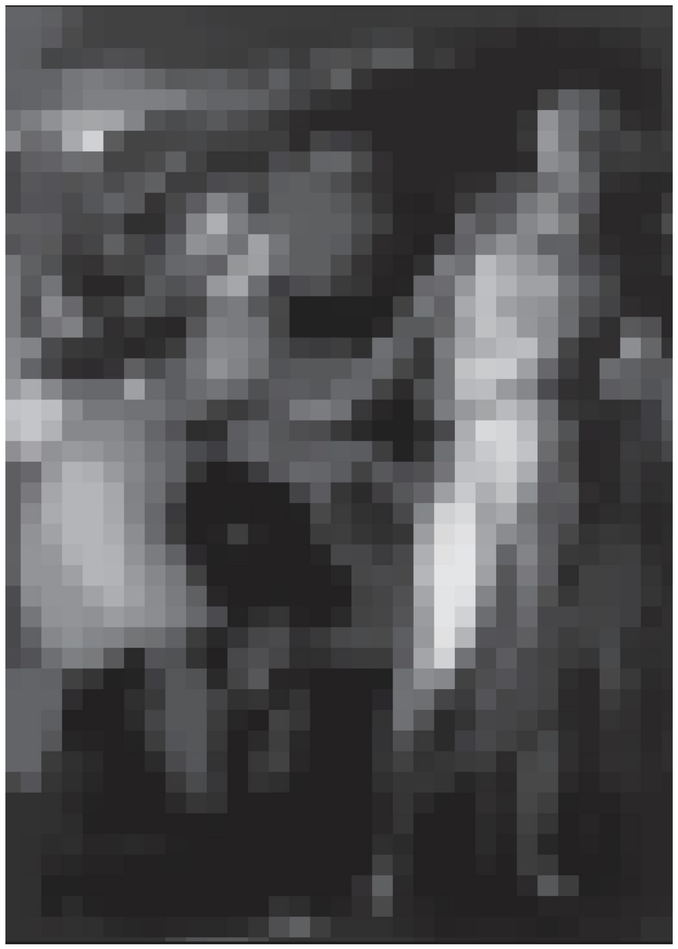
IMPRESSIONS OF A FLOODED PAST

ARCHITECTURALLY SCULPTING THE ARNO'S FLOW TO RE-IMAGINE FLOODED ART

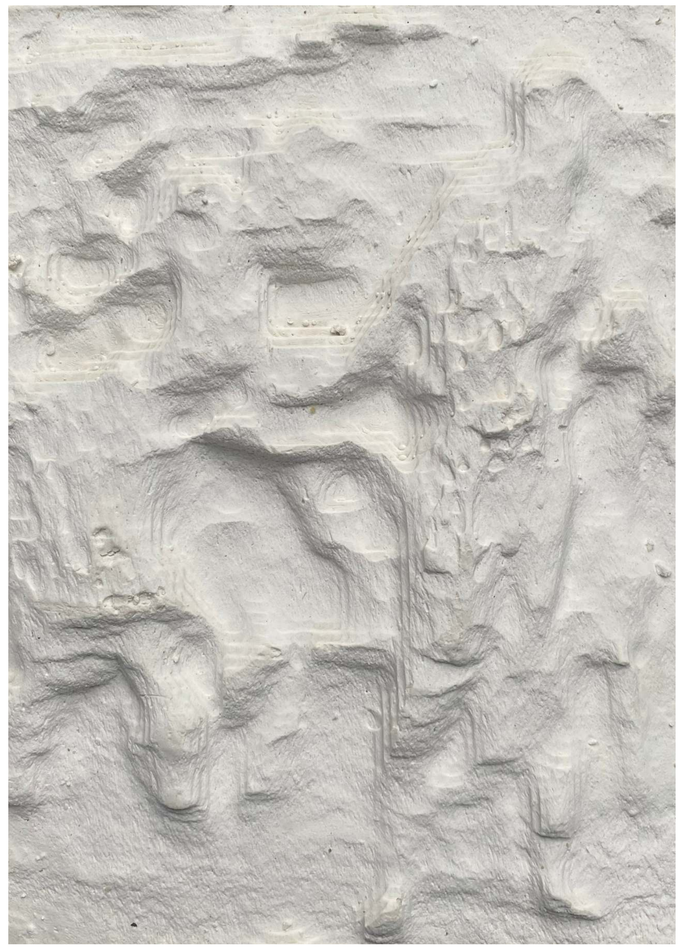
OSCAR LAKATOS - UG03

TECH TUTOR : MARTIN REYNOLDS

BARC0109 25-26 - DESIGN TECHNOLOGY







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0 INTRODUCTION

A river intervention in the historic centre of Florence proposes a new relationship between architecture, water, and cultural memory, through the integration of a museum and institute for flooded art restoration positioned directly within the River Arno. The project seeks to reconnect the city with its river by transforming the Santa Rosa weir into a civic and environmental space, where the flow of water becomes a medium for artistic expression.

Rooted in the legacy of the 1966 Florence flood, this proposal responds to the damage inflicted on the city's artistic heritage by re-imagining the river not as a threat, but as a collaborator. The building programme draws inspiration from the restoration efforts that followed the flood, creating a space where damaged artworks are not only preserved but conceptually reinterpreted through hydrodynamic processes. By situating the architecture above and within the river, the project establishes a direct dialogue between the built form and the natural system it inhabits.

