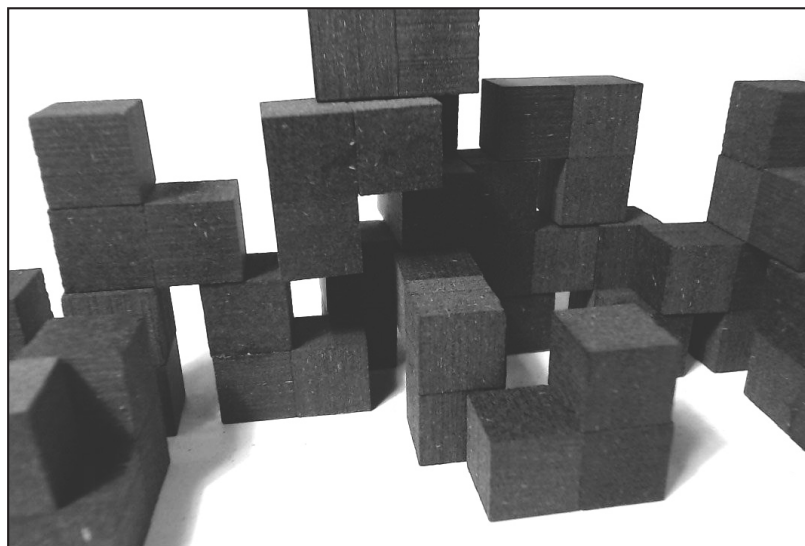
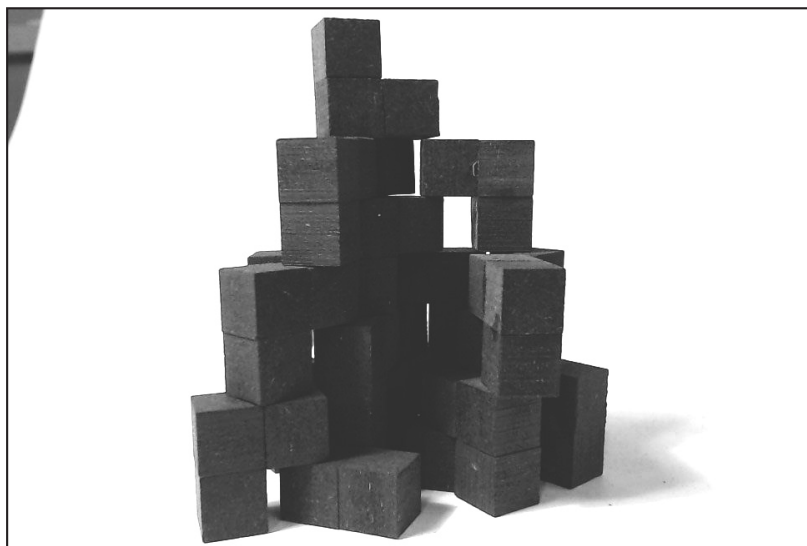
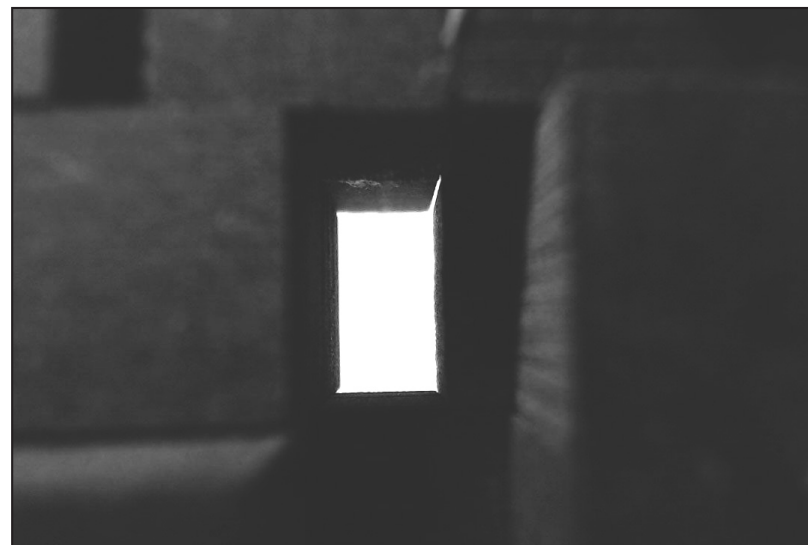
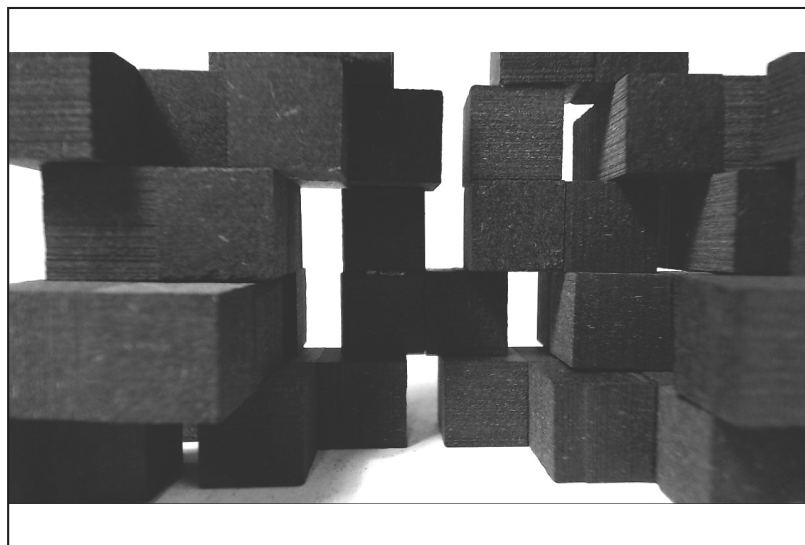
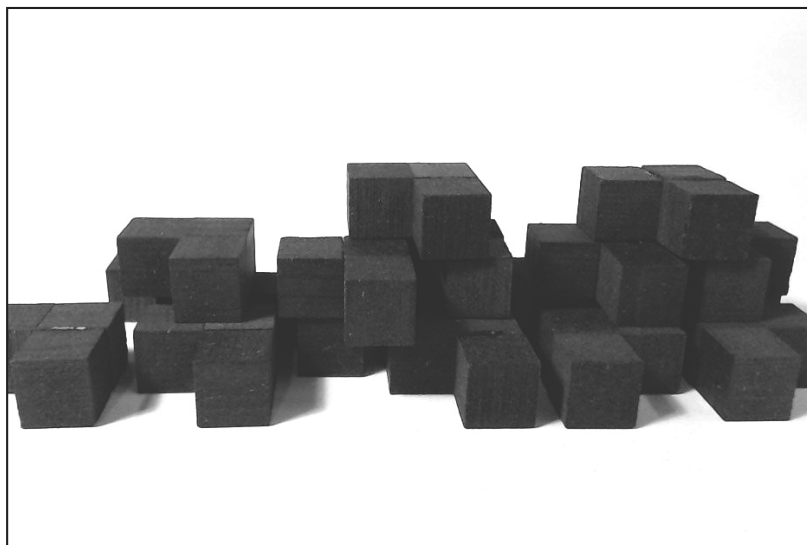
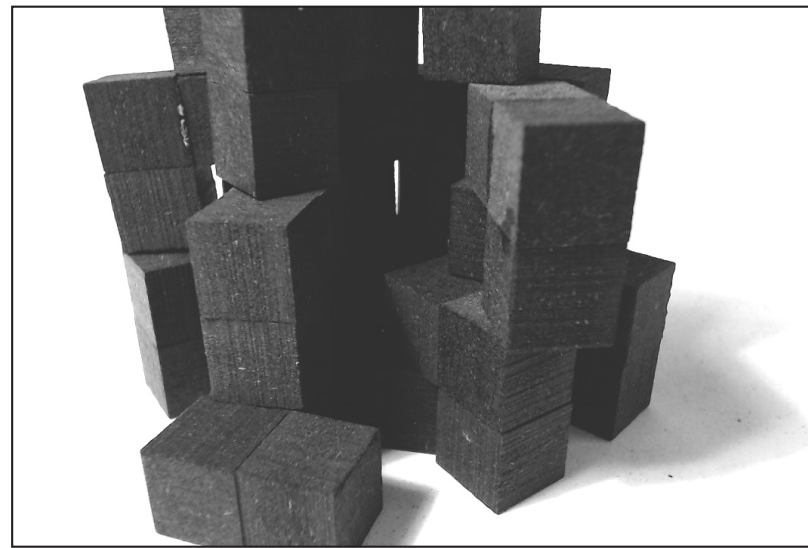
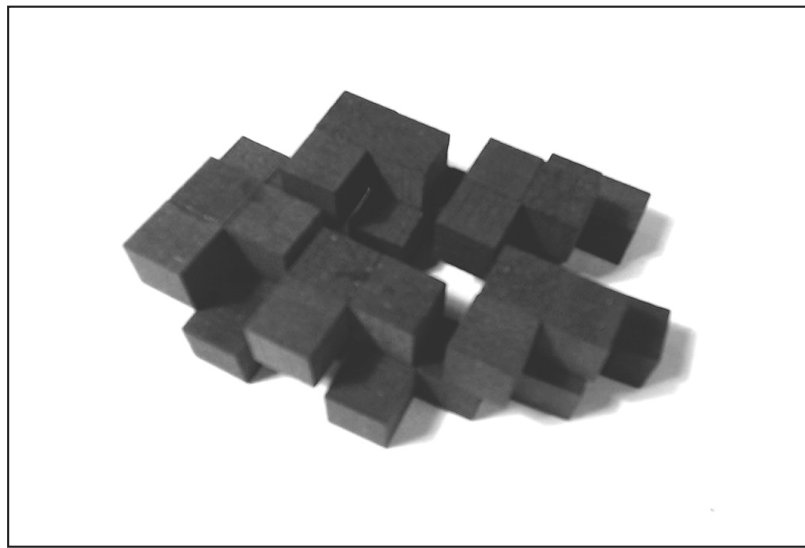
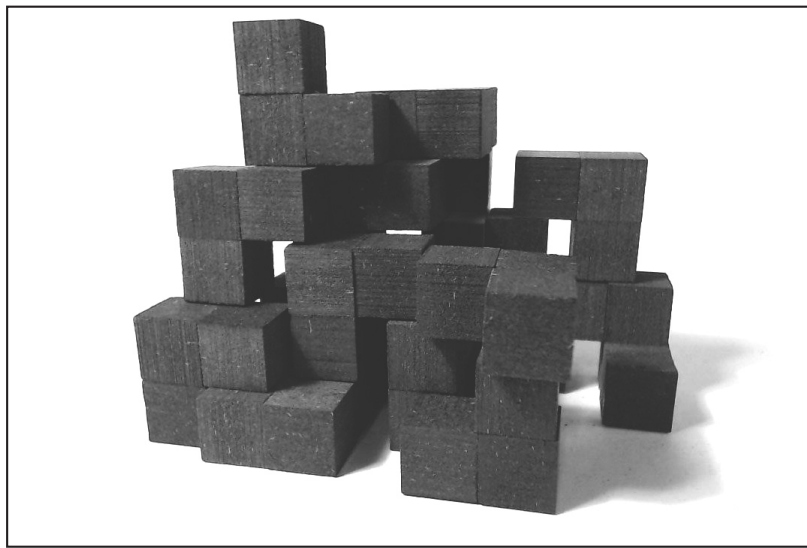


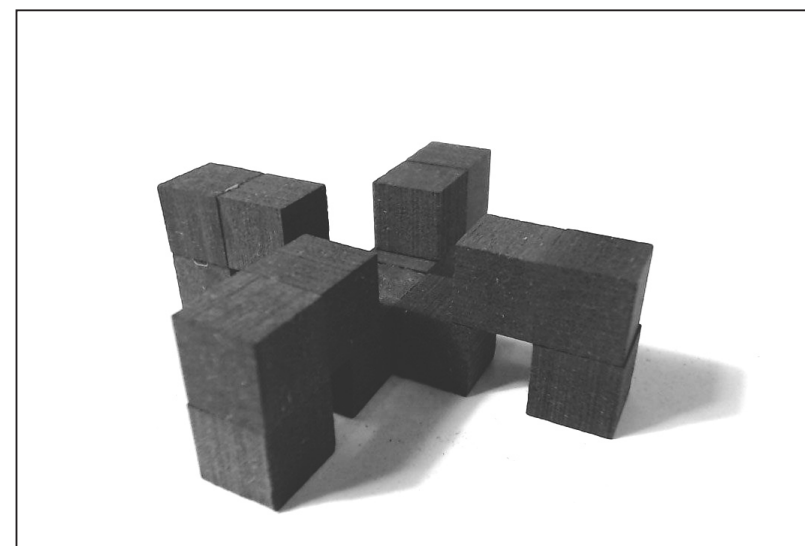
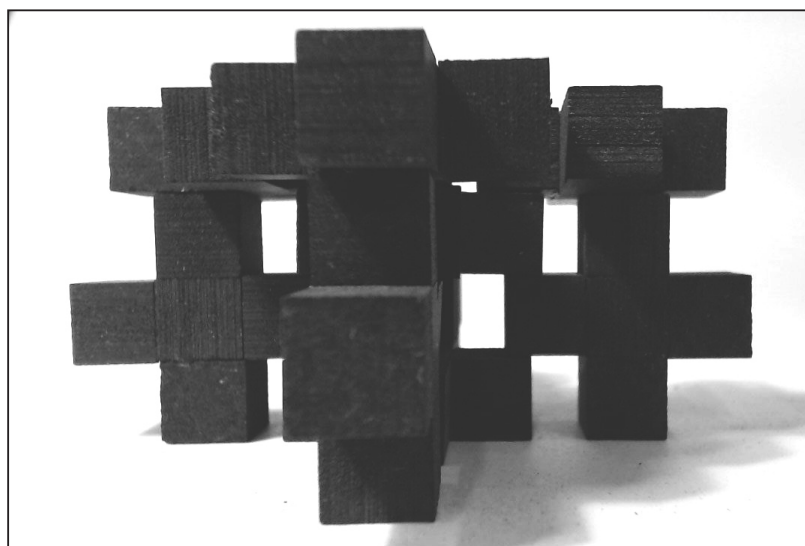
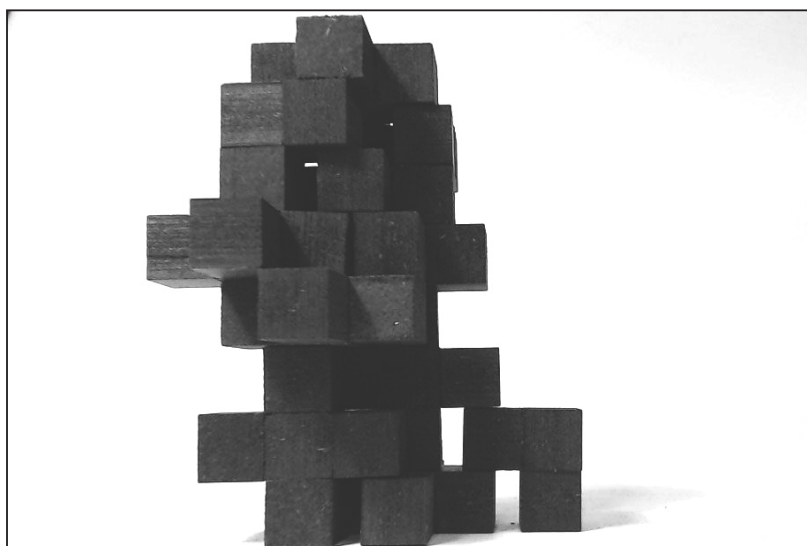
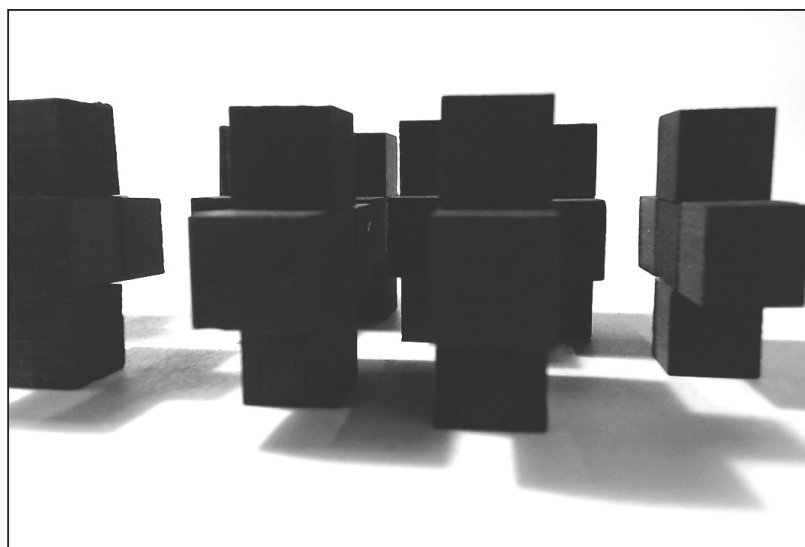
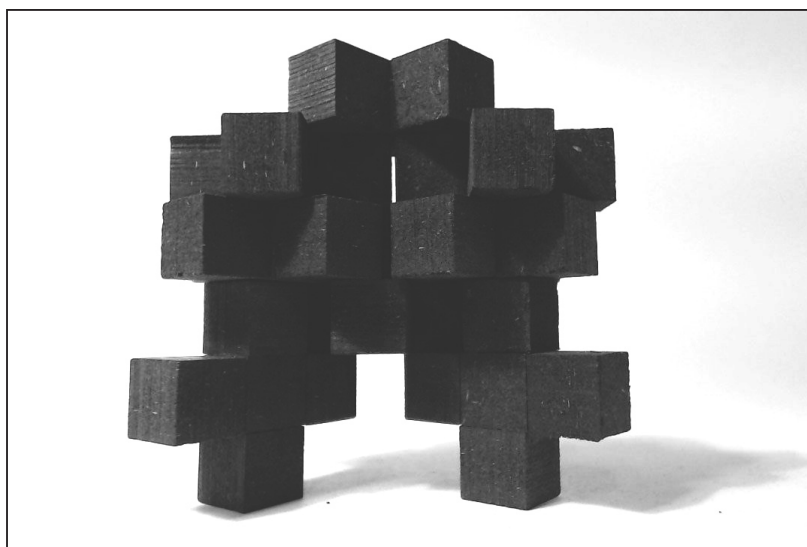
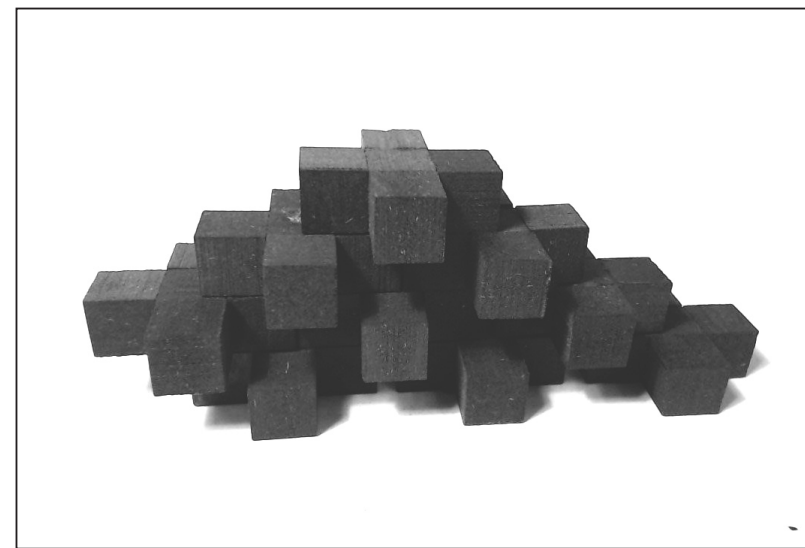
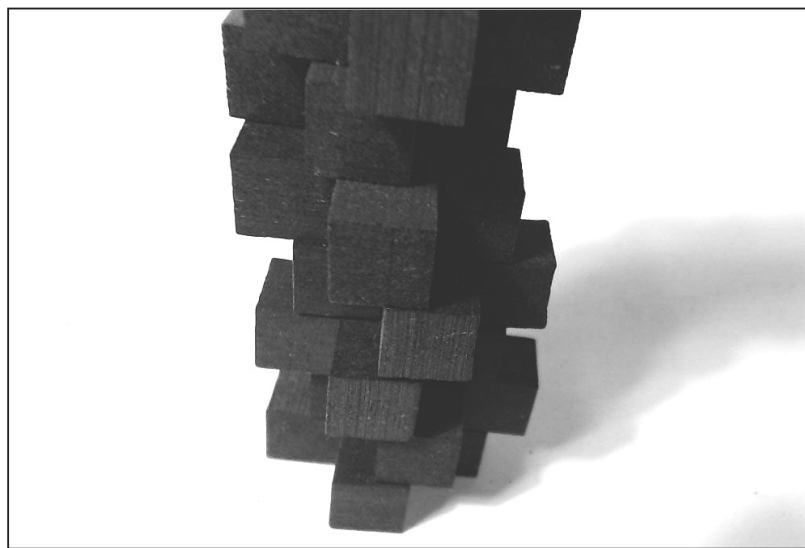
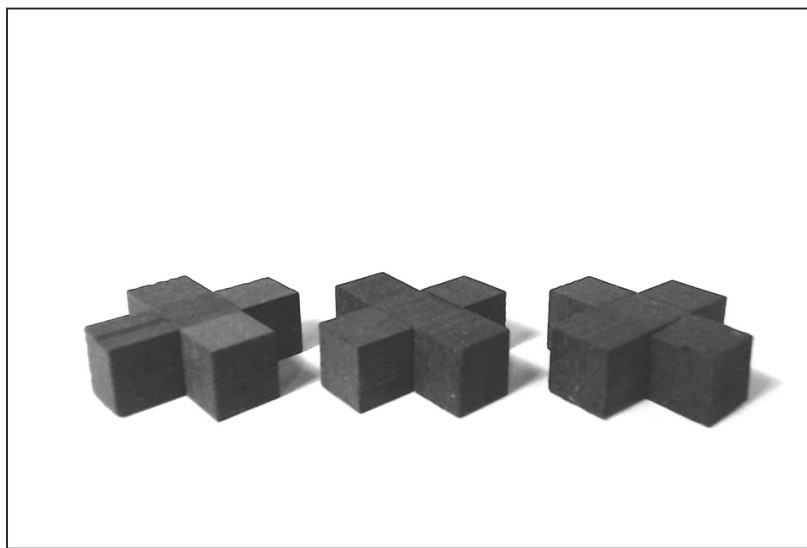
PHYSICAL MODEL TESTS

