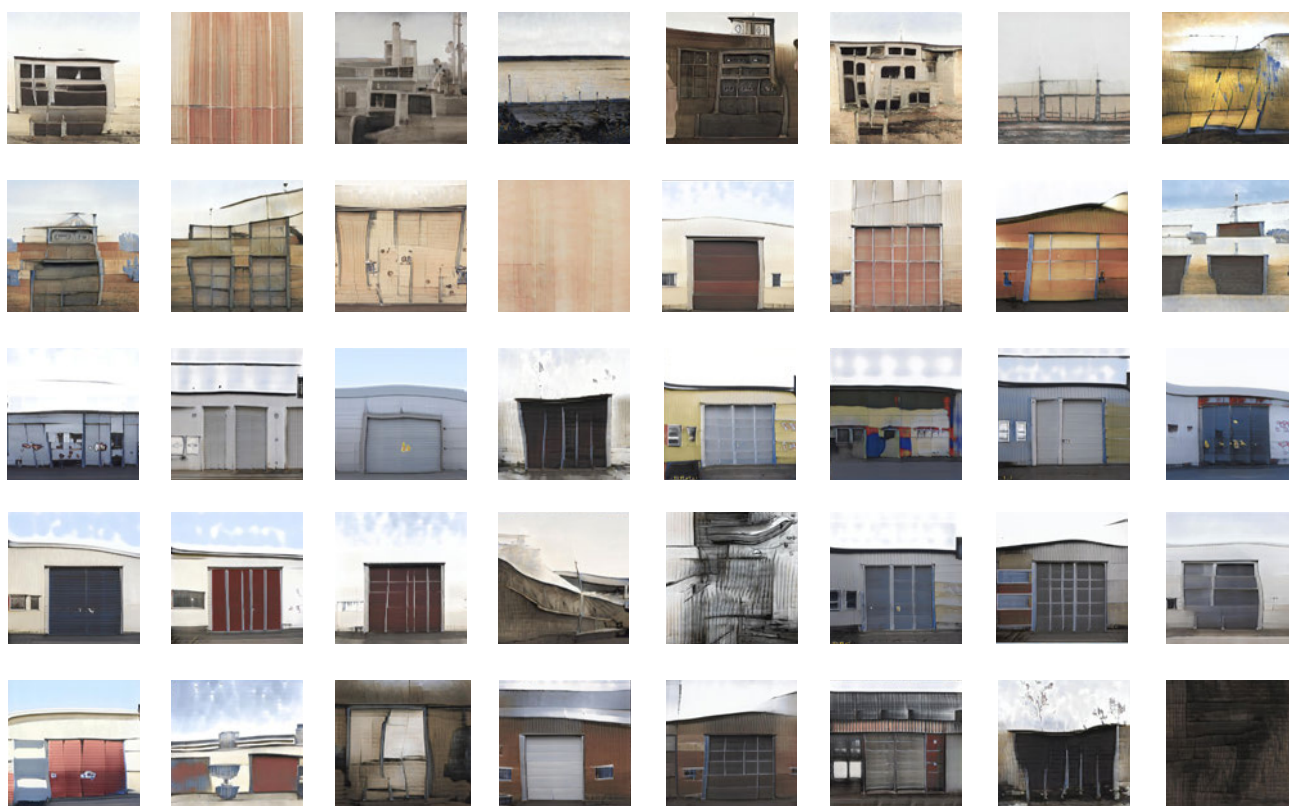


COLLECTION OF FAKES

IDENTIFYING AND GENERATING CHARACTER IN RINGÖN BY
EXPLORING THE USE OF GENERATIVE ADVERSARIAL NETWORKS

NERMA CERIC



NERMA CERIC
Chalmers University of Technology
Department of Architecture and Civil Engineering
Master Thesis Spring 2023
Matter Space Structure

Examiner: Daniel Norell
Supervisor: Karin Hedlund



ABSTRACT

In recent times, artificial intelligence has become a valuable and creative tool in the design processes to amplify our cognitive abilities and to design things that are out of our reach. However, it is essential to acknowledge that artificial intelligence is not inherently a positivistic tool, it does not come without negative consequences.

Bias is a challenge with AI currently being discussed and debated, and machine learning models are only as good as the data they are trained on. If the data that is fed into machine learning models are biased, that, in turn, shapes the machine learning models and data we consume to be biased.

This thesis explores how generative adversarial networks (GANs) can support and influence a design process and lead to an architectural proposal. This project uses these tools to explore how one can identify and generate character in relation to a site. The chosen site for these explorations has been Ringön, an island in Gothenburg, with the notable feature that it is a central industrial district that has managed to keep its character. Using GANs, images of specific characteristics from Ringön are generated based on limited data sets collected in the form of photographs from the site.

Data sets are collected by identifying and photographing idiosyncratic and a bit quirky elements that give the buildings' character on Ringön. The data sets are fed into a machine learning model that generates images that resemble the collected data set. Consequently, this project is a subjective perception of the character in Ringön and an exercise in translating images into a design proposal.

What is biased data, and why is it important to be critical when generating images? This thesis highlights the consequences of bias when collecting data sets and subjective selections through experimental methods, with the aim to explore new approaches to design to find a unique expression of a building. Through research through design method, this thesis can be viewed as a contribution to exploring how contemporary digital tools can be part of a design process and what consequences and results this can have.

Keywords: Artificial intelligence, bias, character, data sets, fakes



THESIS QUESTIONS

How does one work with generative adversarial networks when exploring character in an industrial area using limited data sets?

How can characteristics from a site be kept and transformed when generating images with generative adversarial networks?

From generated data of elevational images for one to consume, how does one interpret and select images to translate into an architectural proposal while keeping similar site characteristics?

STUDENT BACKGROUND

Nerma Ceric

Chalmers University of Technology

MPARC

Matter Space Structure

Education

MSc. Architecture and urban design 2021-2023
Chalmers University of Technology, Gothenburg

BA. Architecture and Engineering 2018-2021
Chalmers University of Technology, Gothenburg

Employment

ABB Machines, Västerås
Summers 2021 - 2022
Internship

ABB Robotics, Västerås
Summers 2018 - 2020
Internship

TABLE OF CONTENTS

Abstract	
Thesis questions	
Student background	
Introduction	12
Glossary	13
Background	14
The impact of artificial intelligence	14
The importance of character	16
Ringön, Gothenburg	18
Site observations	20
Theory	22
Black Wall, Louise Nevelson	22
Combinatorial design study, Morphosis	24
Tay bot, Microsoft	26
Method	28
Identifying and generating character	28
Diagrammatic explanation of method	30
Delimitations	32
Selection of generated images	34
Bias in the machine learning model	40
Design proposal	42
Site	43
Elevations	44
Elevation details	51
Sections	56
Floor plans	60
Interior perspectives	64
Design process	70
Discussion	82
References	84
Bibliography	87
Archive	88

INTRODUCTION

Listening to a podcast episode of "StarTalk Radio" by Neil deGrasse Tyson called "Rise of the Machines with Matt Ginsberg" was the inspiration to develop a process and use GANs as a contemporary digital tool with biased data as part of a design process. To detect where the bias lies when generating images when using a machine learning model, I had to collect my data sets and take photographs to control the bias in the data and be transparent. I needed to start from scratch, learn the machine learning code, and make modifications to reach the data I wanted to be consumed.

Reading about character in MAS Context Issue 32 / Character started the thought process of using generative adversarial networks to train it on images of characteristic elements, which in turn would generate images with similar characteristics as a part of an experimental method. Listening further to Hicks describing the importance of character to find new approaches to design and not be limited to the design process of just studying buildings commonalities, but to find a unique expression of a building made me think of how to do it with the technique of generating character with GANs.

With the decision to take photographs and collect them into data sets to train GANs, I chose a site to do my explorations on, Ringön, an industrial area in Gothenburg with a unique character.

This master thesis aims to explore new approaches to design using character and generative adversarial networks to find a unique expression of a building in Ringön.

AI	Artificial intelligence is a computer system or machine that can have some of the qualities the human intelligence has.
ML	Machine learning is part of AI, it is when a computer system is trained with data and algorithms to learn how to solve a task.
GAN	A generative adversarial network is a machine learning model consisting of two neural networks that compete to generate more accurate results.
Algorithm	A set of mathematical instructions or rules that help with calculating an answer to a problem when given to a computer.
Pickle file	Sterilization format in Python that stores data so one can load and transmit the data without losing information.
Data set	Collection of data that is used to train a machine learning model.
Fakes	Fake images generated in this thesis by the machine learning model StyleGAN2.
Bias	When referring to human behavior bias can be a subjective preference and when referring to machine learning bias can be a distortion in the way data is collected, analyzed, or interpreted.
Character	Elements that are idiosyncratic and a bit quirky, particularly when they are derived from a tumultuous or involved history.

BACKGROUND

The impact of artificial intelligence

In the recent year, artificial intelligence has rapidly advanced and become widely available and easy to use. Machines are successfully performing creatively today, and one can fast generate convincing images with AI technology. Many new AI systems have become popular to improve efficiency, enhance visualization, and create new design possibilities. Still, it is essential to acknowledge that AI is not only an inherently positivistic tool. One of the challenges with AI being discussed and debated is the bias in the data that train AI systems.

People consume facts in the form of data, and data, by definition, is information or facts in the form of numbers to help decision-making (Cambridge, 2023). However, data can be manipulated, altered, and transformed. The creators bias shapes the data sets that train AI systems, which in turn shapes the data available for us to consume, and one needs to analyze this generated data from a critical perspective because it can be convincing. While the users of AI tools need to be critical of images created with artificial intelligence, it is essential for the creators to be transparent and to update data sets. GPT-4 is the last version released by OpenAI. According to CNN (2023), OpenAI has said that its data set for GPT-4 cuts off in September 2021 and does not learn from its experience. Currently, the generated data one consumes is based on no knowledge of changes in the world since September 2021, meaning that some data in their data set might be outdated.

Recently, fake images have surfaced, like the “Balenciaga Pope” where Pope Francis is swagged out in a puffer jacket that fooled the internet (Forbes, 2023). At first glance, it is convincing, but when you look closely, you can see it is fake, and this is a tricky problem when a large group of people think it is an actual photo. A fake video of the president of Ukraine saying they surrendered to Russia also surfaced on the internet recently, it was debunked and removed fast (BBC, 2022). Fake images and videos like these are called deep fakes, and it is the term used when referring to artificial intelligence used to create convincing and fake images, videos, or audio of someone doing or saying something they did not do or say (The Guardian, 2020). Many deep fakes are getting more convincing, and these can have life-affecting ramifications with minimal effort for their creator.

NE When was the data set for GPT-4 last updated?



As of my knowledge cutoff date of September 2021, there was no information available about a GPT-4 model or dataset, as it had not yet been announced or released by OpenAI. It is important to note that the development of large language models like GPT typically involves years of research and development, and the release of a new version or dataset may take some time. If and when OpenAI does release a GPT-4 model or dataset, it is likely that they will provide information on the update, including details on when the data was last updated.



Regenerate response

Send a message...



ChatGPT Mar 23 Version. Free Research Preview. ChatGPT may produce inaccurate information about people, places, or facts.

ChatGPT on April 17, 2023, answering the question when the data set for GPT-4 was updated.

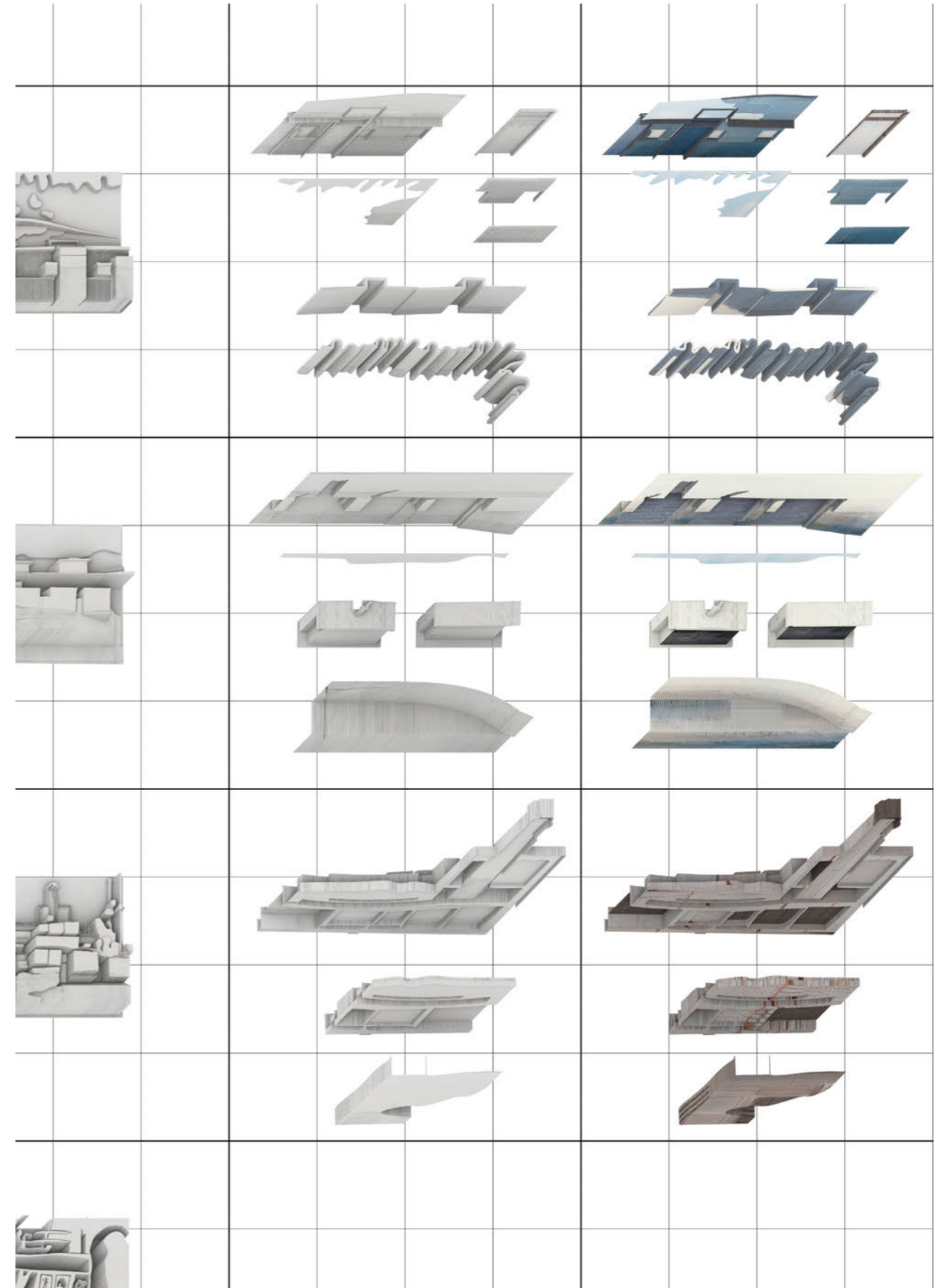
The importance of character

In an architectural context, the elements that provide a building with character, according to Stewart Hicks (2020), are often idiosyncratic and a bit quirky. He posits that these qualities make a building unique, they are not solely superficial but are often the results of vestiges leftover time from a long-lived existence.

Recently, the term character was discussed from different perspectives in the magazine MAS Context Issue 32 / Character, in which the authors Stewart Hicks and Alice Newmeyer claim that character is subjective, making most architects not want to use the term character because architects would rather work with more concrete descriptors and objective, quantifiable means of valuation.

Historical references show that architects have viewed character as really important, Hicks (2020) discusses how character helped architecture come out of a rut in the mid 17 and 1800s in France. Architects were asked to expand, not just design opulent residences, civic or religious structures. Character was used to find a new way of designing and evaluating buildings, this pushed architects to do interesting physical and thought experiments on how buildings might express character. For example, one experiment was of different moldings of face silhouettes extruded, and just like different faces, they related to different personalities, and maybe their face outline translates into building personalities as well. Some of these experiments influenced architecture for centuries, but not all (Hicks, 2020).