In reflection of the Arno itself, the architecture is designed as a dynamic and responsive system. The building's structure, environmental strategies, and material choices are informed by river flow, climate, and ecological conditions, allowing water to pass through, shape, and influence the spaces within. In this way, the project extends beyond a conventional museum, becoming a living interface where river, structure, and artwork converge, enabling visitors to engage with both the environmental forces and cultural narratives that define Florence.

ABSTRACT

This dissertation explores the relationship between architecture, hydrodynamics, and artistic expression through the design of a museum and institute for flooded art restoration situated on the River Arno in Florence. The project is grounded in the historical impact of the 1966 Florence flood, which caused widespread cultural damage and inspired a rethinking of how architecture can engage with water as both a destructive and generative force .

The proposal investigates how the natural behaviour of the river, its flow, turbulence, and erosion, can be harnessed as a creative tool, transforming the river into an active participant in the production of art. By designing an artificial riverbed system, the project explores the possibility of translating historical paintings into hydrodynamic patterns, where water velocity and turbulence recreate tonal compositions of artworks damaged during the flood.

Through iterative digital simulations, physical material testing, and environmental analysis, the project develops a building that not only responds to flood risk, climate, and river ecology, but also integrates sustainable systems such as river-based heating and cooling, water harvesting, and micro-hydropower. The architecture is conceived as a framework where river, structure, and artwork coexist, positioning the building as both a protective and interpretive space.

Ultimately, this research proposes an architectural language in which natural forces are not resisted but embedded into design, allowing the River Arno to act simultaneously as context, medium, and creator.

AIMS

1. To reconnect the city of Florence with the River Arno by re-imagining the Santa Rosa weir as an accessible cultural and architectural intervention.
2. To design a museum and institute for flooded art restoration that commemorates the impact of the 1966 flood and the efforts of restoration initiatives such as the “Mud Angels.”
3. To investigate how hydrodynamic processes (flow velocity, turbulence, erosion) can be used as a design driver and artistic medium within architecture.
4. To develop a system where the river generates visual representations of historic artworks, using artificial riverbeds to translate tonal information into water movement.
5. To explore flood-resilient architectural strategies, including permeable ground floors, flow-directed structures, and hydrodynamic piling systems that minimise disruption to river behaviour.
6. To integrate sustainable environmental systems such as river heat exchange, passive ventilation, rainwater harvesting, and hydropower generation into the building design.
7. To test the long-term interaction between water and materials, particularly sandstone, and understand how erosion can become part of the evolving architectural and artistic expression.

RESEARCH QUESTIONS

1. How can architecture transform a natural force such as a river from a destructive agent into a creative and generative design tool?
2. In what ways can hydrodynamic behaviour be translated into spatial, structural, and artistic outcomes within an architectural framework?

Specific Investigation Questions:

3. Is it possible to translate the tonal composition of paintings into river flow dynamics using artificial riverbed geometries?
4. How do variations in river velocity, turbulence, and depth influence the visual outcome of hydraulic “artworks”? What role does surface geometry and friction (informed by Manning’s equation) play in controlling water behaviour across designed riverbeds?
5. How can hydrodynamic pile design and structural systems minimise turbulence and maintain stable flow conditions around the building?
6. To what extent can erosion and material degradation (e.g., sandstone weathering) be predicted and incorporated as part of the architectural design process?
7. How can the building respond to flood conditions through adaptive design strategies, such as open ground floors, flood gates, and vegetation-based mitigation?
8. How can river-based energy and environmental systems (cooling, heating, and hydropower) reduce the building’s reliance on conventional mechanical systems?


FLORENCE
SITE
PESCAIA DI SANTA ROSA

SITE INTRODUCTION

Situated in the center of Florence this site offers a unique opportunity to reconnect the population with the river Arno. With limited river side accessibility, the weir feels very separated from the surroundings city. I saw this as a great opportunity to re-imagine an iconic Florentine viewpoint and more importantly to experiment with interesting Hydrodynamics.

KEY FEATURES:

1. RIVER WEIR
2. BRIDGE CONNECTIONS
3. RAISED RIVER PROMENADES
4. RIVERSIDE ACCESS
5. RIVERSIDE PROMENADES
6. RIVERSIDE BIODIVERSITY
7. CAR PARK
8. PUBLIC SQUARE
9. CHURCH

KEY:

Features.

Site.

Bus stops.

View points.



A.



B.



C.



D.



E.