In the attempt to find a system for clustering, the first step was to try and find a rule set of clusters that would give the desired effect. To start with three different block shapes was tested.

The following images are of some of the tests with physical models using different basic building blocks and rules.





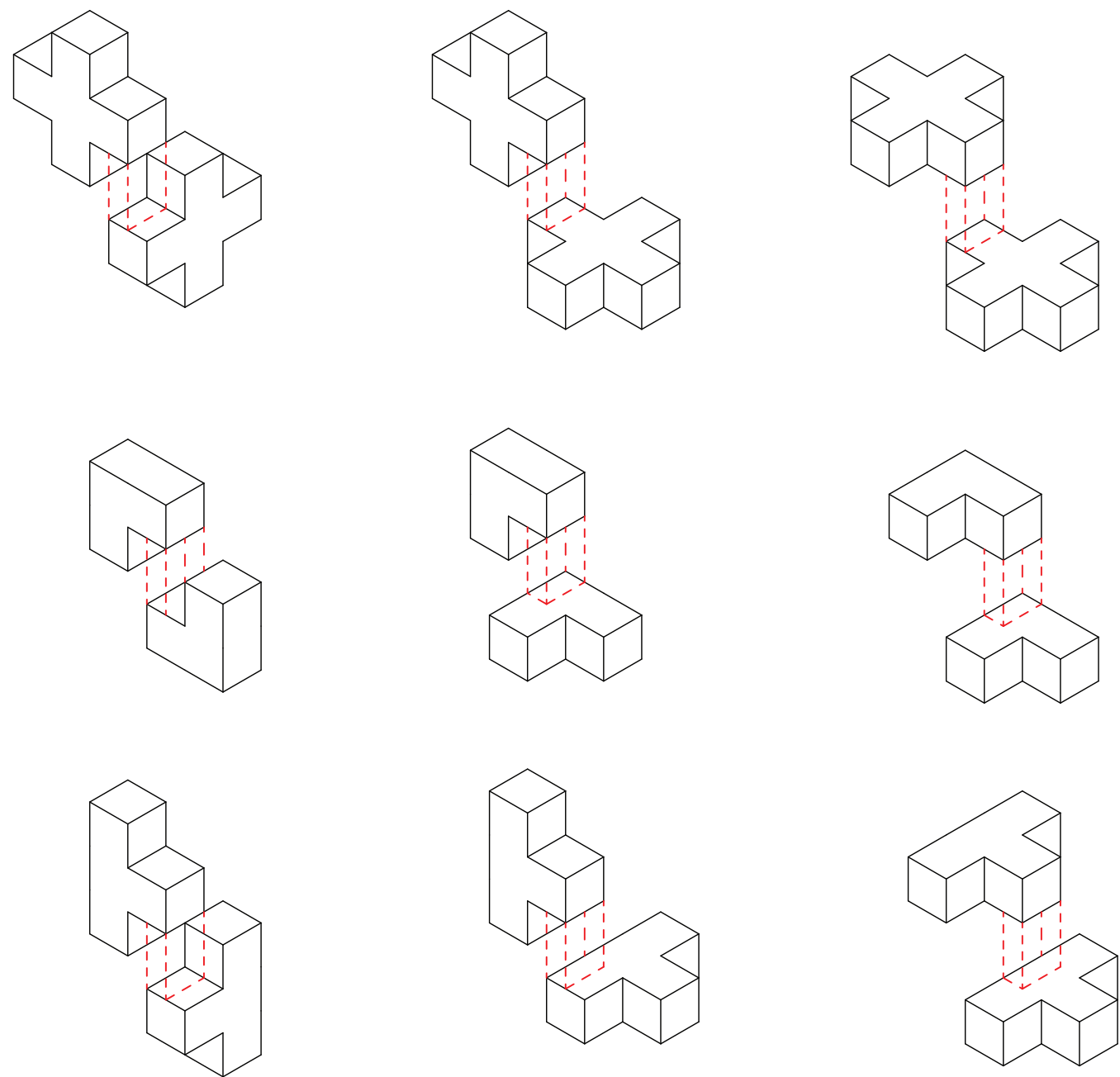


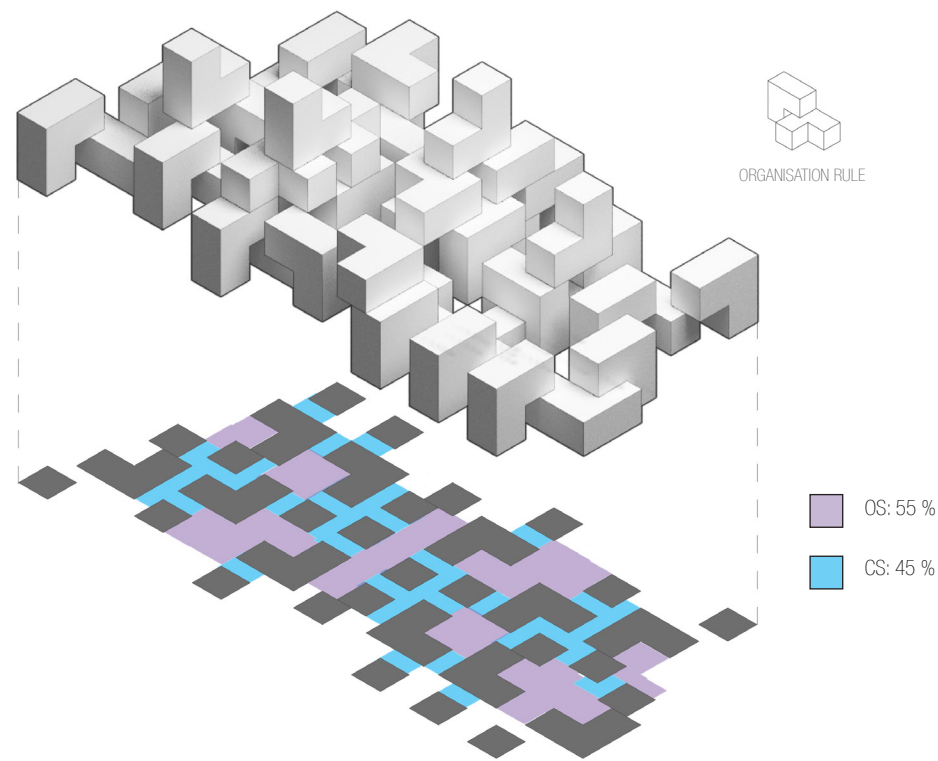
After testing different configurations with the blocks it was decided that the blocks are always placed with a gap half a block width from another block representing openings in the urban fabric. Another thing measured was how restrictive the rules were where and how much that system controlled the outcome versus the designer.

The outcome of the testing was a set of rules where three block types could be used configured in three different ways each: standing, laying flat or a mix of both, for a total of nine different morphological rules.

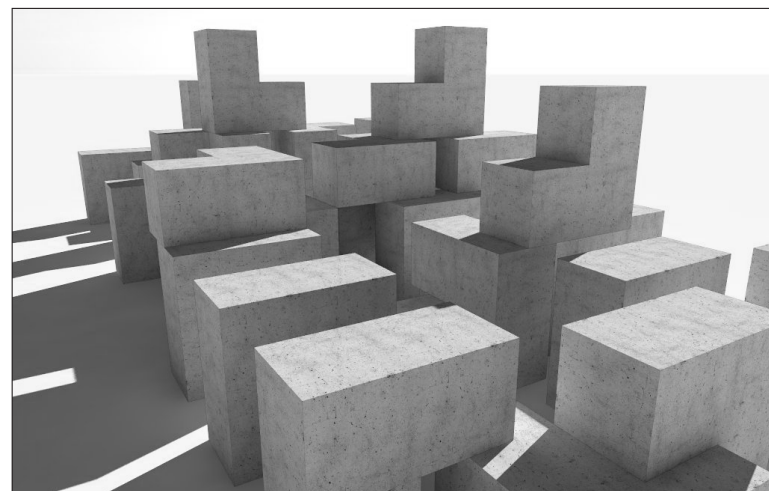
The nine different morphologies were brought to digital form and were analyzed, checking for footprint area, terracing area, communication space and Occupiable space. The results show that the variations of the simple rule set yields a rather large spectrum of qualities.

- Occupiable space
- Communication space

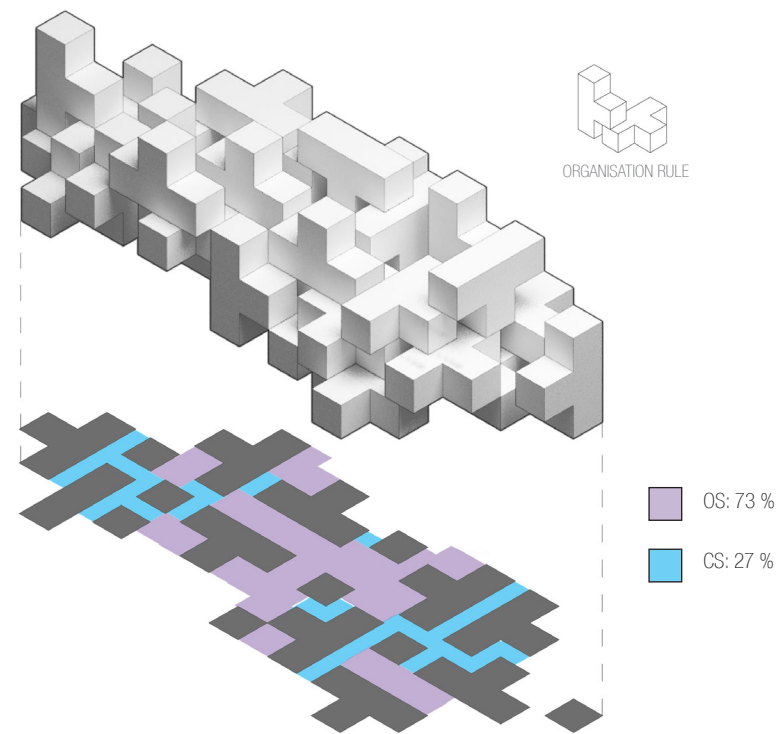




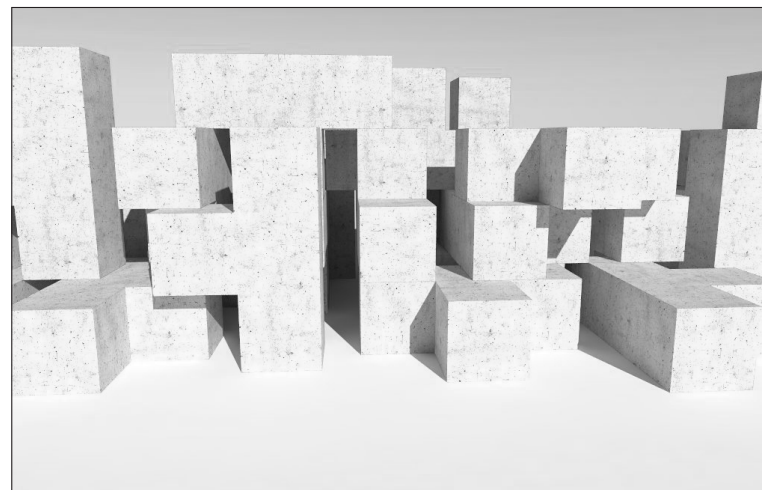
FOOTPRINT AREA: 57
FOOTPRING / VOLUME RATIO: 0.42
TERRACE AREA: 115



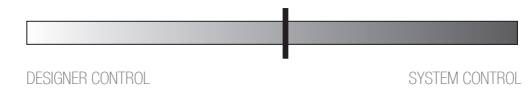
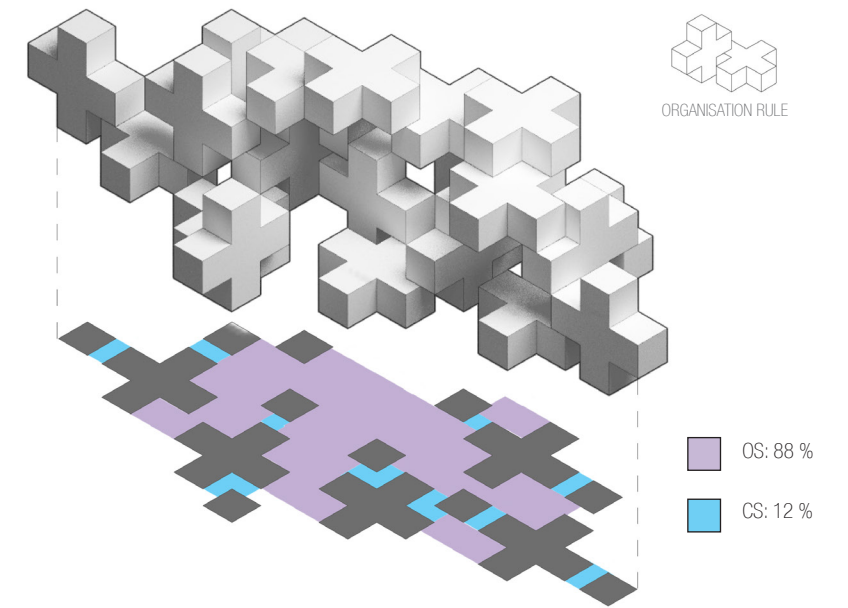
Creates a sprawling, evenly distributed dense inner space with few open areas.