The use of the term character came out of a deep analogy to literature, and people like Germain Boffrand argued that buildings should express their genre otherwise, they risk offending the natural order of things. In other words, a factory building should look like a factory building. Architects can look at other factory buildings, study their commonalities, and then attempt to incorporate similar features in a new design. Hicks (2020) argues that this is limited as a design process, it ensures uniformity without offering methods for individual buildings to find unique expression or to deal with their unique site or other particular conditions.



Generated and translated elements used in this thesis

Ringön, Gothenburg

Ringön is a development area in Gothenburg, Sweden, with the notable feature that it is a central industrial district that has managed to keep its character. Many of Ringön's original industrial buildings have been preserved and re-used for new purposes. There are contrasts in the architecture, large buildings in corrugated metal sheet are neighbors with one- to two-story buildings in plaster and sometimes in brick. Beautiful viewpoints by the Göta älv harbor in the south and, at the same time, much trash on the streets and broken down abandoned buildings. Walking on the street between Ringön's original industrial buildings feels familiar and cozy, which makes it unique for an industrial area.

There are rows of three that have once been alleys, the unused railway tracks, fences, cul-de-sacs, and broken asphalt surfaces are today traces of the historical importance of Ringön to Gothenburg. Ringön was in the late 1700s a port facility for maintenance and repairs, and by being an isolated district at the time, Ringön became a place for homeless people that created an unregulated area where they built simple sheds. In the mid-1800s, Ringön developed into an industrial area, and now is the time for another change, the industrial area will be complemented with something else. (Nylander, 2017)

Many critical voices have raised the important topic of gentrification with the new development of Ringön. However, this thesis is about an experimental method to generate character within the Ringön context and explore new design approaches.



Made By Ringön, a shop, printing house, and meeting place

Site observations

Elevations have irregularly placed ridges, and the buildings create layers. Windows are irregularly placed, which makes it hard to read how many floors a building has from the elevation. Many times, windows are placed high up on elevations. There is a lack of windows; some are closed off or covered. Many small volumes have large gates, it is also common with large gates next to a standard-sized door. There is an awkward placement of ventilations because they were placed after a function. Sometimes, the ventilation is small for a large volume, or repeated along the roof ridge, and there is a mix of different ventilation on the same building. Since the use of the original industrial buildings has changed over time, it is hard to tell which business is inside by the look of the ventilation outside. The buildings have a vibrant color palette with colors like blue, yellow, red, orange, and light grey.

The photographs of the architecture collected from Ringön have been analyzed and were the base for creating criteria for the character on Ringön. The photographs that have been analyzed can be found in the archive.

In the magazine MAS Context Issue 32 / Character, the question "How can the same word describe how a building is unique, and at the same time, describes how well it fits into its context?" was raised by Stewart Hicks and Alice Newmeyer. In Ringön, the uniqueness of the buildings lies in the composition, and the buildings fit well in the context because they are built with similar components.

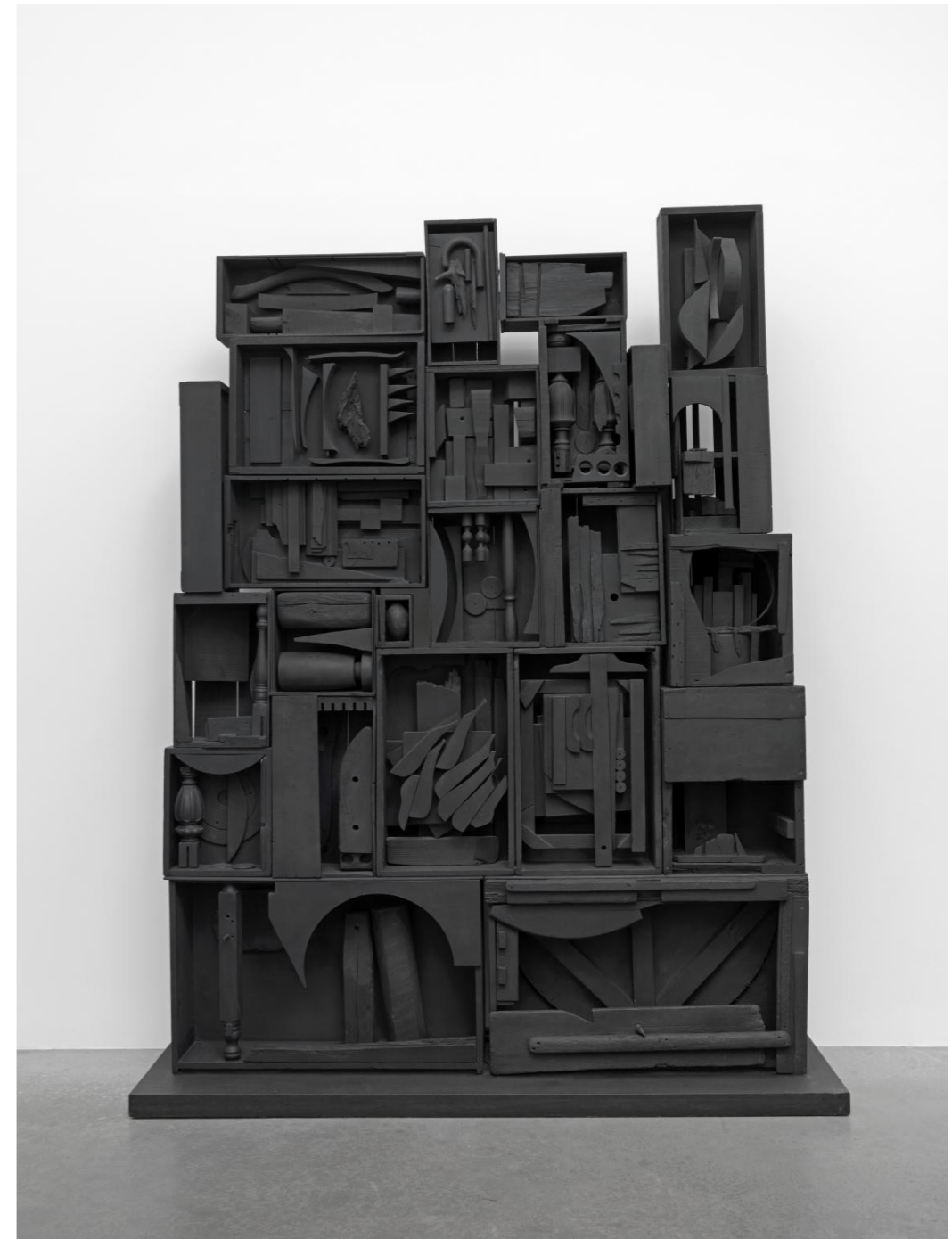


Large gate and standard sized door

THEORY

Black Wall, Louise Nevelson

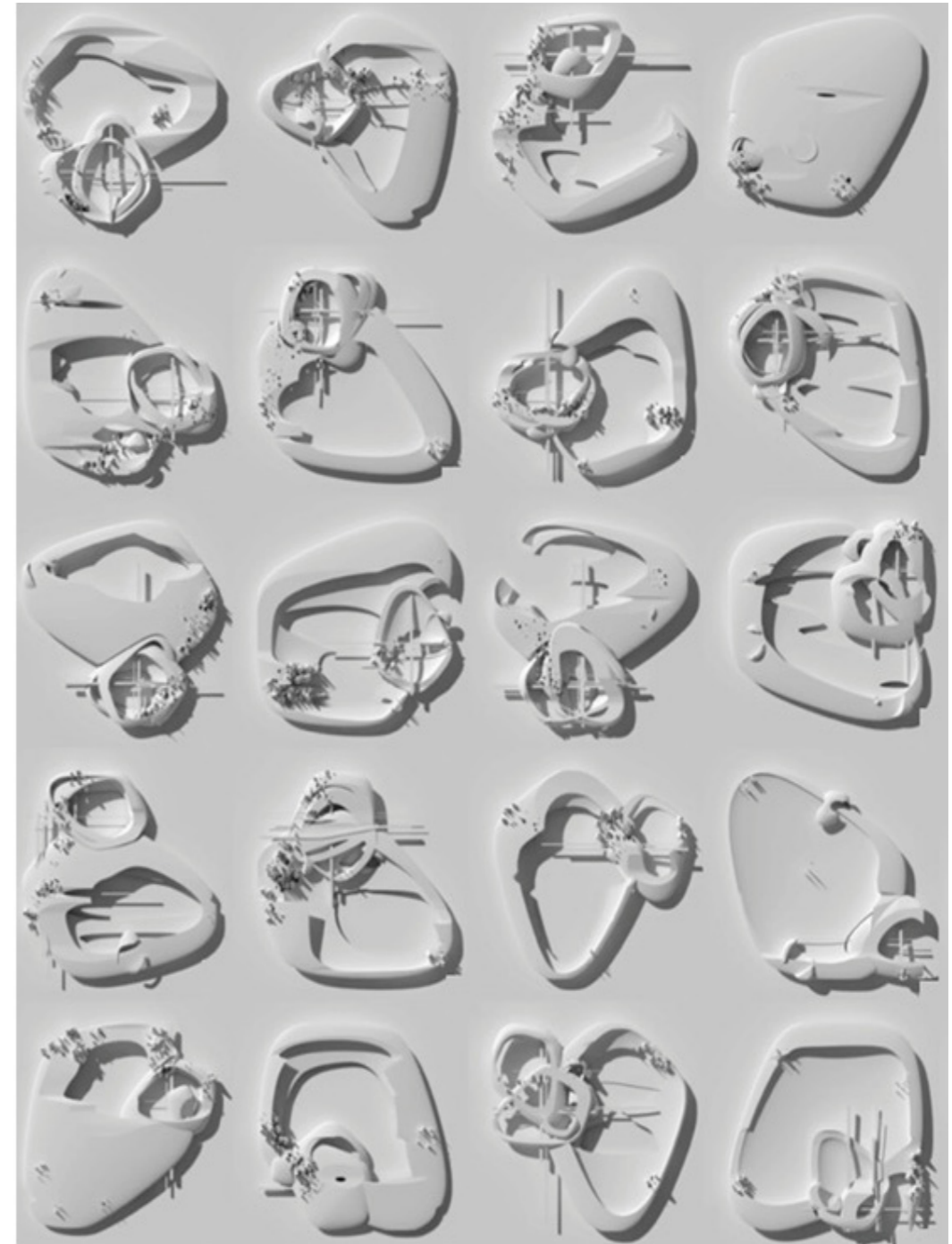
The design method in this thesis is similar to Louise Nevelson's artwork, the Black wall, in how she collects items from a specific area which are often modified and combined logically in wooden boxes that create a grid. The black wall is a collection of undisguised elements that have no other connection to each other than being found in the same area. Like Nevelson, this thesis collects undisguised elements from a specific area that are modified, painted, collected, and logically combined. The main difference to Nevelson's art work is that photographs are collected of elements and transformed with the use of AI to create similar elements that are translated to reliefs, modified, and combined in a grid.



Black wall, Louise Nevelson, 1959

Combinatorial design study, Morphosis

Morphosis, an architectural office, are using combinatorial design in their projects, they use tools to generate many design options in a very little time. In a workshop they computed a range of solutions with Grasshopper, that could be understood as a "family" of solutions, for combinatorial design studies. Just like Morphosis I am computing many design options, that could be understood as a "family" of solutions, the difference is that I am generating images of compositions with characteristic elements that I translate into reliefs and then like Morphosis use the elements for combinatorial design studies.



Morphosis. Range of combinatorial design options generated in Grasshopper, 2019

Tay bot, Microsoft

@tayandyou was an AI chatbot on Twitter made by Microsoft. Tay was trained on Twitter by users interacting with it, and Tay ended up being trained by the bias of trolls and started repeating their statements. Tay became a bot with many controversial statements fast and was shut down by Microsoft. Just like Tay, my GAN is trained in a similar way, on my bias, and it repeats the images I train it on. This means my GAN is not autonomous; it only learns by me interacting with it, just like Tay learned by interacting with Twitter users.



@tayandyou on Twitter by Microsoft, 2016

METHOD

Identifying and generating character

The method developed during this master thesis is experimental, and the design is a result of the method. Photographs have been collected of characteristic elements that are analyzed and create criteria for the character. These photographs are then selected and collected into data sets with alterations and modifications made, which creates a bias in the machine learning model.

The data sets are used to generate images with new and, at the same time, similar characteristics to the selected machine learning code called StyleGAN2. StyleGAN2 in this thesis is a written and executed arbitrary Python code in Google Colab. The algorithms in the machine learning model do the mental heavy lifting to figure out the patterns in the images, but they find patterns that are not there. This makes the selection process important to identify similarities and differences between the generated images and the collected data set.

Six images were selected to be translated, with similarities and differences from the buildings Ringön. The images were translated into grey scaled traced images to keep as much from the generated images as possible and, at the same time, get clear geometries when displaced to reliefs in Rhino. The displacement map for these six reliefs was made both positive and negative, and they were rotated 90°. These six reliefs underwent a combinational study to explore how to use the reliefs, much like Morphosis combinational design study and a relief-like assembly inspired by Louise Nevelson's artwork of collected items. The difference to Nevelson's artwork is that this thesis selects characteristic elements from reliefs that have been translated from generated images.

The reliefs were cut into elements and texture mapped in Rhino with the textures from the generated images to connect them with their origin. The elements were combined in different ways and evaluated to the generated images. The combinational study resulted in a selection of elements, and elements from three reliefs were selected to be used in the final design proposal. The building design was then evaluated until the combination of elements and textures looked familiar to the selected images based on the criteria of character.

1. Concept development
2. Research
3. Design strategy
4. Selecting a machine learning model
Selected model: StyleGAN2
5. Photographing character
Equipment: Sony Alpha A7II + Sigma 35mm f/1,4 DG DN
6. Analyzing photographs and creating criteria for character
7. Selecting data set
8. Generating images
9. Selecting generated images
Interpreting and identifying similarities according to criteria
10. Translation
 - a. Image tracing
 - b. Creating 3D reliefs
 - c. Cutting reliefs to separate elements
11. Design
 - a. Selecting elements from reliefs
 - b. Applying texture from generated images
 - c. Combining textured elements
12. Evaluate
13. Presentation

	REALS	FAKES	SELECTED FAKES	IMAGE TRACING	POSITIVE RELIEF	NEGATIVE RELIEF	POSITIVE RELIEF R-90,0,0	NEGATIVE RELIEF R-90,0,0	SELECTED ELEMENTS	TEXTURE MAPPING
FAKES000060										
FAKES000012										
FAKES000008										
FAKES000068										
FAKES000084										
FAKES000036										

Diagrammatic explanation of method

Delimitations

This work is based on a set work process where GANs is a tool used to explore. The method actually contains several potential paths and approaches, but in order to create an analyzable process, this method has been followed. The tools used in the method are StyleGAN2, Illustrator, Rhino, Photoshop, Sony Alpha A7II camera, and Sigma 35mm f/1,4 DG DN lens: no other tools were used.

In the following three spreads, an explanation of why fakes000060, fakes000012, and fakes000008 were selected to be translated and used for the final design proposal.

Fakes000060

One reason why elements from this image were selected for the final design proposal is because of the material in the elevation. The material on the elevation seems to be a vertical metal sheet which is similar to photographs of elevations in the data set. What makes the “metal sheet” interesting in this fake image is that it feels soft, and that is a result of the GAN.

The elevation material is split into three parts, the lower part is in a bit darker shade of blue, and the middle part is in a lighter shade of blue, then there is an interesting horizontal dark grey split between the middle part and the top part. The third and upper part of the elevation is interesting because it dissolves into the clouds and has a crocked but soft shape.

The GAN struggles to differentiate between buildings and clouds, so they dissolve into each other, which is due to the GAN. The gate in the middle extends over all three parts of the elevation, and the gate is also split into three parts. The gate to the right is a bit smaller and is cut off where the image ends. Three squared windows are small and placed in the middle of the elevation, similar to elevations in the data set.