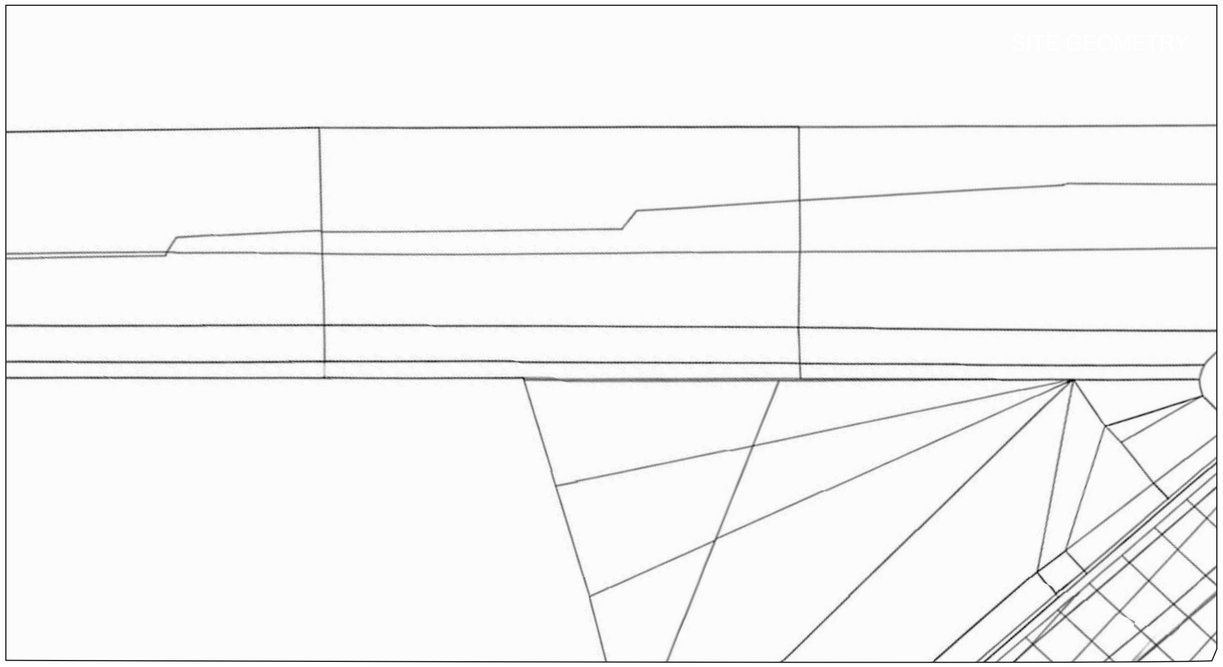
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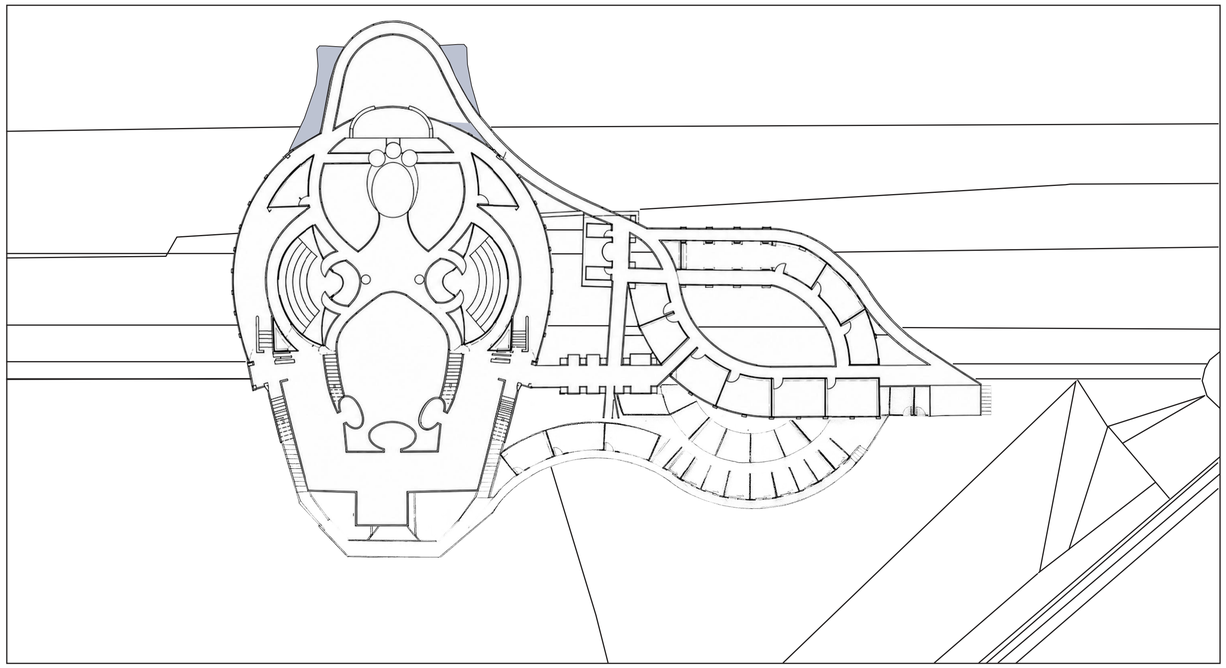


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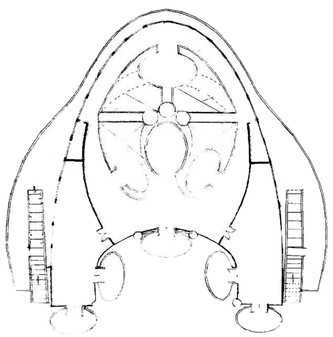