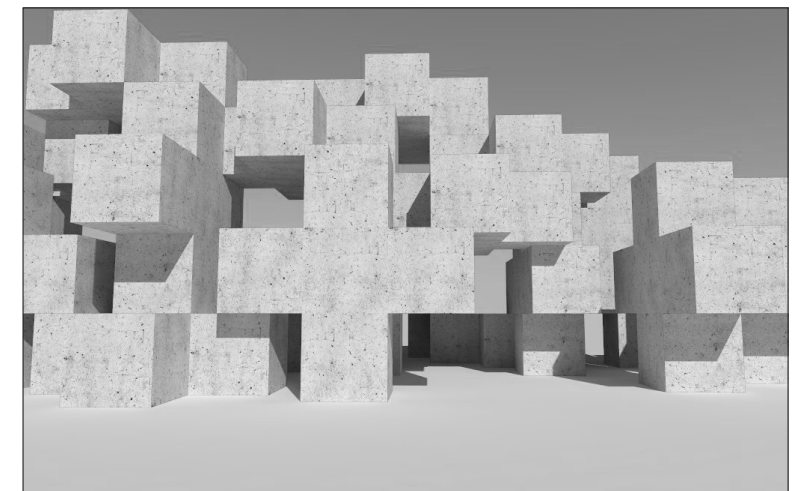
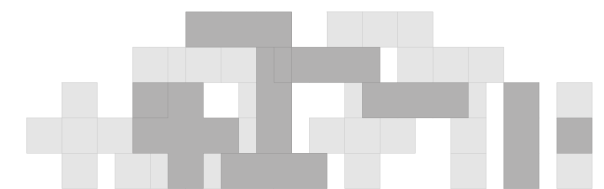
FOOTPRINT AREA: 47
FOOTPRING / VOLUME RATIO: 0.35
TERRACE AREA: 120



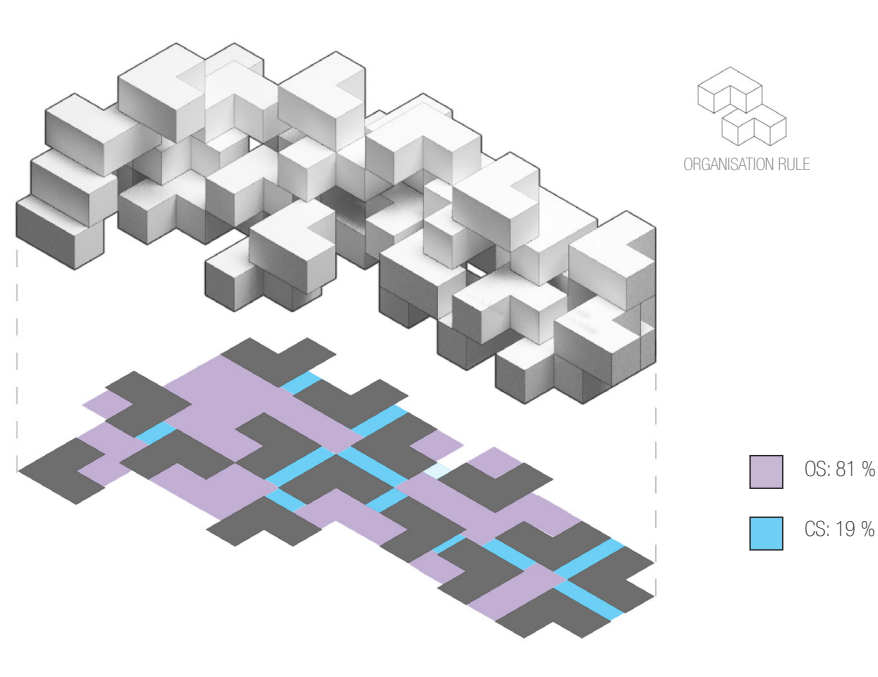
Creates a combination of corridors and open areas with many vertical openings and shafts.



FOOTPRINT AREA: 35
FOOTPRING / VOLUME RATIO: 0.29
TERRACE AREA: 120



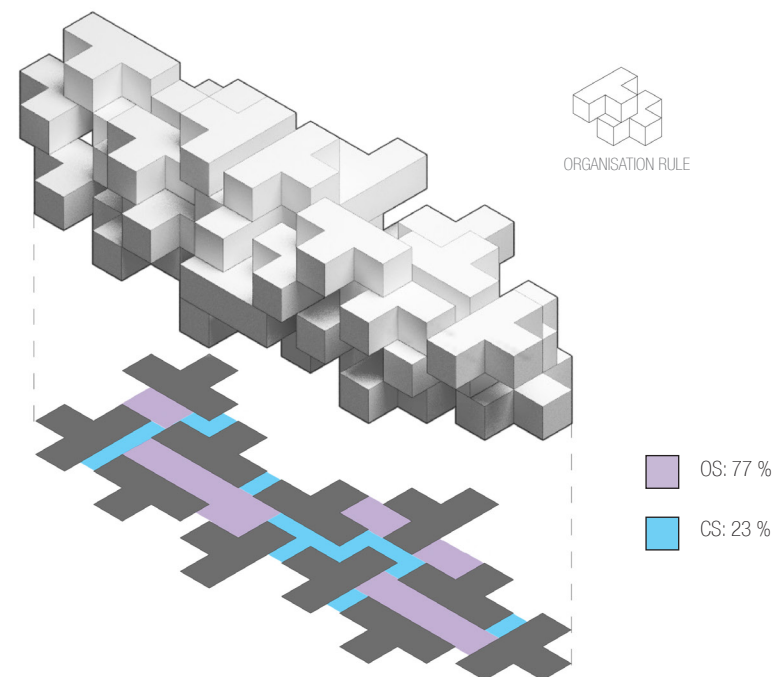
Creates a footprint of mixed density and openness. Also create big open spaces.



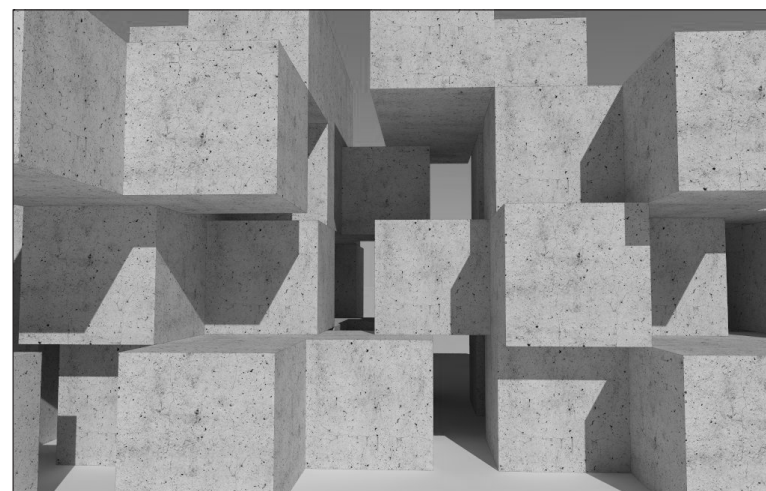
FOOTPRINT AREA: 39
FOOTPRING / VOLUME RATIO: 0.37
TERRACE AREA: 115



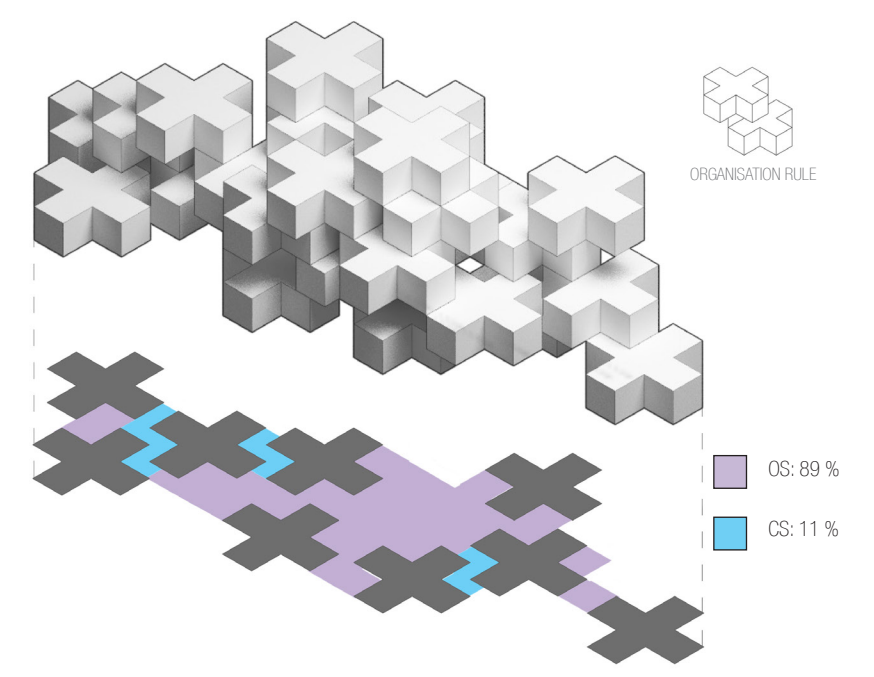
Creates a structured but dense inner space with some open areas and long narrow corridors.



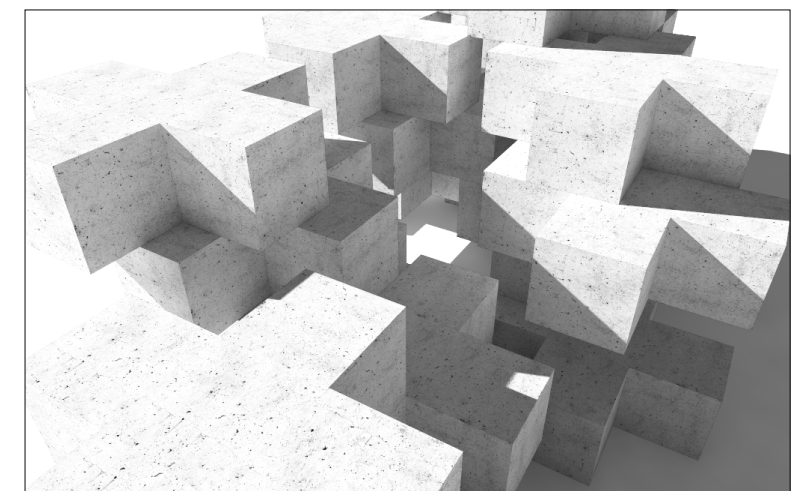
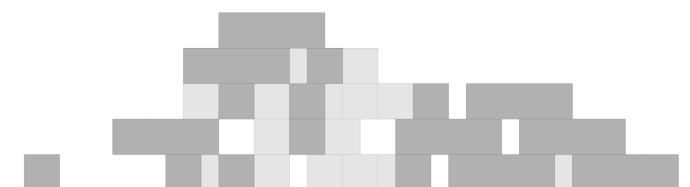
FOOTPRINT AREA: 44
FOOTPRING / VOLUME RATIO: 0.33
TERRACE AREA: 140



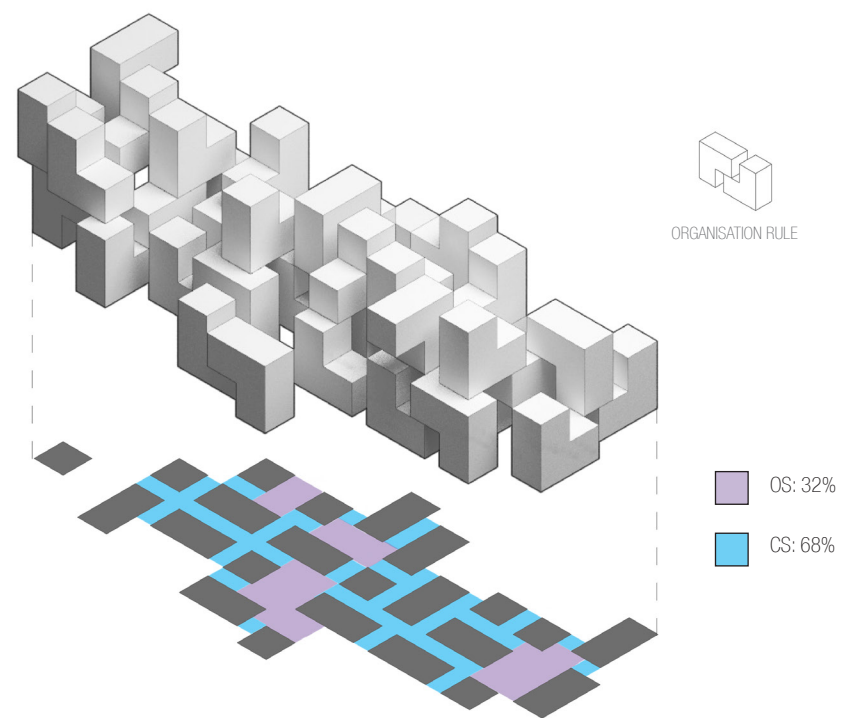
Creates a system of maze like corridors with many turns.



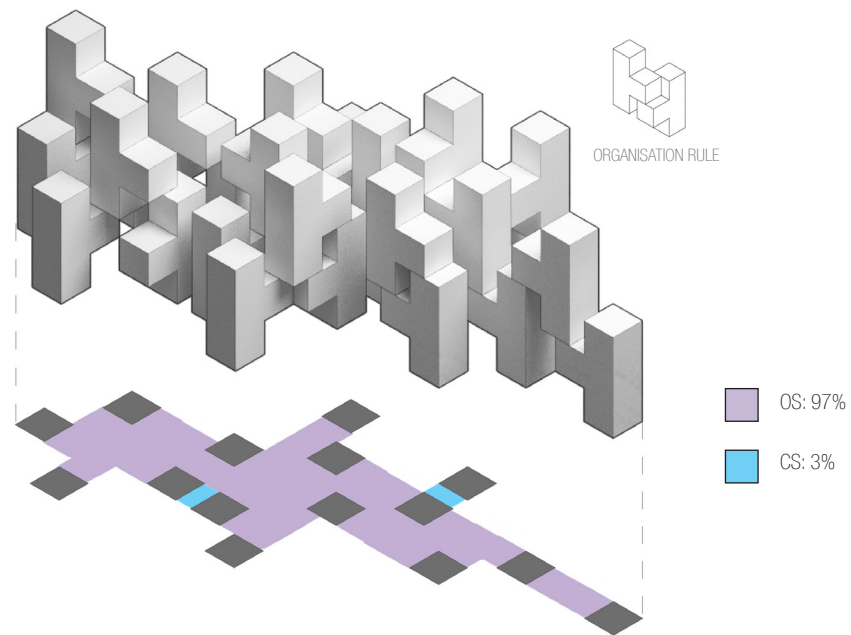
FOOTPRINT AREA: 45
FOOTPRING / VOLUME RATIO: 0.32
TERRACE AREA: 165



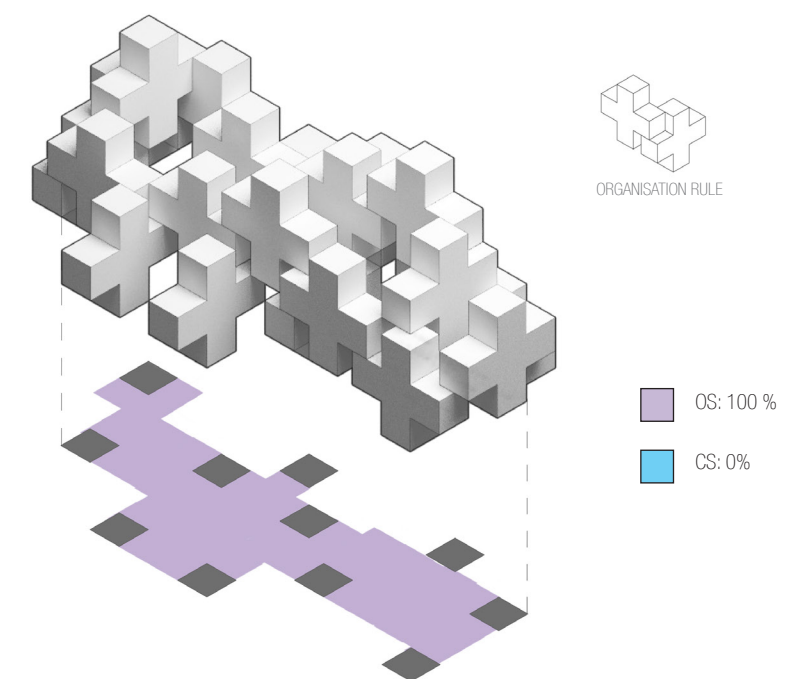
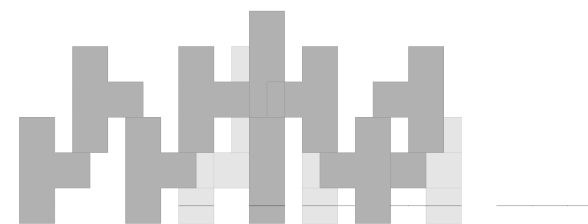
Able to genereate both large open areas and density depending on the choices made by the designer.



