

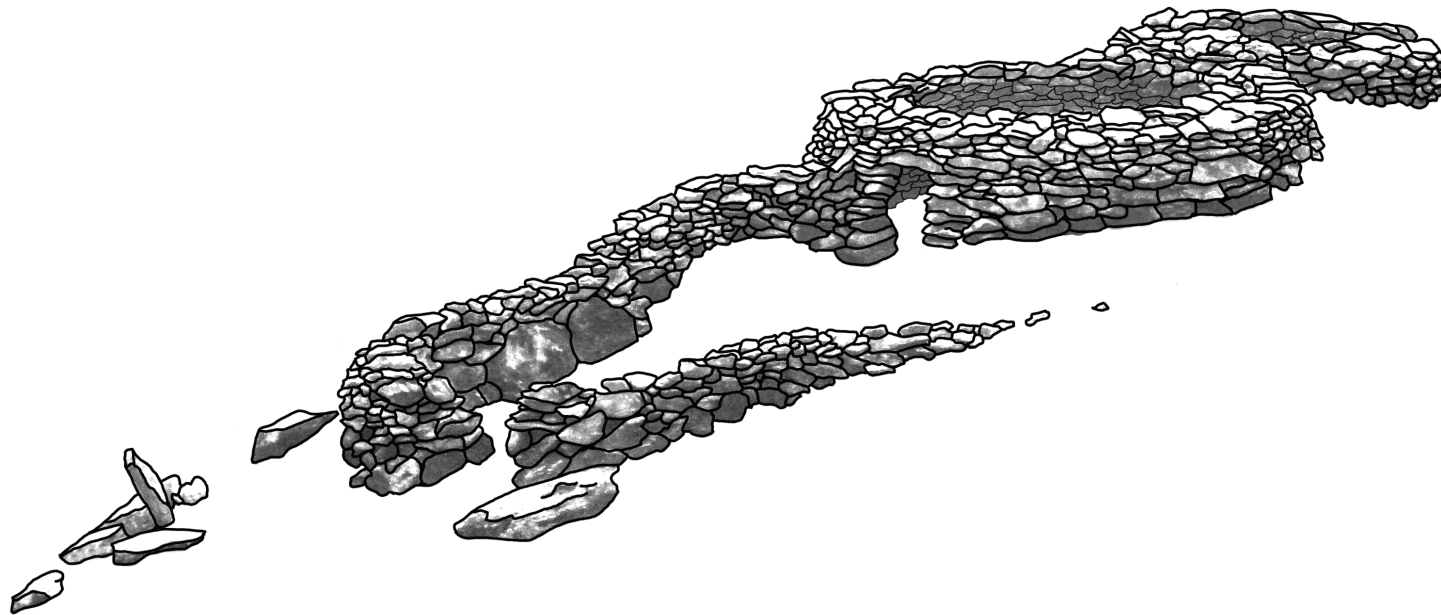
Processing Matter

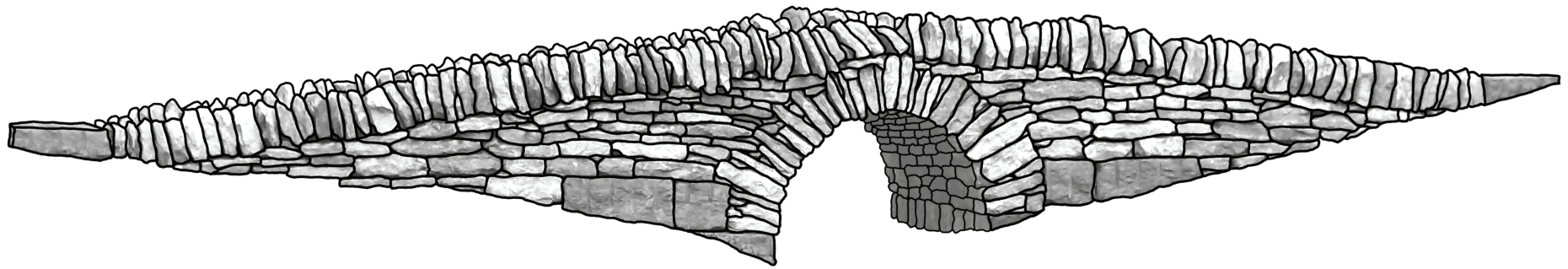
A contemporary view on dry stone construction

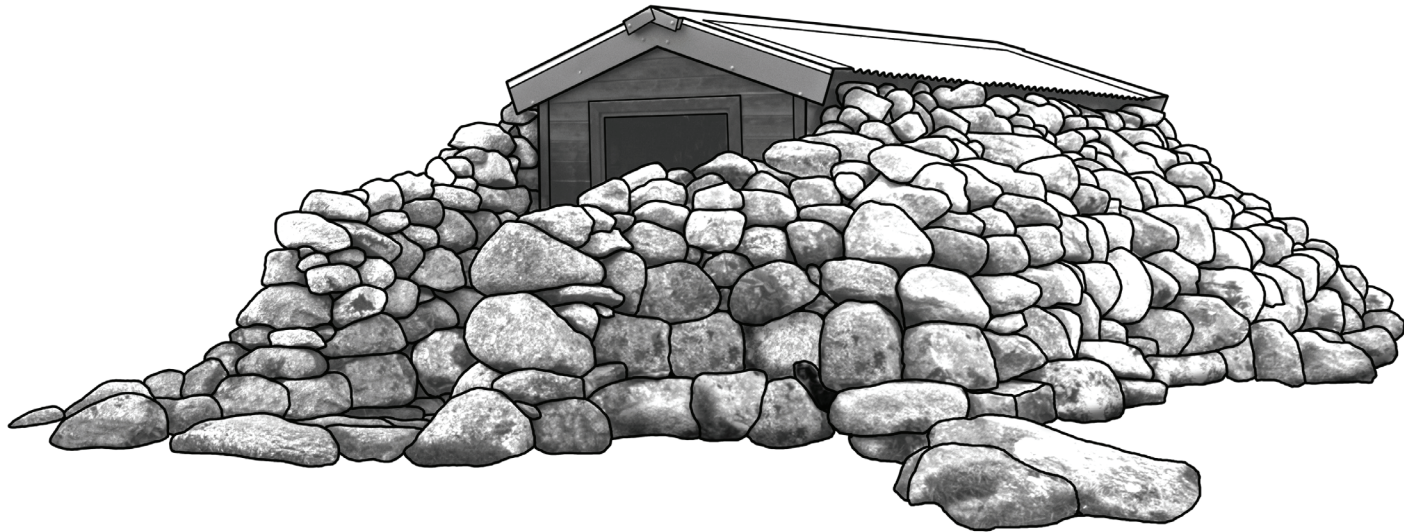
Master Thesis

Jan Philipp Drude

Dry Stone Construction









Starting Thoughts

Dry stone construction – or the laying of stones without utilizing mortar – is the oldest form of construction made of stone.

It comes in many forms and styles, mainly dependent on the level of work spent on the individual stones and the layout of the overall wall.

Whereas the first advanced civilizations, like the Egyptians or Babylonians, spent tremendous work on the individual stones leading to a form of masonry basically without gaps, the construction was also used in everyday life, where the stones found in the fields were laid in walls surrounding said fields or were used for primitive housing, where the stones were basically used as found.

While the constructions with found stones, like in Ireland for example, do need touching up quite often, so as not to deteriorate as do many ruins standing there, the construction with massive formed stones lasts millennia.

For the idea I have in mind for this project though, I do not want to work with highly formed or machined stones, but with the assembly of found matter.

The starting thought leading to this work was therefore the consideration of what to do, if all that I have to start with is a certain amount of stones from a blasting, for ex-

ample. What to do with a load of different matter in different sizes and maybe even different materializations?

For a possible solution to this problem I want to design several algorithms, to address the problem of stacking irregular geometry and to find ways of assembling those.

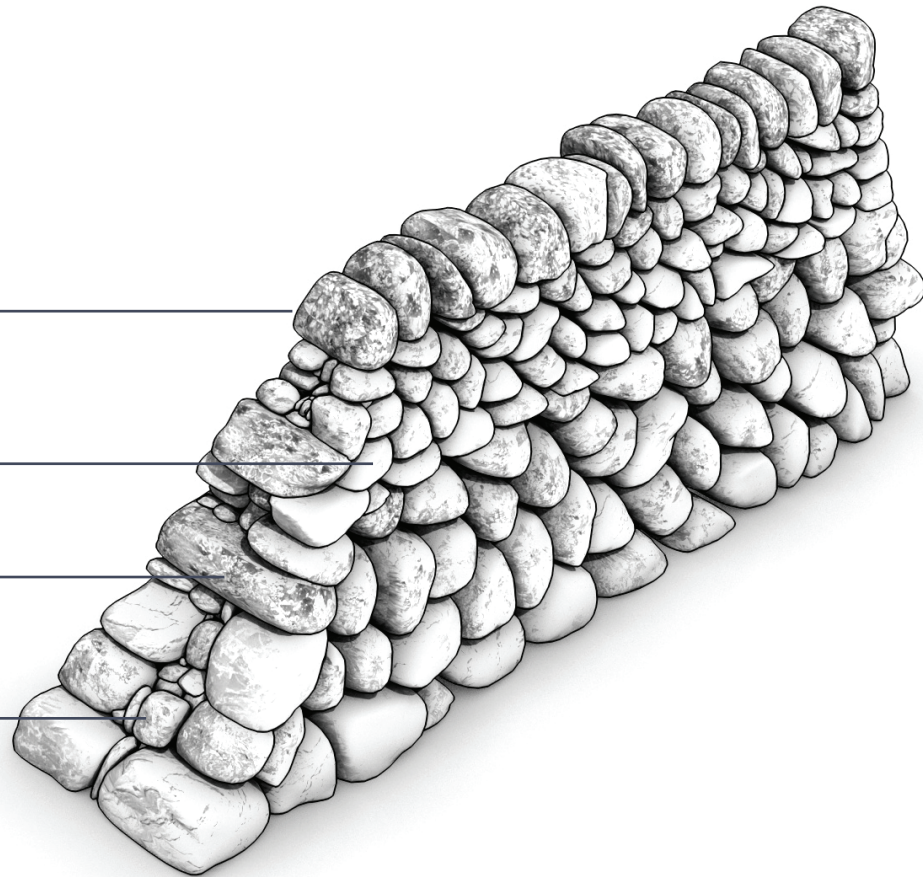
This shouldn't be the answer to the problem however, but the research is destined to end in an architectural design utilizing said research and giving not only an example of its usage, but also a pleasing design.

Top Stone

Face Stones

Through Stones

Filling Stones



Top Stone

The wall is capped with large heavy stones. They are aligned with the wall and have to rest solidly upon it. They have the purpose of ensuring that the underlying stones are secured from shifting.

Face Stones

The face stones have the purpose of giving the wall its outer appearance. They are selected for the beauty of their front and their capacity to sit solidly within the wall.

Through Stones

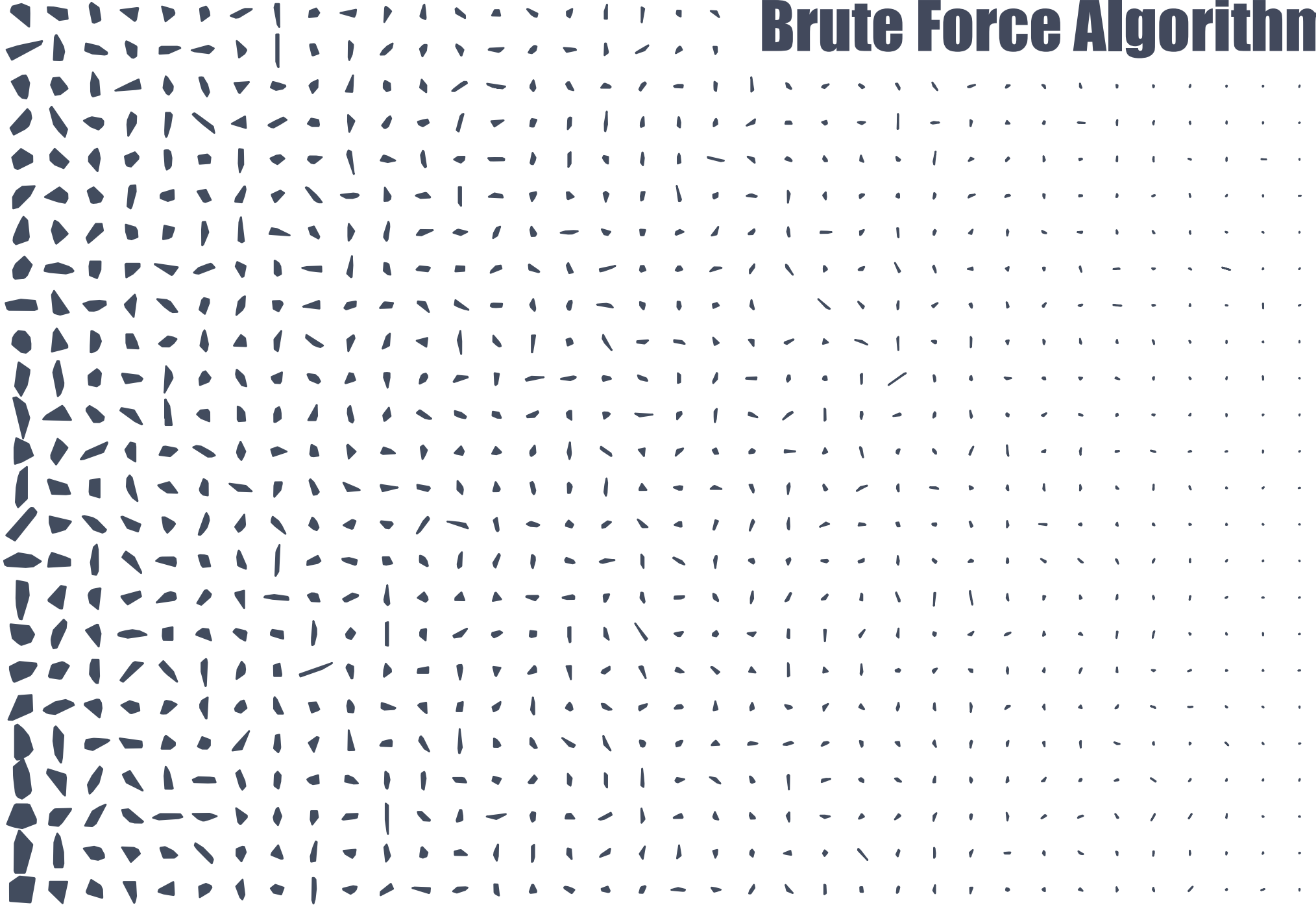
The through stones give the wall its maximal stability by connecting its outsides to the inner part of the wall or even all the way through the wall. Like the face stones they are chosen for the appearance of their front and their depth, for them to reach deep into the wall.