PROPOSED DRAWINGS

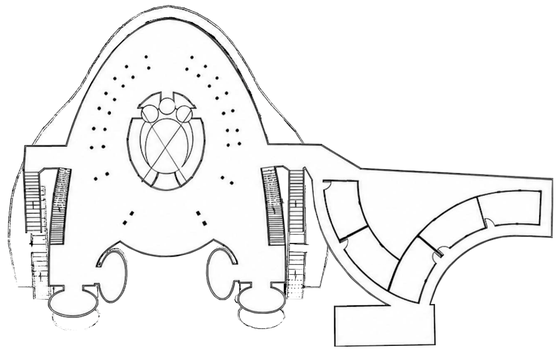




FIRST FLOOR



SECOND FLOOR



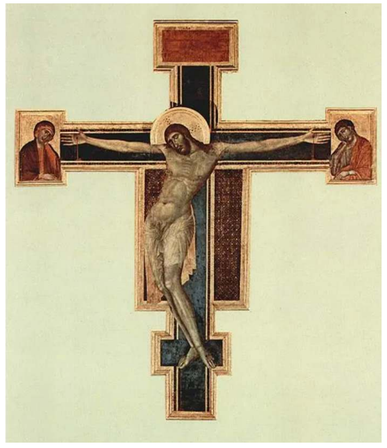
SITE CONTEXT & HISTORY







PHOTOGRAPHS FROM THE 1966 FLOOD





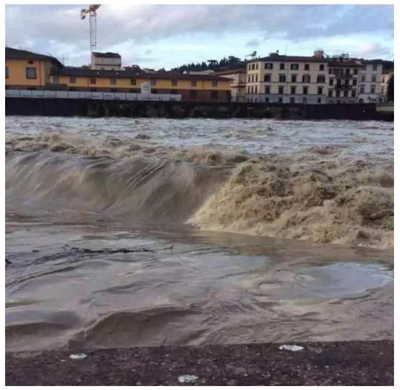


CIMABUE'S CRUCIFIX DAMAGED IN THE 1966 FLOOD

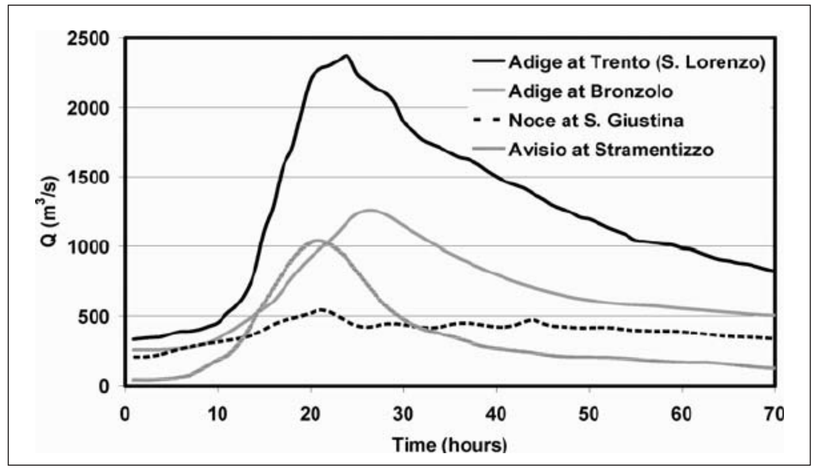
In November 1966 Florence was hit with one of the most extreme European flood events in recent history. A lack of river monitoring across the Arno systems meant that the city was unable to predict the extremity of the flooding and therefore suffered severe damage from the event. As a result of the flood, up to 14,000 cherished pieces of art were damaged including paintings, sculptures and panels. Given the rich artistic history within the city of Florence people went to great lengths in order to initially protect and later restore and repair these pieces of art. My building programme hinges on the damage caused to these specific artworks.