FOOTPRINT AREA: 36
FOOTPRING / VOLUME RATIO: 0.3
TERRACE AREA: 90



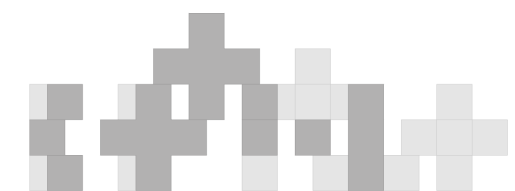
FOOTPRINT AREA: 15
FOOTPRING / VOLUME RATIO: 0.13
TERRACE AREA: 60



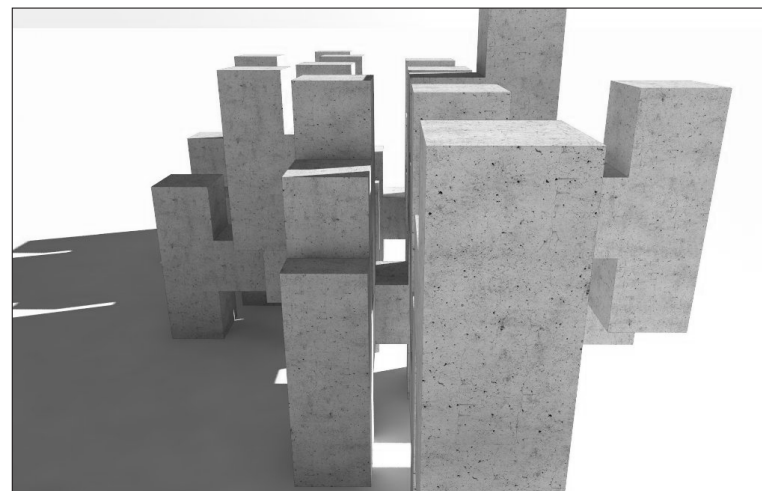
DESIGNER CONTROL

SYSTEM CONTROL

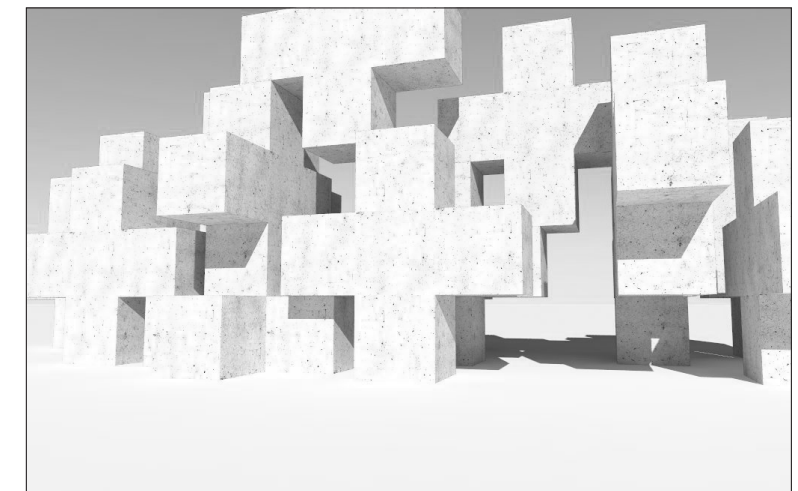
FOOTPRINT AREA: 20
FOOTPRING / VOLUME RATIO: 0.2
TERRACE AREA: 70



Creates a strucuted inner space with many open lines of sight.

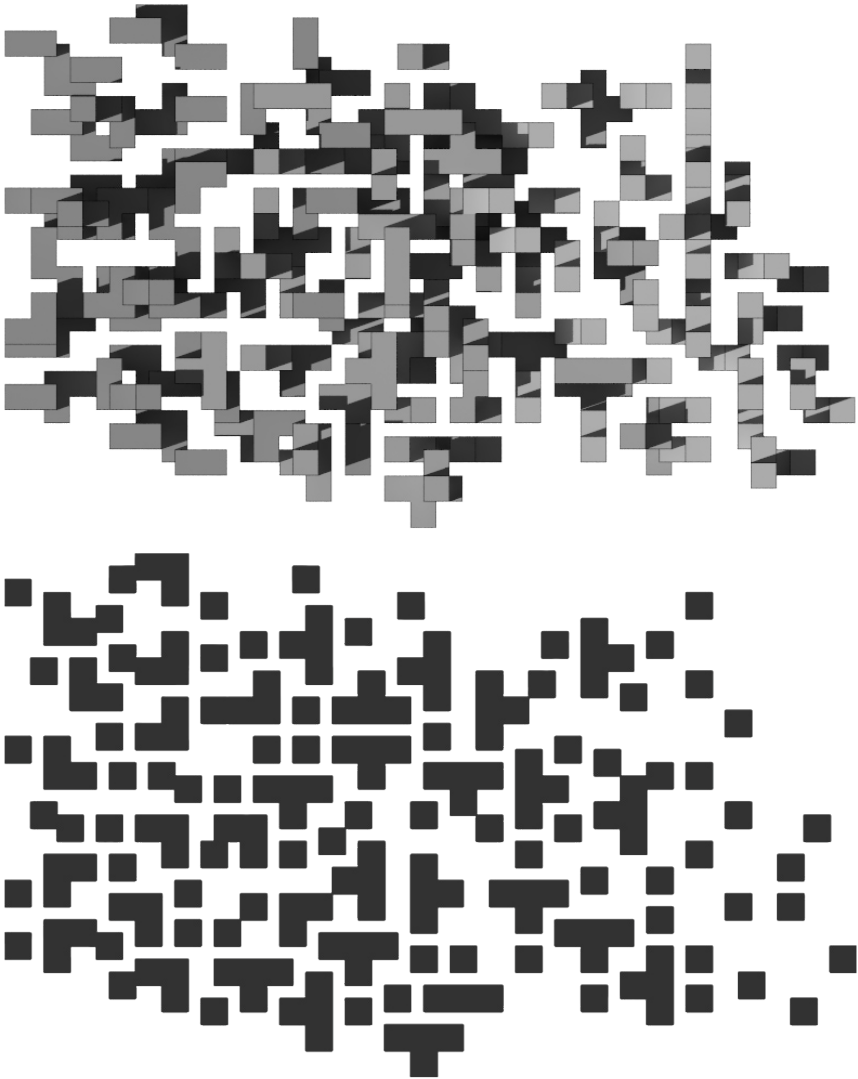
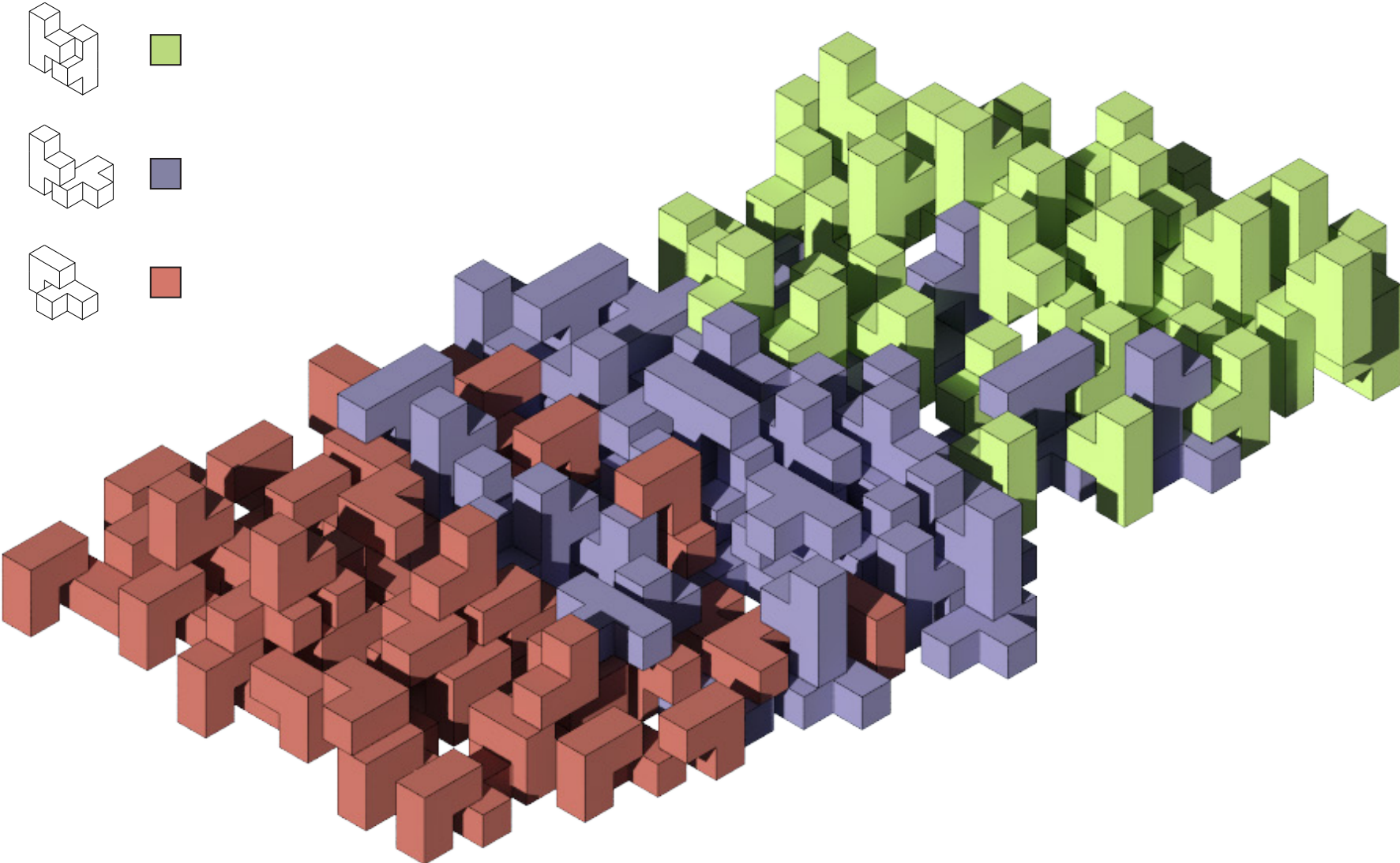


Creates an open footprint with low density as well as vertical openness.



Creates a minimal footprint with many inner openspaces and a closedness outward

Combining the different morphology types gives the opportunity to have a transient urban lanscape, shifting from dense to open.



In order to test the system and see what spatial qualities could be yielded, four sites were chosen in the Gothenburg area where the clustering system was allowed to grow in different ways in relationship with its surroundings. The sites were Skanstorget, Fiskhamnen, Rödasten and Skeppsbron.


SITE: Skanstorget


The location at Haga has long been a dead area in the city of Gothenburg. It's a good location to examine what would happen if one were to apply a dense urban morphology to try to activate the site.


People often use shortcuts to cross over the parkinglot, by respecting the people's movement at the site, volumes are placed around the flows making for an open and inviting cityscape.