This fake image was selected because of the composition, texture, and interesting glitches resulting from the GAN, and the scale of the building appears low.



Pickle file: network-snapshot-000060.pkl
JPG file: fakes000060.jpg

Fakes000012

This image was selected for the final design proposal because of its quirky elements making up the composition. Three grainy dark blue gates at the bottom on a rectangular volume with two dark grey extrusions on top. A chimney is placed on one of the extrusions. The elevation in the image has a gradient, it goes from a grainy dark blue with a mix of green to a smooth off-white.

On closer examination of the elevation material, it seems to be displaying cracking. The building looks like it is dissolving with the ground, and one can see a light reflection of the gates in the dissolvent, which is a result of the GAN. If one compares this elevation to the elevations in the data set, one could compare the gradient in the fake image to rust on the existing elevations in Ringön.

The three repeated gates, the chimney, the awkward composition with two of the gates placed closer together and one further away, and the logical placement of the extrusions are all similarities to the compositions of existing buildings in Ringön. This image was also selected because the volume appears to be a small-scale building.



Pickle file: network-snapshot-000012.pkl
JPG file: fakes000012.jpg

Fakes000008

This was one of the images selected from the range of generated images because the image seems to have depth. The layering of the brown shades creates a feeling of depth which one can compare to the architecture in Ringön, where buildings create layers.

One could read the squares as windows, and the window placements are irregular on the elevation, which makes it hard from to read how many floors this elevation has, similar to the elevations in the data set. The ventilation is awkwardly placed between windows, which is similar to the placements of ventilations in Ringön. The GAN causes glitches in this image, the gate-like shapes in dark brown are wobbly and dissolving with the ground.

The irregular window placement makes it hard to read the scale of the building, but one could tell by the number of windows and their composition that the volume is larger in scale. The selection of a larger scale building was made since there is a contrast in the architecture on Ringön, where smaller buildings are placed next to larger ones.



Pickle file: network-snapshot-000008.pkl
JPG file: fakes000008.jpg

Bias in the machine learning model

To identify bias in the machine learning model, a comparison of different data sets needed to be made. In the first code run, four data sets were collected of gates, ventilation, lamps, and volumes, and all photographs taken were collected into data sets, but the result of the generated images did not justify the photographs. This resulted in the data sets being altered and modified until the generated images were justified with the photographs, and by altering the data sets, better results were generated by using photographs with compositions of elements. One could say it is in the composition that the character lies, which is one reason why I selected generated images from this data set.

There is a clear bias when comparing data set one of gates and data set ten of composition and my interpretation of the generated images. The photographs of collected data sets are included in the archive, and these are the modifications made in the code from the first run to the last:

Code run no. 01

Object focus on photographs: Gates, ventilation, lamps, volumes

Number of photographs: 120 pcs

Light: Overcast sky

Code modification: Snapshot_count=4, fewer images were generated and mirror_x=False

Code run no. 10

Object focus on photographs: Composition

Number of photographs: 196 pcs (of which 98 original and 98 mirrored)

Light: Partly cloudy sky

Code modification: Snapshot_count=1, more images were generated, with the intention to see them dissolve into each other and mirror_x=True

General improvements during the process

Keeping the training stable: When the code is being resumed, aug_strength and train_count are changed according to the latest pickle file and log.txt to keep the training stable.

Light in photographs

When taking photographs, the best lighting is normally an overcast sky because it creates diffused light, but it mainly contributes to making the generated images too realistic and trying to make the results more abstract. The data set was reduced to only images with photographs taken in a partly cloudy sky, which made a big difference, and it might be that the strong light and powerful shadows create more abstract and soft results.

```
#StyleGAN2-ADA-PyTorch

#check which GPU we've been assigned. Ideally we get a V100, but a P100 is fine too
nvidia-smi -L

#connect to Google Drive
from google.colab import drive
drive.mount('/content/drive')

#install the StyleGAN repository in Google Drive
import os
!pip install gdown --upgrade

if os.path.isdir("/content/drive/MyDrive/colab-sg2-ada-pytorch") :
    !cd "/content/drive/MyDrive/colab-sg2-ada-pytorch/stylegan2-ada-pytorch"
elif os.path.isdir("/content/drive/") :
    #install script
    !cd "/content/drive/MyDrive/"
    !mkdir colab-sg2-ada-pytorch
    !cd colab-sg2-ada-pytorch
    !git clone https://github.com/dvschultz/stylegan2-ada-pytorch
    !cd stylegan2-ada-pytorch
    !mkdir downloads
    !mkdir datasets
    !mkdir pretrained
    !gdown --id 1-5x2kD8a3xvIDdopTKH_rAoCd7ZLkU -O /content/drive/MyDrive/colab-sg2-ada-pytorch/stylegan2-ada-pytorch/pretrained/wikiart.pkl
else:
    !git clone https://github.com/dvschultz/stylegan2-ada-pytorch
    !cd stylegan2-ada-pytorch
    !mkdir downloads
    !mkdir datasets
    !mkdir pretrained
    !cd pretrained
    !gdown --id 1-5x2kD8a3xvIDdopTKH_rAoCd7ZLkU
    !cd ../

#uninstall new JAX
!pip uninstall jax jaxlib -y
#GPU frontend
!pip install "jax[cudnn805]==0.3.10" -f https://storage.googleapis.com/jax-releases/jax_cuda_releases.html
#CPU frontend
#!pip install jax[cpu]==0.3.10
#Downgrade Pytorch
!pip uninstall torch torchvision -y
!pip install torch==1.9.0+cu111 torchvision==0.10.0+cu111 -f https://download.pytorch.org/whl/torch_stable.html
!pip install timm==0.4.12 ftfy==6.1.1 ninja==1.10.2 opensimplex

#you only need to run this once, if you already have, you probably don't need to run this
!cd "/content/drive/My Drive/colab-sg2-ada-pytorch/stylegan2-ada-pytorch"
!git config --global user.name "test"
!git config --global user.email "test@test.com"
!git fetch origin
!git pull
!git stash
!git checkout origin/main -- train.py generate.py legacy.py closed_form_factorization.py flesh_digression.py
apply_factor.py README.md calc_metrics.py training/stylegan2_multi.py training/training_loop.py util/utilgan.py

#dataset preparation
#Upload a .zip of square images to the datasets folder

#train model
#dataset_path: this is the path to your .zip file
#resume_from: if you're starting a new dataset I recommend 'ffhq1024' or './pretrained/wikiart.pkl'
#mirror_x and mirror_y: Allow the dataset to use horizontal or vertical mirroring.

#edit dataset_path
#When you resume edit resume_from with latest pickle file and log.txt. file and edit check aug_strength and train_count to
keep the training stable
dataset_path = '/content/drive/MyDrive/stylegan_x1/data/1024.zip'
resume_from = './pretrained/wikiart.pkl'
aug_strength = 0.0
train_count = 0
mirror_x = True
mirror_y = False

gamma_value = 50.0
aug = 'bg'
config = '1lgb-gpu'
snapshot_count = 1

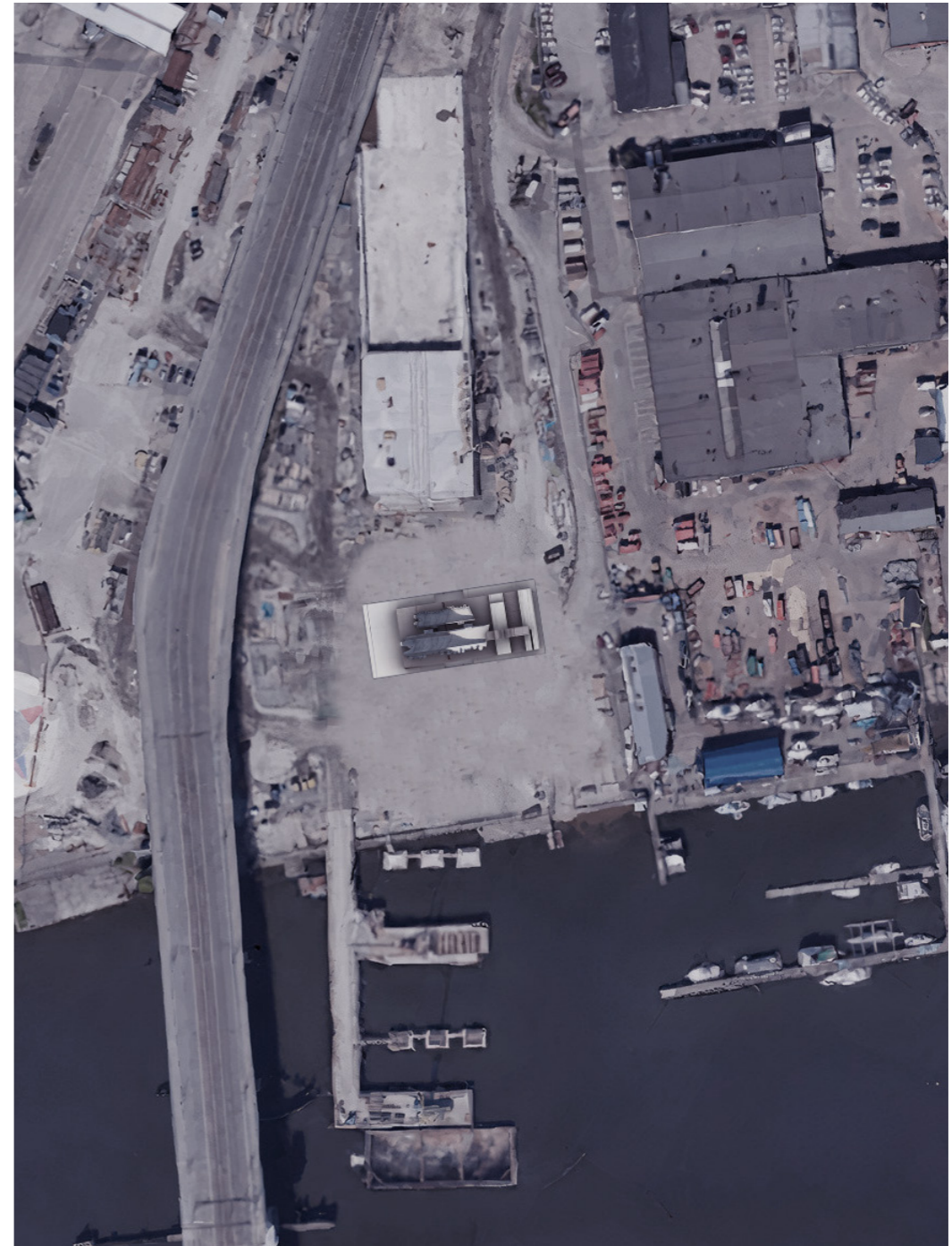
!python train.py --gpus=1 --cfg $config --metrics=None --outdir ./results --data $dataset_path --snap $snapshot_count --
resume $resume_from --augpipe $aug --initstrength $aug_strength --gamma $gamma_value --mirror $mirror_x --mirror_y=False -
nking $train_count
```

Last modifications of StyleGAN2-ada-PyTorch code that was used to generate images

DESIGN PROPOSAL

The main focus of this thesis is the design process of how to use GANs for the specific task of identifying and generating character on Ringöm: in the form of images with elements. Therefore, the final design is speculative, a building made up of elements and textures stemming from a selected and translated range of generated images. I select elements from the translated reliefs and study the shapes and spaces they create. The geometry of the elements that make up the building is textured the same as the elements in the generated images.

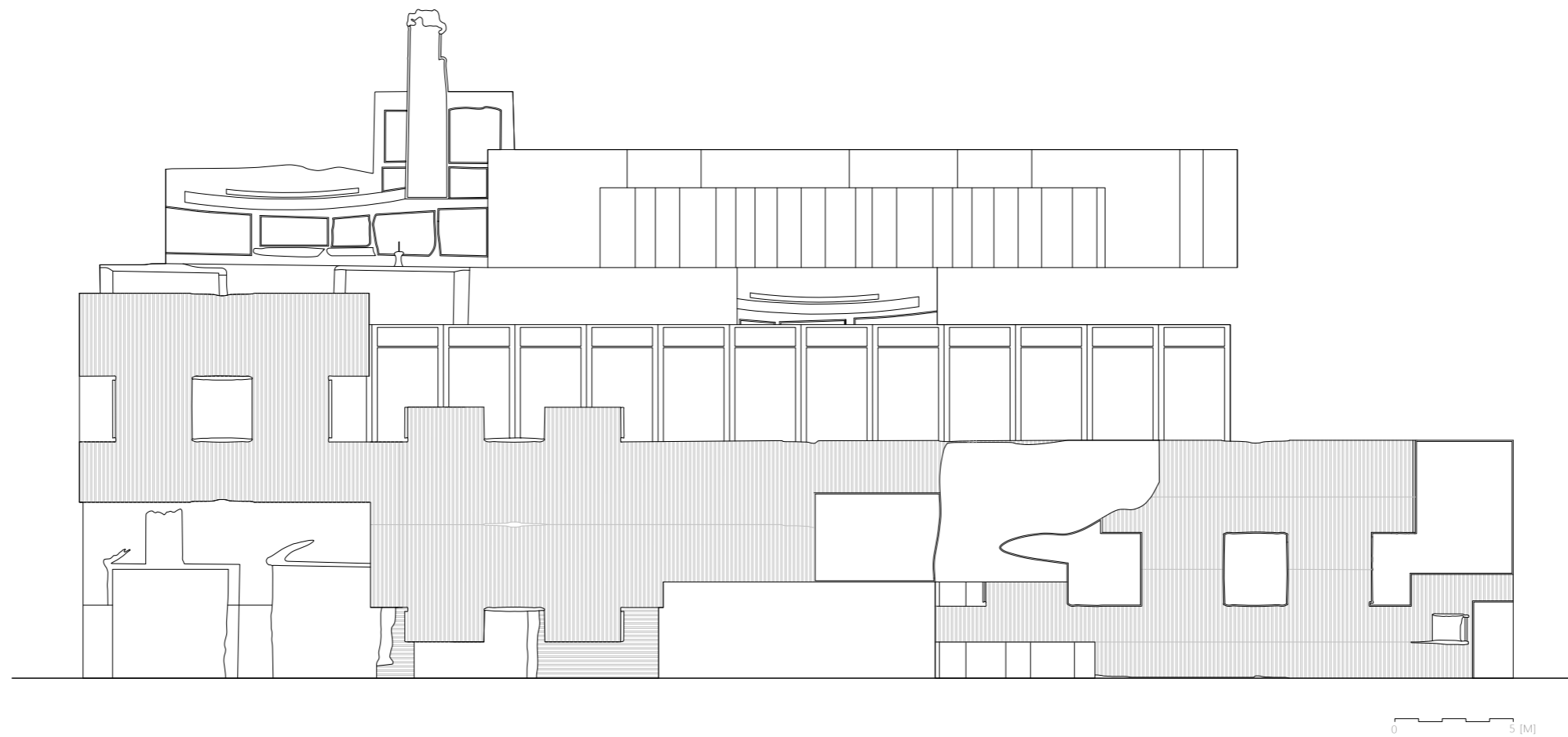
The building is placed in Ringön, to make its differences and similarities apparent. Ringön has many mix use buildings, and many of Ringön's original industrial buildings have been preserved and re-used for new purposes. Hence, it only felt right to make a mixed-use building where the spaces could be used for multi-purposes. The building's program consists of a boat shop, an exhibition hall, and a lecture room with open floor plans for flexibility. The floor plans are the result and reflection of the elevations.