Filling Stones

The filling stones are to fill out the gaps left between the others. They can range from large stones in the broad middle parts of the wall all the way to small stones filling tiny holes left between the others.

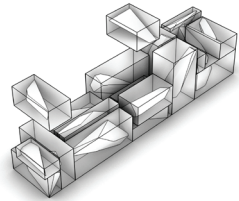


Brute Force Algorithm

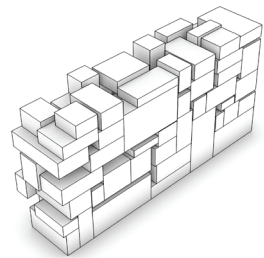
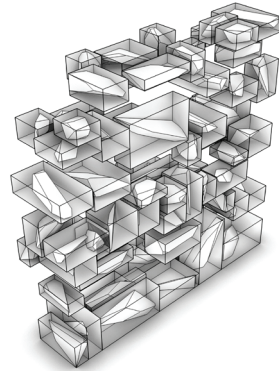




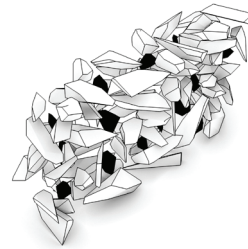
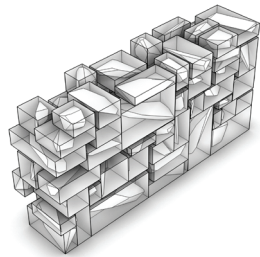
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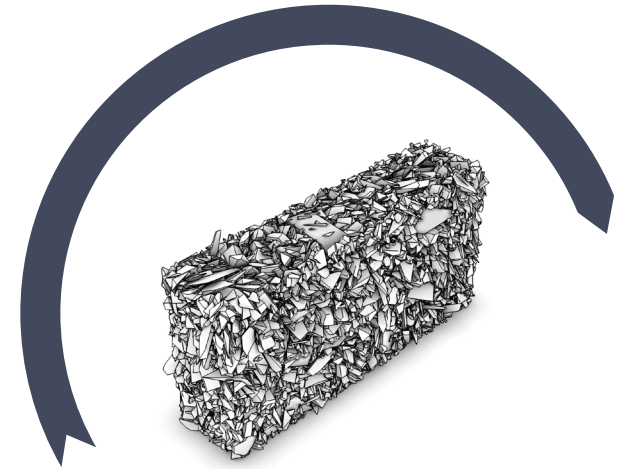
Packing Algorithm



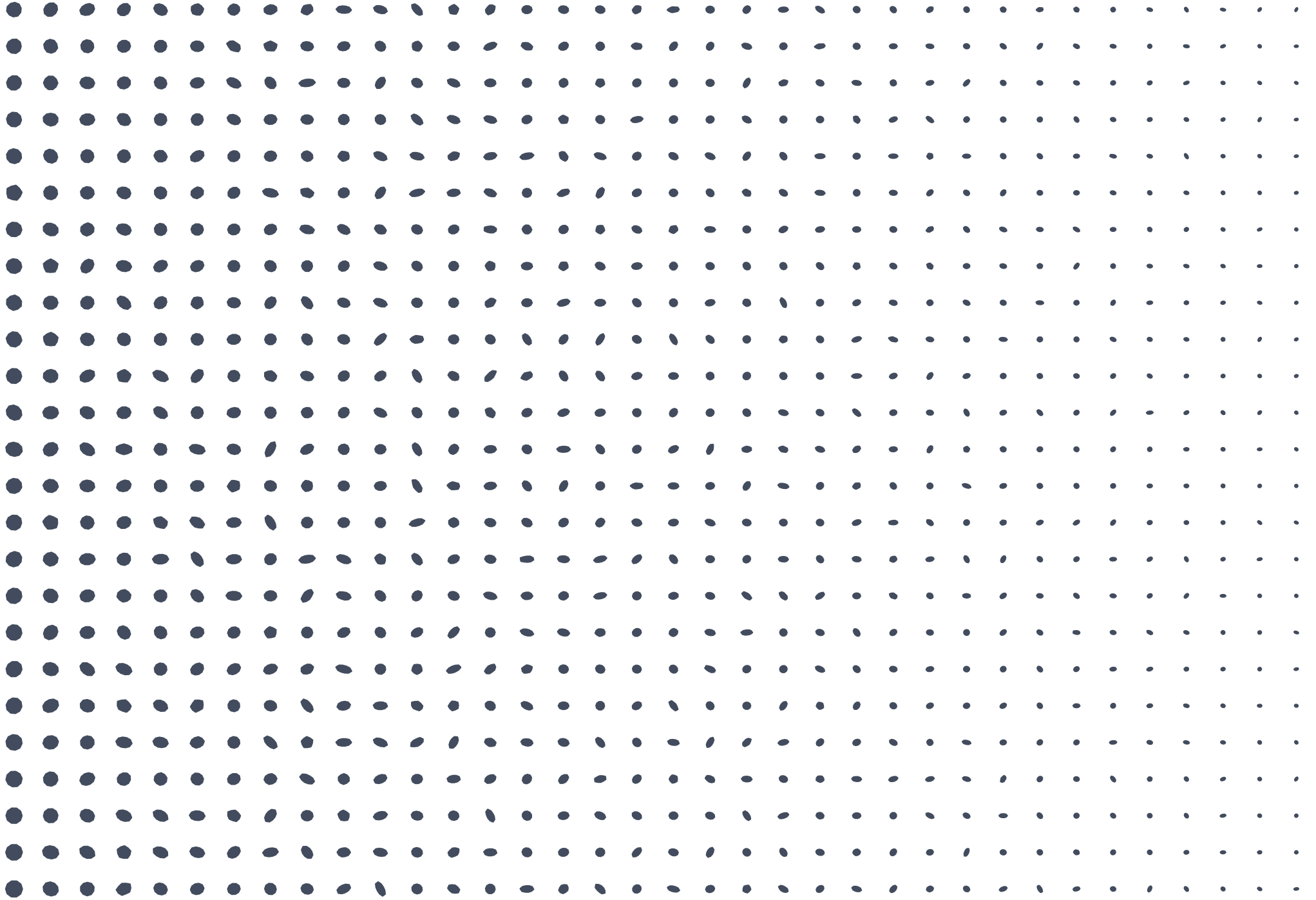
After Packing



Random Fill



54%





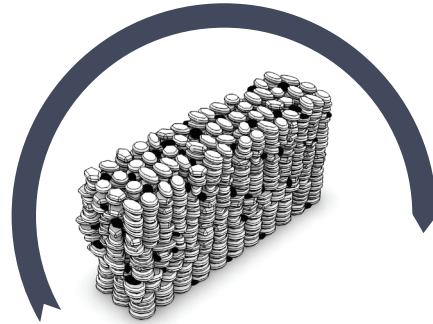
Input Geometry



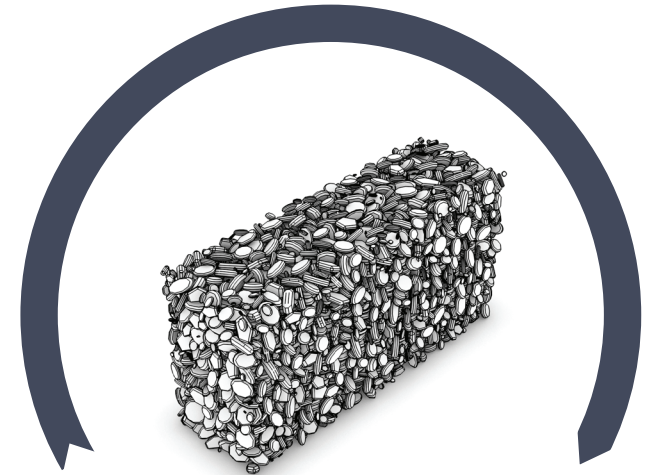
Packing Algorithm



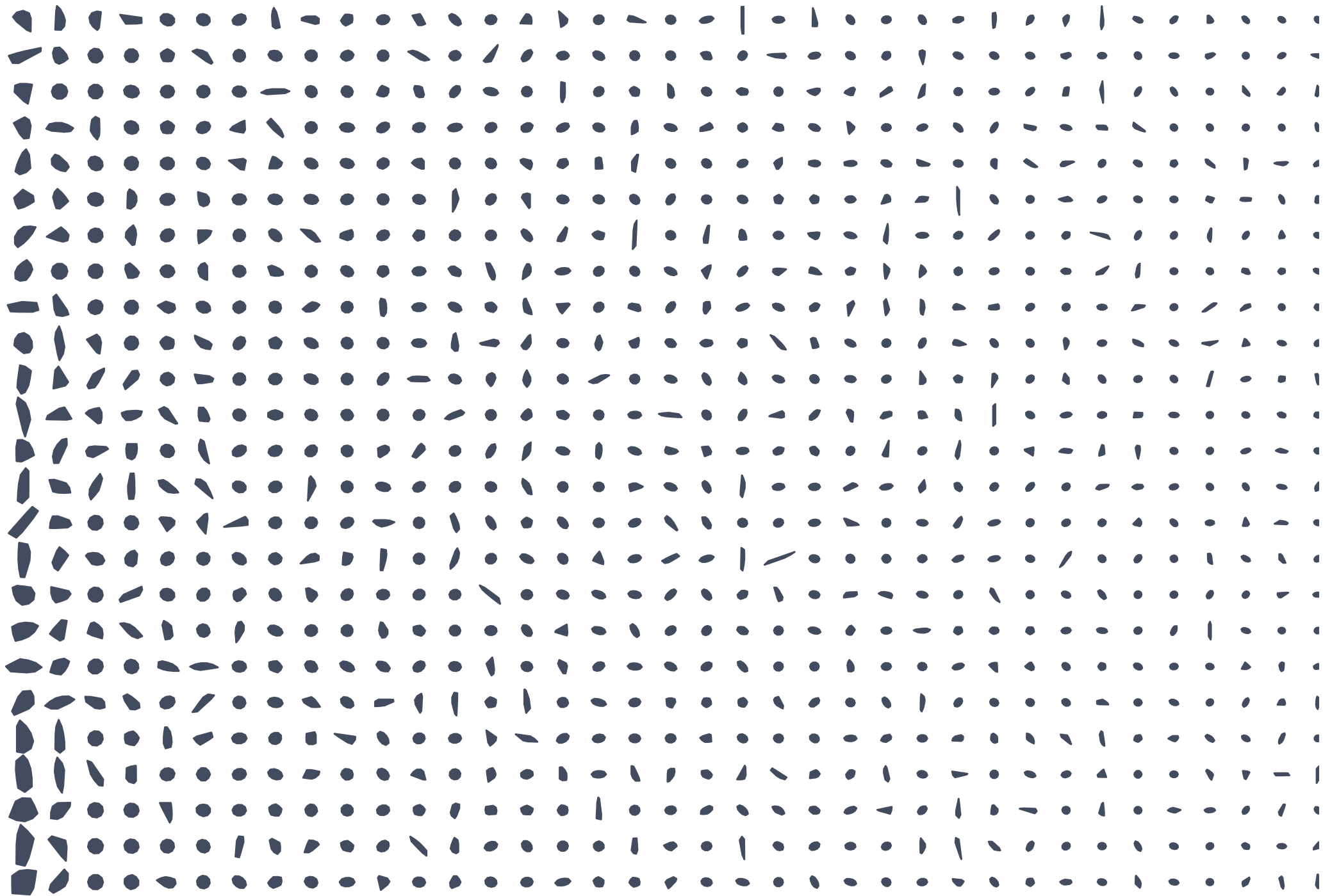
After Packing

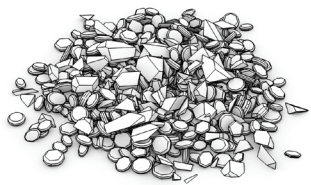


Random Fill

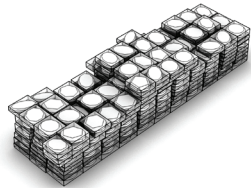


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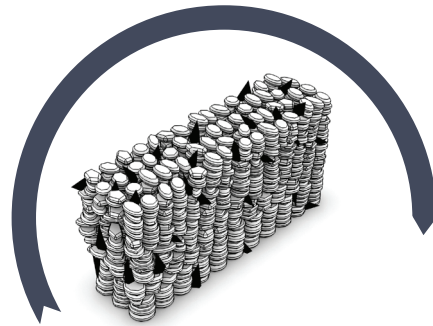
Input Geometry