MORE RECENT, LESS EXTREME FLOODING

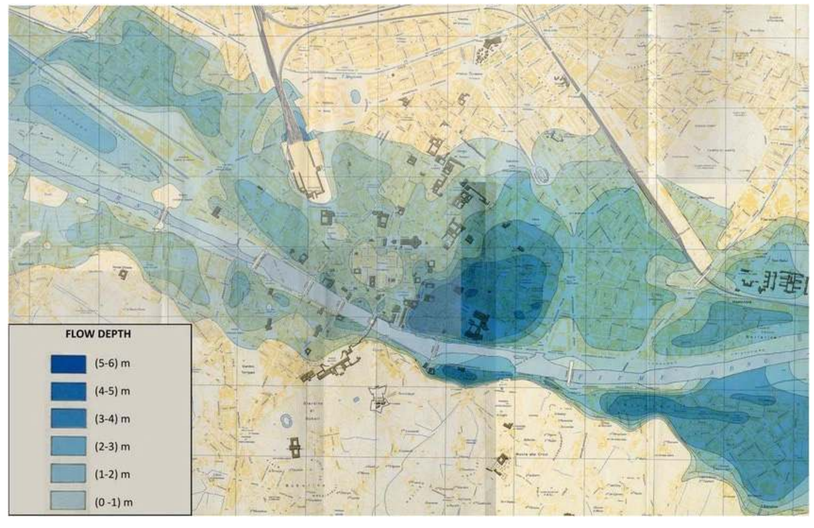




1966 FLOOD HYDROGRAPH



1966 FLOOD EXPANSION ACROSS FLORENCE



PROGRAMME - MUSEUM & INSTITUTE FOR FLOODED ART RESTORATION







VASARI'S LAST SUPPER, DAMAGED IN 1966 AND LATER RESTORED

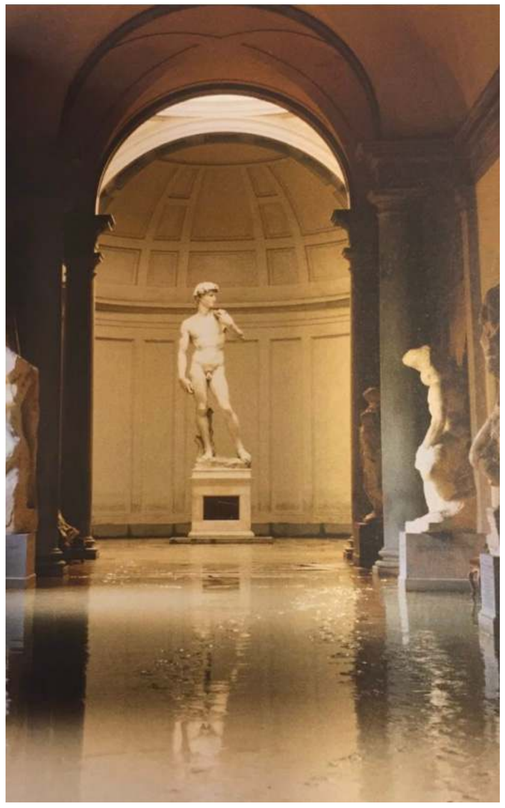
A lot of the immediate, makeshift response to protect these art works from water contamination came from a group of student volunteers named, 'The Mud Angels'. Most of their work included initially finding and transporting art to dry buildings, quarantining the art, drying, disinfecting, and peeling mud from nuanced surfaces. A large reason artworks such as Vasari's 'Last Supper' and Cimabue's crucifix are currently restored and displayed is due to these initial efforts made by the Mud Angels.

My building programme aims to recognise these efforts, by displaying these specific artworks in an institute of flooded art restoration. On top of this I wanted to place my museum directly above the Arno in order to reconnect the cities population with the river and overcome the city's cultural and even architectural divide with the body of water. This also provided plenty of potential for an exciting water based technical investigation.



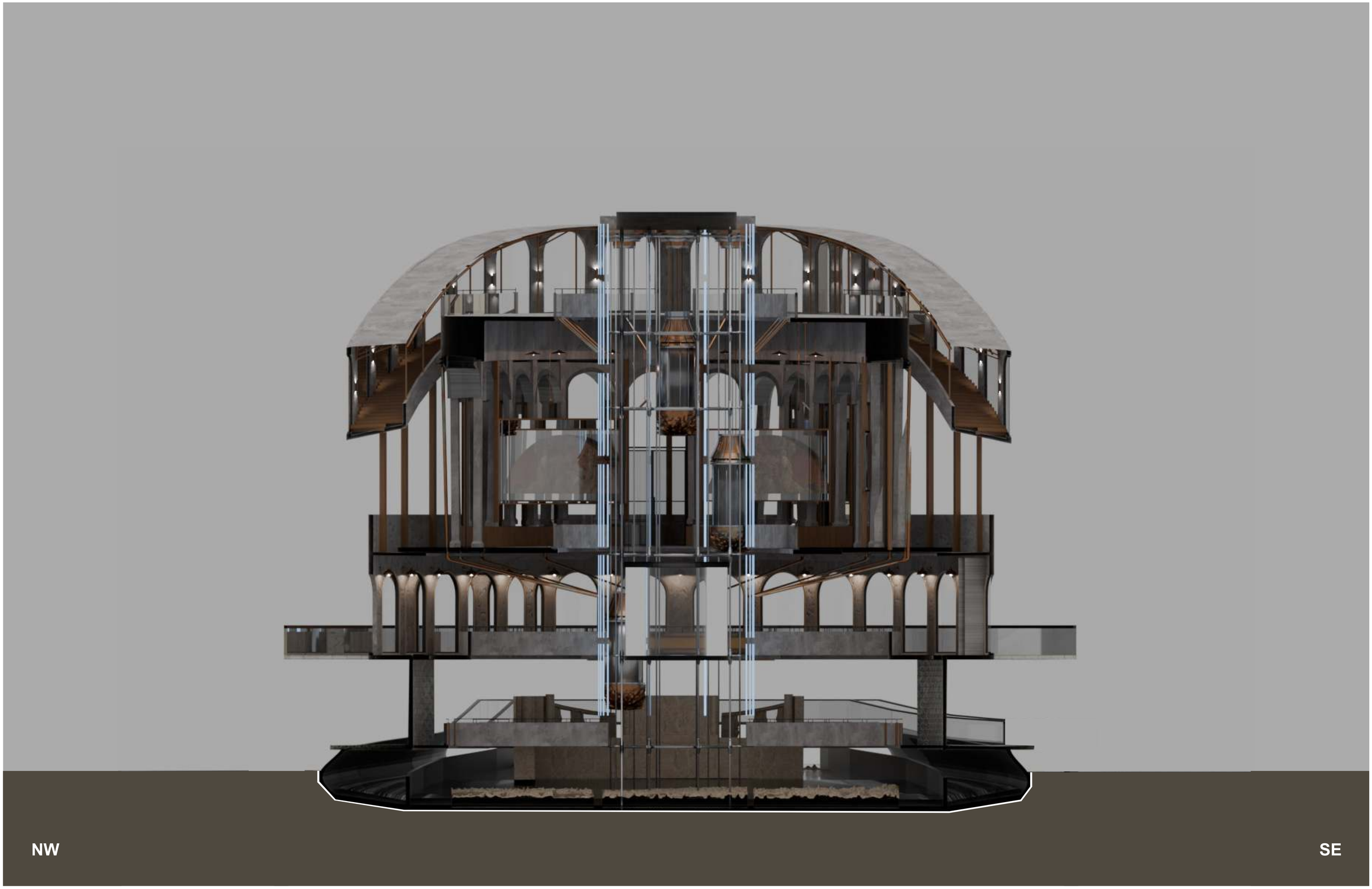


THE EFFORT'S OF FLORENCE'S 'MUD ANGELS'