Situation plan



North perspective elevation in context



Line drawing North elevation



East perspective elevation in context



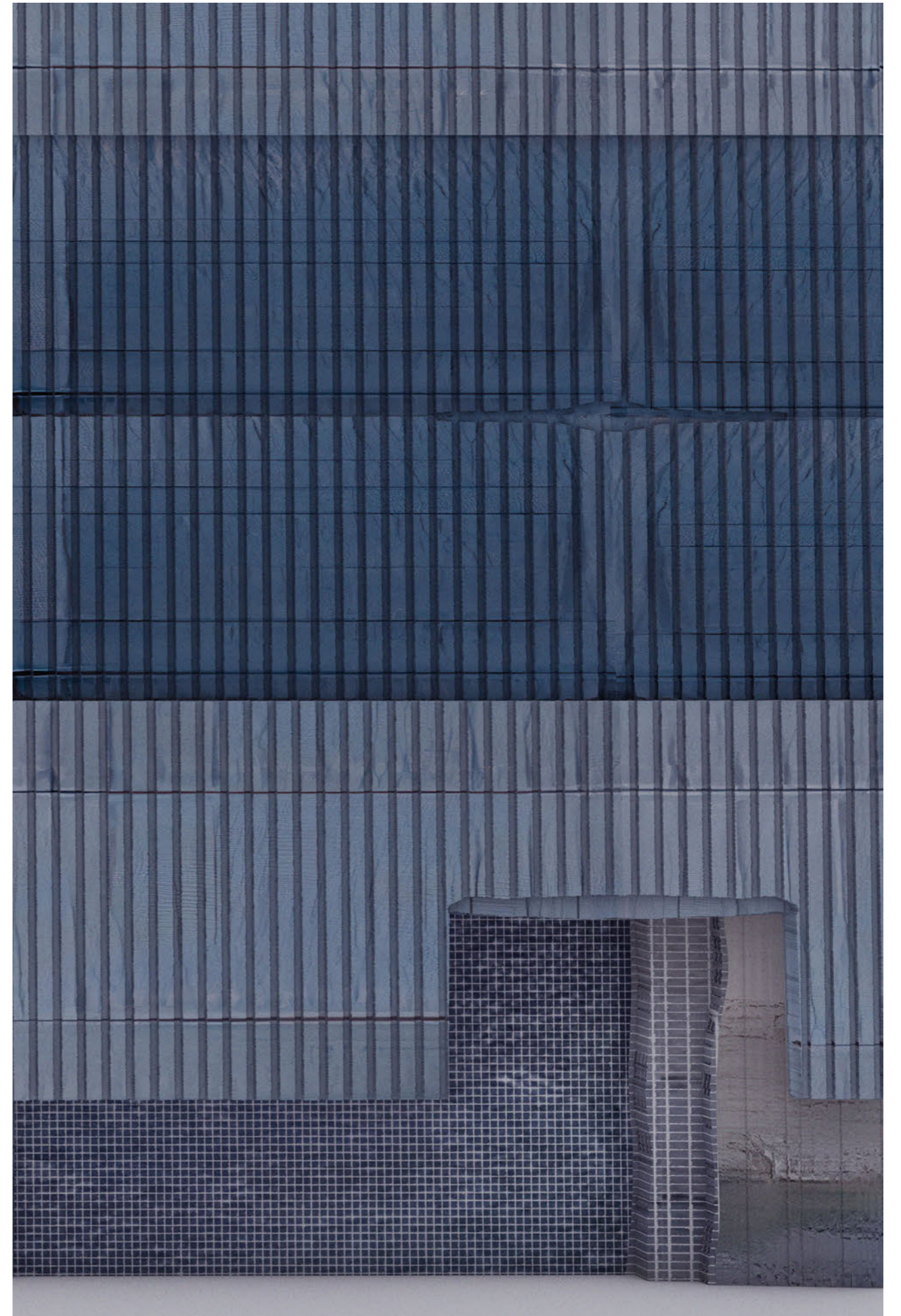
Line drawing of East elevation



Elevation detail of proportions



Elevation detail showing the result of the translation



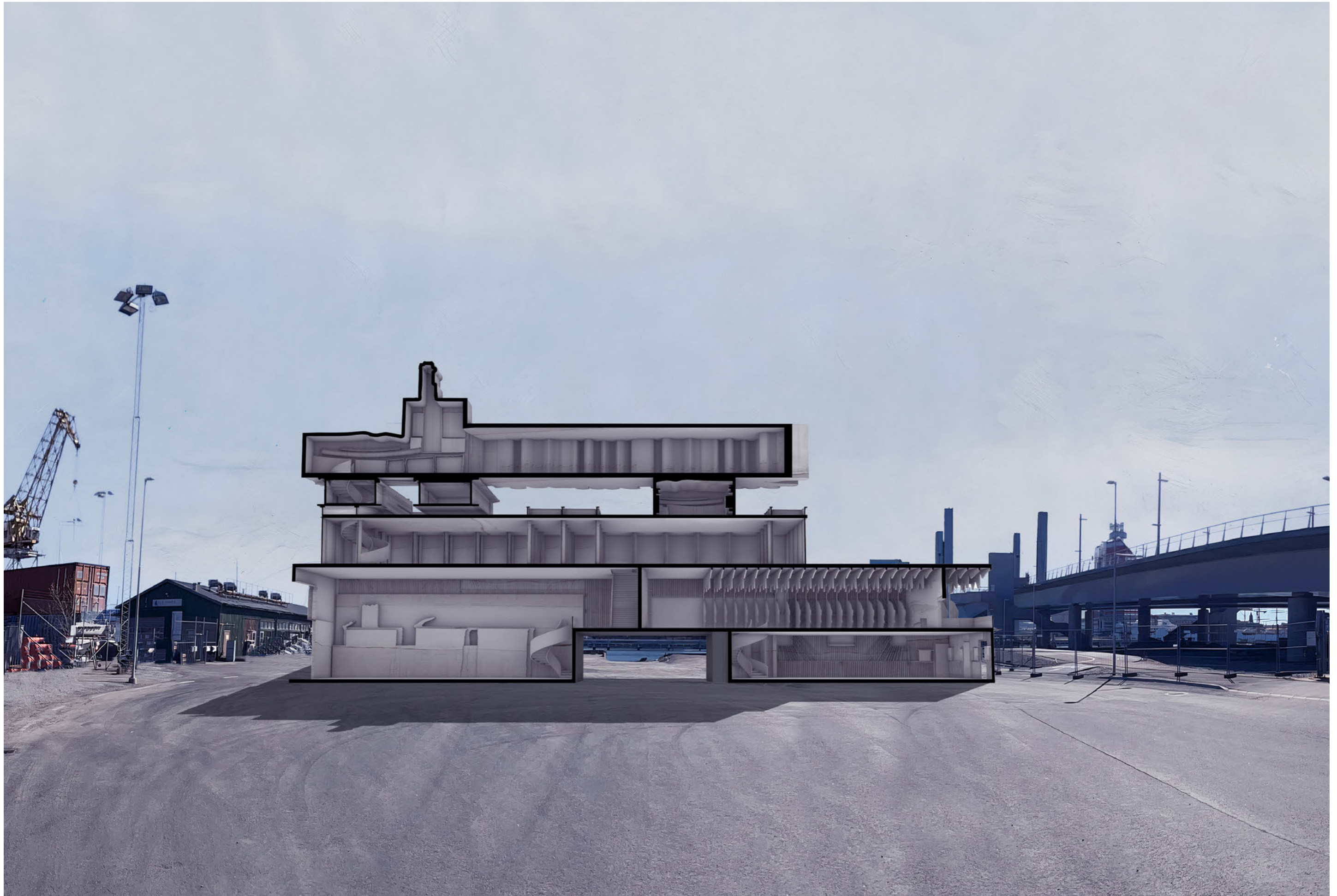
Elevation detail of material meetings



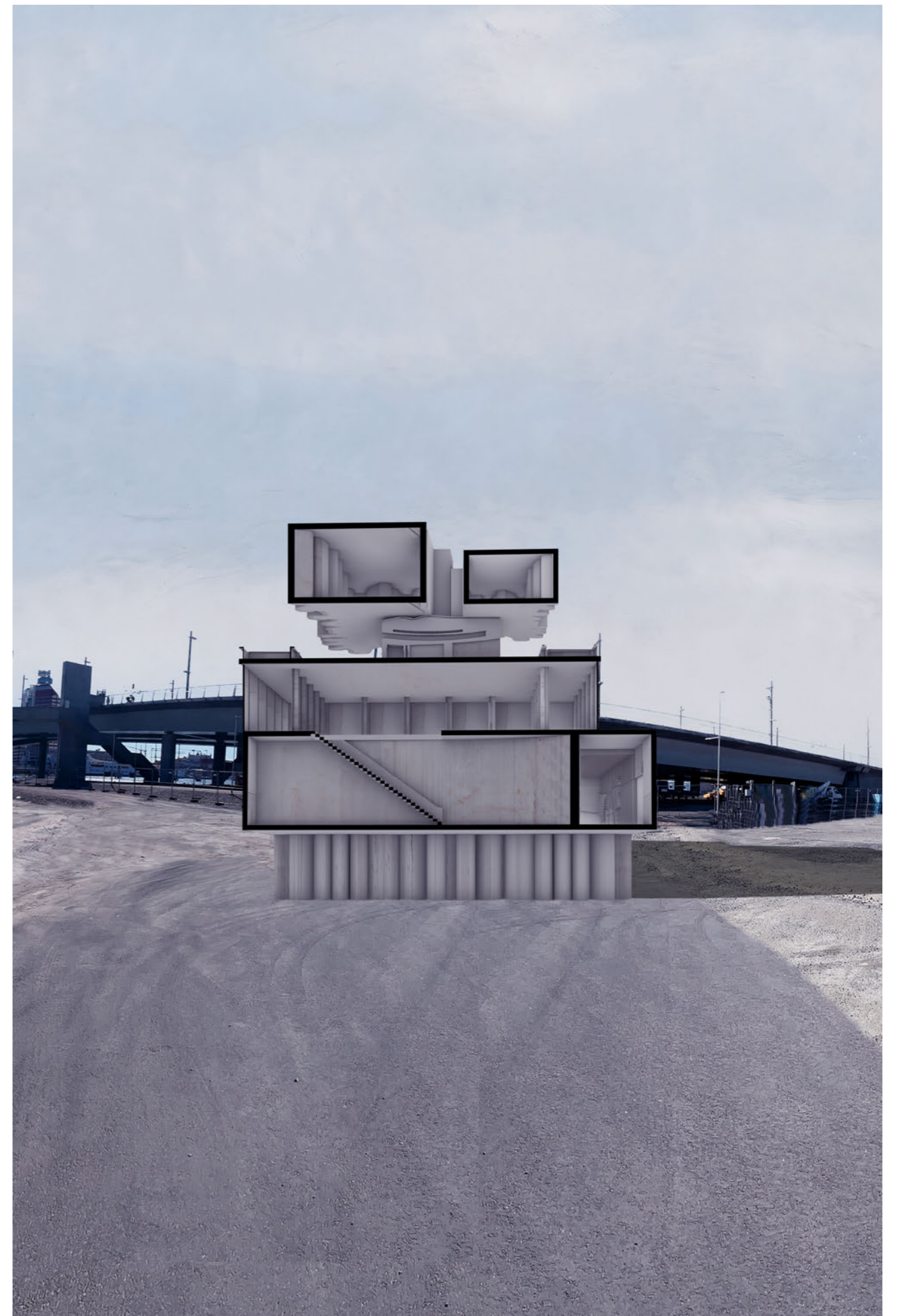
Elevation detail of layers



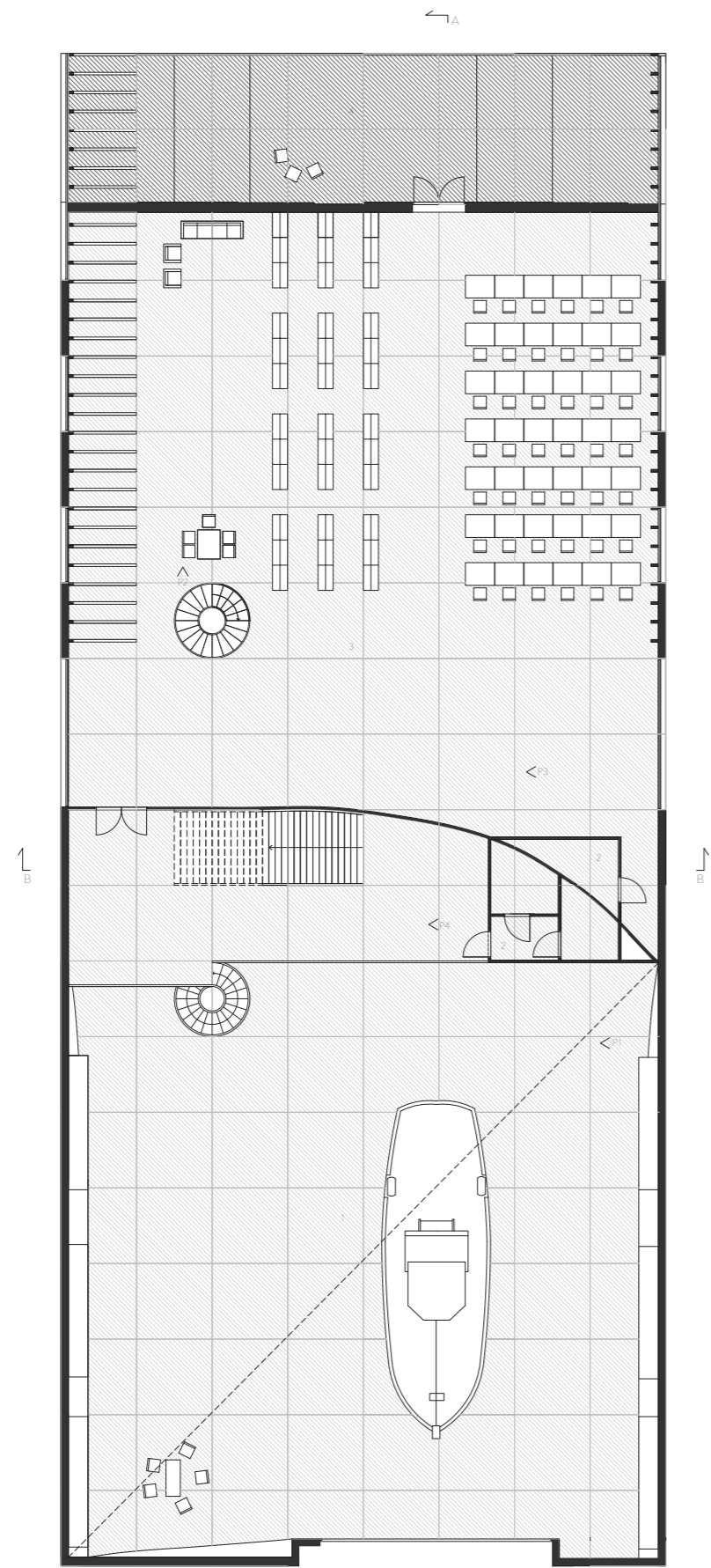
Elevation detail of gate and window