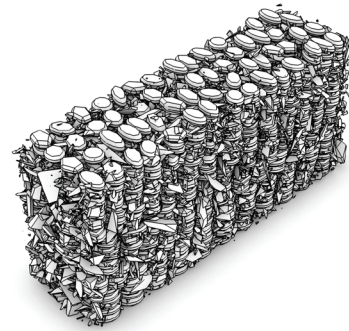
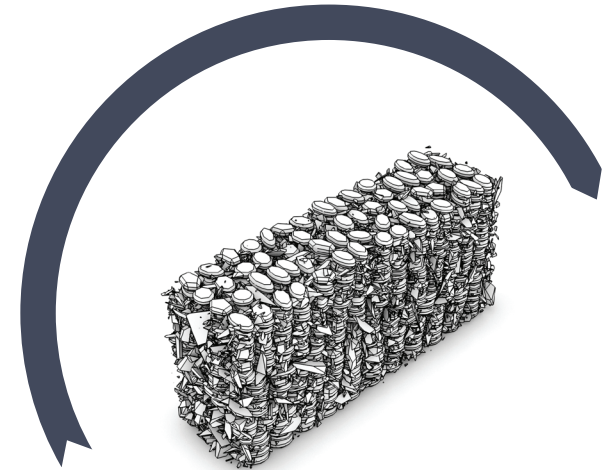
Packing Algorithm



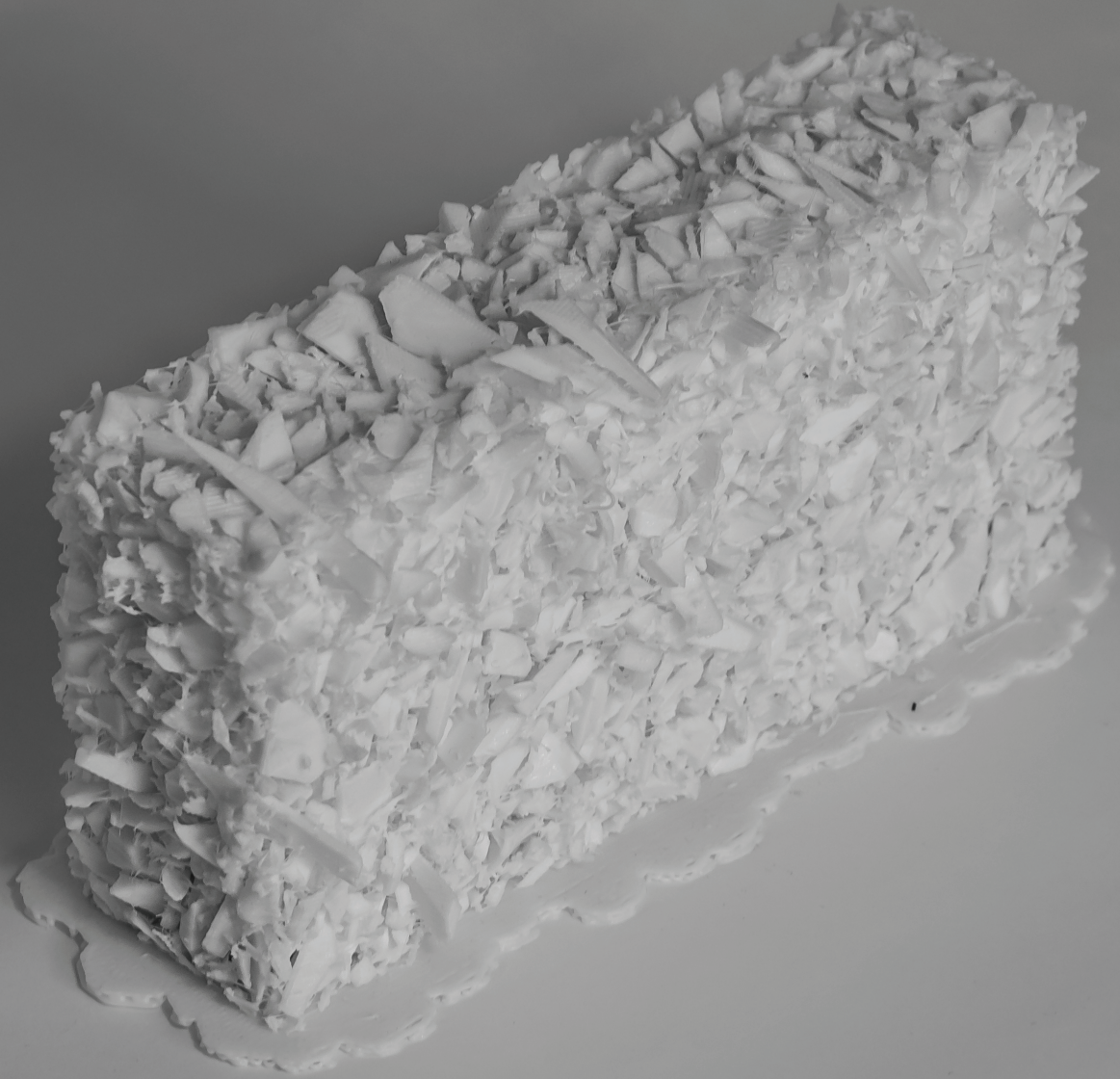
After Packing



Random Fill



52%



Brute Force Algorithm

The first algorithm I designed starts out by sorting the input data. At first the geometry was only sorted by its size, later there were steps of sorting by form as well.

An appropriate part of the input is then fed into a packing algorithm, written by Yannis Chatzikonstantinou.

This algorithm tries to find an optimal structure to pack geometry into a container. It has a downside, though, in that it can only work with rectangular boxes.

This led to the input being chosen by its volume in relation to the volume of its bounding box.

An optimization of the bounding box was achieved via a brute force method. This means that the geometry was rotated by random values, comparing the volume of its bounding box after rotation with that before and choosing the better orientation.

After the packing method the main brute force algorithm comes into action. It goes through the remaining geometry and places it randomly inside the container.

After each placement it looks for a collision with another object, leaving it at its place if none is detected. By the sheer amount of placement and trial and error, the gaps get filled up. Again it is important to start with bigger geometries and work towards

smaller ones, so as not to divide large gaps with tiny pieces of matter.

The algorithm was tried with different types of matter and different assemblies from the packing algorithm.

While a high density after packing should lead to a good start, it doesn't work too well because the blocks don't interdigitate very much, leading to poor static properties. Additionally the gaps between them are too tiny to allow matter of a medium size inside them. The result looks a little plucked aesthetically.

The most pleasant results utilizing this algorithm come into existence by creating fairly paced starting assemblies with the packing algorithm and using matter of an irregular form.

This leads to the geometry interdigitating and giving a good density and overall appearance.

Greedy Algorithm

The second algorithm was designed with another purpose in mind. Its aim is to work from the perspective of a robot, building a

wall. This means that the algorithm tries to place the stone at a spot where it is actually supported by the stones lying beneath it and working from there on.

With each stone that finds its place the model must be updated to accommodate it.

In this task, the problem was worked on in two dimensions so as to gain knowledge of how it would work in three dimensions.

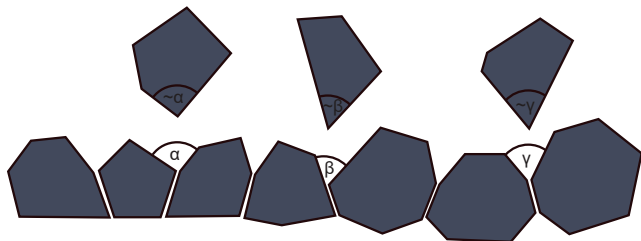
The tool begins with a base of starting stones and constructs a polygonal line above them, simplifying it with certain rules.

When the program runs through its input of stones, it checks their angles and determines, where each fits best to place it there. After each placement, the polyline is redrawn to place the next stone.

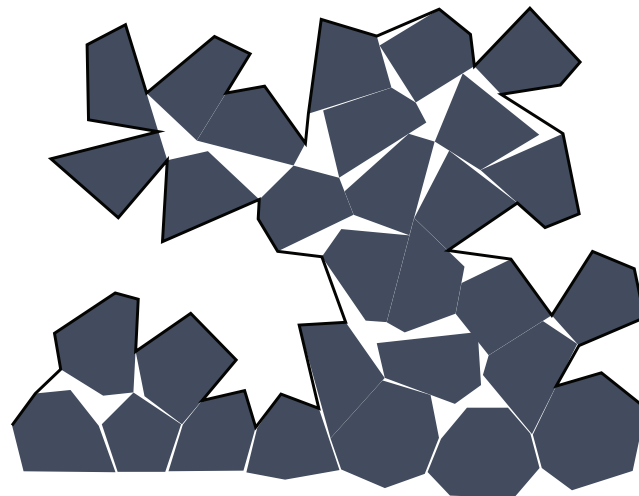
This of course would be possible in three dimensions as well with having not a polygonal line, but a surface.