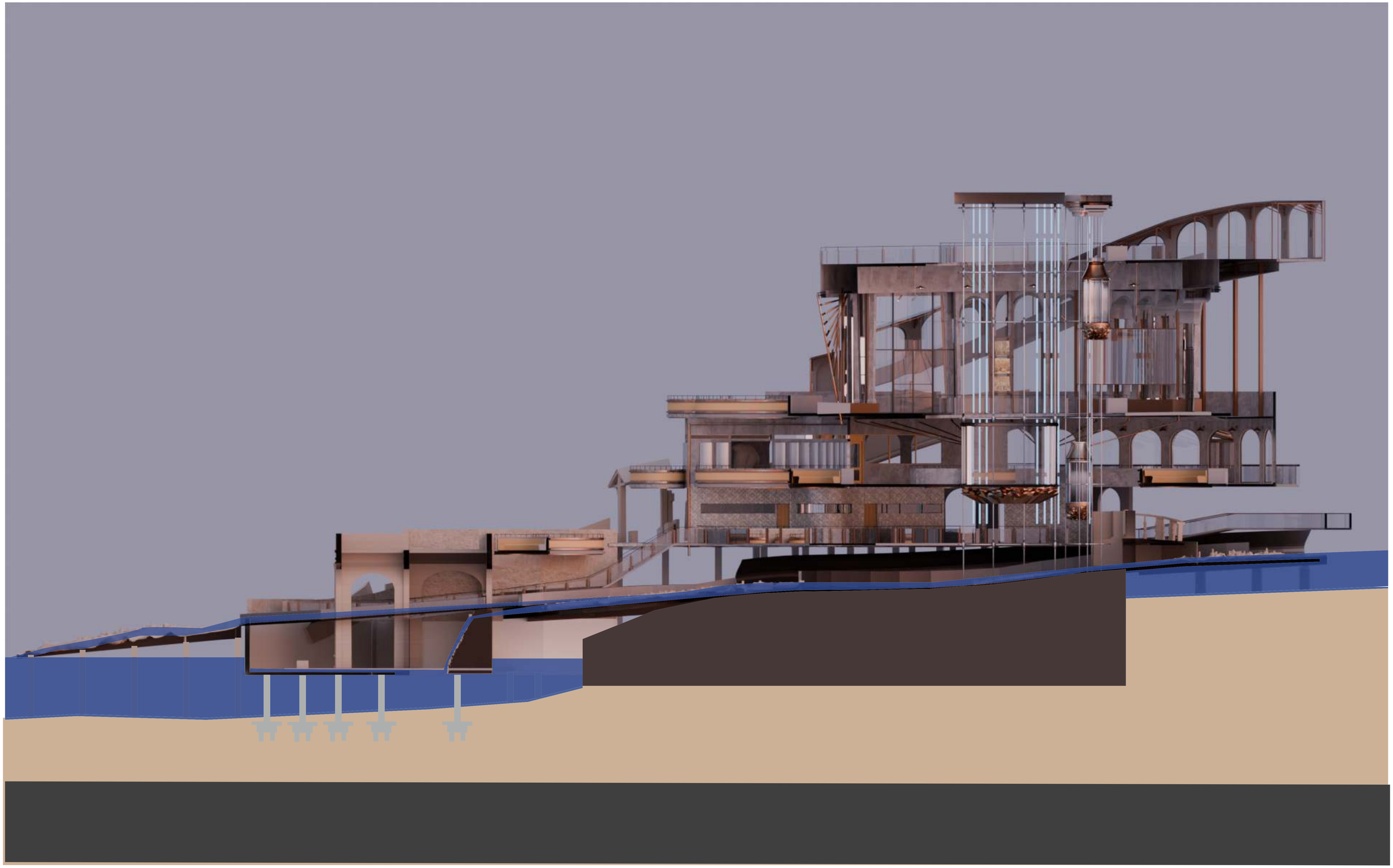
FLOODED MUSEUMS DURING THE 1966 FLOOD





NW

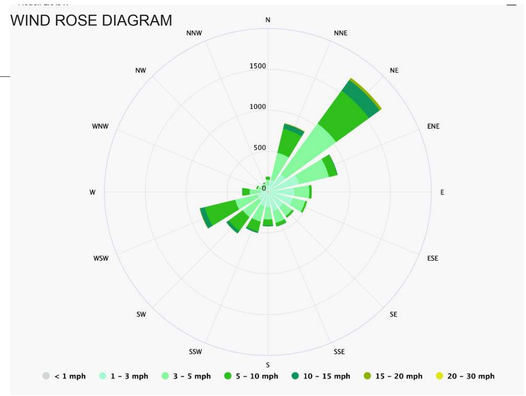
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1 SITE ANALYSIS AND RESEARCH

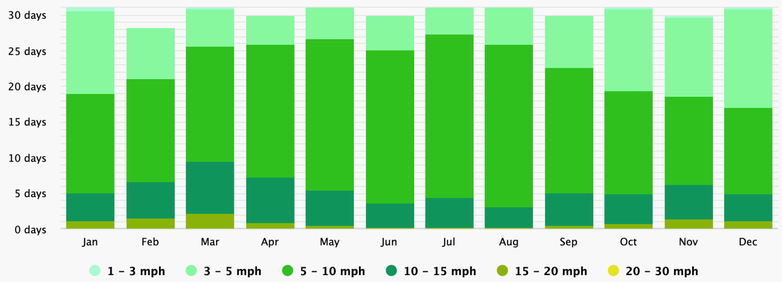
SITE CLIMATE RESEARCH

WIND ROSE DIAGRAM



The prevailing wind force in Florence is called the Grecale wind and comes from the North East. This is a cold and dry wind originating from the Apennine mountains. The less dominant south westerly wind is called the Libeccio, coming from the Tyrrhenian Sea. It is typically mild and often brings rain and cloudy skies. It is associated with unsettled, gusty weather but is not as cold as the Grecale wind.