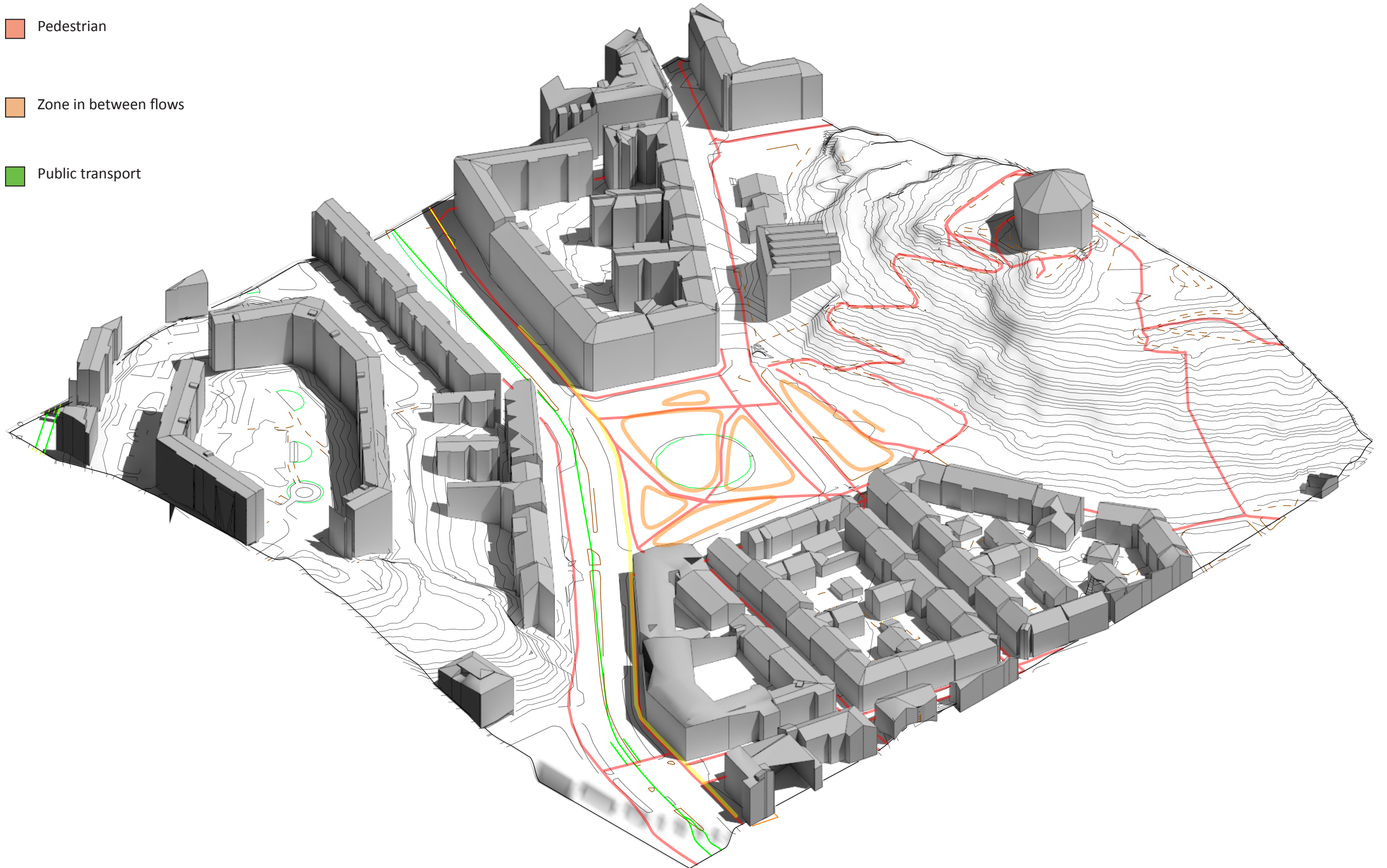


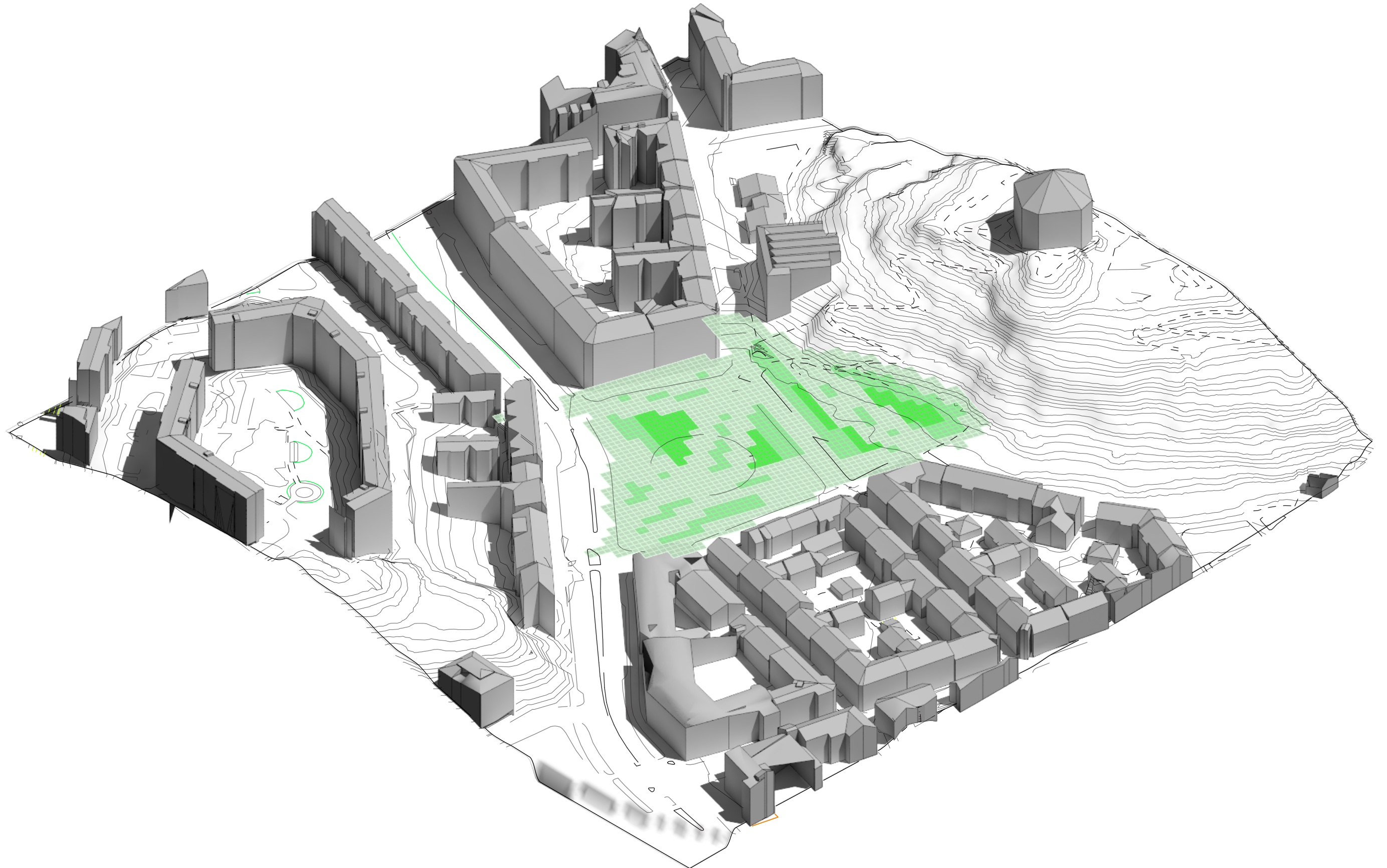
Flows at the site of Skanstorget

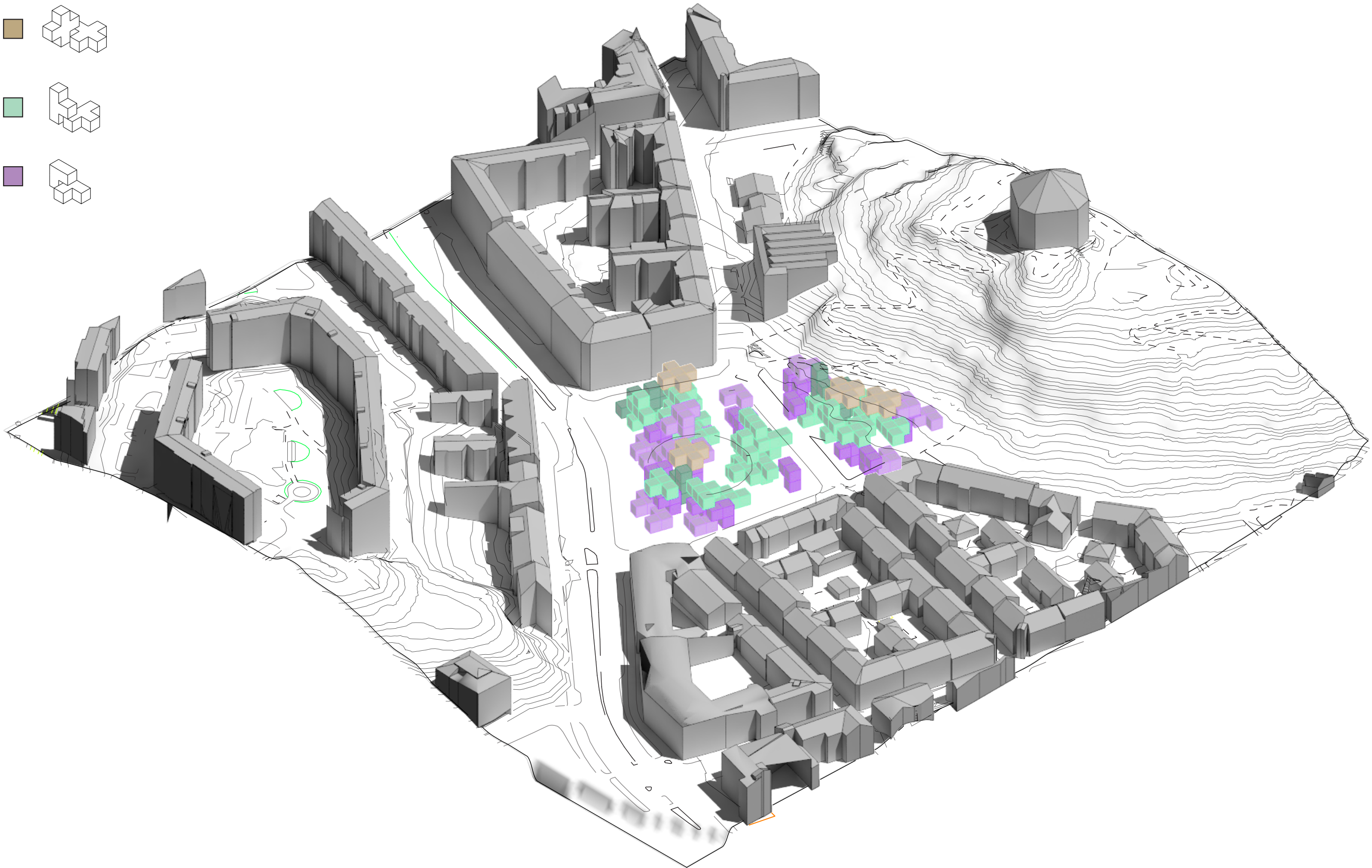
 Pedestrian

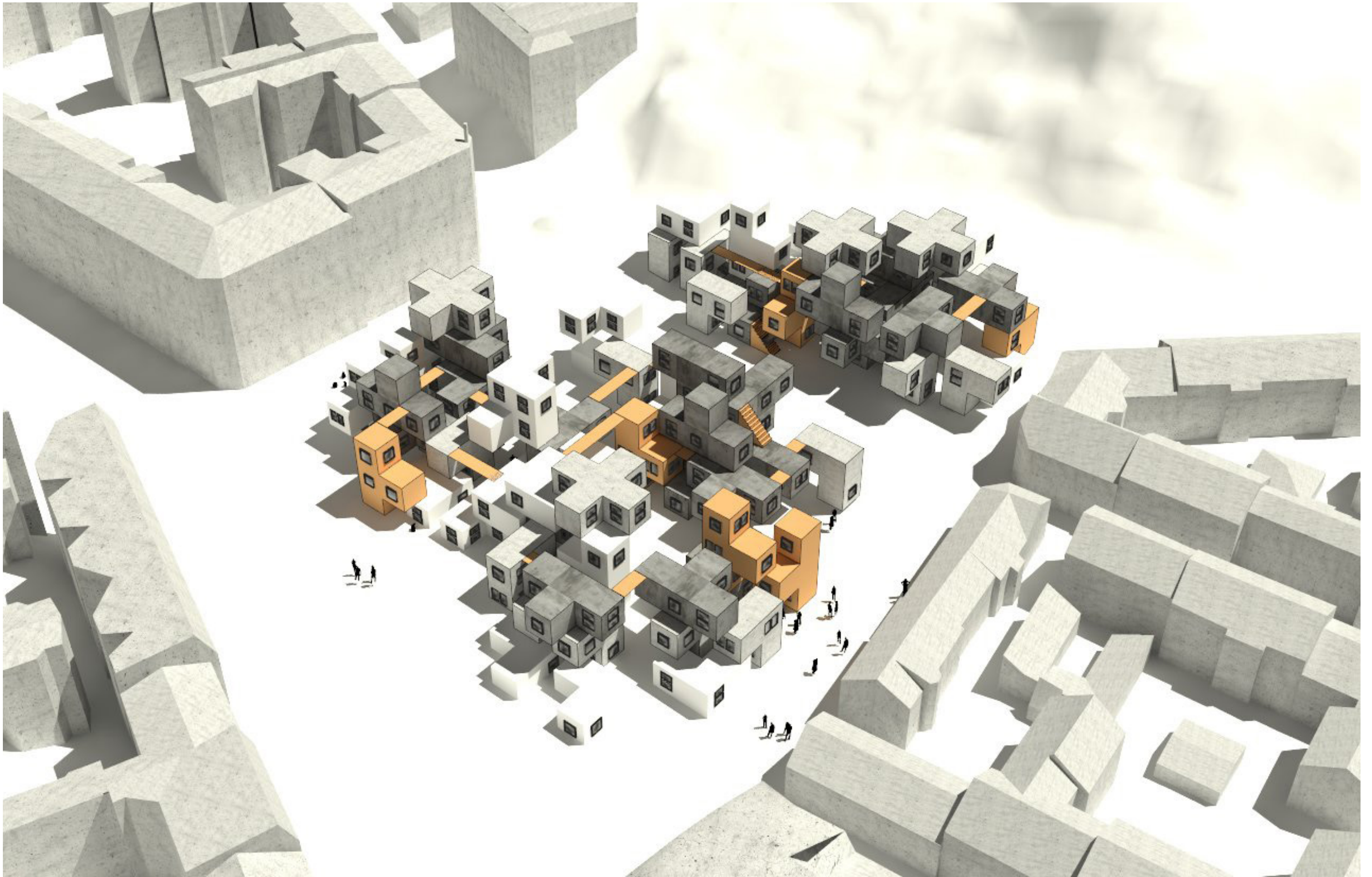
 Zone in between flows

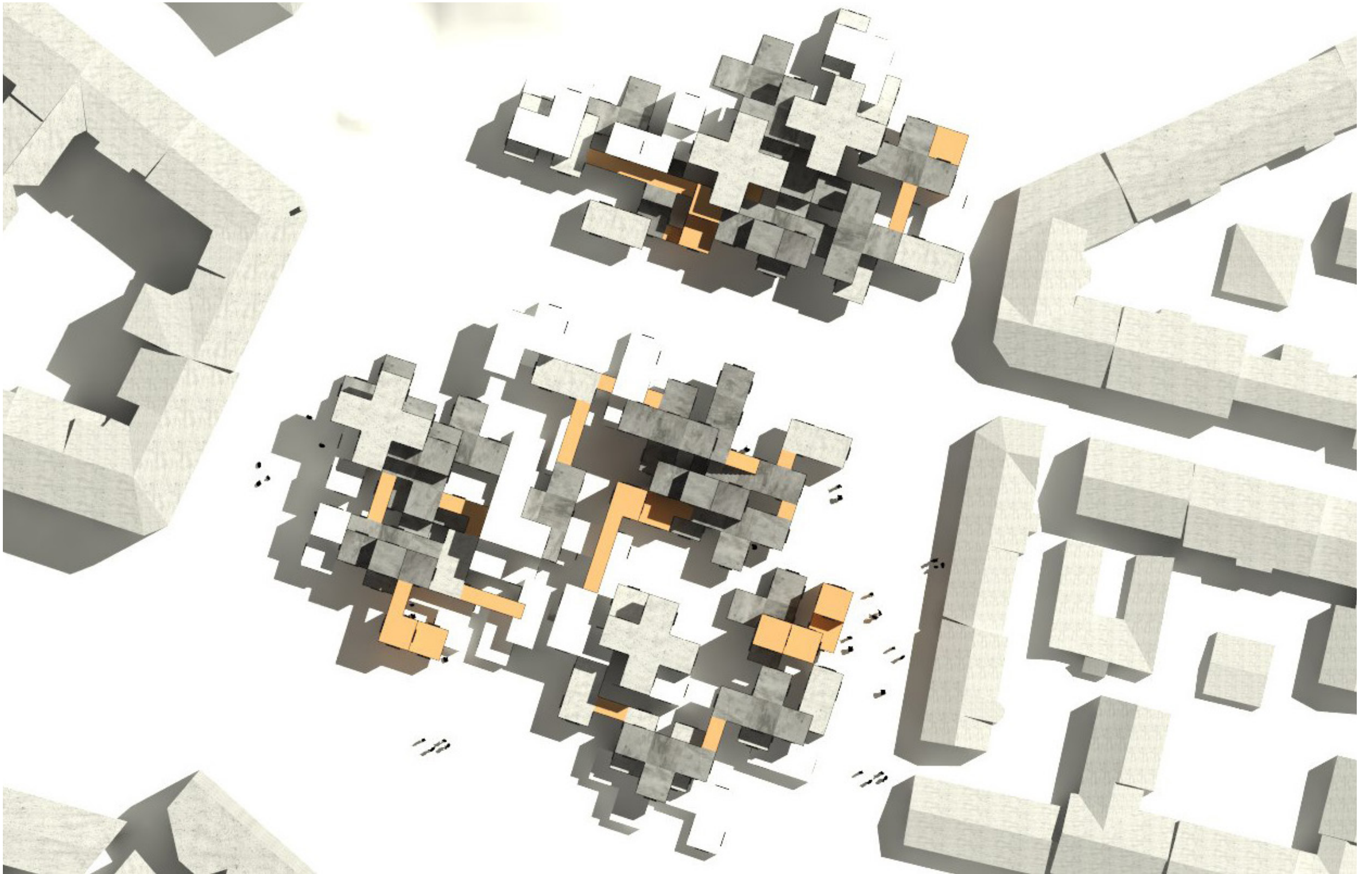
 Public transport












SITE: Fiskhamnen

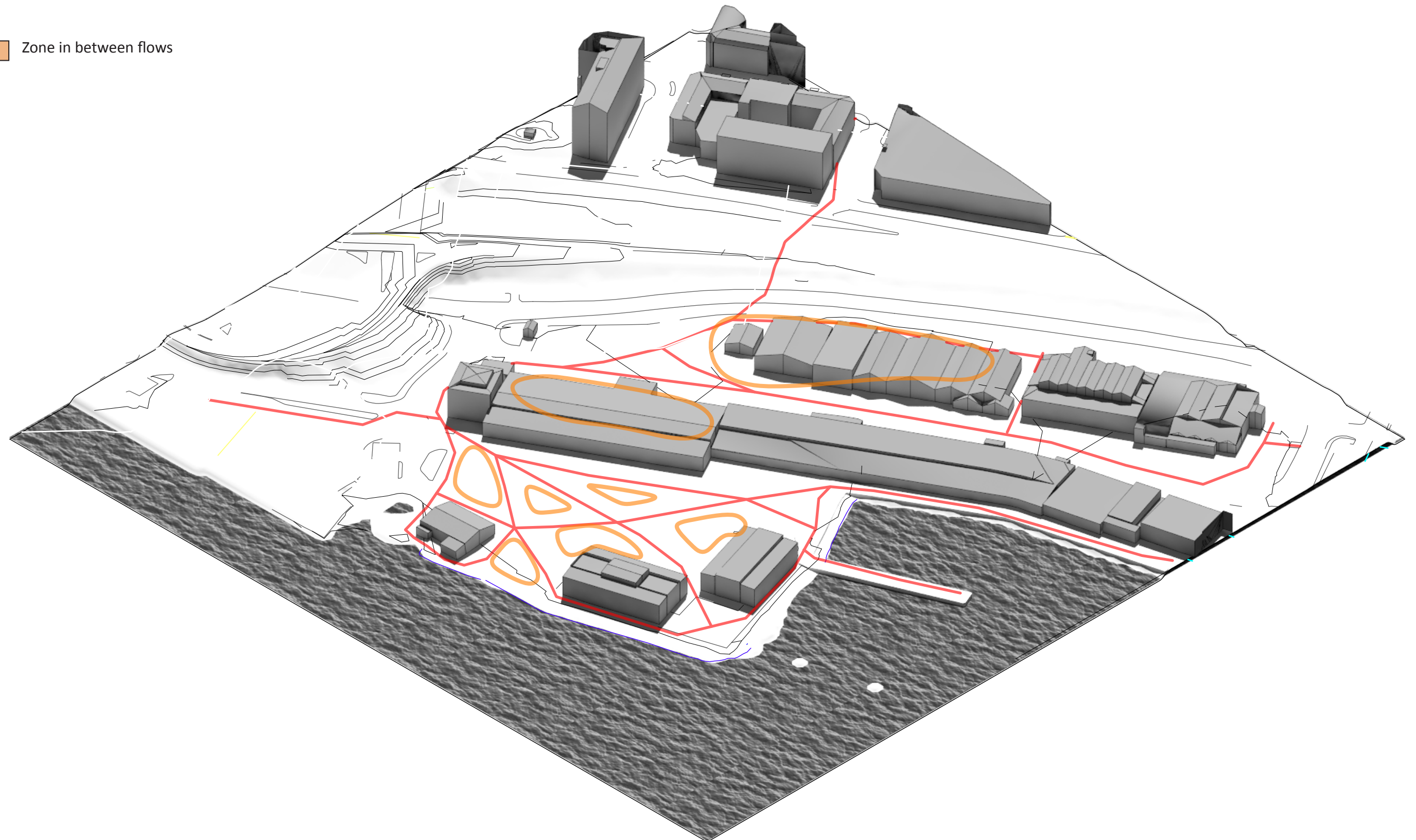
Fiskehamnen has a long tradition as a dock and industrial site. Instead of tearing down the warehouses now occupying the location, the system is allowed to grow on top of the existing structure like an organism, allowing the old structure to live on in the undergrowth of the new city.

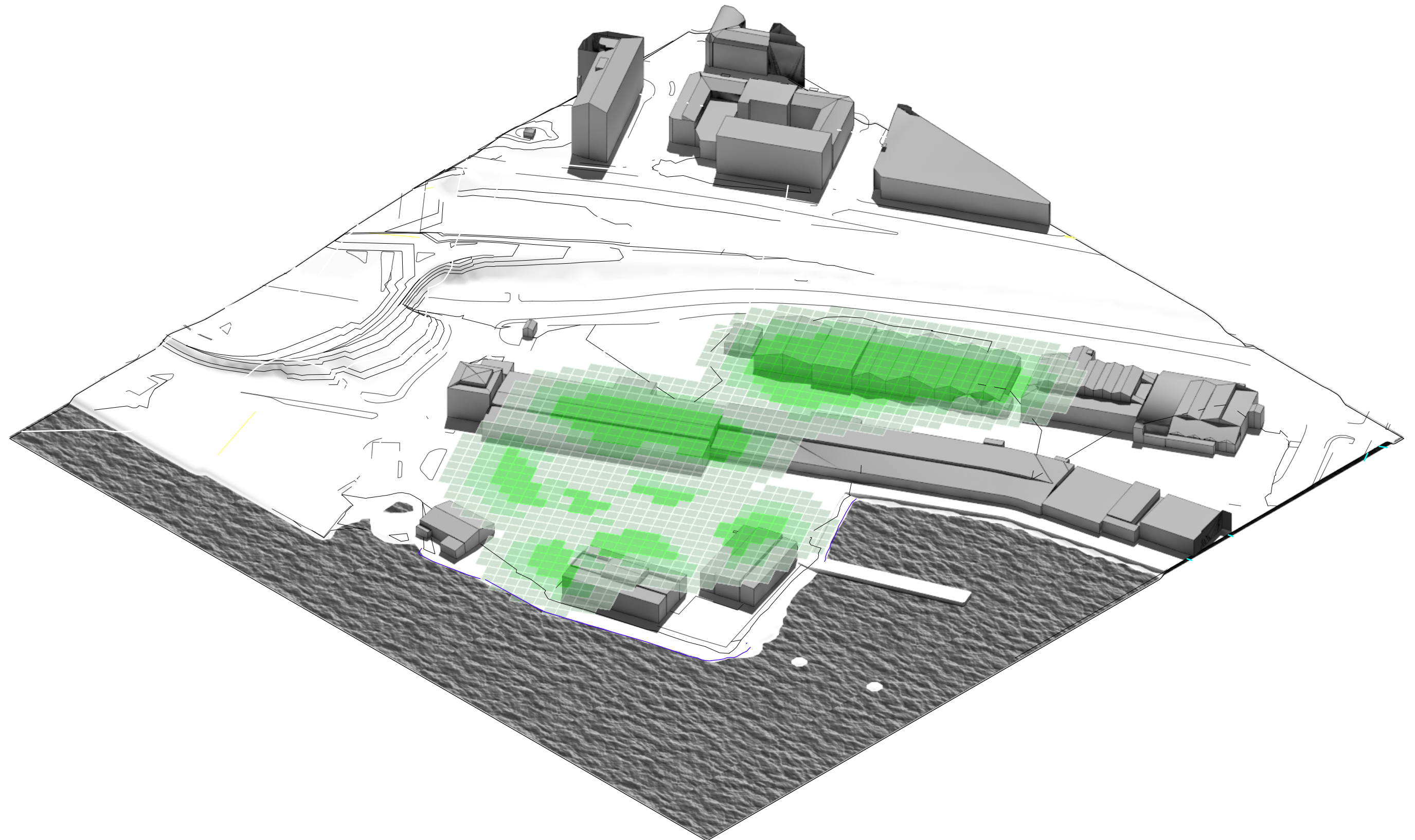
The new structures are placed with low density around paths to the shore in order to not block access for people who want to visit the dock side.