Greedy Algorithm

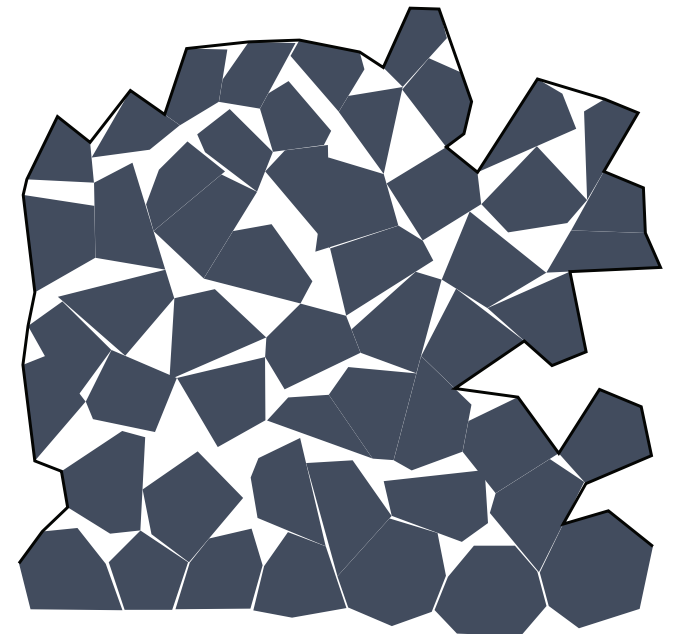
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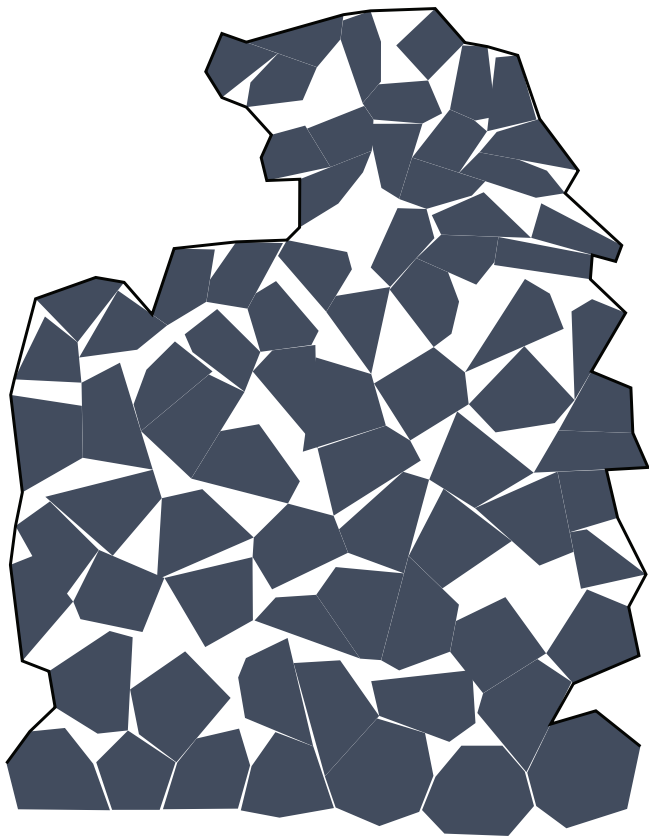
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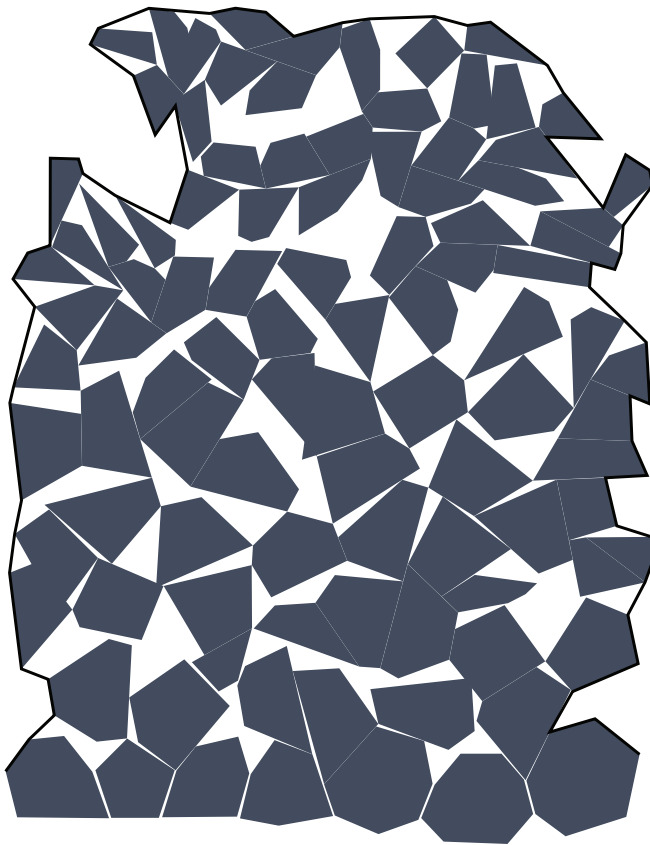
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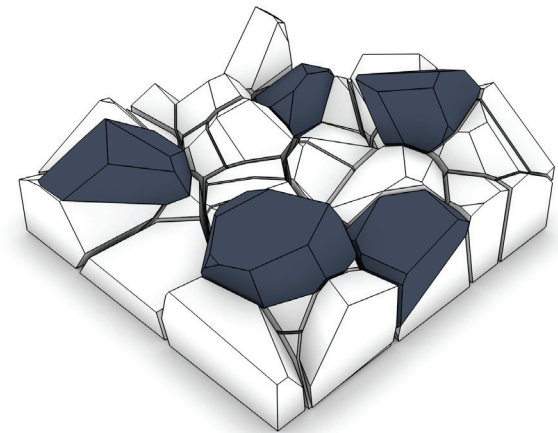
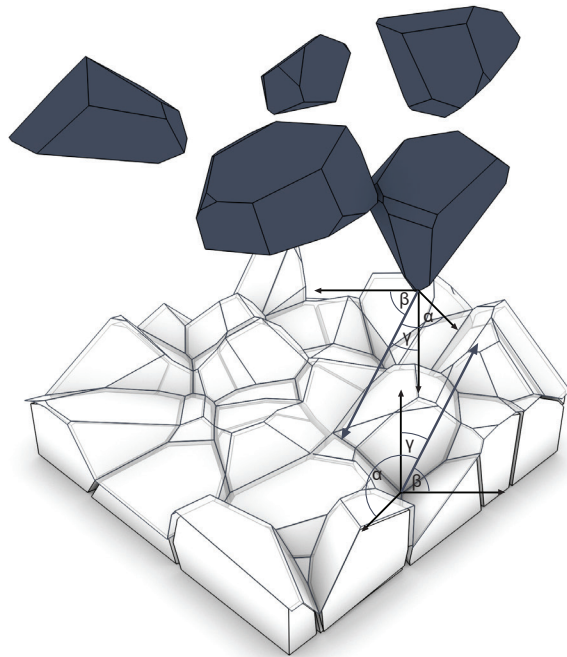
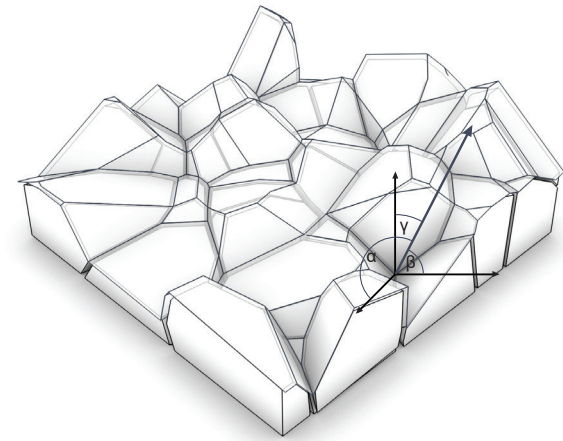
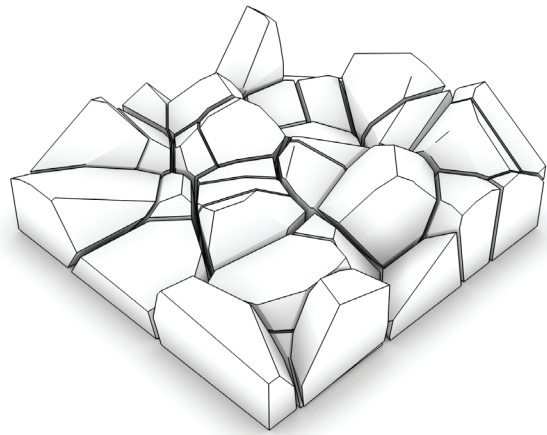


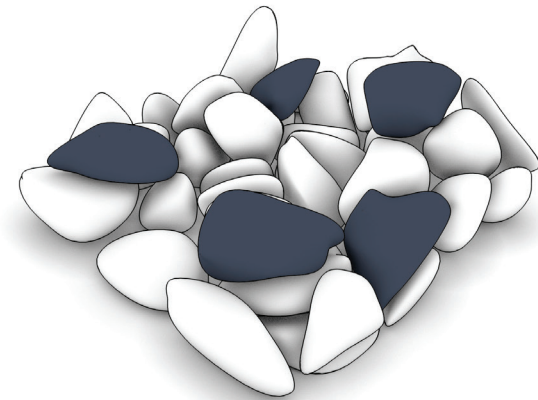
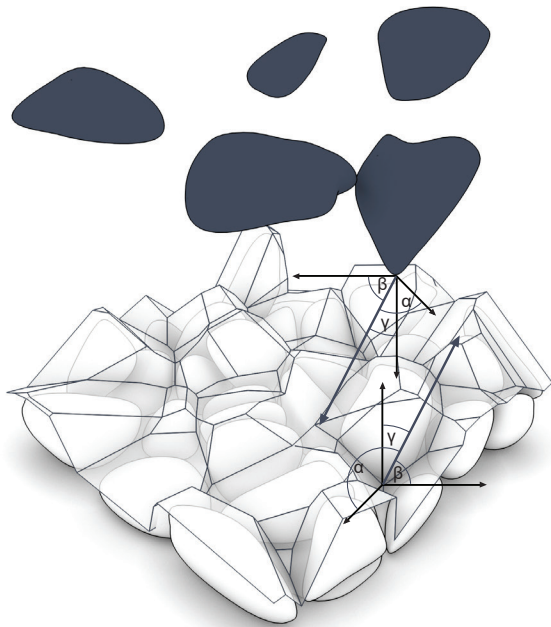
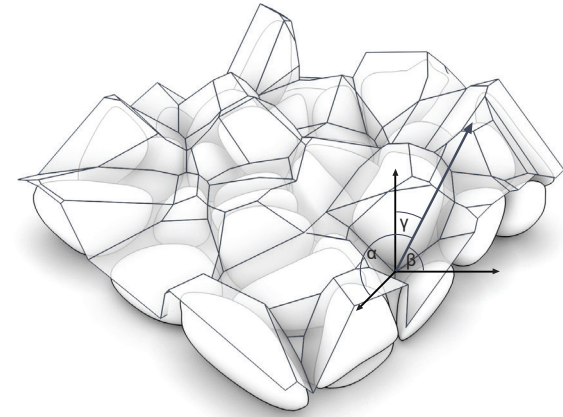
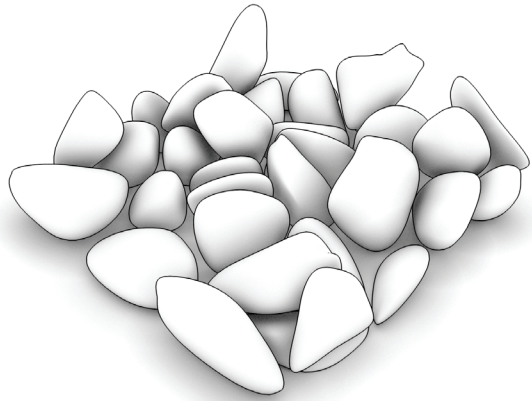
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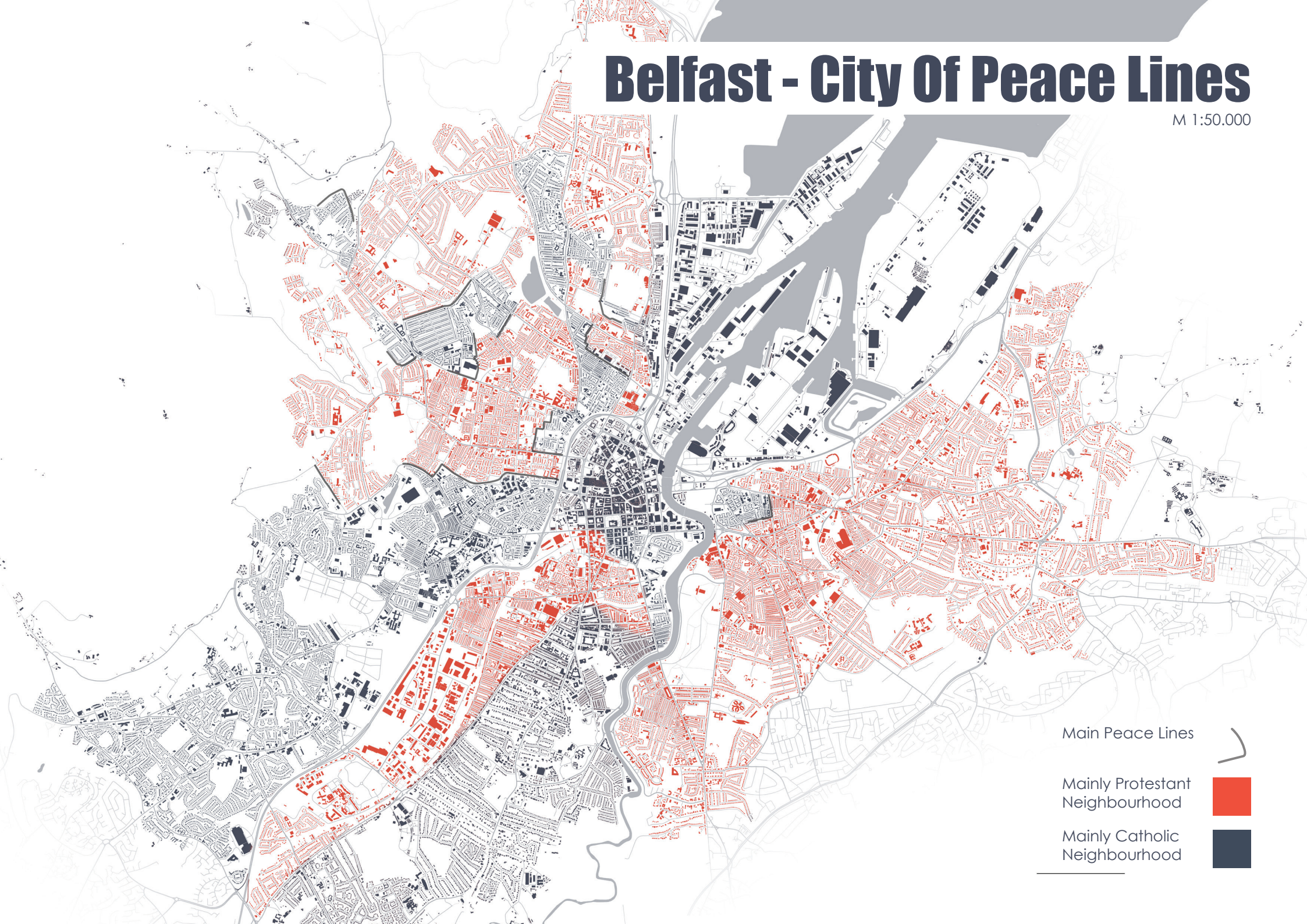






Belfast - City Of Peace Lines

M 1:50,000



Main Peace Lines

Mainly Protestant
Neighbourhood

Mainly Catholic
Neighbourhood



Why Belfast?

Belfast, capital of Northern Ireland, has been engulfed in recurring times of riot, violence and murder.

The Northern Ireland Conflict, commonly known as “The Troubles”, started in the late 1960s and officially ended in 1998 with the Good Friday Agreement.

The conflict broke out over the country’s status as a part of the United Kingdom, with whom the protestant part of the population felt their allegiance, while the catholic part wanted to reunite with the Republic of Ireland.

This dispute led to radicalising and the rise of paramilitary groups on both sides, most importantly the Irish Republican Army (IRA) on the catholic side and the Ulster Defence Association (UDA) on the protestant side.

The Troubles quickly led to massive bloodshed in the population with its peak death toll in 1972 when 500 people were killed, half of them being civilians.

The conflict soon led to the erection of so called Peace Lines between catholic and protestant neighbourhoods, which were supposed to protect the citizens on both sides.

While the Troubles officially ended in 1998

with a cease fire agreement, the number of peace lines since then has in fact risen. A big part of the population still thinks within the lines of the Troubles, not having been able to overcome their hatred and fear. Part of the problem being not only the peace lines, but also the school system, which is still mostly confessionally divided. For this and other reasons the walls still tower high and although the government wants them to be demolished by 2023, a big part of the population do not see this in store.