MONTHLY WIND SPEED

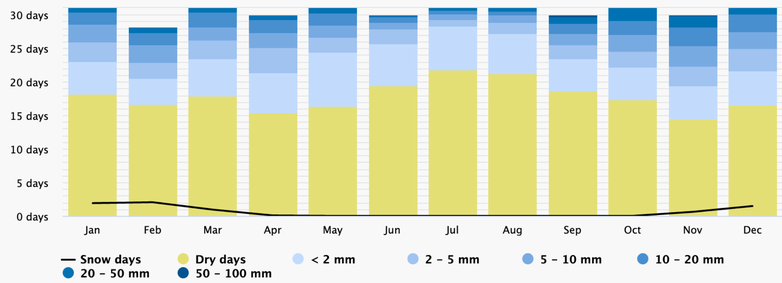


From the graph you can see that extreme wind are rarely experienced in Florence, with the most extreme month being March, averaging two days of winds ranging from 15-20 mph. The month with the most consistent wind speed is July, with roughly 23 days of mild winds between 5-10 mph. The month with the lowest average wind exposure is December, with 14 days of winds between 1-3 mph.

NATURAL VS URBAN NOISE

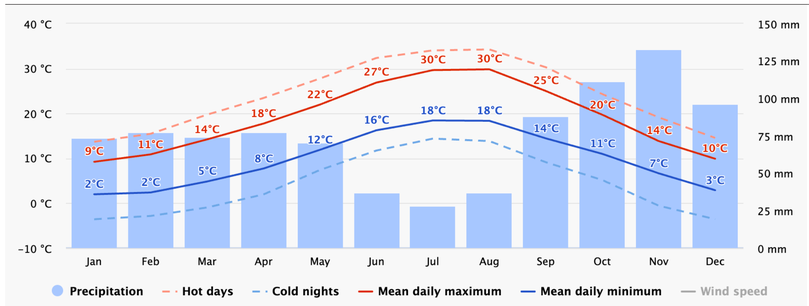
The soundscape around the Santa Rosa weir is dominated by the continuous noise of water flowing over the structure, typically around 70–80 dB, similar to a small waterfall. This forms a constant acoustic base, partially masking intermittent urban noise from nearby roads and bridges, which generally ranges between 50–70 dB, creating a dynamic yet layered environment.

MONTHLY PRECIPITATION



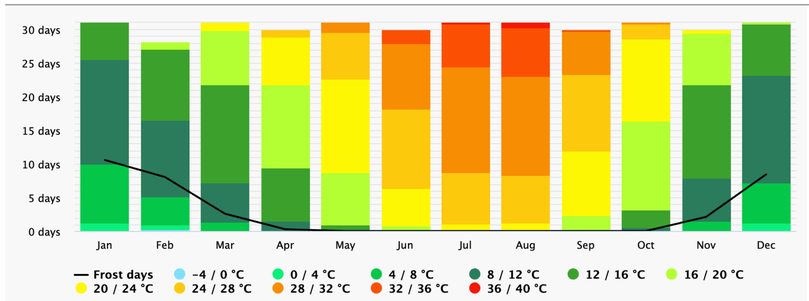
Florence is generally dry for just above half of the year, with very few snow days between November to February. Extreme rain is also very rare, November being the rainiest month with only 2-3 days of rainfall between 50-100mm. July is the driest month with above 20 days without rain, and the majority of the rainy days being under 2mm of rainfall.

CLIMATE GRAPH



Florence has a Mediterranean climate with hot summers and mild winters, as shown by mean daily maximum temperatures rising from about 9 °C in January to around 30 °C in July–August, while minimum temperatures remain above freezing for most of the year. Precipitation is moderate but unevenly distributed, with drier summer months (especially June–August) and wetter periods in autumn, peaking around October–November.

MONTHLY TEMPERATURES

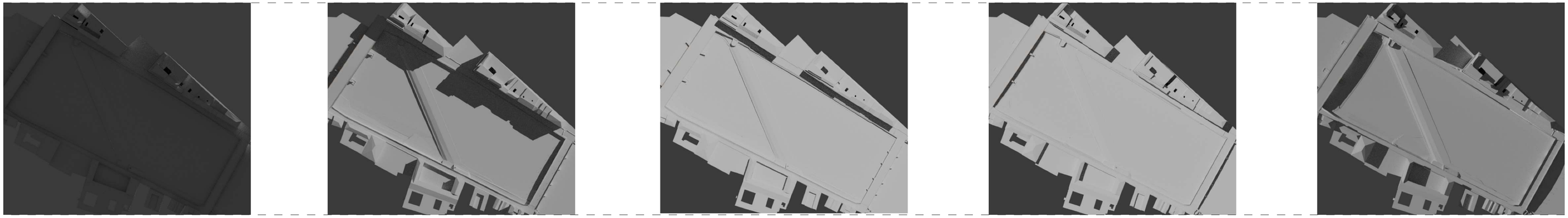


This graph highlights strong seasonal variation in temperature ranges, with many frost days in winter, but a high frequency of warm (20–32 °C) and very hot days (above 32 °C) in summer, indicating a pronounced continental influence despite being close to the Mediterranean.