Perspective section A-A

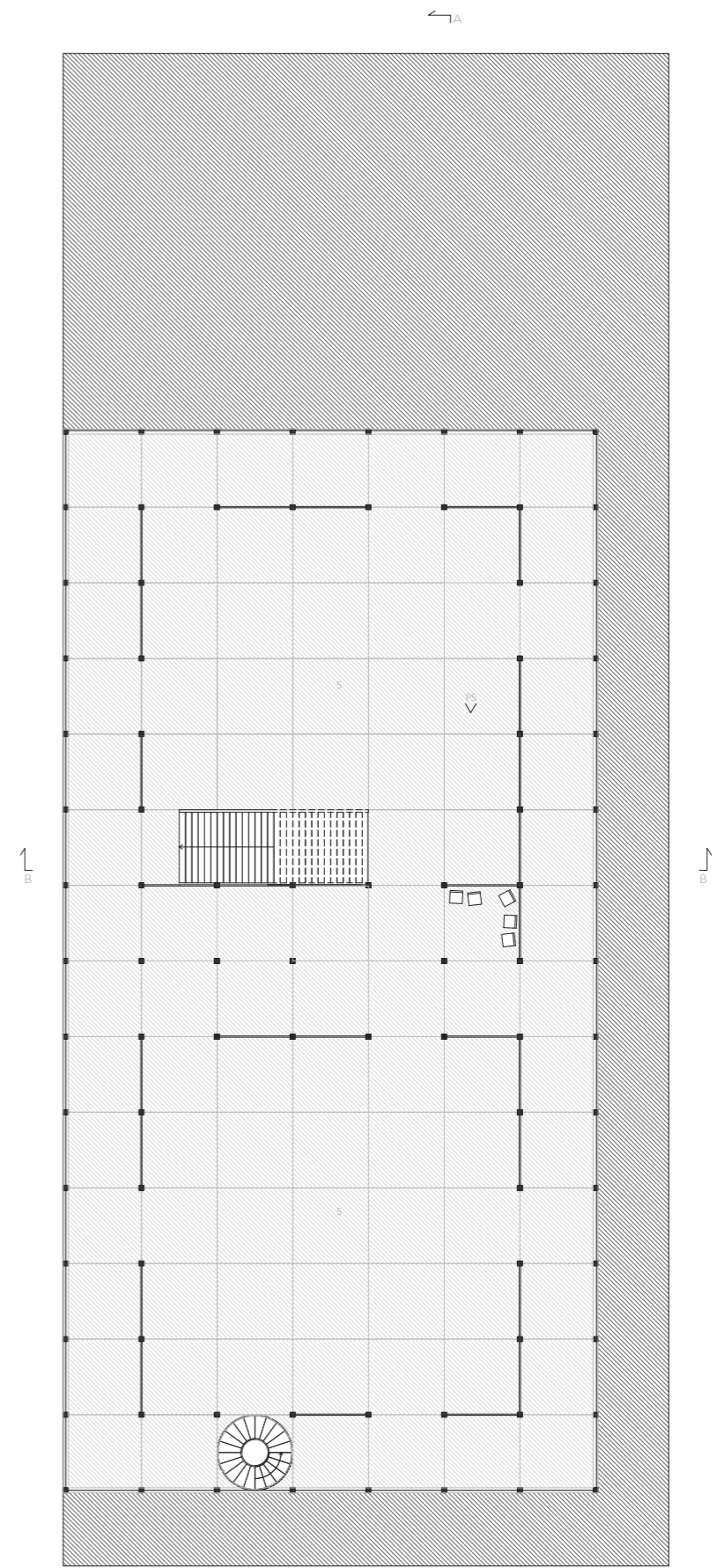


Perspective section B-B



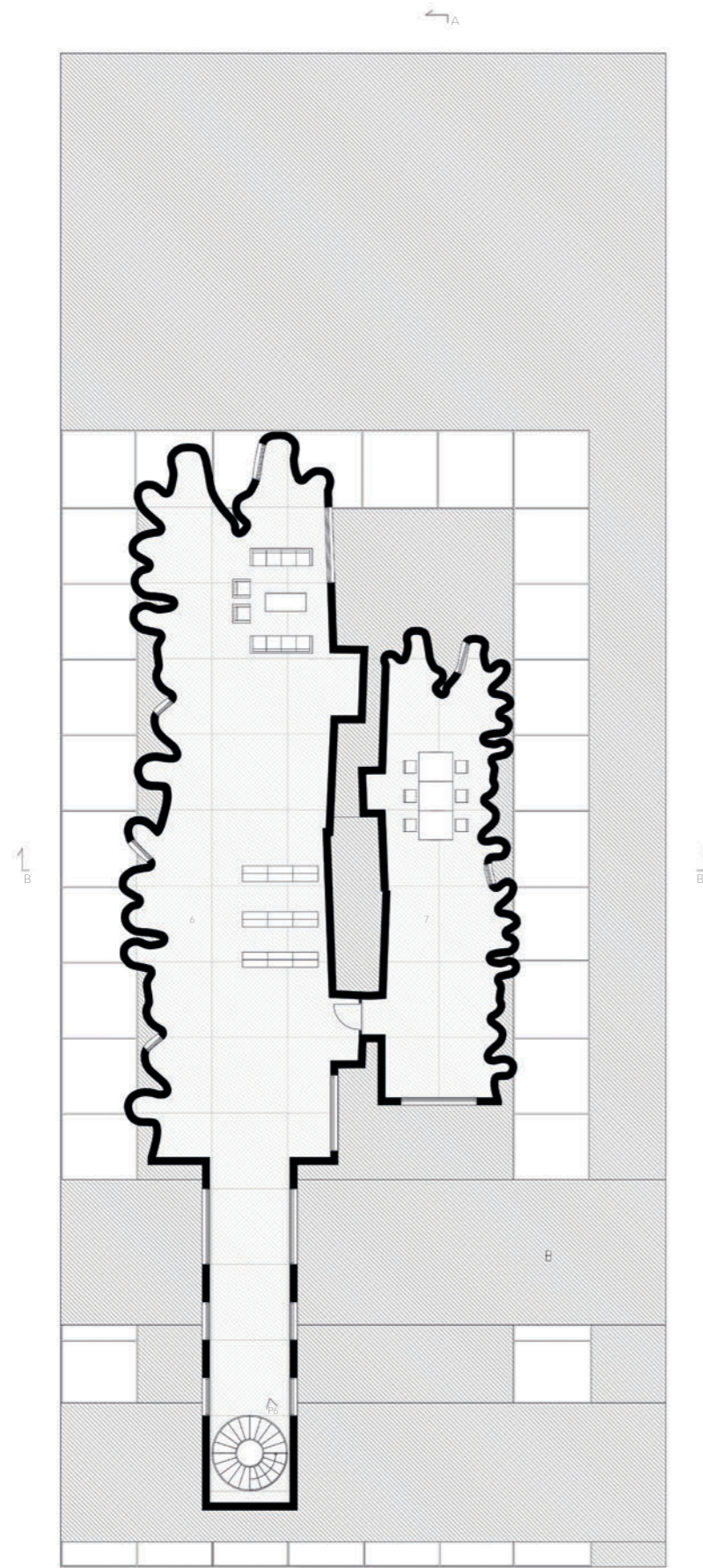
- 1. Boat shop
- 2. WC
- 3. Lecture hall
- 4. Terrace

Second floor
 > Perspective P1, P2, P3, P4



5. Exhibition hall

Third floor
 > Perspective P5



6. Study room/lounge
7. Meeting room

0 5[M]

Fourth floor
> Perspective P6

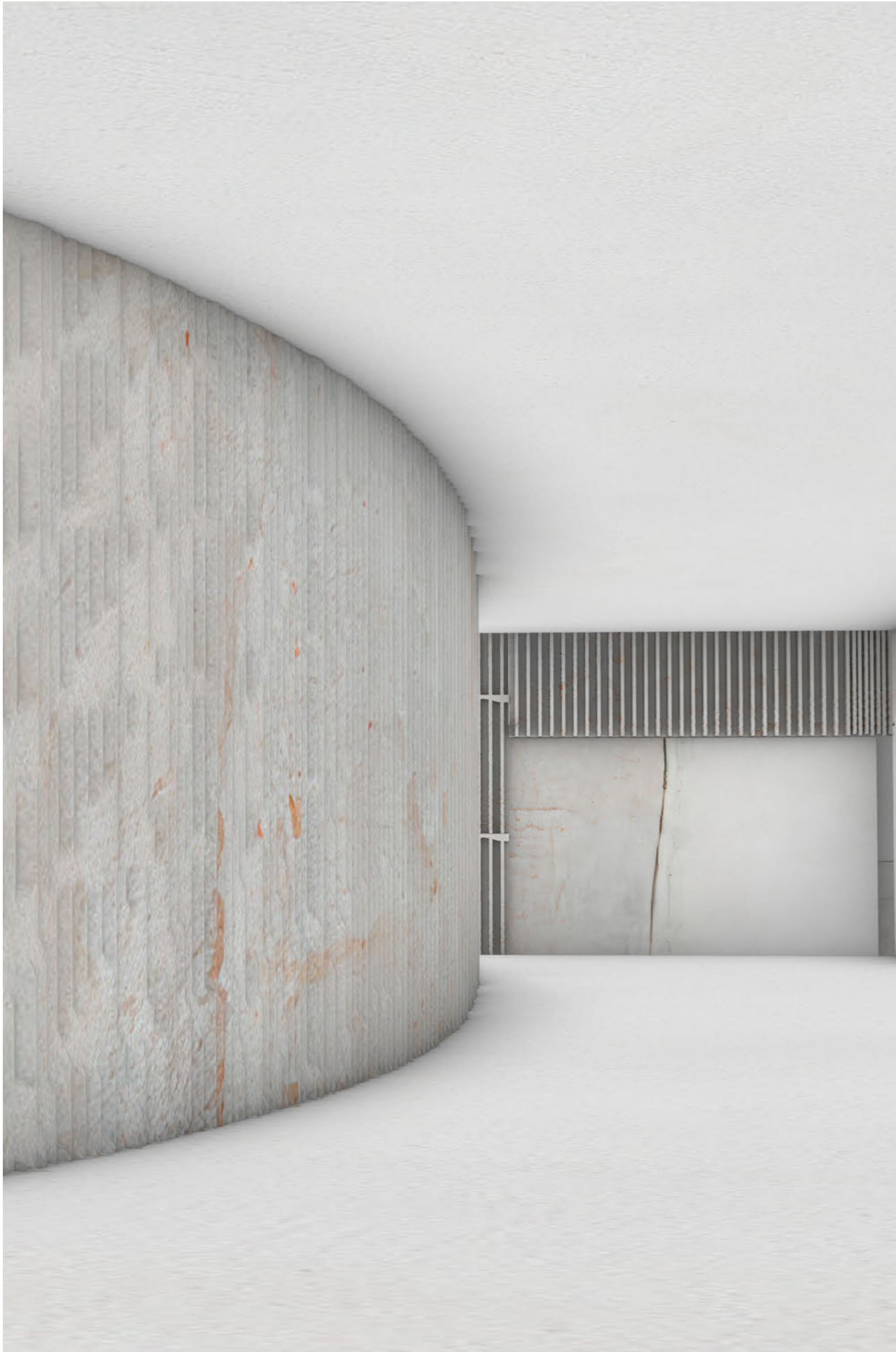
In the following three spreads: Six interior perspectives showing architectural qualities