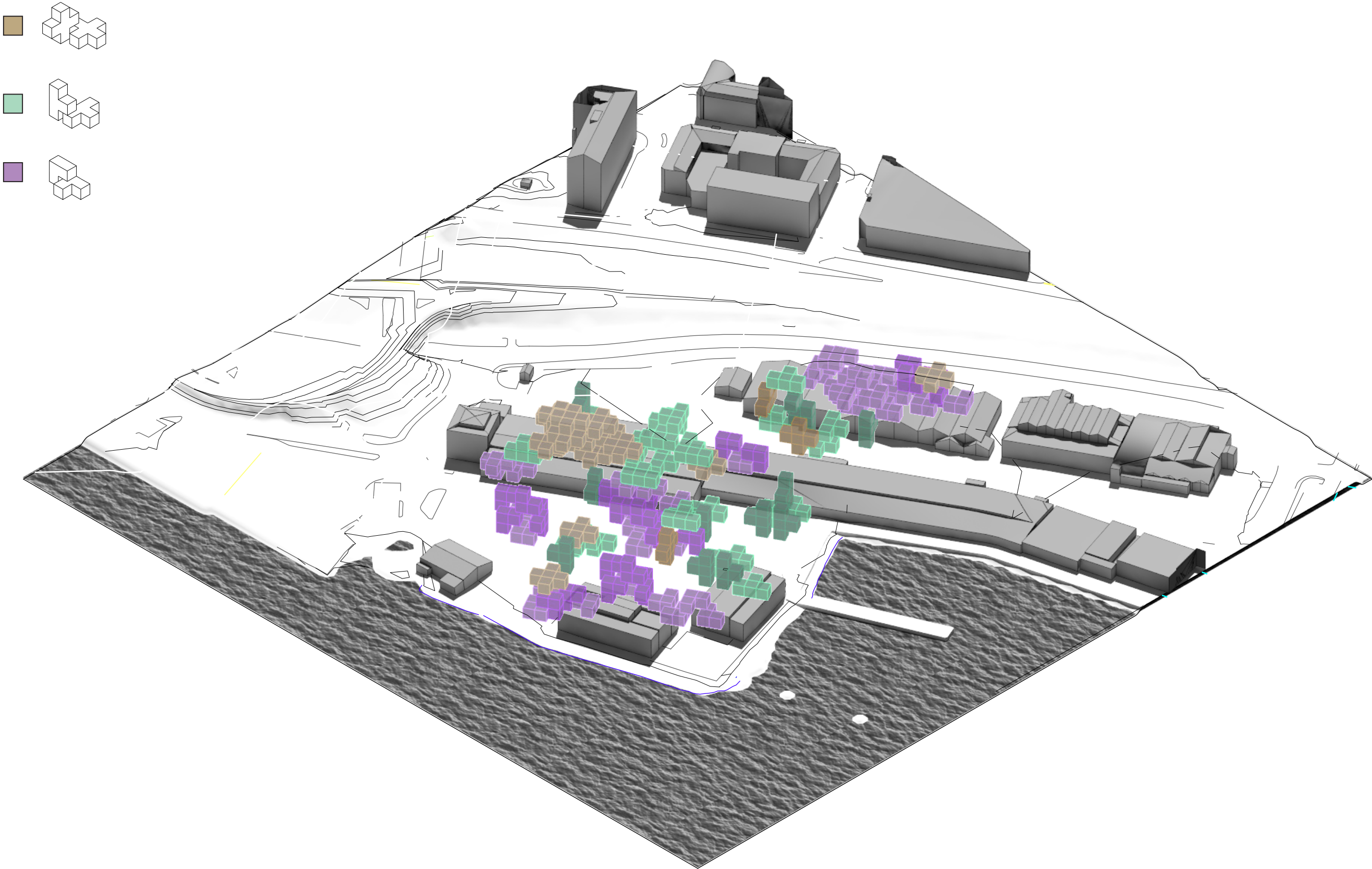


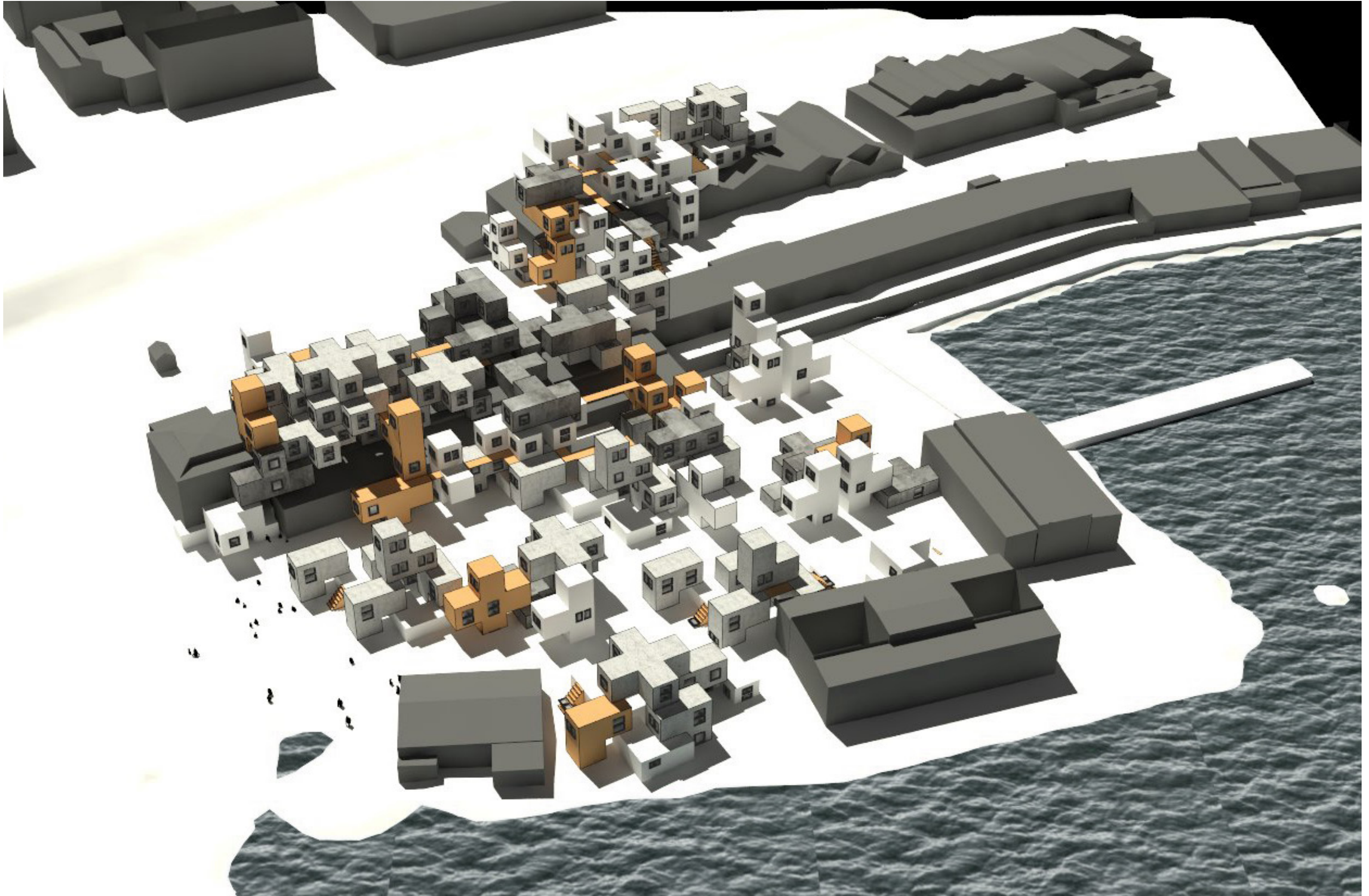
 Pedestrian

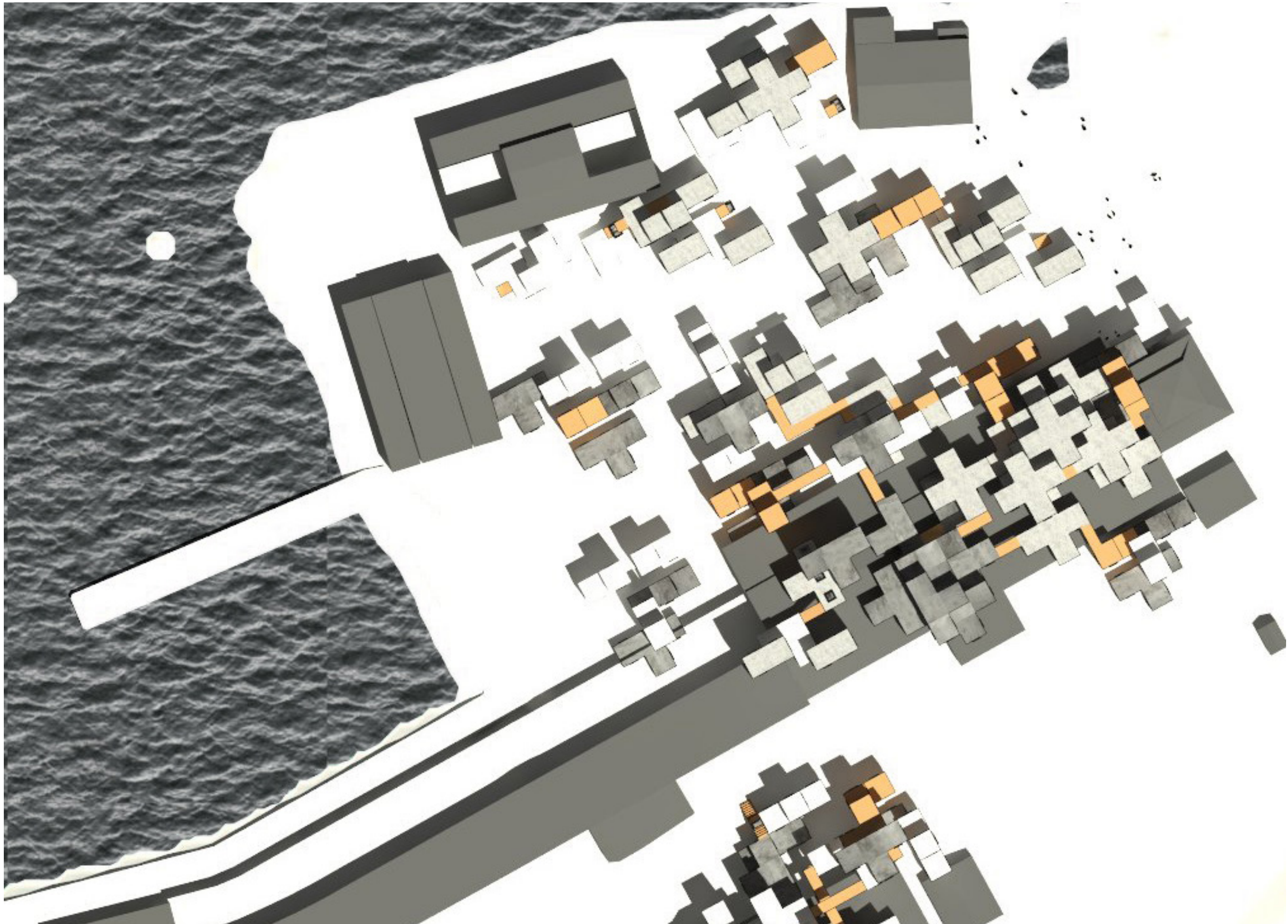
 Zone in between flows











SITE: Skeppsbron


The site at Skeppsbron has long been a dead space in the site surrounded by traffic and towering buildings. The system is allowed to grow tall to create a transient space between the tall city scape and the shore. It also bridges over the road near the coast leaving it open to be used by pedestrians or traffic.

The volumes are placed bridging over the tram lines and bike cycle paths in order to not disturb the flows of the city.