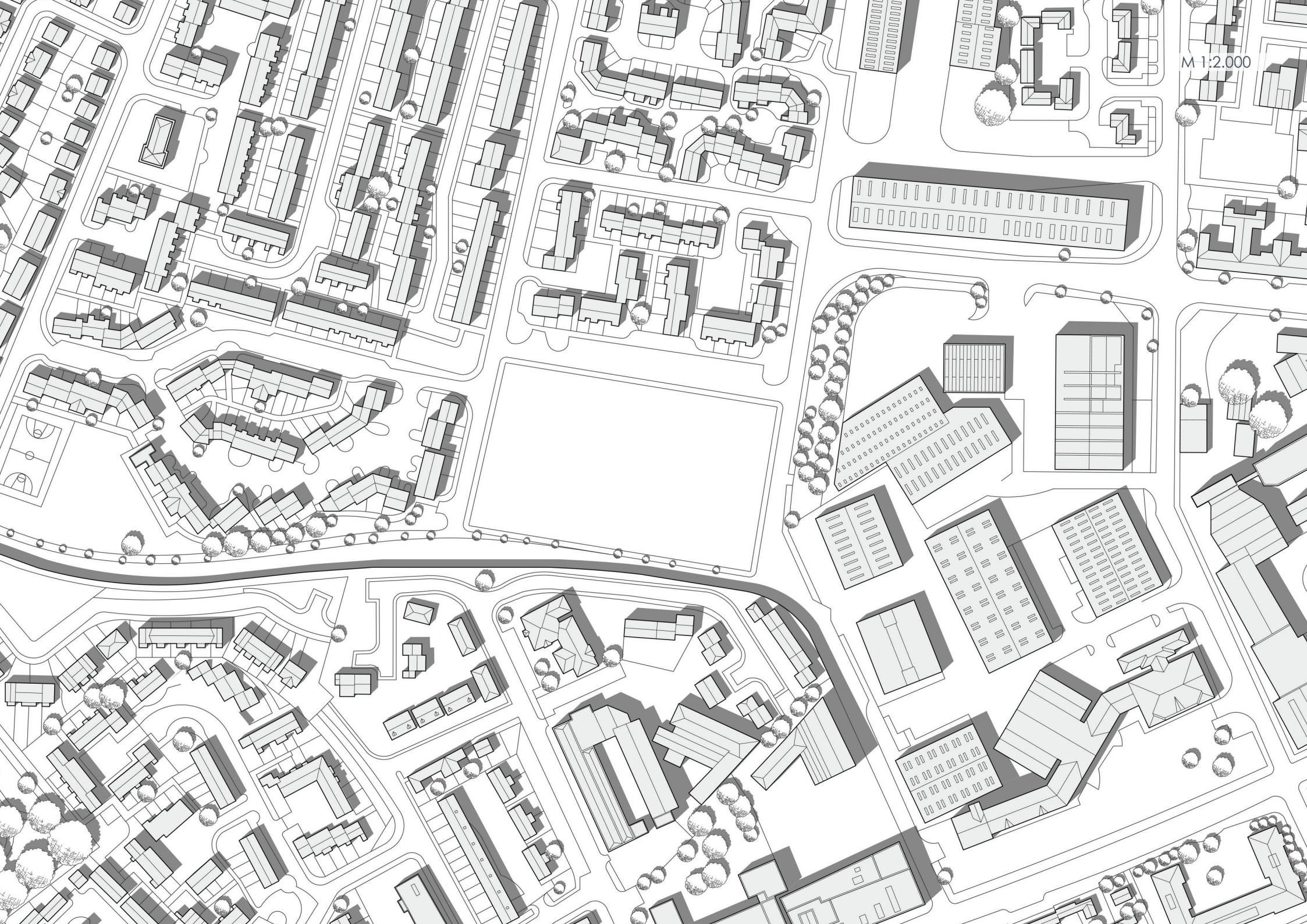
I started out this thesis with the simple aim of finding a new take on dry stone construction, but my goal is not only to design architecture out of any rubble, but to make this a statement as well.

It is a disgrace, that in the midst of Europe there is still such violence and hatred for religious reasons. The people of Northern Ireland have to be brought together, their conflict must finally end.

While countless social workers work towards this goal in the streets of Belfast every day, I want to try and contribute a small part myself with this design. I want to use the rubble of the demolished peace lines to build an architecture of connecting people and a sign that walls in our heads and in our cities only lead to division and

bigotry, when we want to live in a world of peace and understanding.





M 1:2.000

The Site

The site chosen for the project lies next to the Falls Road Peace Wall in Cupar Way. The Irish district around Falls Road and the Protestant district around Shankill Road are separated by the longest Peace Wall of Northern Ireland.

Measuring around 8000m² the site is rather big, but perfect for a small park in the vicinity of the then demolished wall and right between the two hostile districts. A place to get together and bury the hatchet.

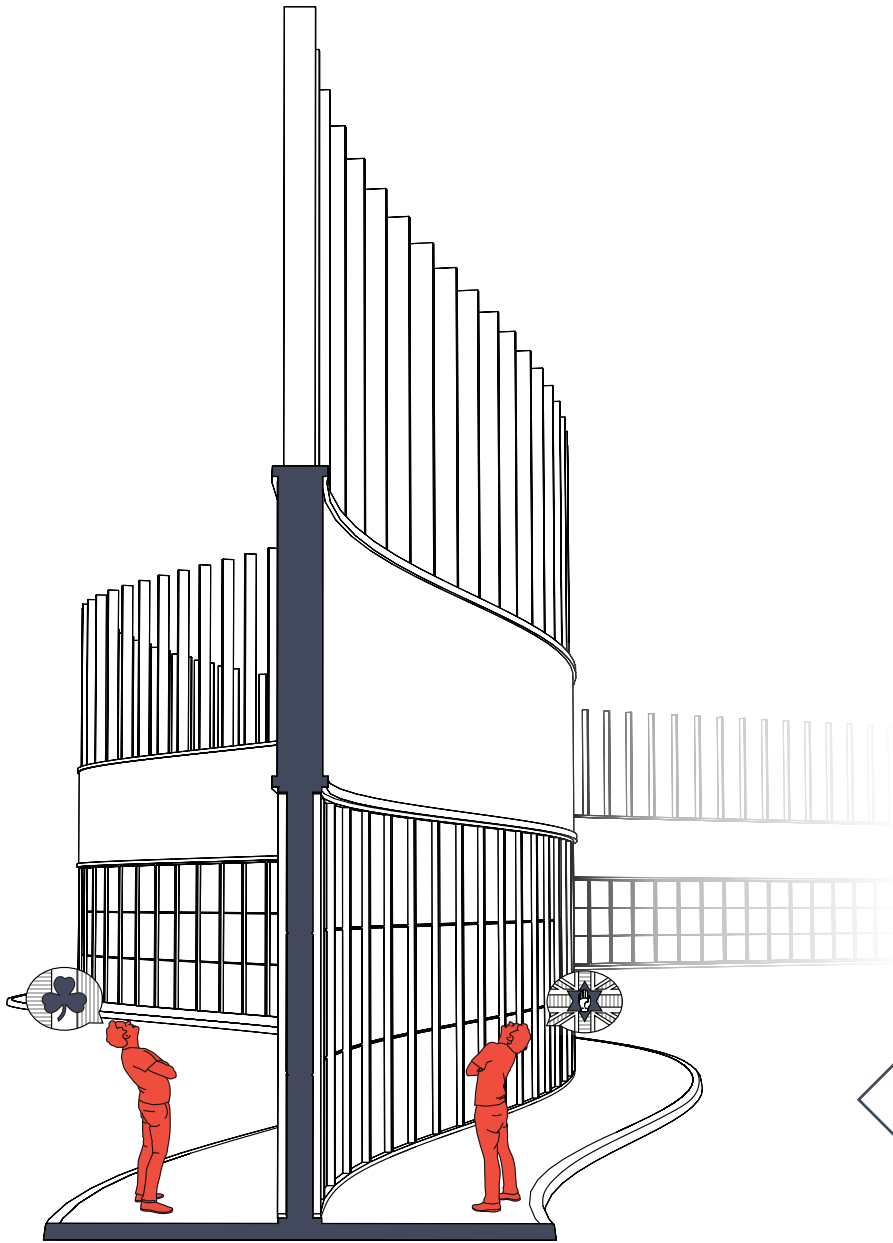






Peace Wall Memorial Park



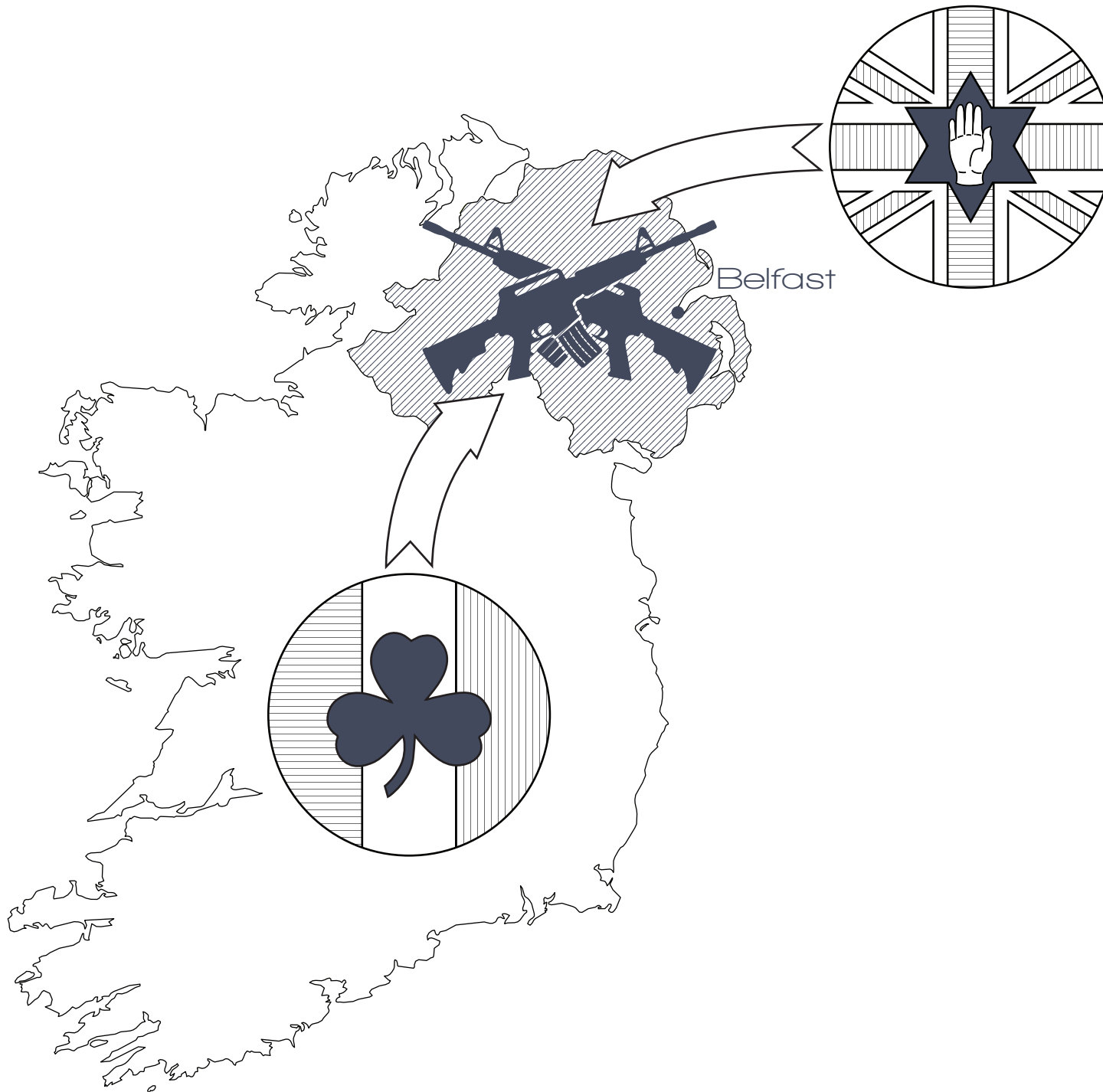


A new
kind of
wall!