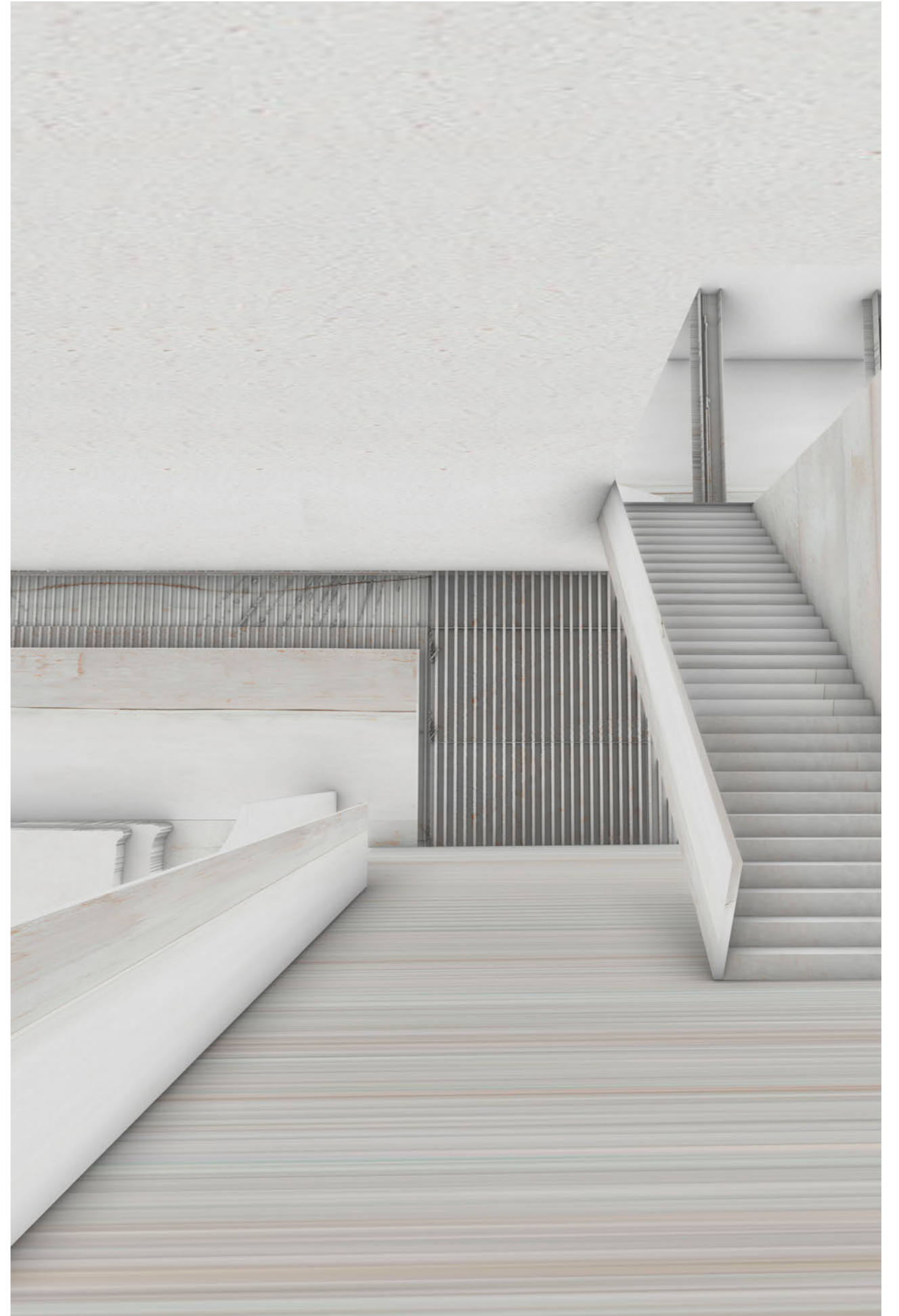
Perspective P1



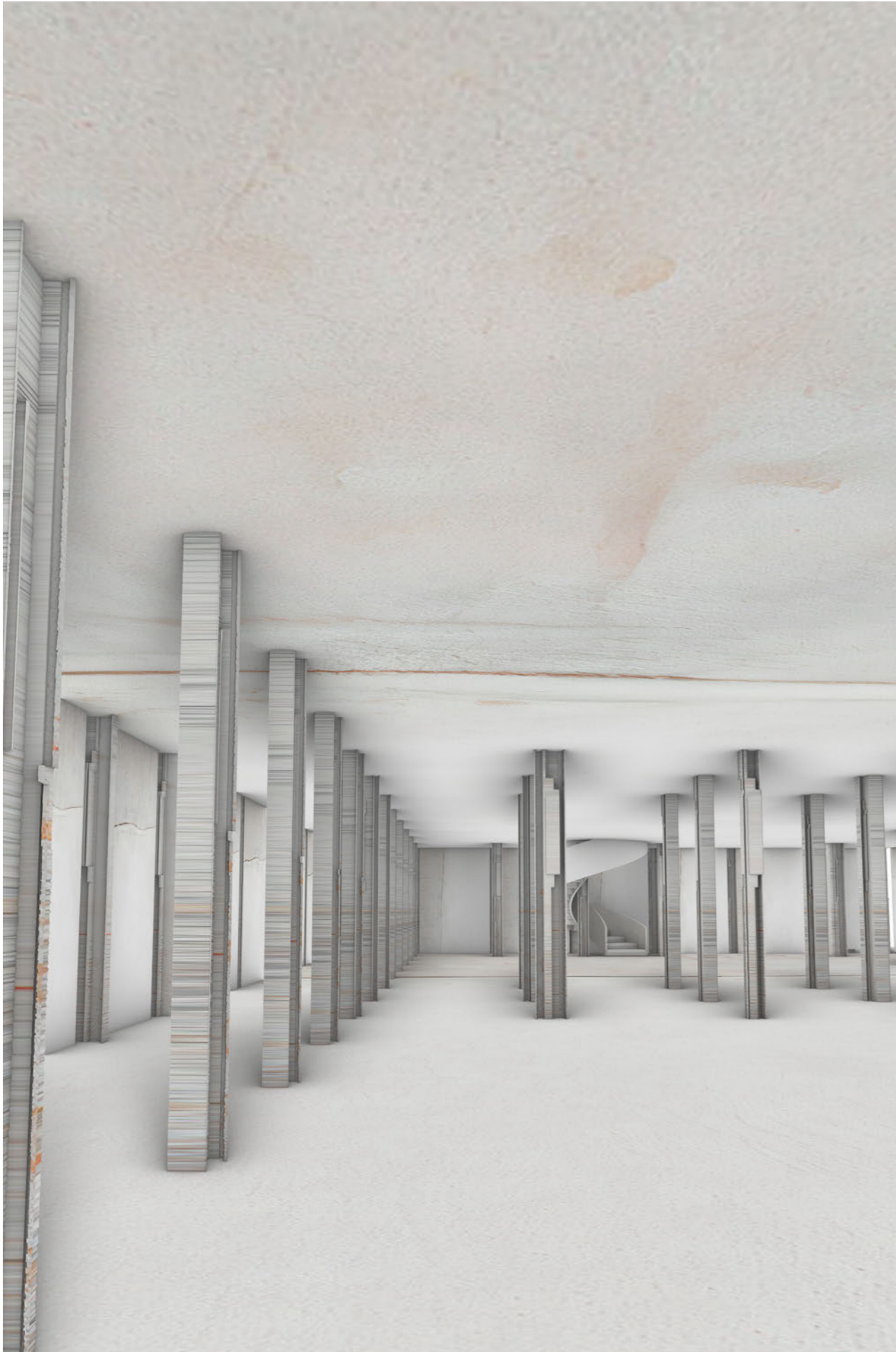
Perspective P2



Perspective P3



Perspective P4



Perspective P5



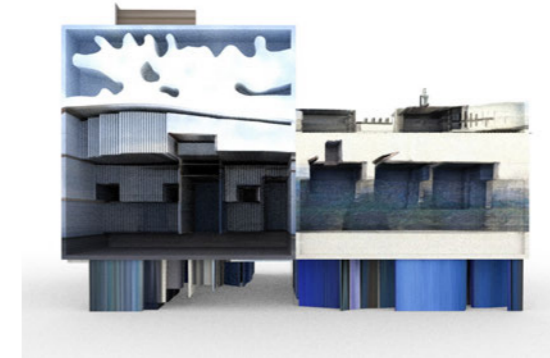
Perspective P6

DESIGN PROCESS

The process started with translating a range of generated images into reliefs and applying the textures from the original images. In the first interim, the reliefs were combined in different ways to explore the potential of combinations, space, and geometries. Many interesting spaces were created by combining them in different ways, both from the exterior and interior. The downside was the lack of flexibility in combining large reliefs containing fixed elements.

The next iteration, for mid-critic, was made of elements cut out from the reliefs, which created more flexibility to develop logical placements of the elements to create spatial qualities. The downside was the use of many different modified elements, making it hard to connect to the selected generated images.

For the last iteration, some elements were selected that had strong connections to the selected images and similarities to Ringön: this strengthened the conceptual narrative. The elements were also placed in a grid to create logic in the spaces created by the objects.



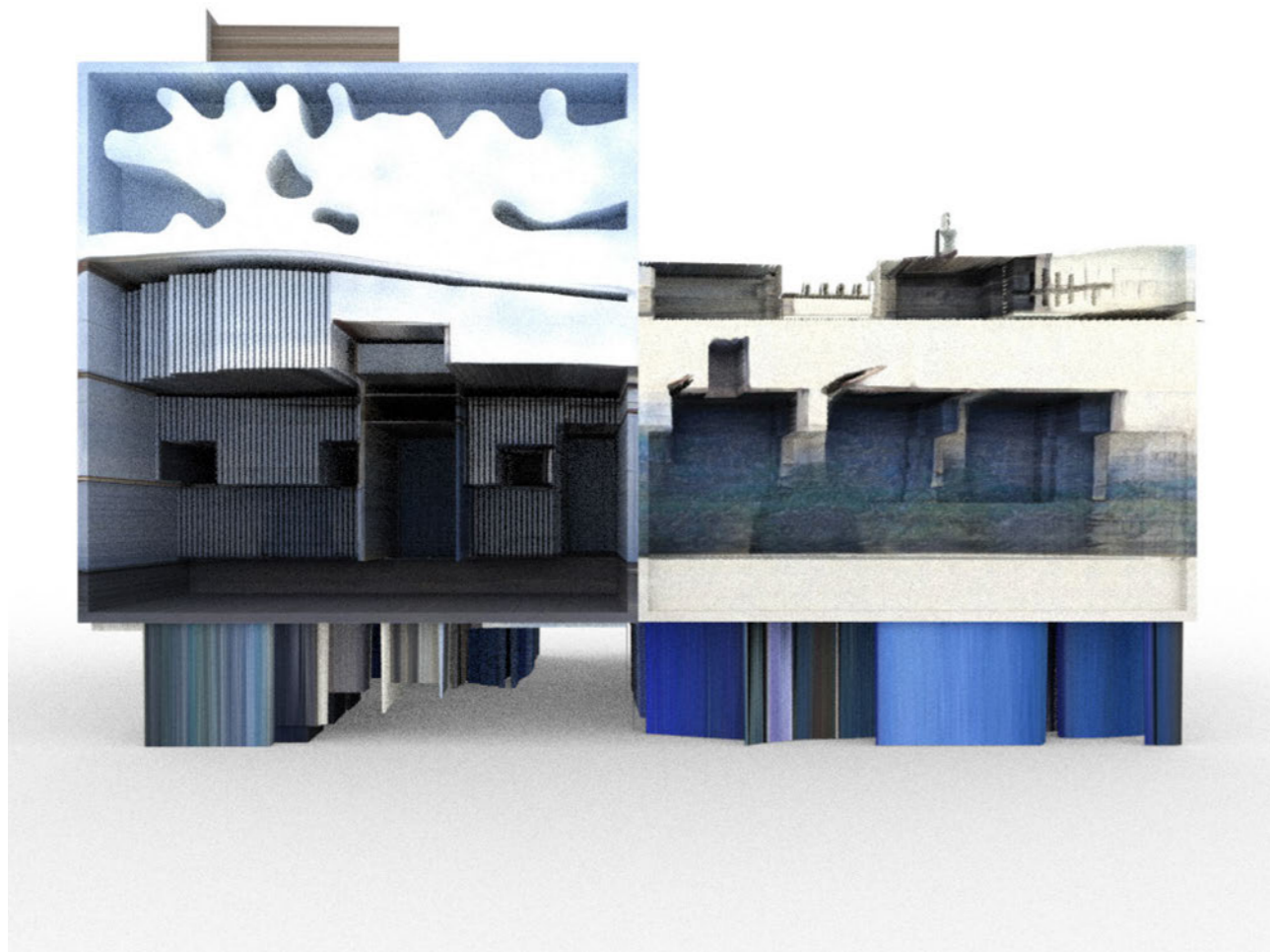
Interim one



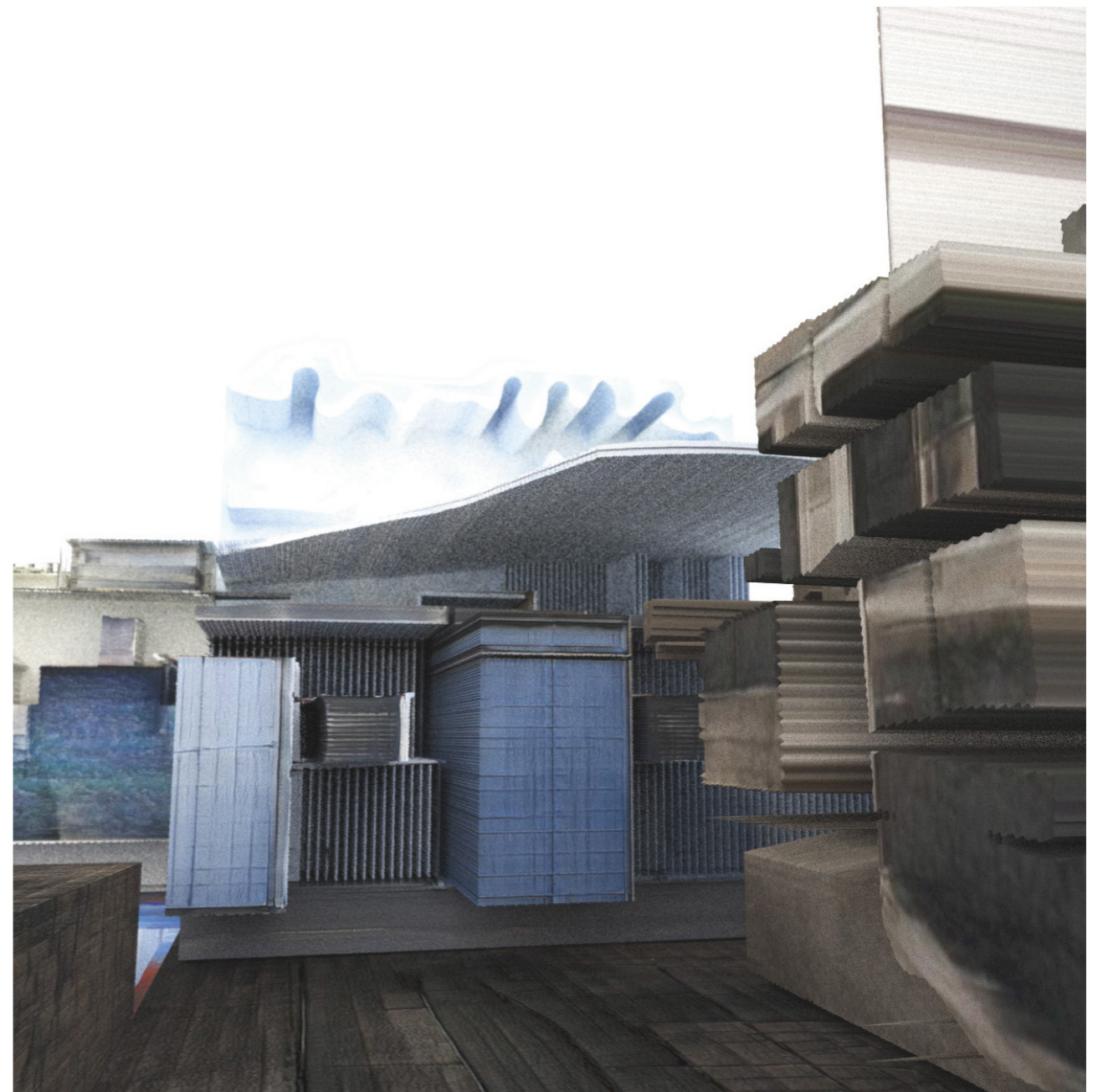
Mid-critic



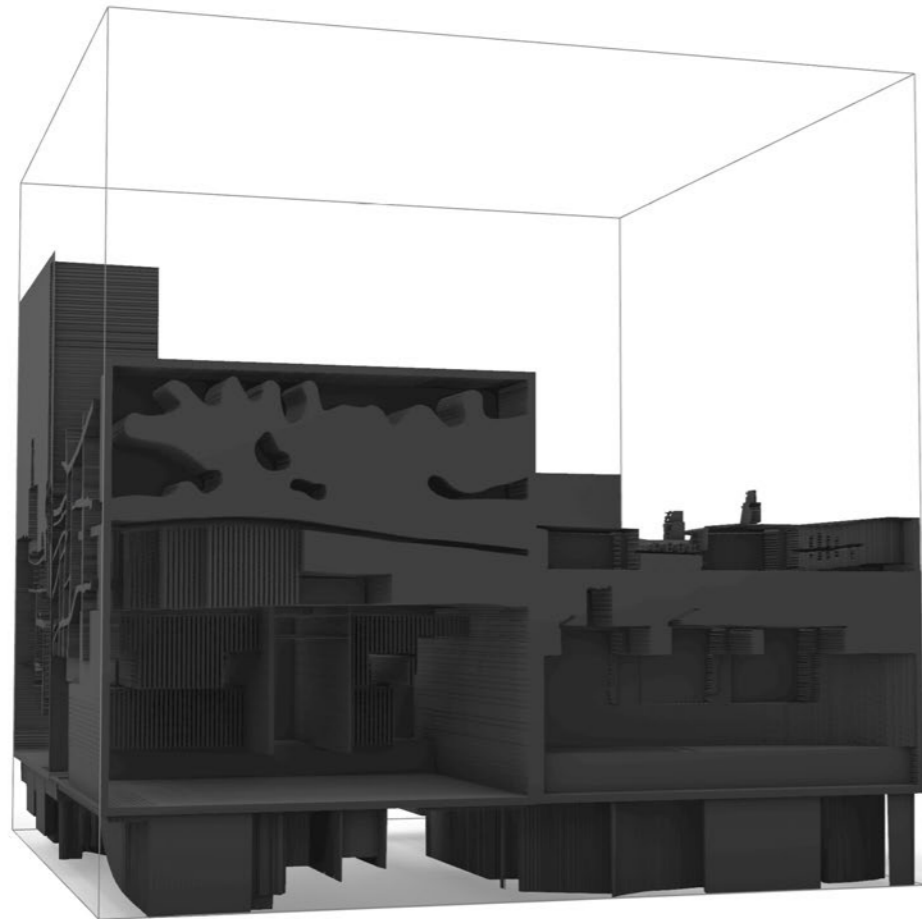
Final presentation



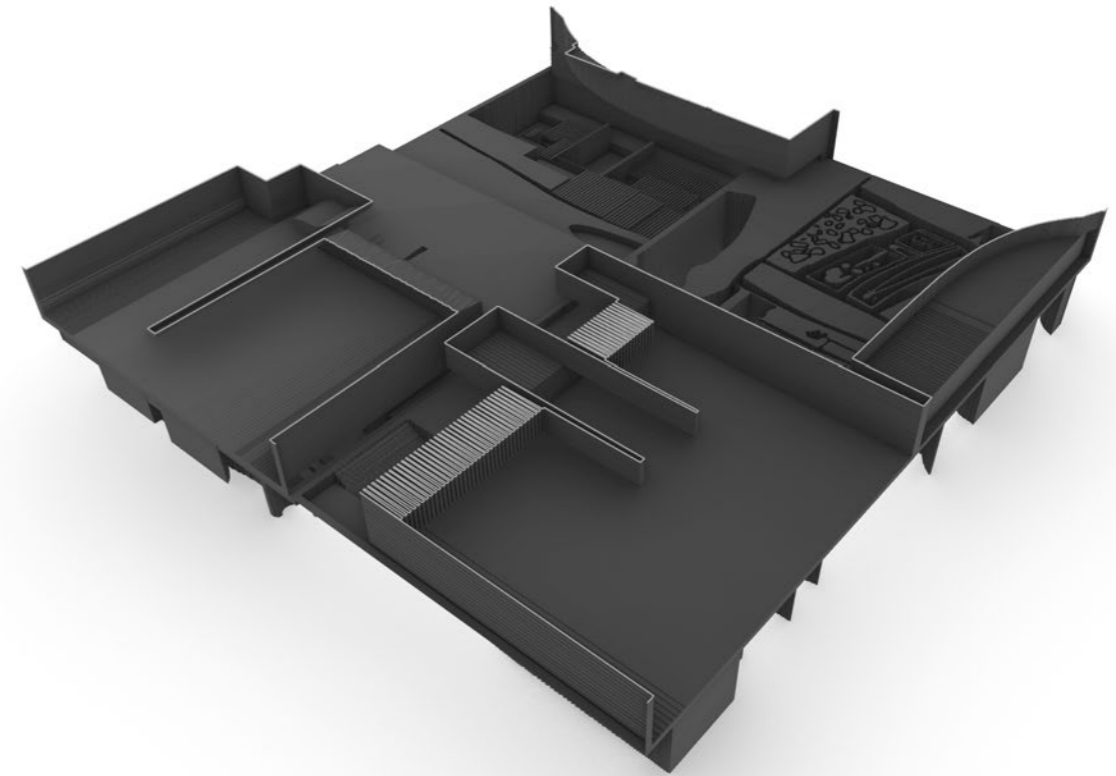
Elevation - combined reliefs, interim one