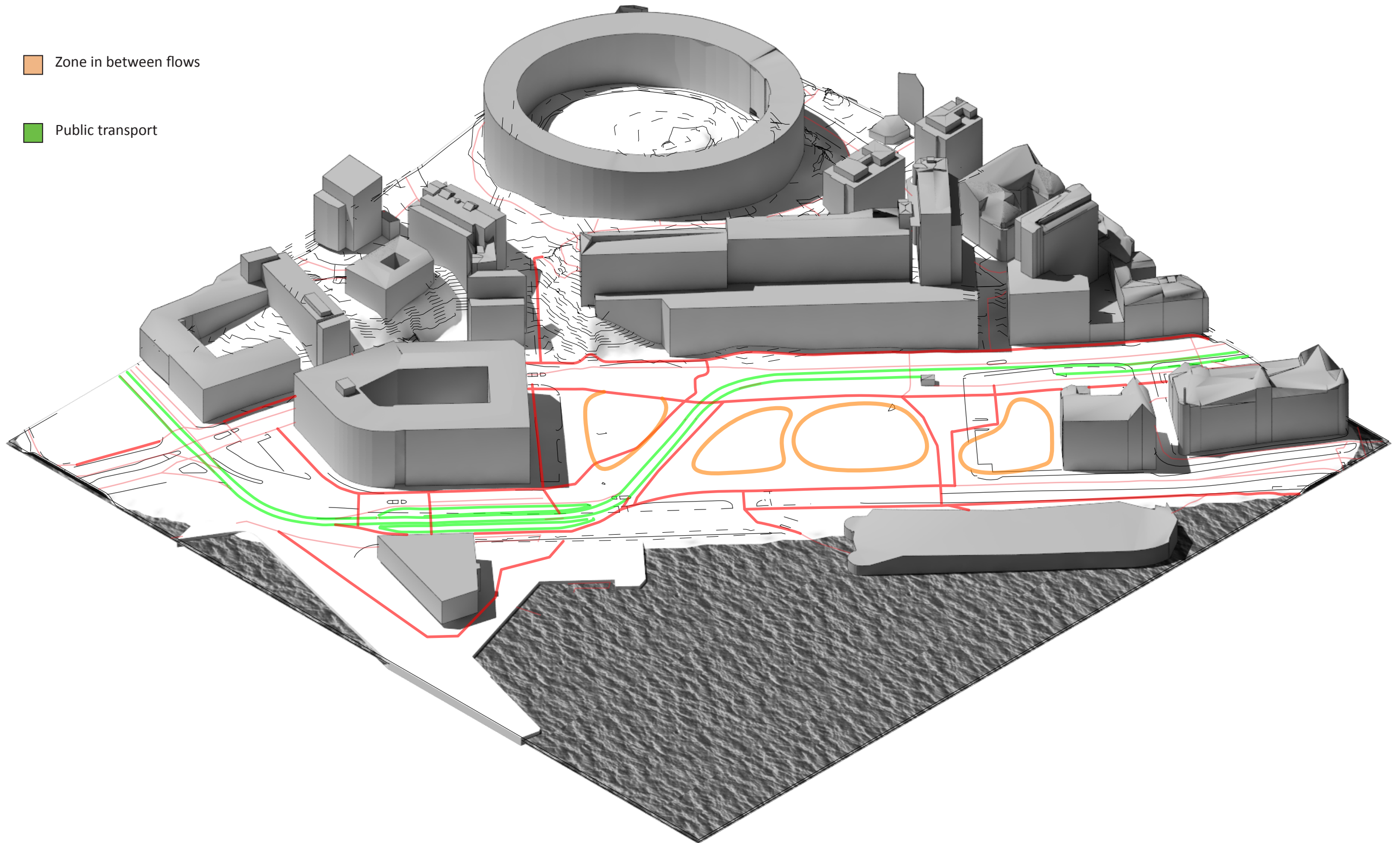


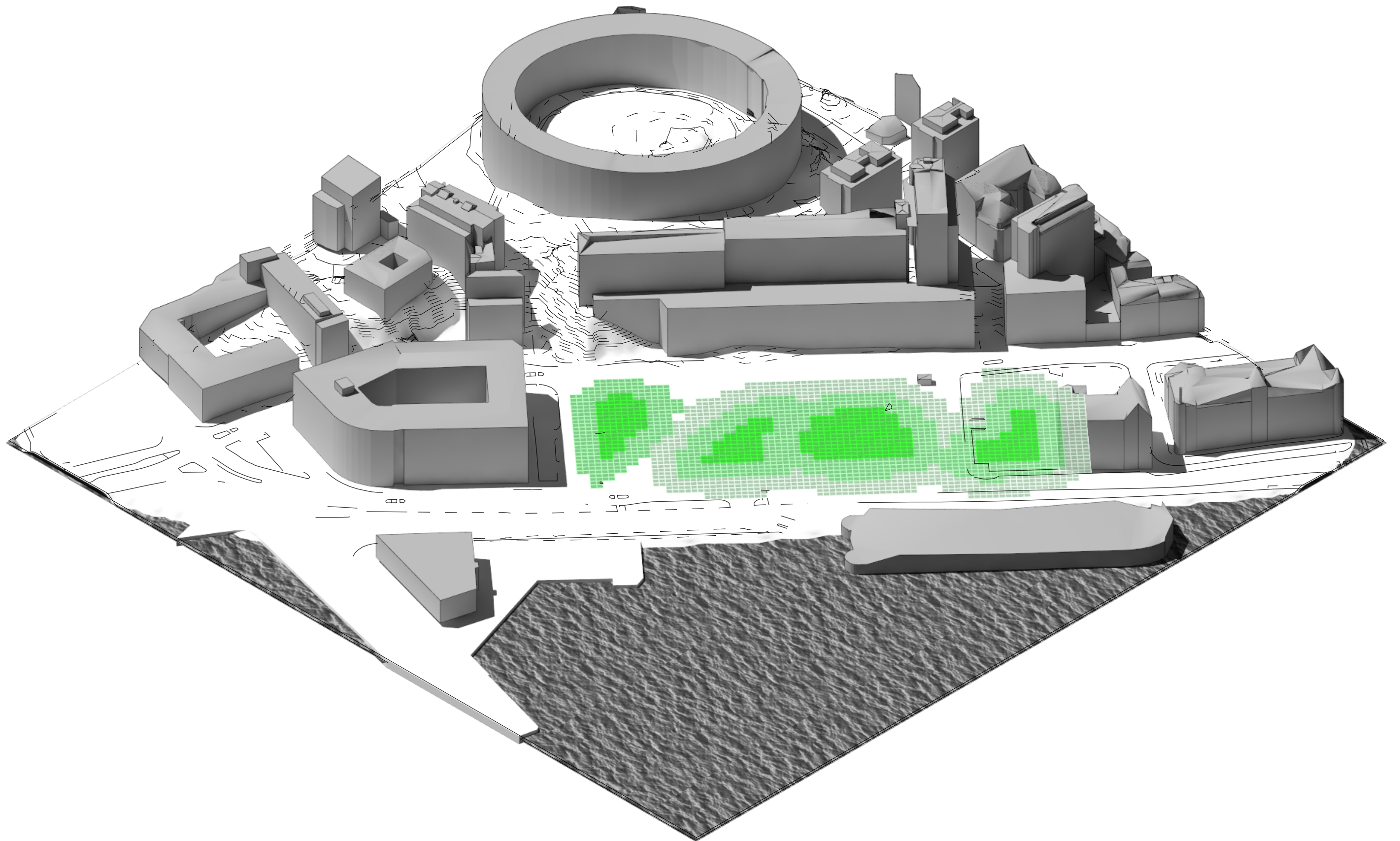
Flows at the site of Skeppsbron

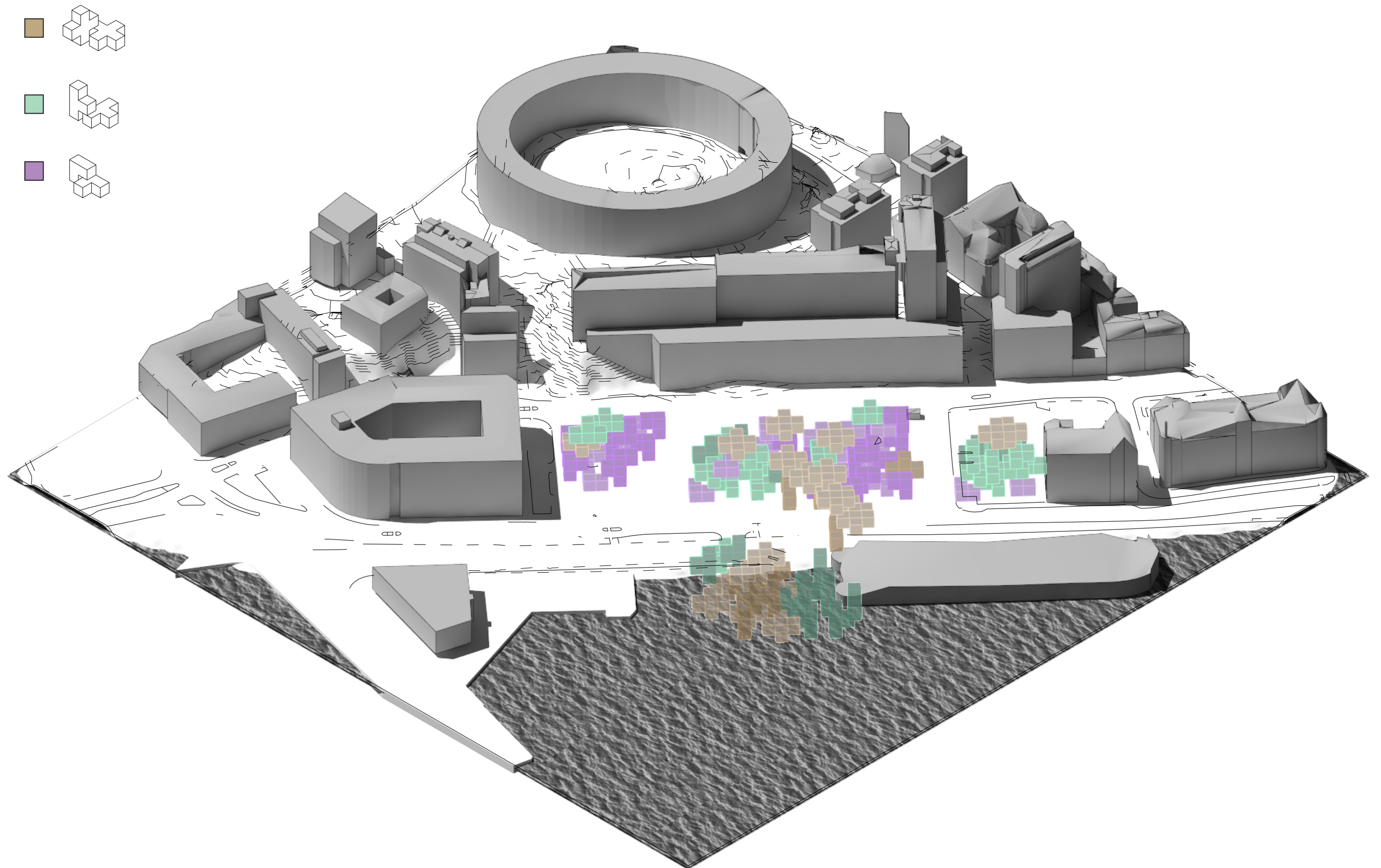
 Pedestrian

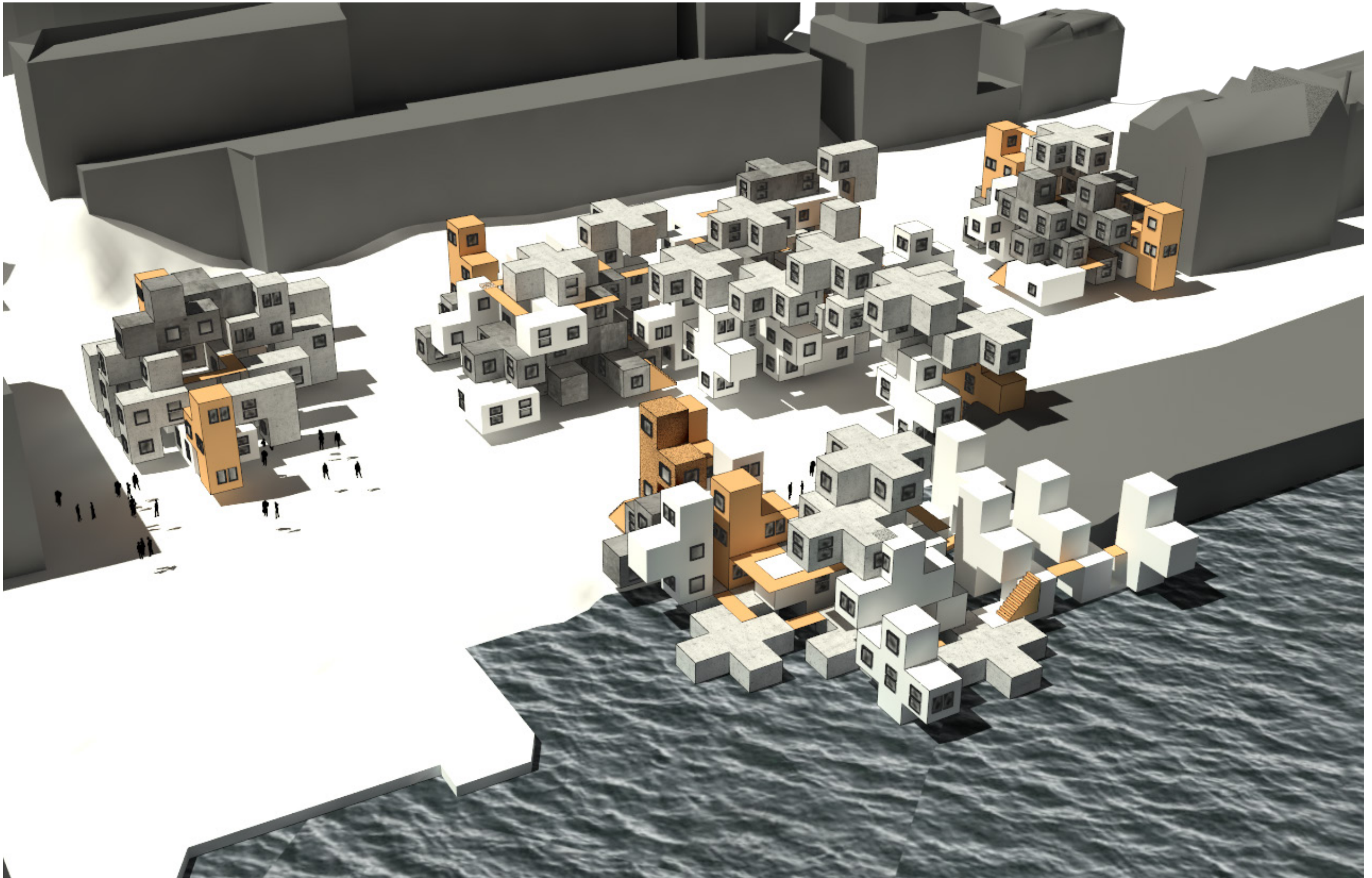
 Zone in between flows

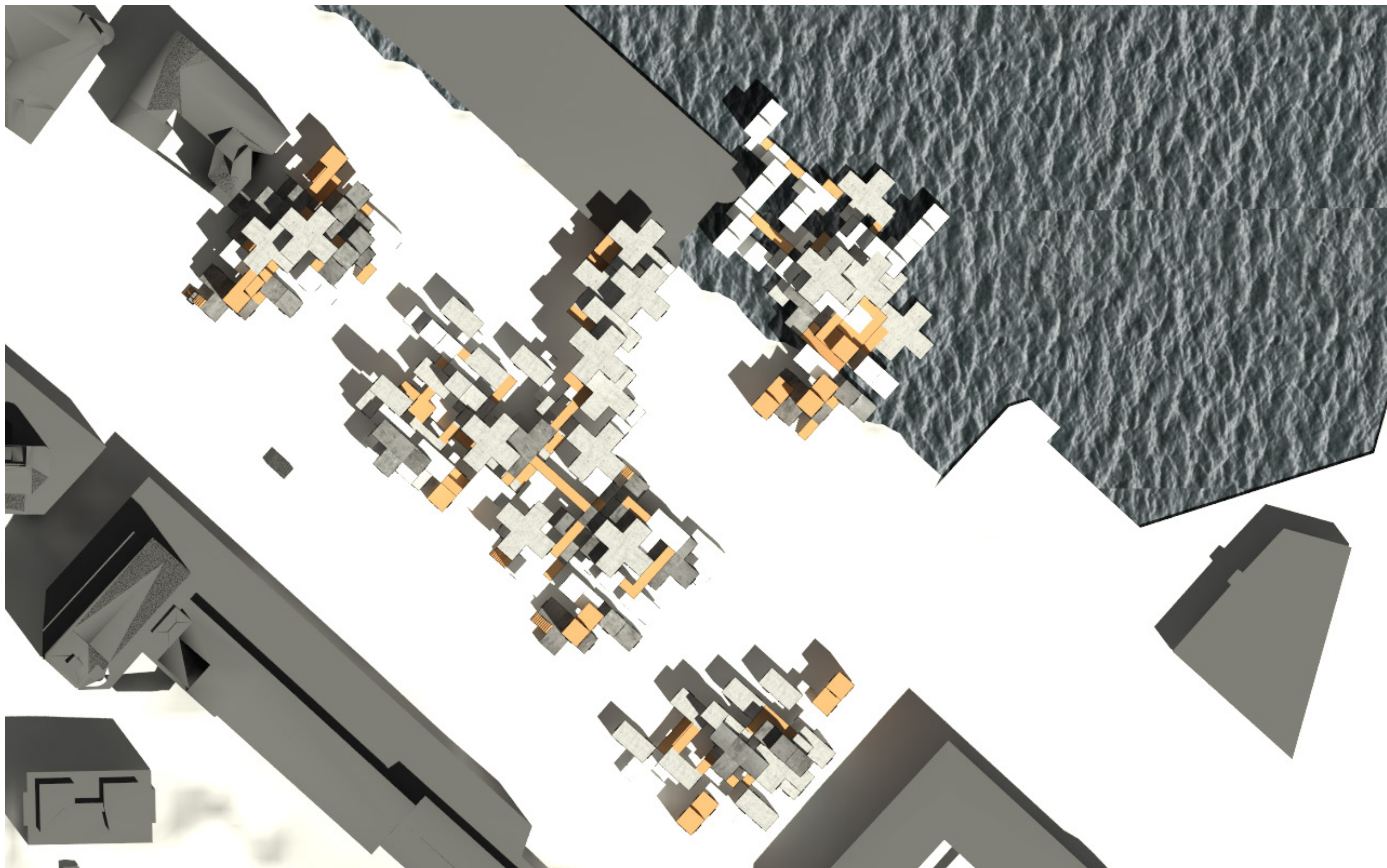
 Public transport





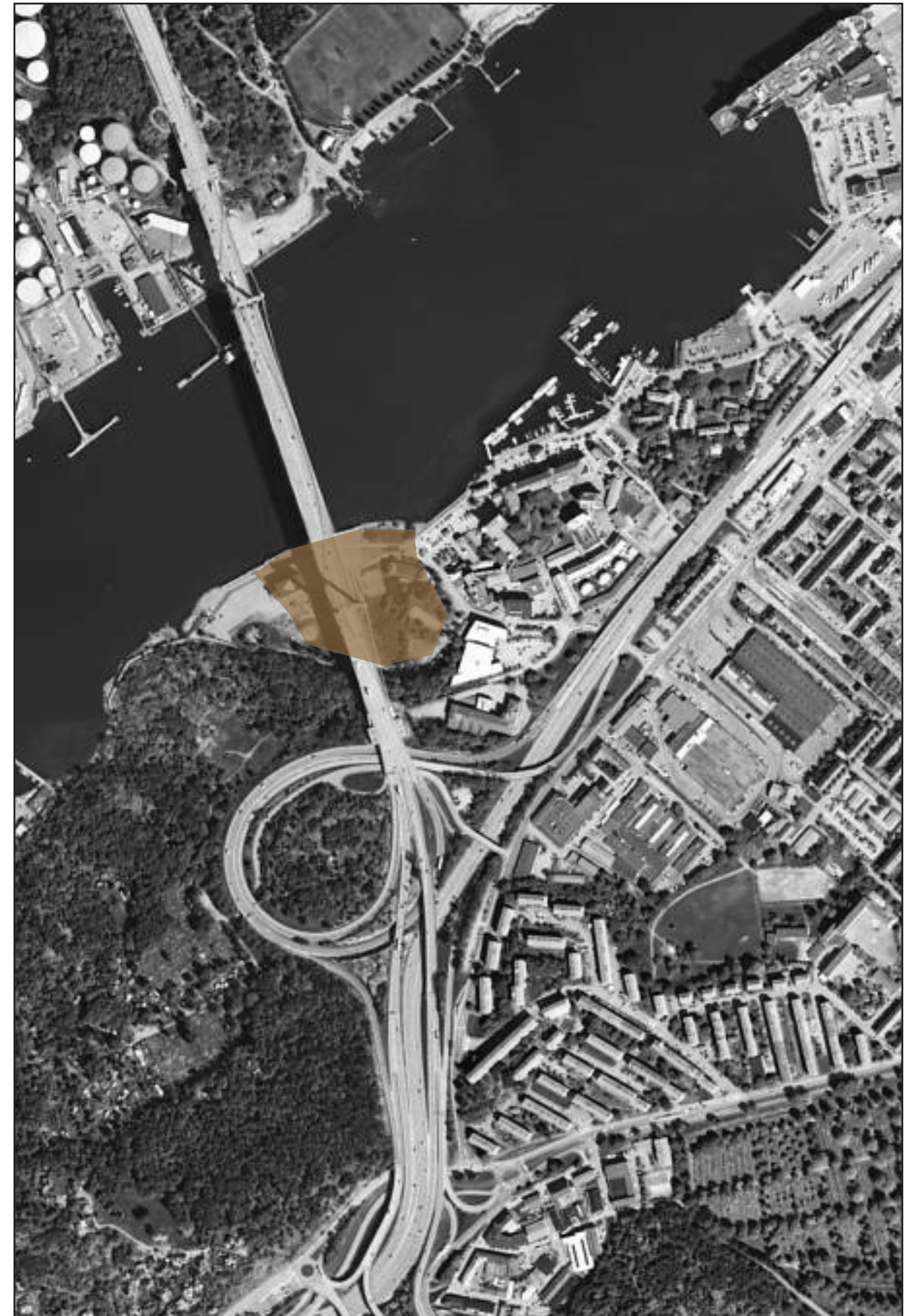







SITE: Rödasten


The site around röda sten underneath the bridge is largely unused. The system is allowed to grow around the flows of the area and around the bridges support like ivy, creating an urban jungle and vertical sprawl.