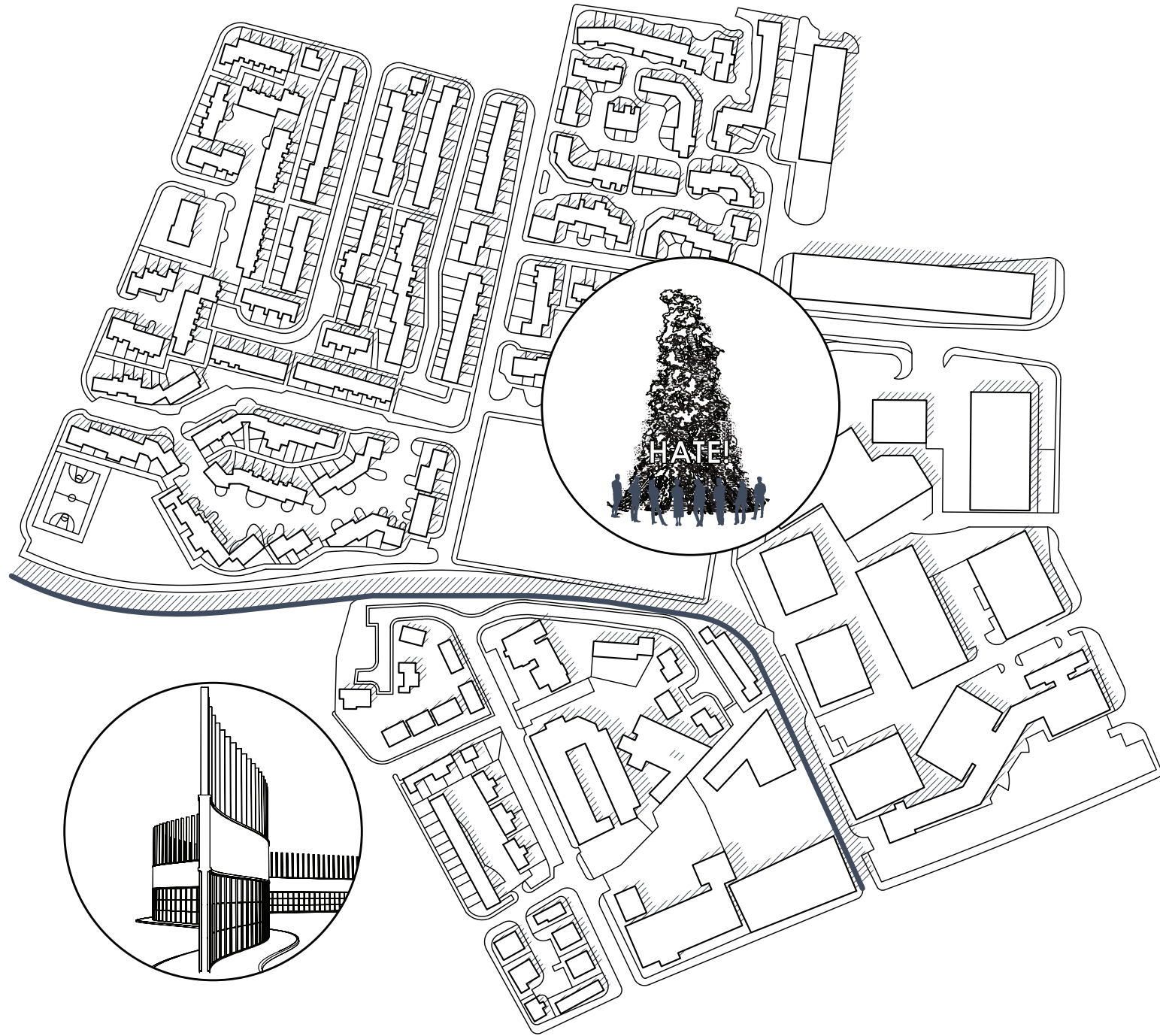




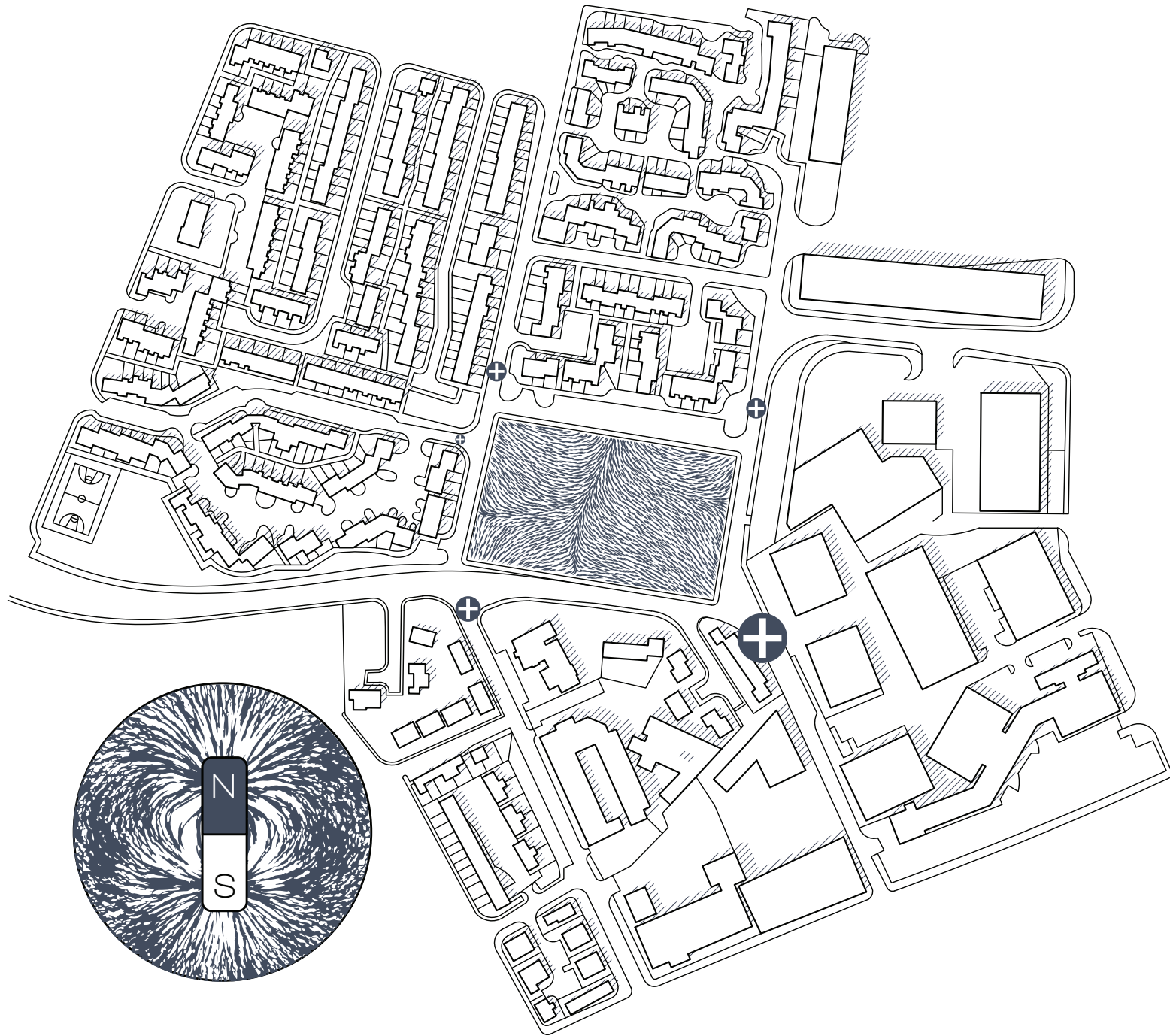
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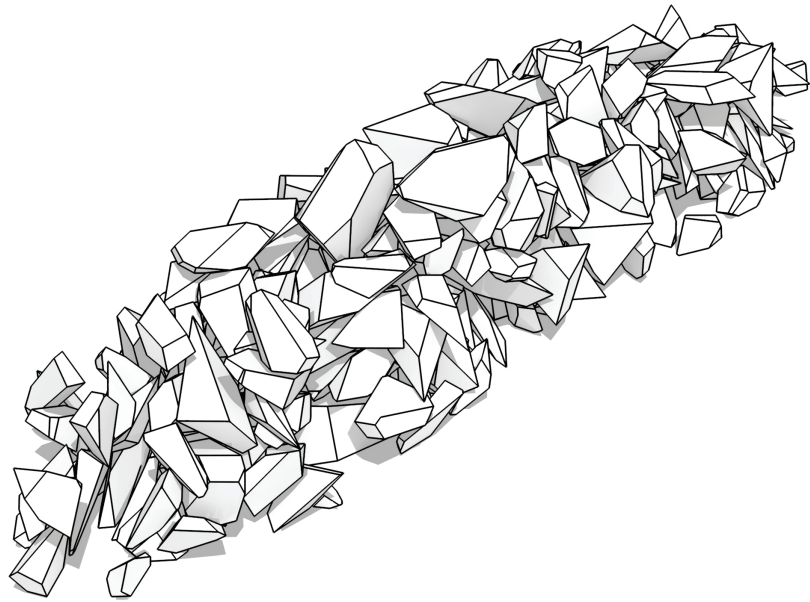




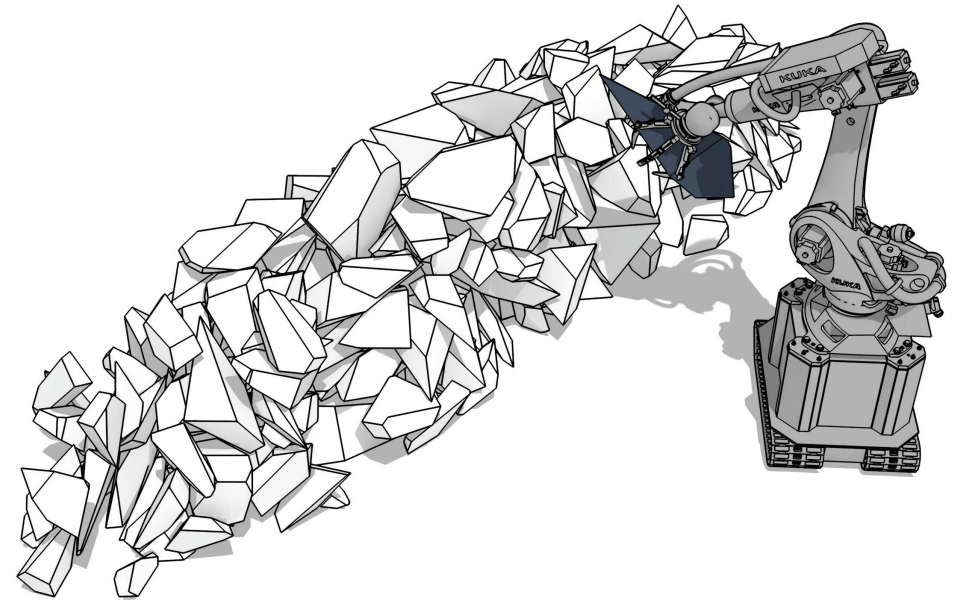




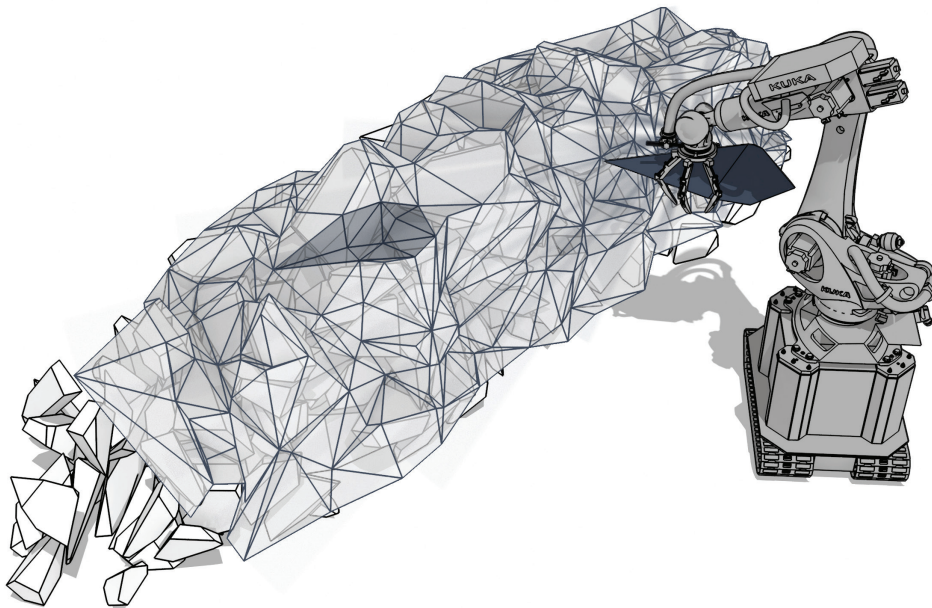
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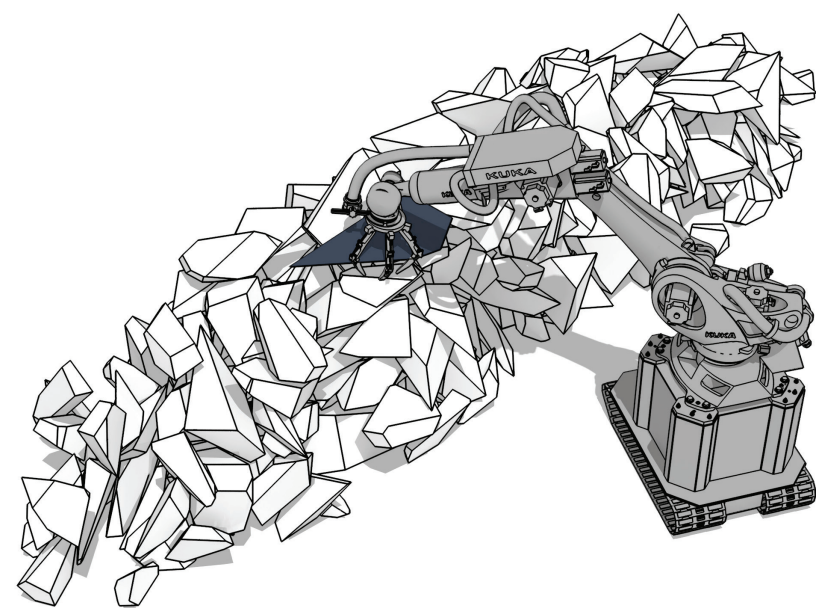
State