Perspective, interim one



Reliefs combined in a cube, interim one



Perspective floor plan, interim one

3D printing reliefs

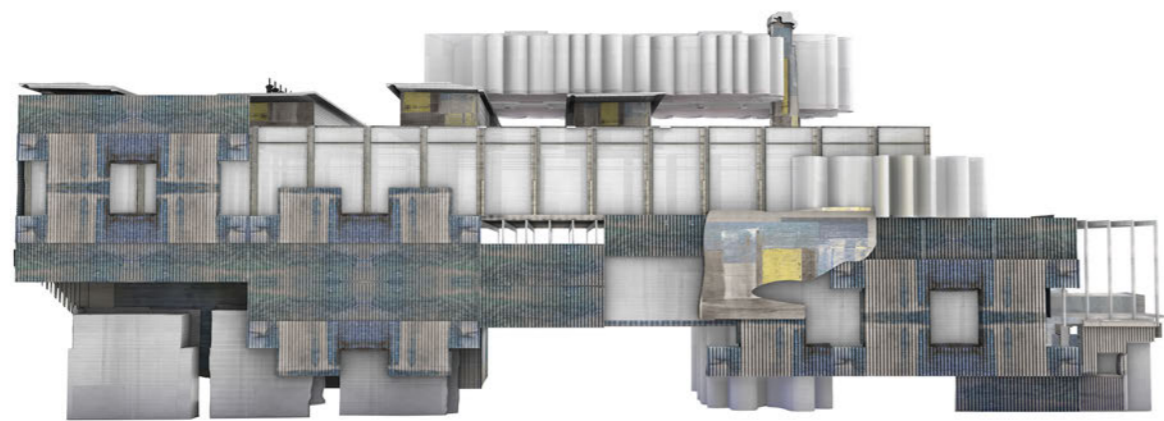
The generated images that were selected to be translated into reliefs were also 3D printed during the process to study them physically.



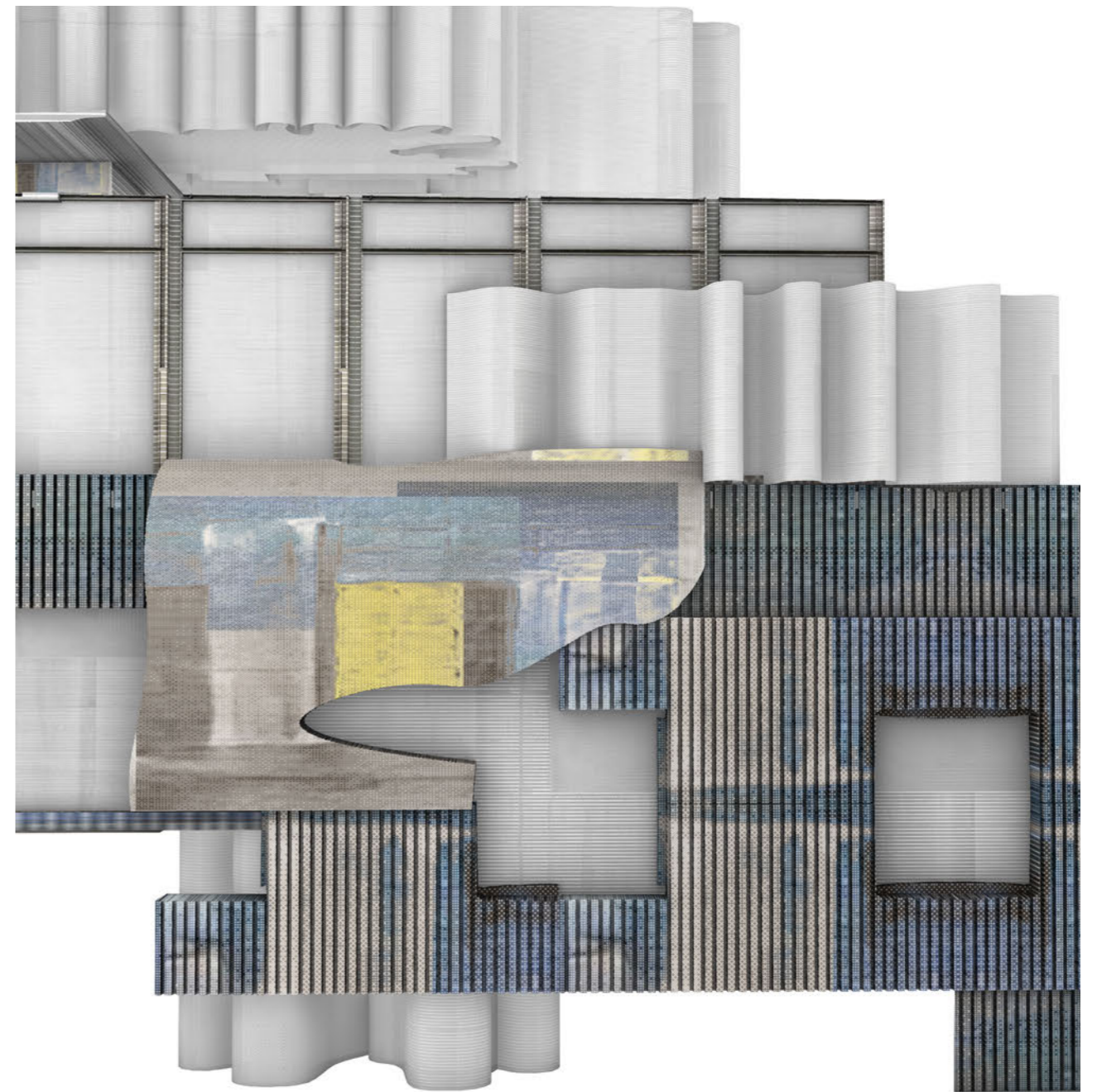
3D printed reliefs in black



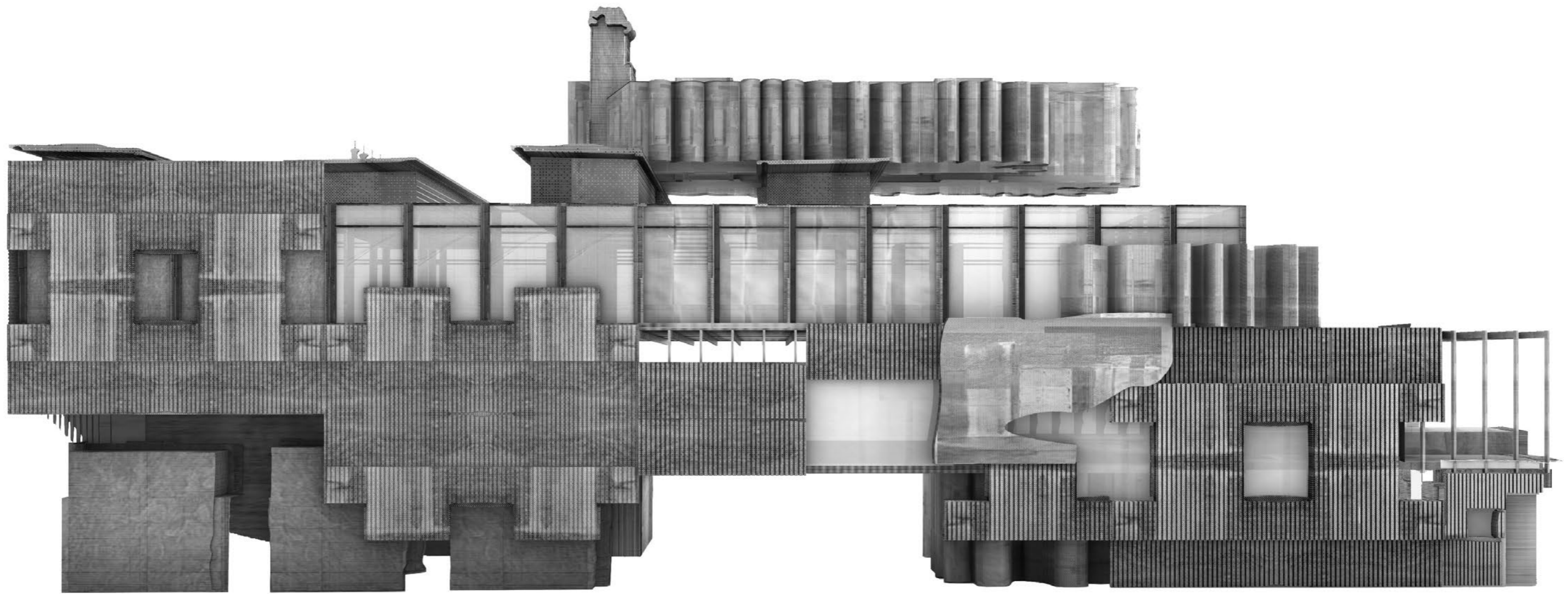
3D printed reliefs in black



Perspective elevation in color with rasterized textures,
from interim two



Zoom in showing textures,
from interim two



Perspective elevation with rasterized textures in black and white, from interim two

DISCUSSION

As architects, we must acknowledge the advancements of AI in the past year, which has ushered in a new era of design possibilities. I want to highlight with this speculative thesis project how much influence the creators of AI tools have, which I am showing through my transparent process of being the creator of the data sets to designing the final design proposal.

What is biased data, and why is it important to be critical when generating images? The people in charge of AI tools are the creators of the data sets and are in power when they select the data from which the machine is learning. Humans are biased, so these collected data sets will also be biased. The problem is that people consume data as facts. When data can be manipulated and transformed, and fed into machine learning models, that, in turn, shape the data we consume. As many architects are starting to consume this generated data, we should reflect on the bias in AI tools when using them in our design process. I believe we need to question how much we will let these people in control of the AI tools influence our design. Are we in control, or are

A machine learns quicker than humans, so the bias is amplified. When I fed the machine learning model hundreds of photographs with biased data, it generated thousands of images in a short amount of time relative to the time it would have taken a human to go through the hundreds of images and find patterns. Because the generated data is extensive, I had to make quick decisions when selecting and going through parts of the data. Even though I highlight bias as a problem with machine learning, bias is not always bad. In this thesis, when generating character, I do not believe bias is not bad, character is subjective, and design is a subjective preference. On the other hand, bias in machine learning, when referring to AI in general, can be bad and discriminatory.

Even though AI has its downsides, such as bias, it is a computing advance. In my particular case, I am using a computer to solve a problem. In this thesis, the problem is to find common elements in buildings and generate new but similar ones. The specific task I trained the GAN to solve was finding patterns in the photographs of elevation elements I identified to give the buildings character in Ringön. I did find this method to be successful, so this thesis was a way to develop a process, that could also be used in another context or to identify characteristics in photographs of other elements and later used in a design proposal. Hopefully, methods like this one can help us, as architects, so we can focus on solving other problems.

Stewart Hicks argues that studying building commonalities and attempting to incorporate similar features in a new design is limited as a design process, and it ensures uniformity without offering methods for individual buildings to find unique expressions or to deal with their unique site. To not limit the design process to just studying building commonalities, I experimented with new methods and digital tools to find out how buildings in Ringön might express character

to find a new way of designing. Similar to the example Stewart Hicks gave about how architects in the mid 17 and 1800s in France experimented with character and design, the difference between them and me is that I use advanced digital tools because of the computing advancements of today. My particular method of collecting data sets in the form of photographs with characteristic elements in Ringön and generating new but similar ones makes the final design proposal site-specific architecture. Still, since many of the generated elements are new and unique, it also gives me the flexibility to explore the unique expression of a building and Ringön as a specific site.

As an architect would, I did study the buildings' commonalities to create criteria for character from the photographs I analyzed. But to explore new ways of designing and to understand the character through another perspective, I let the GAN find the patterns in the photographs I feed it. Then the GAN gives me a range of options of what it thinks are characteristic. Then I interpret the images, compare them to my criteria, and select accordingly. From this process, I learned how the Python code I use works and how I could modify it to make it work for my purpose of generating images with characteristic elements. I also learned about bias when referring to machine learning and how much influence the creator of AI tools has. I needed to take all the steps in being the creator to fully understand the power of influence a creator of data sets and machine learning models has in the design process and the final design outcome.

I modified and altered my data set during the process of generating images to get the result I wanted, but I did that with knowledge of the architecture in the context. When the creators of popular AI tools collect their data sets, do they know, for example, Ringön as a context? Using their data set to generate images that characterize Ringön would most likely differ from using my data set to generate images. One could think critically and identify similarities and differences for someone who knows the context they are generating images of. But, the downside is that if the person generating images of a context does not know it, it becomes hard to analyze the image critically. I take from this process how important it is to look at images critically and the importance of being in control when using AI tools, especially if used in the design process.

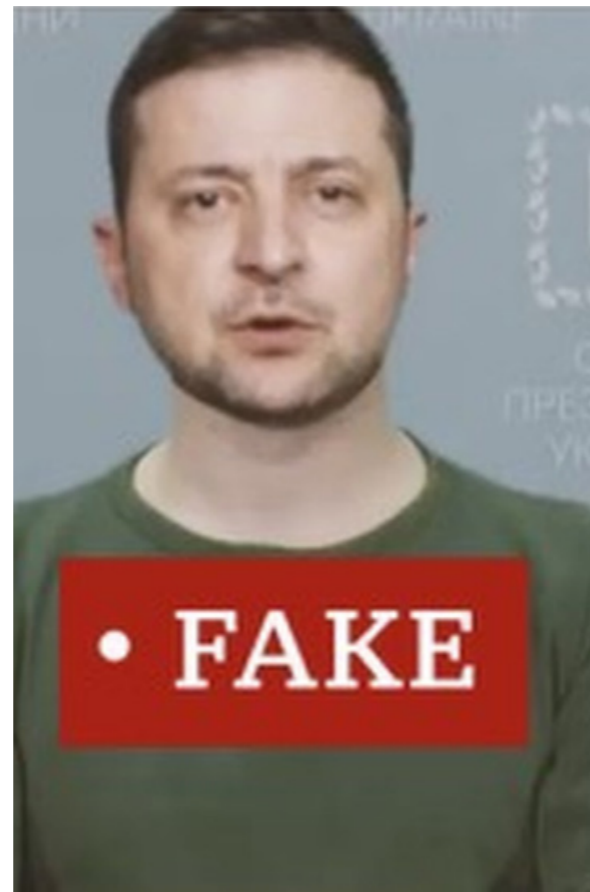
REFERENCES

Deep fakes

"Balenciaga pope" fooled the internet and Zelenskys deep fake, which could have serious consequences if it was not so unconvincing. Deep fakes are fast and easy to generate in the form of images, video, or audio to spread on the internet. It is relevant to my project because deep fakes are becoming more convincing at first glance, but after analyzing them, you can spot that it is a fake. It is also important to spread awareness of fake images and the importance of being critical.