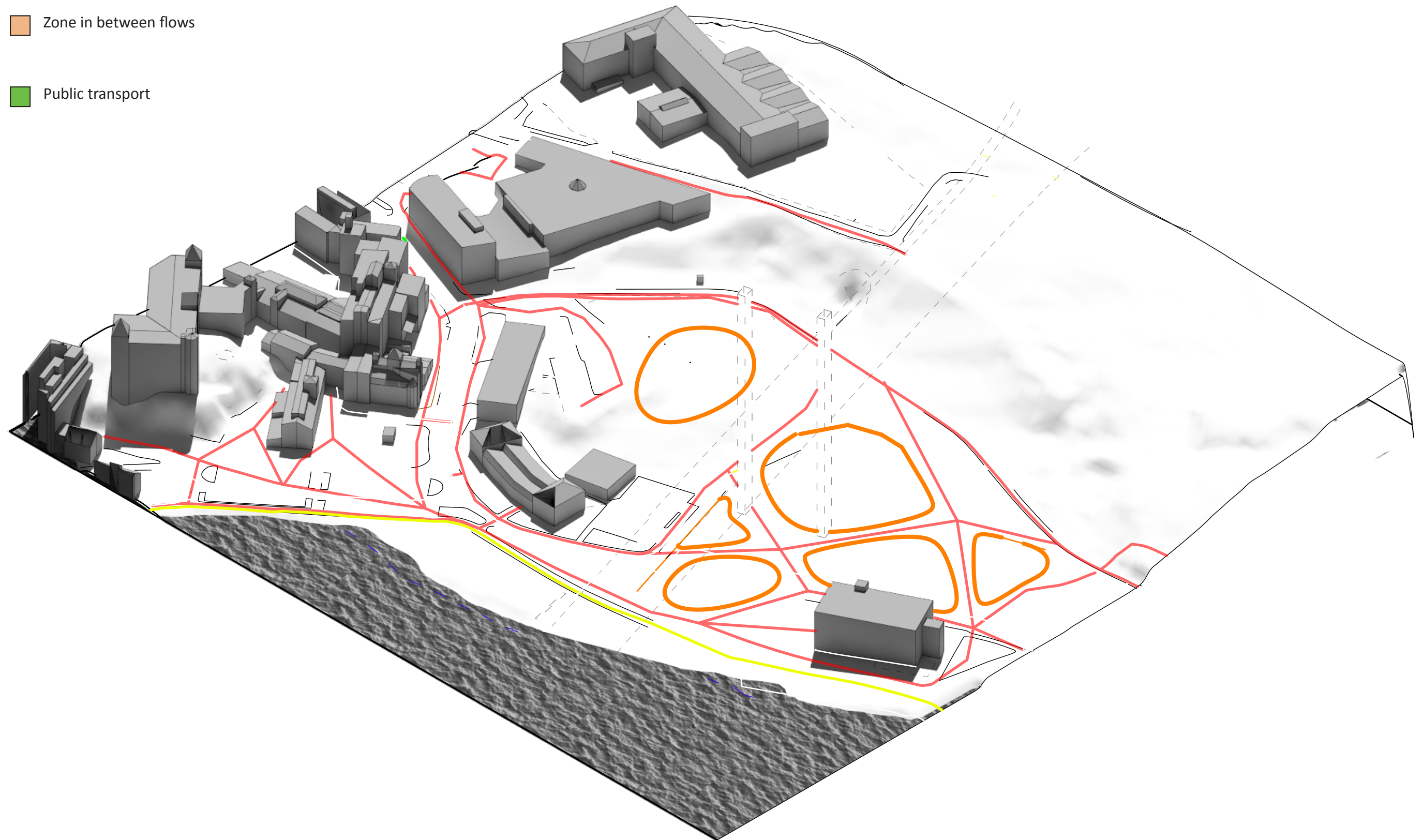


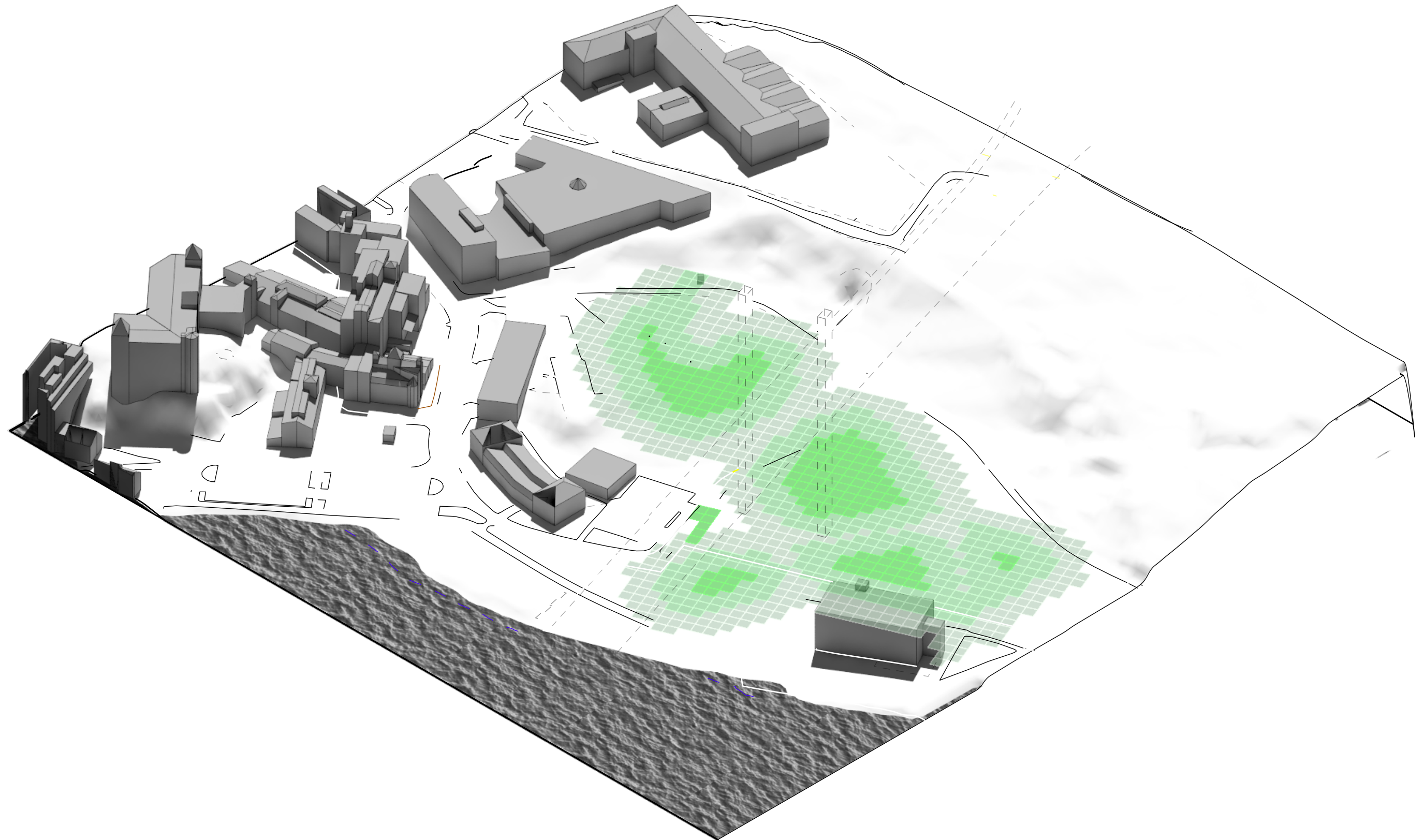
Flows at the site of Röda sten

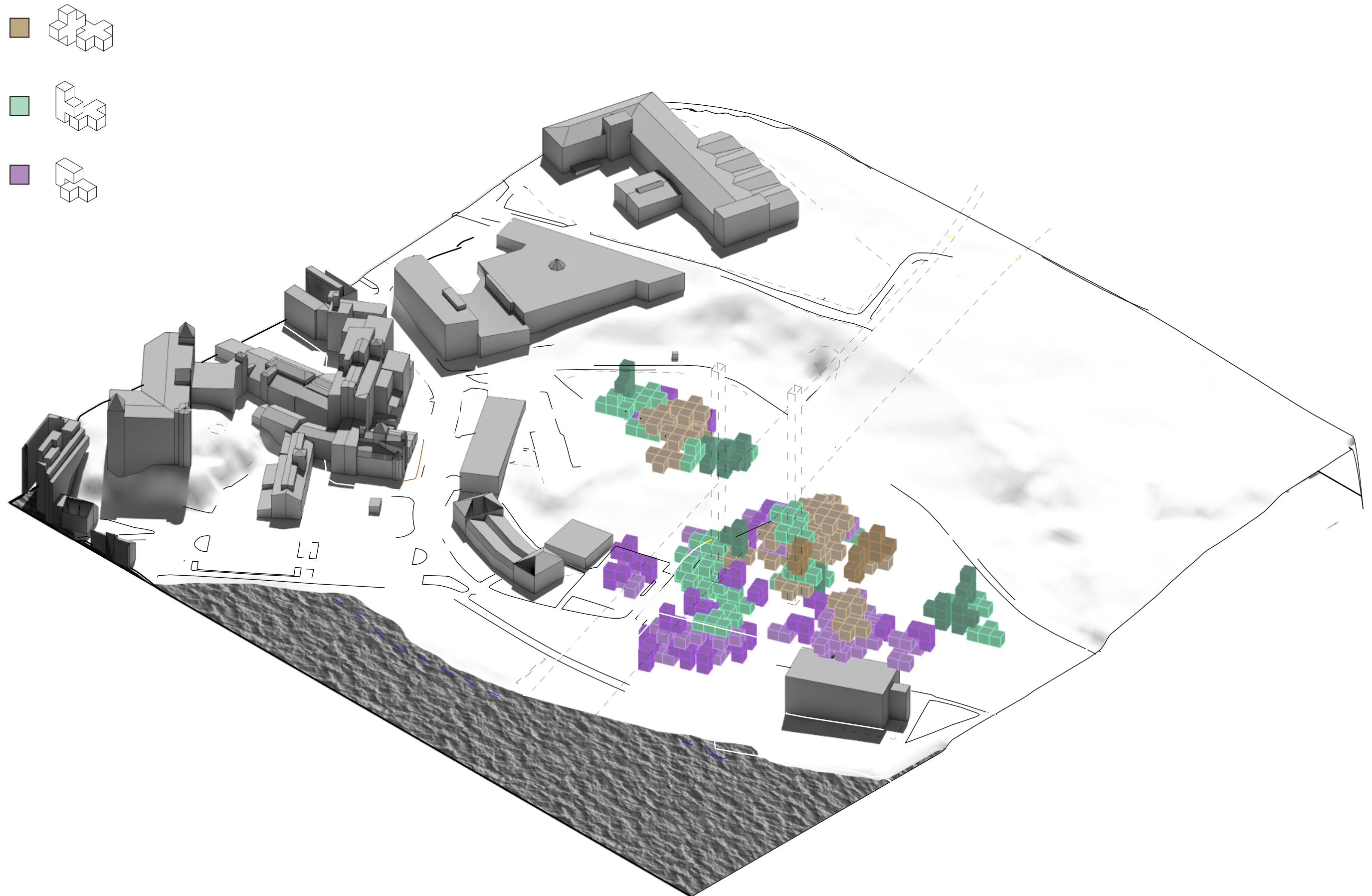
 Pedestrian

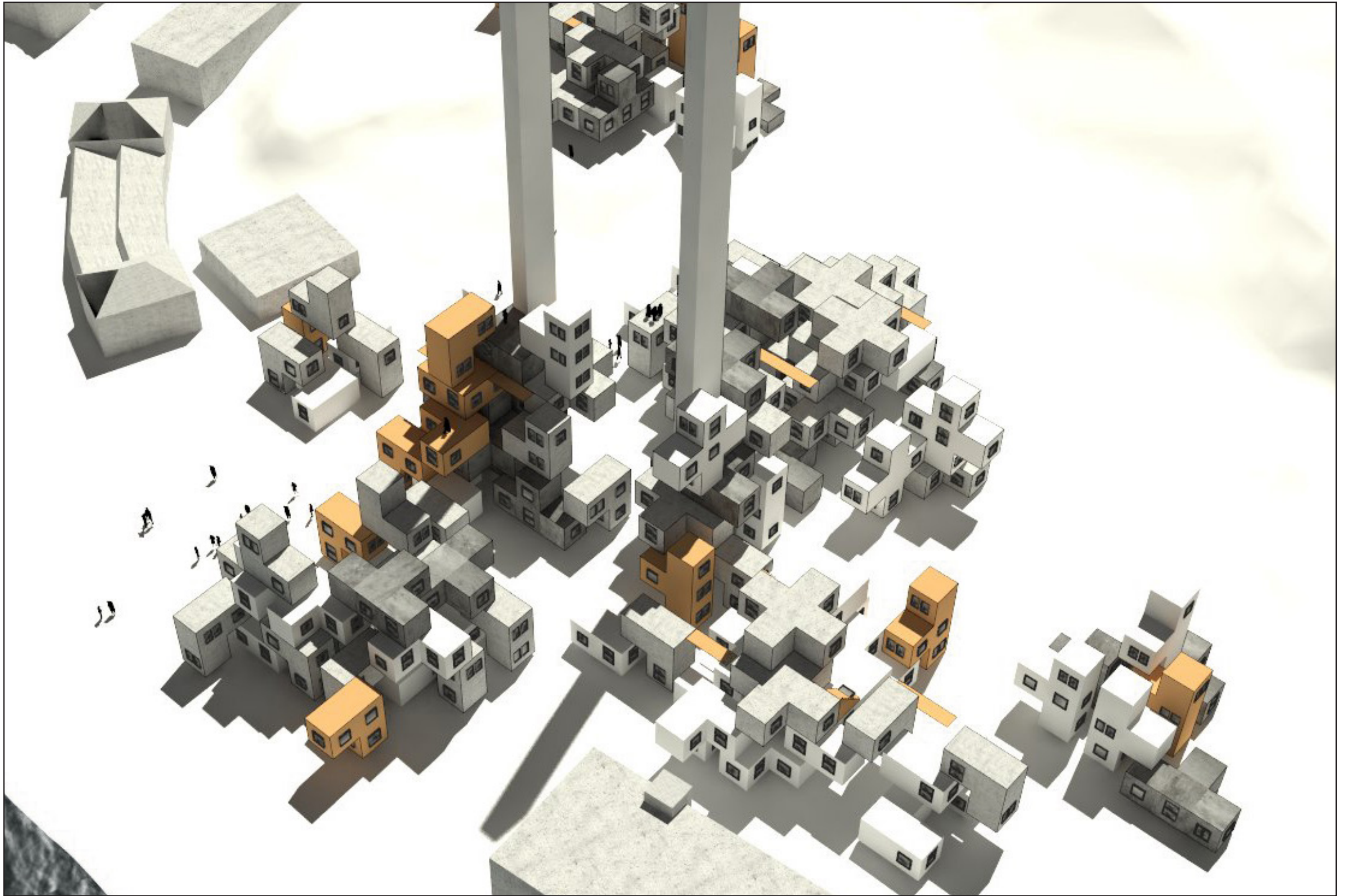
 Zone in between flows

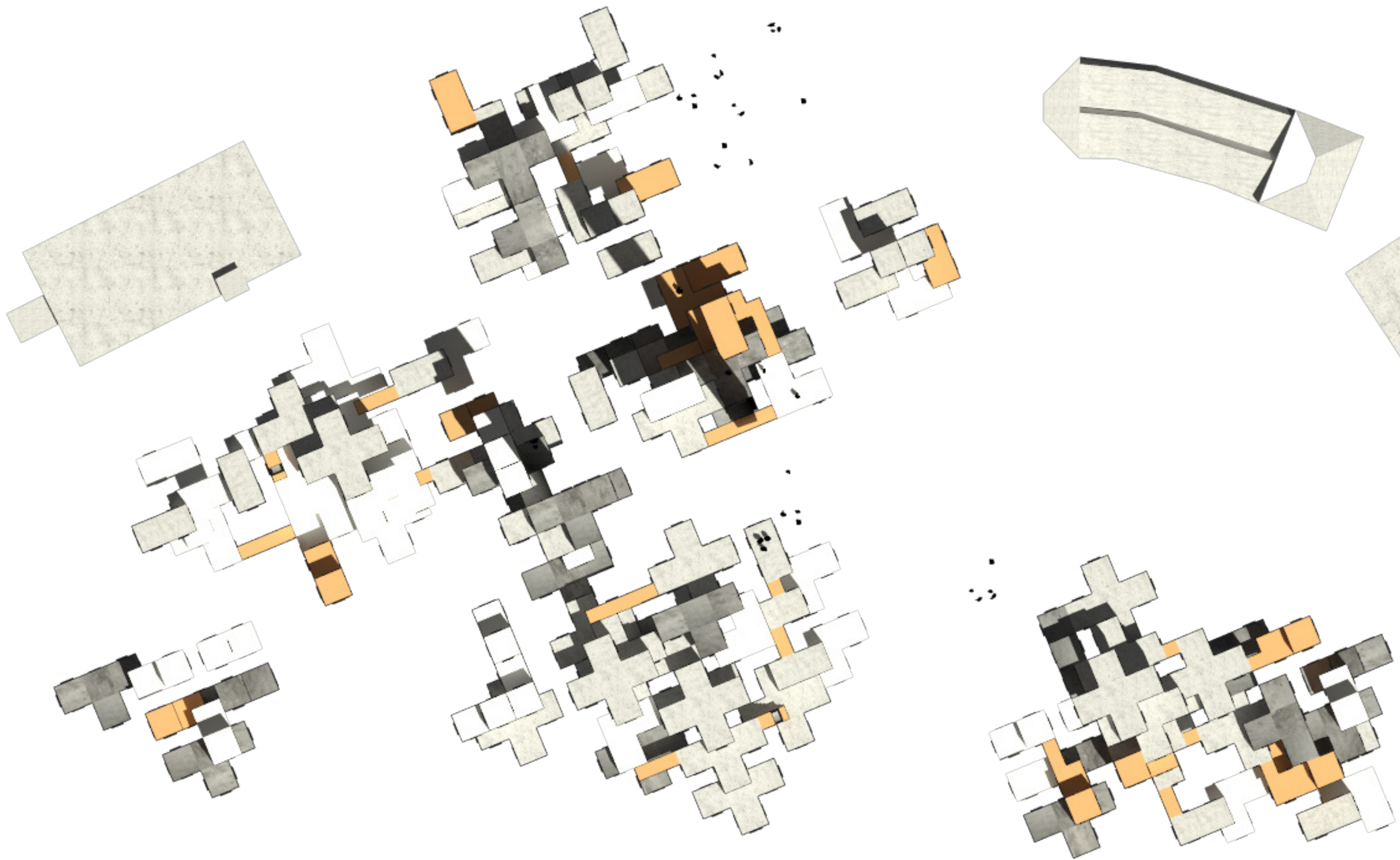
 Public transport











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In conclusion the project has given som insight in the potentials of using rules and algorithms as a driver in the design process and the relationship between a designer and design methodology. It has also helped me explore the nature of spatial predictability.