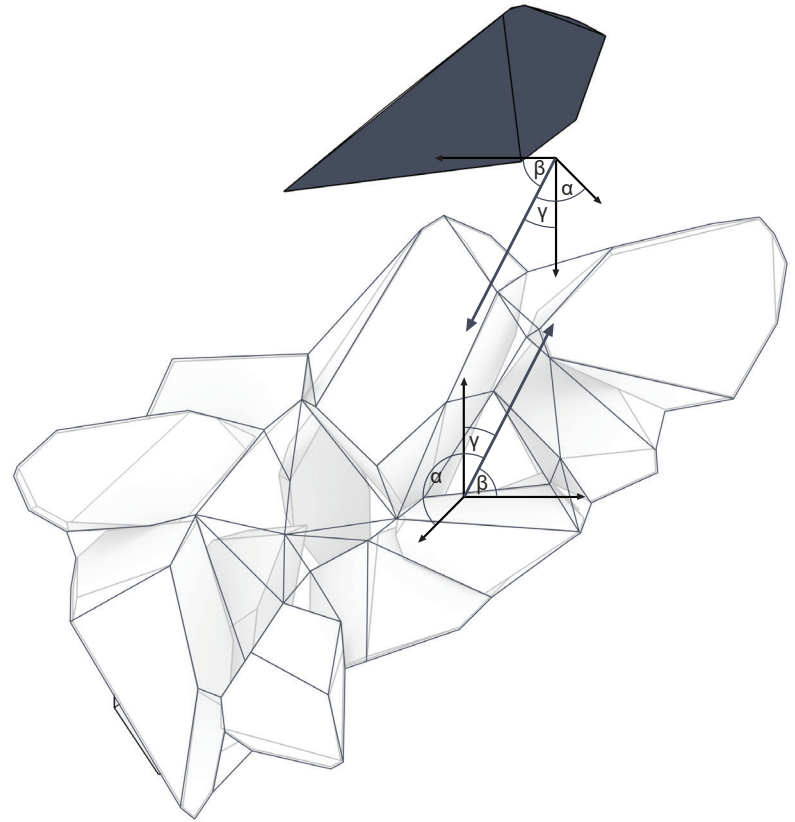
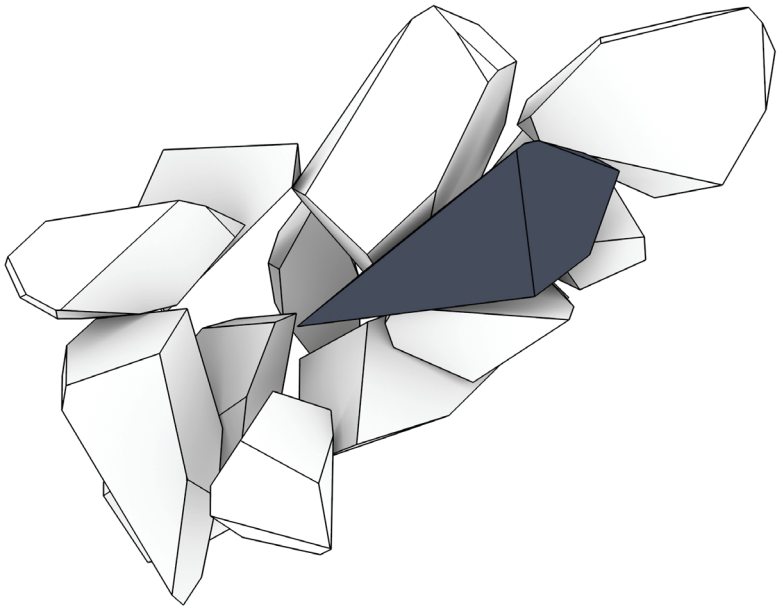
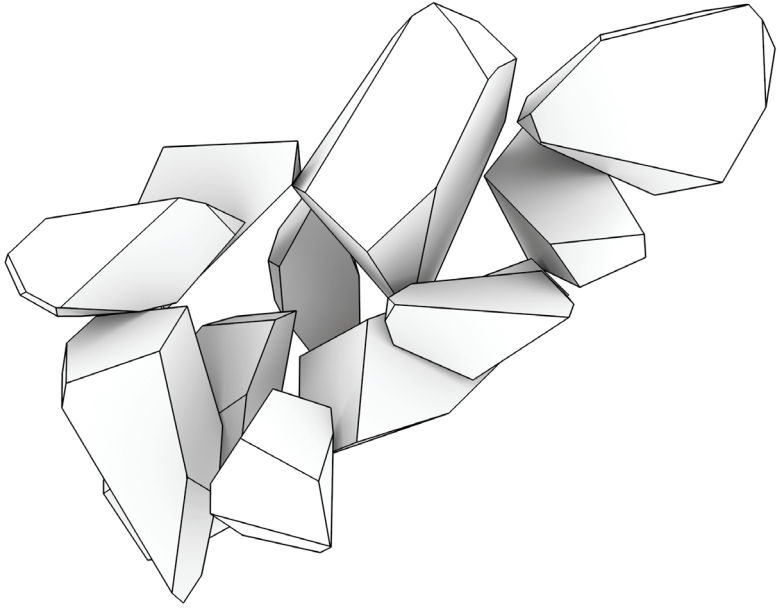
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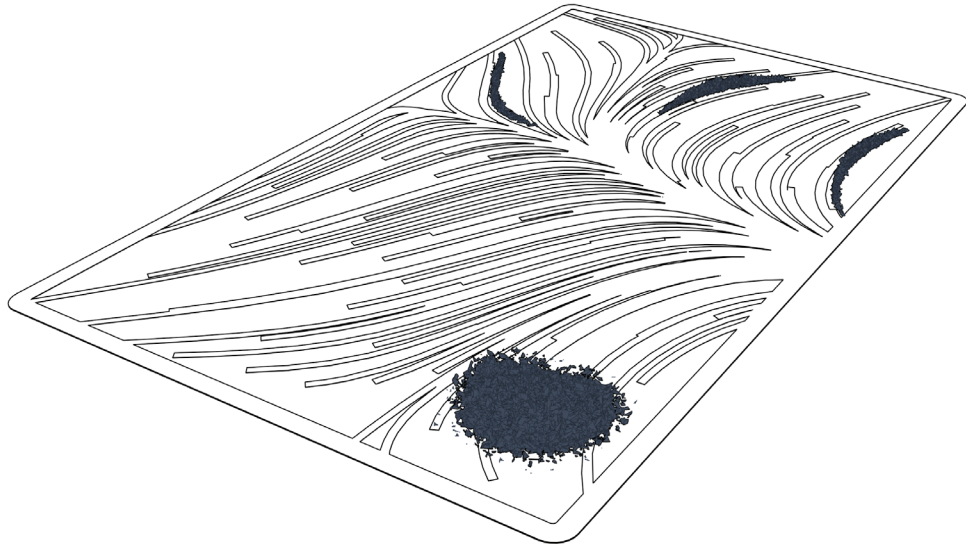