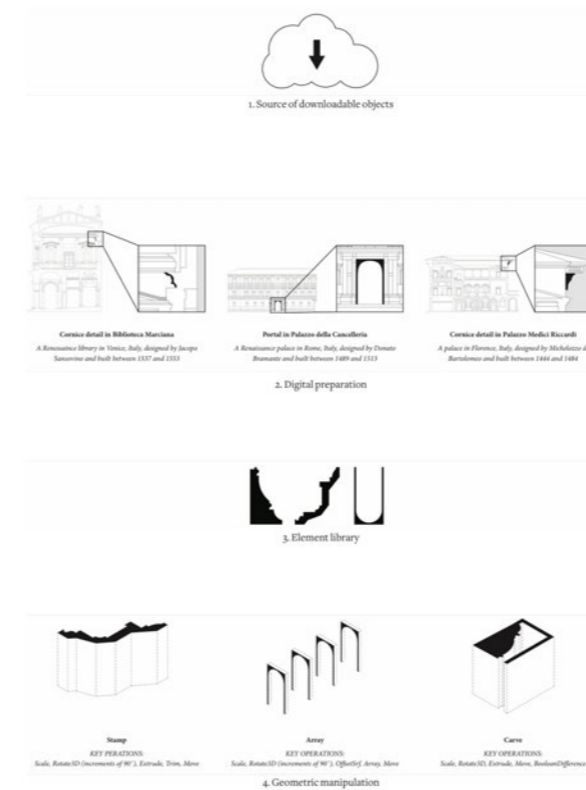
(Forbes, 2023)



(BBC, 2023)

Library of Echos, Johan Dahlberg

In the master thesis, "Library of Echos" Johan Dahlberg is building a library of collected parts from classical architectural elements downloaded from the internet. This project was relevant in the phase of translating the generated images in the method and the way of applying Object Trouve.



BIBLIOGRAPHY

Magazine

Hicks, S & Newmeyer, A. (2020) Why we got into character, MAS Context Issue 32 (2020) <https://www.mascontext.com/issues/32-character/why-we-got-into-character/>

Articles

Kelly, M. S (2023, March 16). 5 jaw-dropping things GPT-4 can do that ChatGPT couldn't. CNN. Retrieved from: <https://edition.cnn.com/2023/03/16/tech/gpt-4-use-cases/index.html>

Sample, I. (2020, January 13). What are deepfakes - and how can you spot them? The Guardian. Retrieved from <https://www.theguardian.com/technology/2020/jan/13/what-are-deepfakes-and-how-can-you-spot-them>

Wakefield, J (2022, March 18) Deepfake presidents used in Russia-Ukraine war. BBC. Retrieved from: <https://www.bbc.com/news/technology-60780142>

Placido, D. D (2023, March 27). Why Did 'Balenciaga Pope' Go Viral?. Forbes. Retrieved from: <https://www.forbes.com/sites/danidiplacido/2023/03/27/why-did-balenciaga-pope-go-viral/?sh=5c898efb4972>

Tung, L (2016, March 24). Microsoft's Tay AI chatbot goes offline after being taught to be a racist. Zdnet. Retrieved from: <https://www.zdnet.com/article/microsofts-tay-ai-chatbot-goes-offline-after-being-taught-to-be-a-racist/>

Images

Wakefield, J (2022, March 18) Deepfake presidents used in Russia-Ukraine war. BBC. Retrieved from: <https://www.bbc.com/news/technology-60780142>

Placido, D. D (2023, March 27). Why Did 'Balenciaga Pope' Go Viral?. Forbes. Retrieved from: <https://www.forbes.com/sites/danidiplacido/2023/03/27/why-did-balenciaga-pope-go-viral/?sh=5c898efb4972>

Tung, L (2016, March 24). Microsoft's Tay AI chatbot goes offline after being taught to be a racist. Zdnet. Retrieved from: <https://www.zdnet.com/article/microsofts-tay-ai-chatbot-goes-offline-after-being-taught-to-be-a-racist/>

Video

Hicks, S (2020). Why Architecture Today Lacks Character [Video]. Youtube. <https://www.youtube.com/watch?v=tcNMQilPkn8&t=30s>

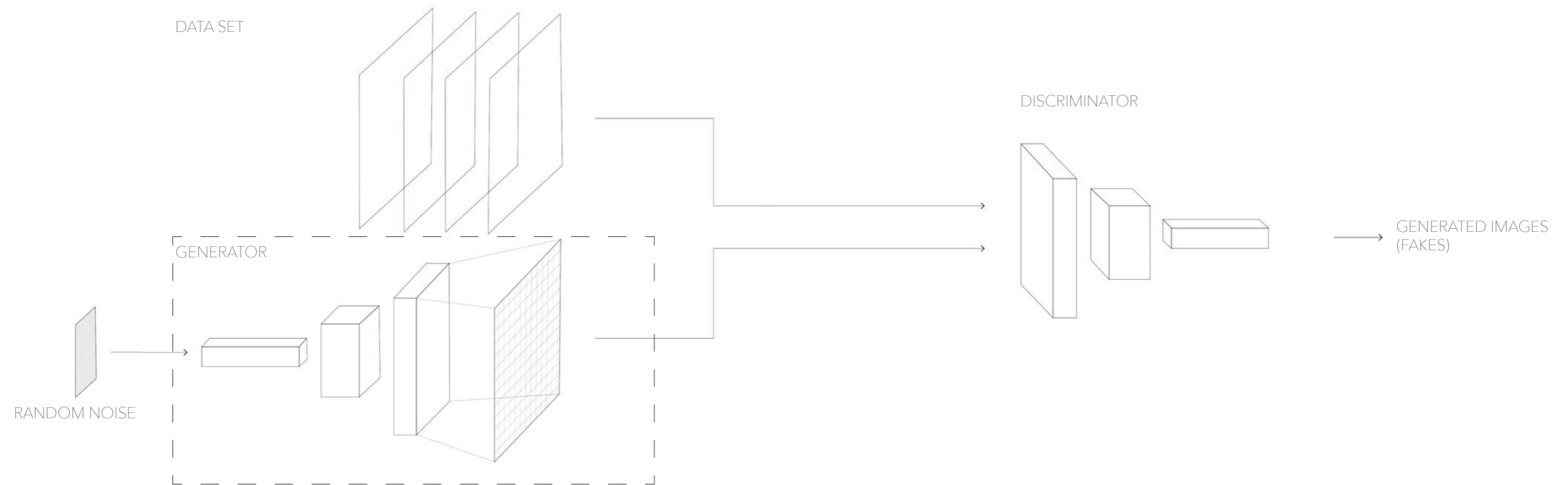
Google Colab Notebook

Shultz, D (2022). Stylegan2-ada-pytorch [Notebook]. Google Colab. https://colab.research.google.com/github/dvschultz/stylegan2-ada-pytorch/blob/main/SG2_ADA_PyTorch.ipynb

ARCHIVE

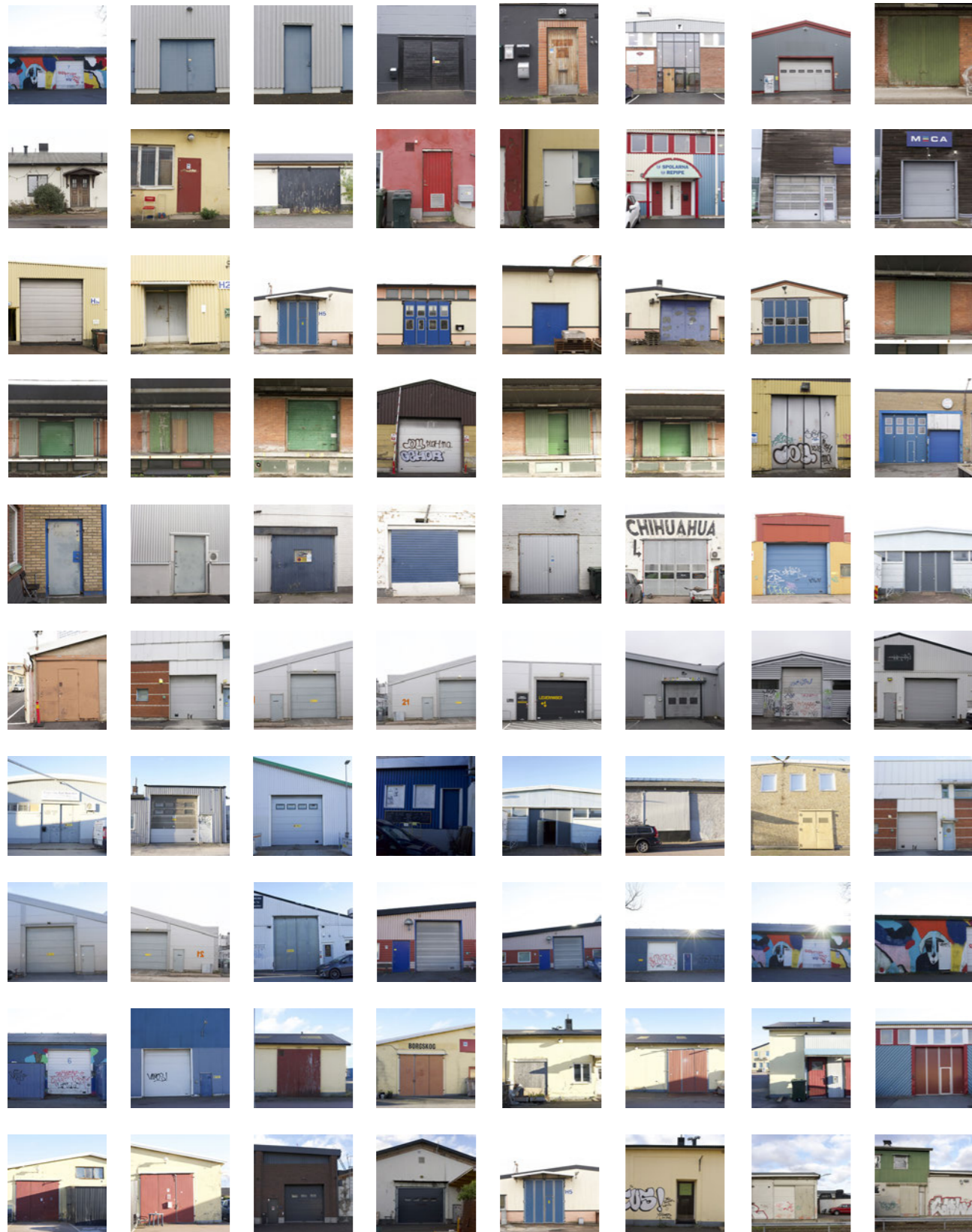
How a GAN works

A generative adversarial network is a machine learning model consisting of two neural networks, a generator, and a discriminator, that compete to generate more accurate results. The generator feeds off random noise to generate images, and the discriminator compares the generated image to the data set and decides whether it is a similar image to the ones collected. The discriminator gives hints to the generator when it gets closer to the data set, and the generator can refine the image.



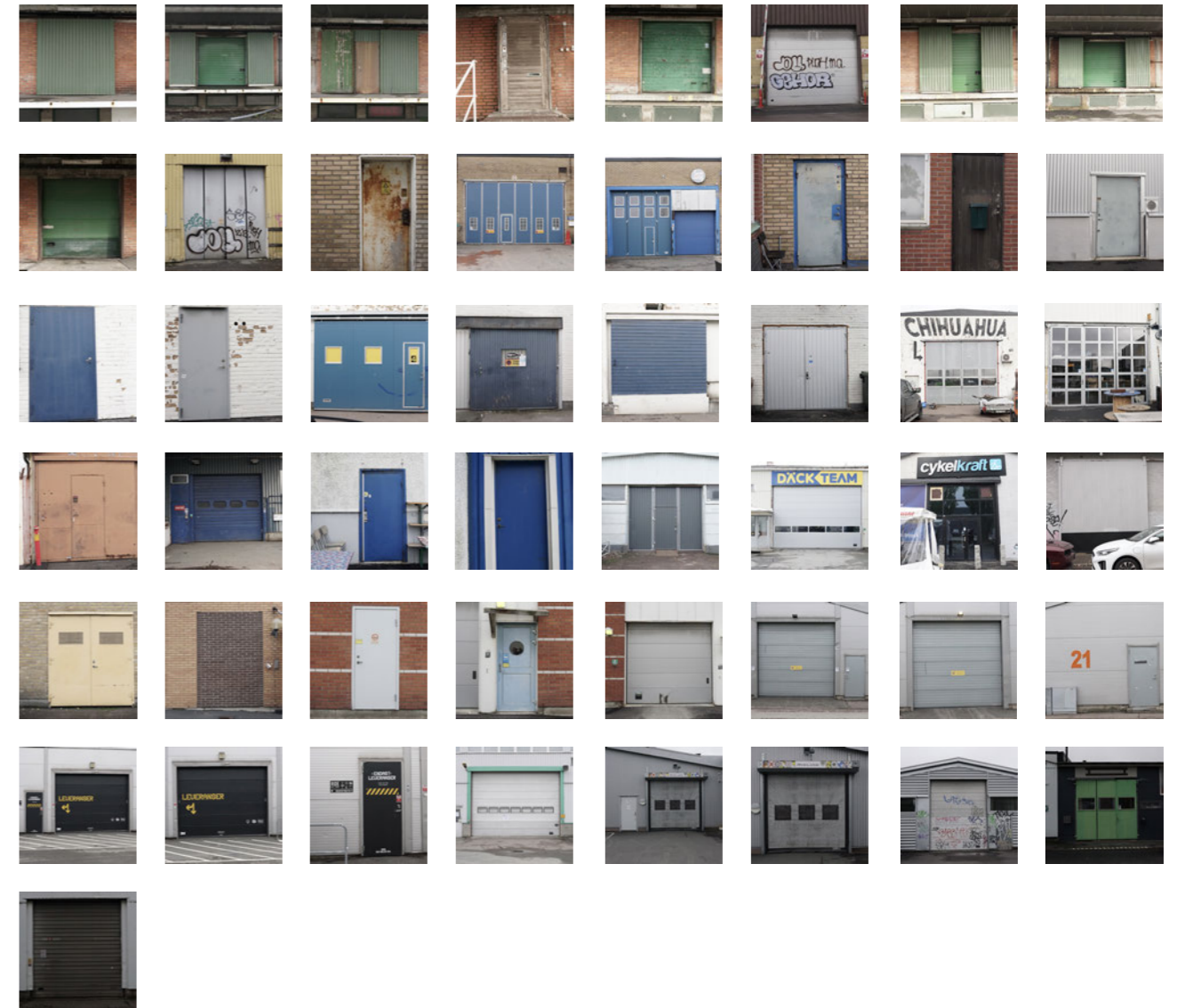
The last collected data set

This data set was the last and tenth data set collected.
98 images of compositions were collected.



First collected data set

120 images of gates were collected in this data set.



Criteria for character

The following four spreads are photographs that were analyzed to create criteria of character to select the generated images.

Volumes

Contrast: Low-rise buildings placed next to large buildings
The original industrial buildings: one- to two-story buildings
Roofs with irregularly placed ridges.

Windows

Irregularly placed
Placed high up on elevations
Lack of windows
Closed off or covered

Gates

Large gates on small volumes
Standard-sized doors next to large gates

Ventilation

Sometimes small for a large volume
Awkward placements of ventilation: placements followed function
The use of many buildings has changed over time: it is today not always easy to reveal the business inside by the look at the ventilation from the exterior

Materials

Vertical metal sheet
Plaster
Brick

Colors

Blue, yellow, red, orange, light grey, and black



Collage-like geometry and irregular window placement make it hard to read the number of floors from the elevation.



Small volume with a standard-sized door placed deep in the elevation. On the roof are pipe ventilation and two rectangular ventilations. There is a frame extruded around the wooden door. The plaster is painted yellow and has a grey strip at the bottom.



The gate is large in proportion to the volume. The ventilation is small in proportion to the volume and gate. The red color of the gate is peeled off, while the yellow plaster facade is in good shape.



Buildings are creating layers that are creating depth and shadows.



Covered windows, and if a closer examination of the material on the elevation is made, it seems the material is displaying cracking.



Three gates placed on top of the elevation are repeated along the elevation.



Material meetings, yellow plaster in good shape, meets wood painted in red. The red color is peeled off.



Standard-sized door next to a large gate, blue vertical metal sheet, ventilation along the roof ridge



Elevation - vertical metal sheet with decay