Scanning

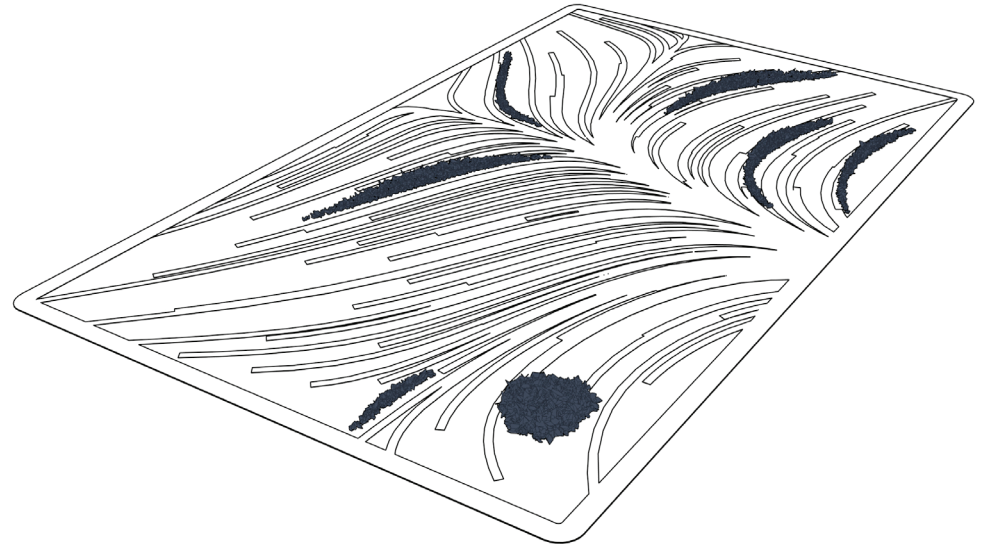


Placement

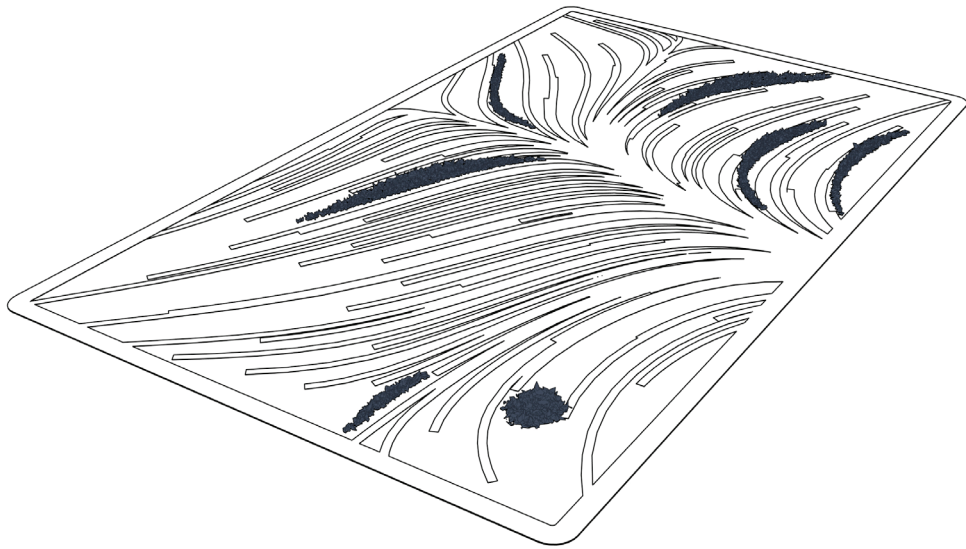




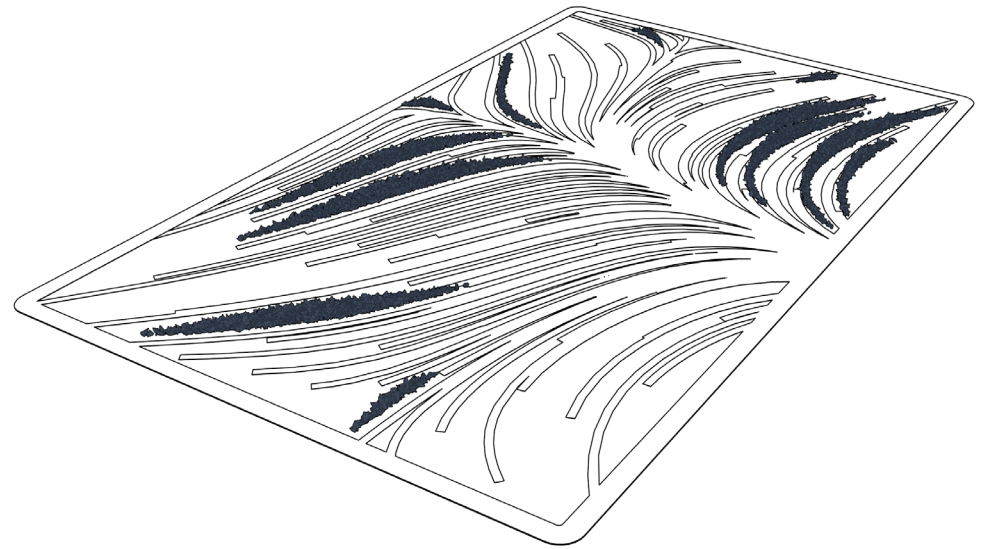
1st Month



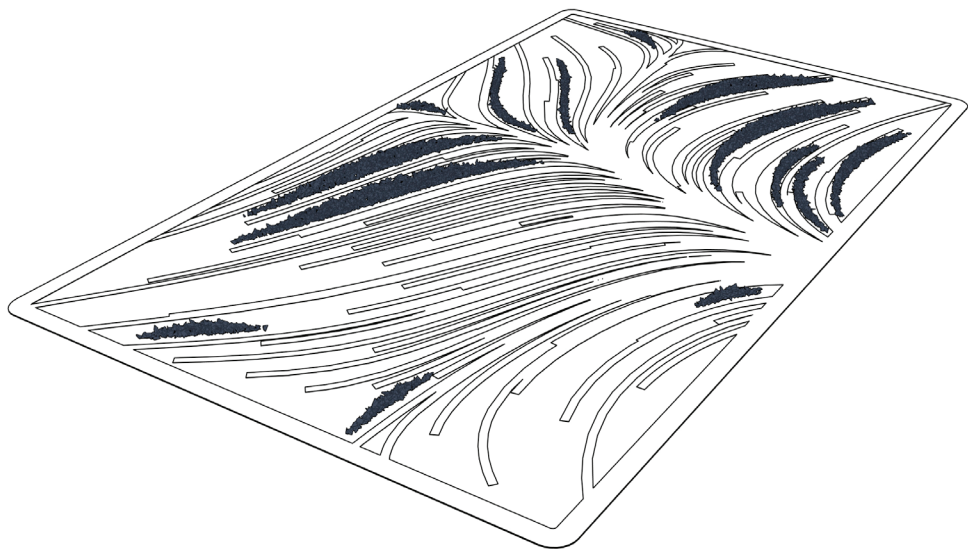
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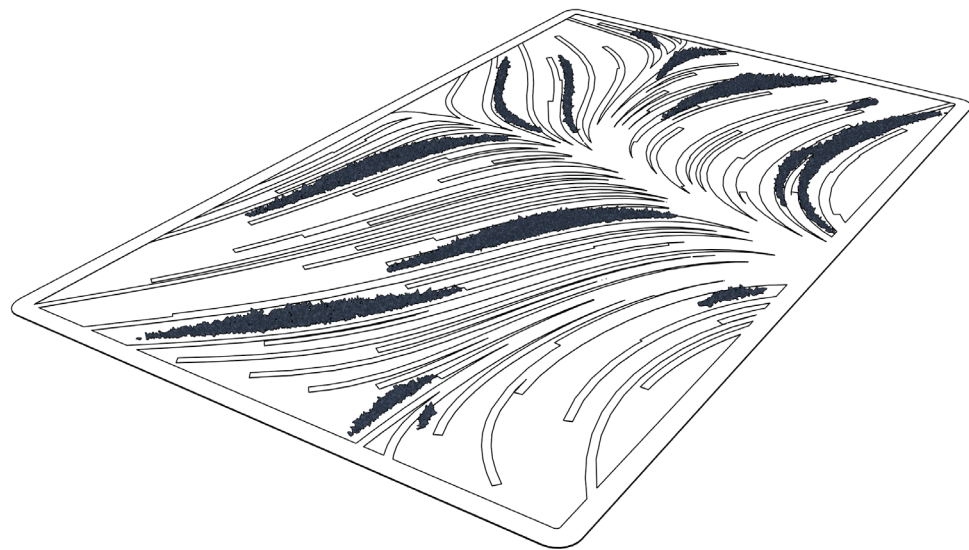
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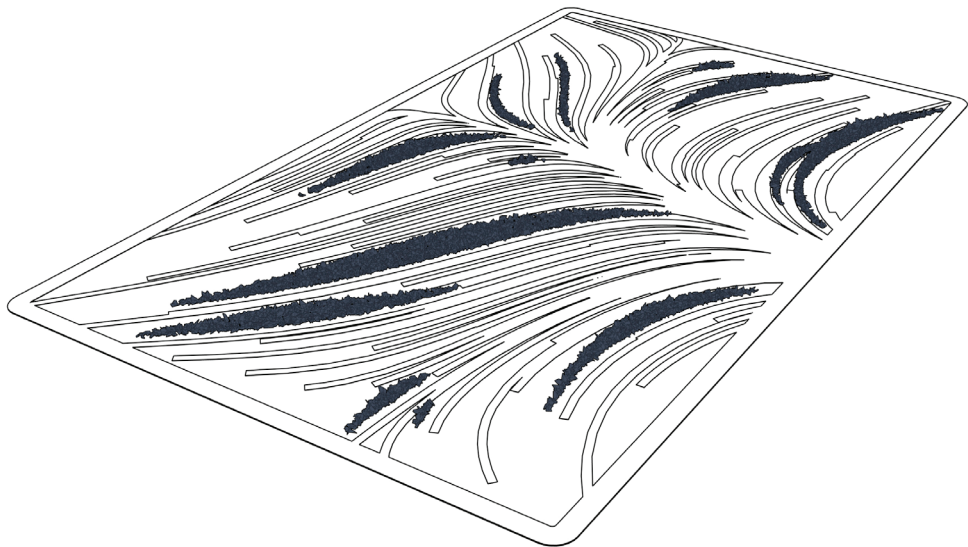
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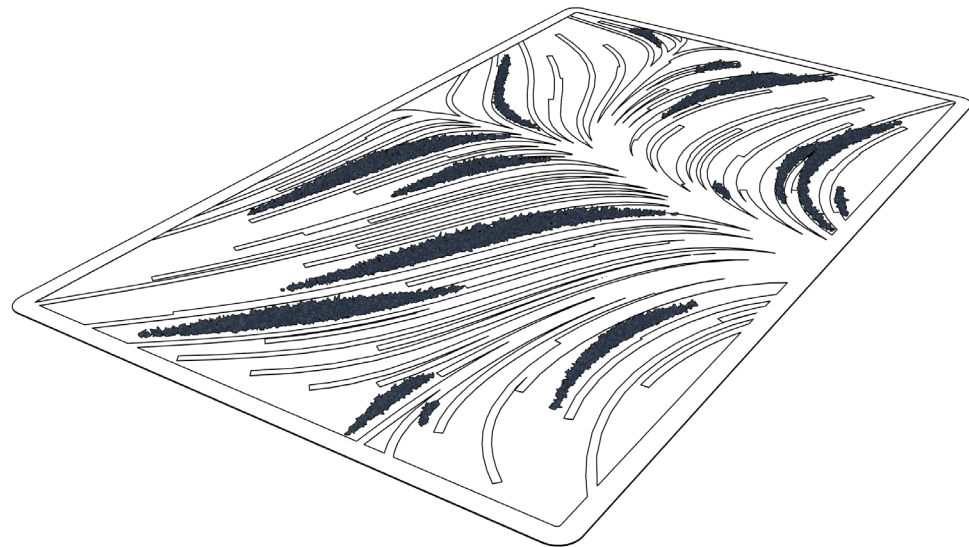
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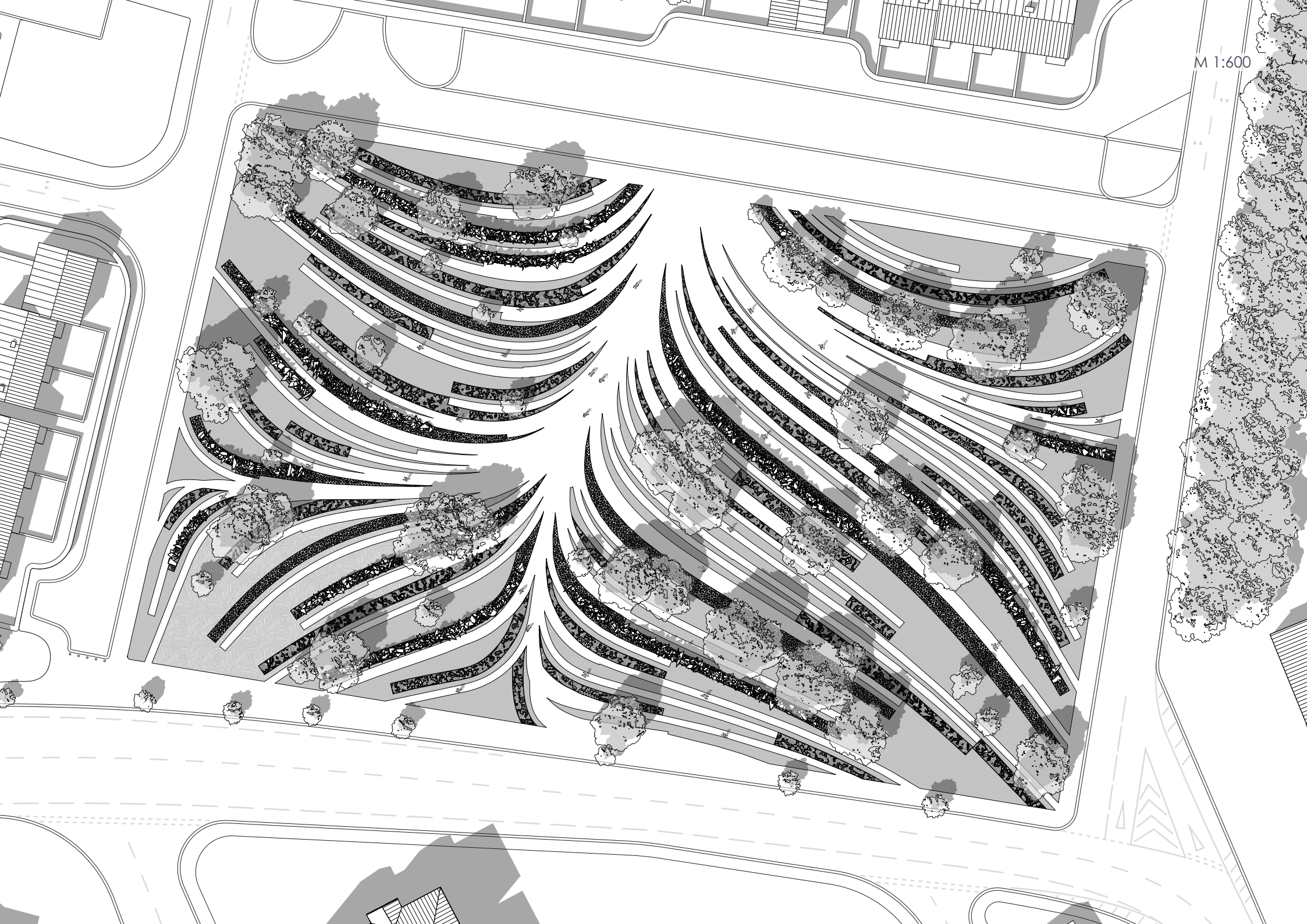
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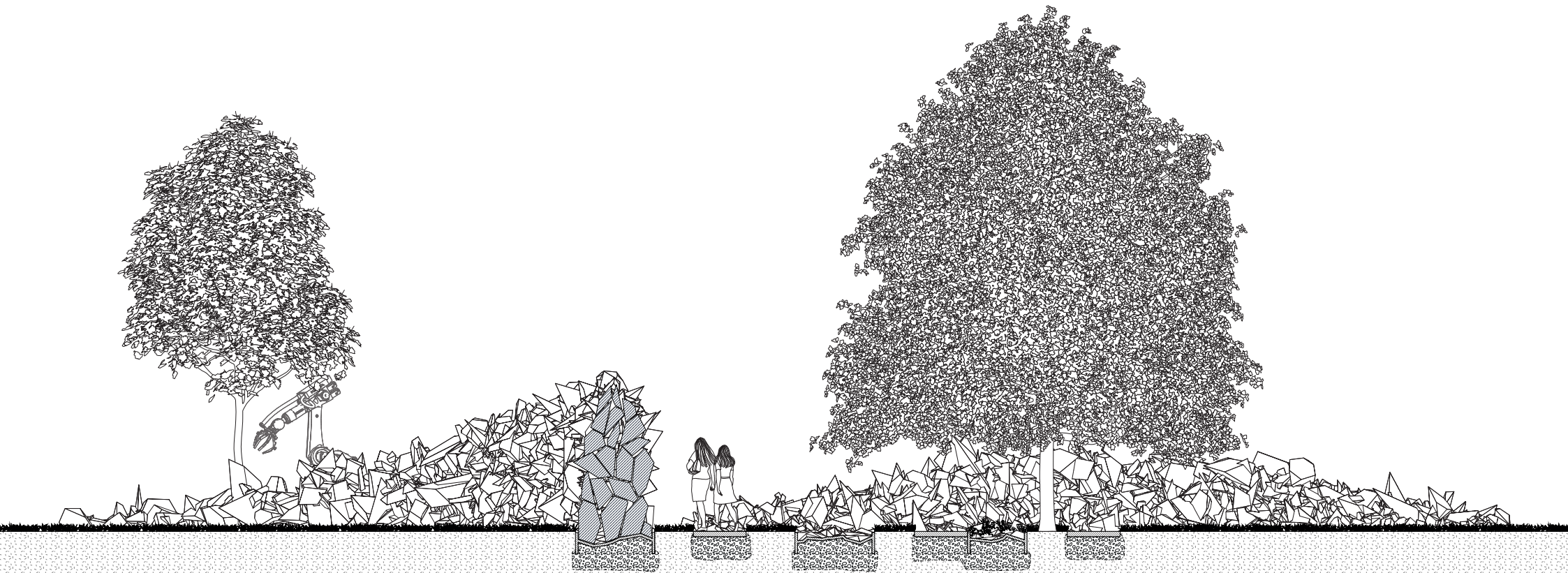


13th Month



16th Month







The Design

Contrary to the rigid barriers, that form the peace lines, the structure of the park had to be a rather more fluent network, constituting a framework in which the walls could be build.

From the main access points of the site a spine was developed, utilizing a magnetic field line simulation.

This created a meandering set of paths, merging in the central axis.

This aggregation of ways not only forms access for the people using it, but also a central spine and nervous system for the robot.

Parallel to the ways, determined by the reach of the robot, special areas are placed for the walls to sit on; some of those being flower beds, others filled with water.

In the beginning of the process, the robot is placed in the park without any walls being there. It starts out with a pile of rubble from the destroyed peace lines, which is dumped onto the site.

Via CCTV or other means it is determined which strand is used the most actively. Within a certain time interval this is evaluated and set in a list of priorities.

The strand with the highest priority is the one where the wall is built until it is finished. It then starts building the second wall and

so on. When enough matter is in use, no new rubble is added, so the robot starts dismantling the walls with least priority.

In this way people can influence the process, by setting up points of action to attract the robot. These fluent barriers lead to an ever changing architecture.

With new arrangements of walls the space changes and new spots of interest emerge.

In this way the walls that divided the city stay in peoples minds.

Walls get in the way and change the place. But they are different from the peace lines in that they create space and not divide spaces.

Thus a memorial is created, while also having a place for people to get to know each other and overcome barriers in their minds.