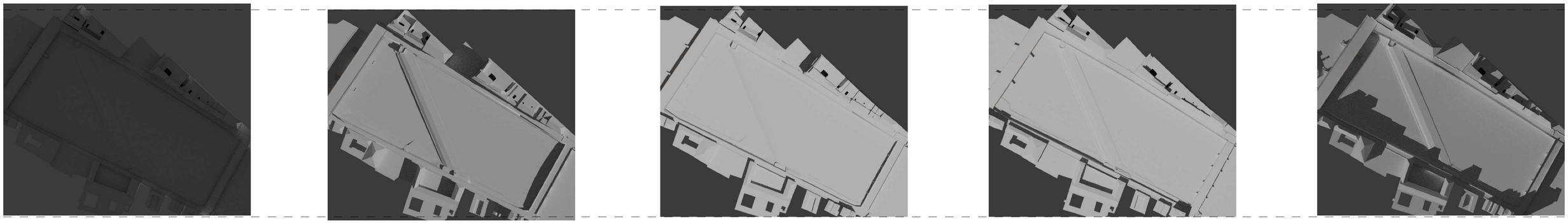
SUN BEHAVIOUR ON SITE

SUMMER SOLSTICE



6 AM | 9 AM | 12 PM | 3 PM | 6 PM

WINTER SOLSTICE

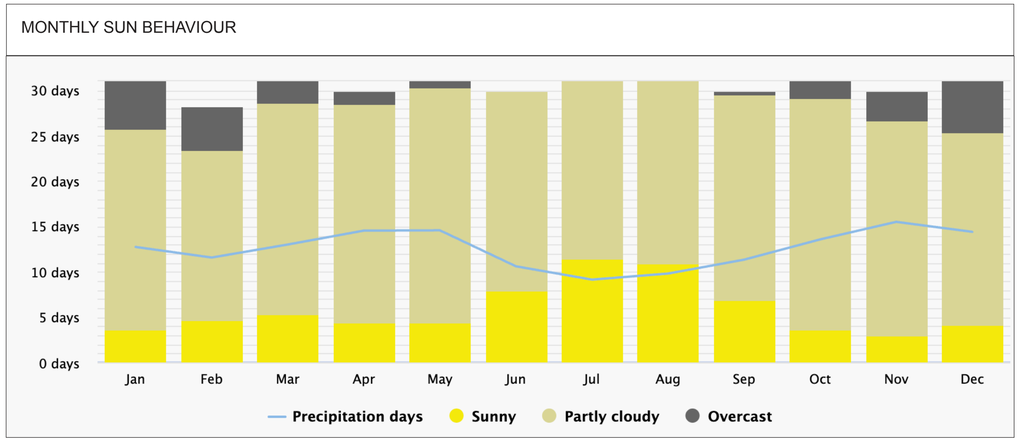


6 AM | 9 AM | 12 PM | 3 PM | 6 PM

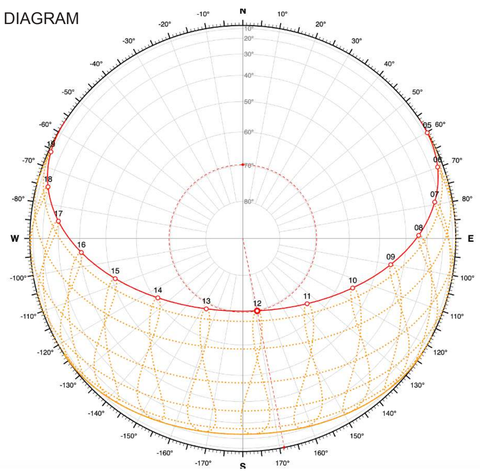
After simulating the river's flow in blender I thought it would be informative to do a similar thing with sunlight in and around my site. I made timelapse videos of both the summer and winter solstice over my site (videos attached in seperate submission), including screenshots at key times during these dates (above).

From the graphs on the right you can see that sunlight is generally inversely proportional to precipitation days, with the most sunny months being July and August.

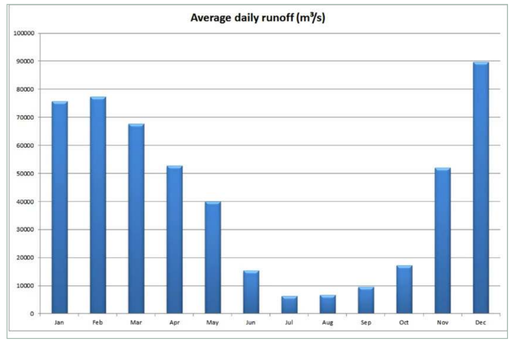
MONTHLY SUN BEHAVIOUR

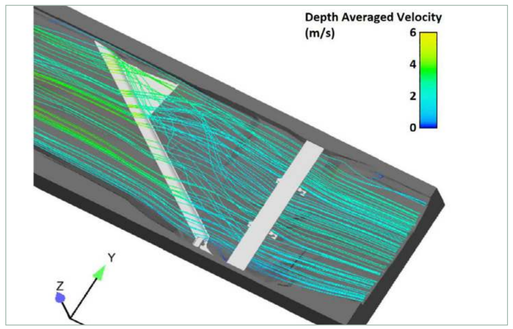


FLORENCE SUN PATH DIAGRAM

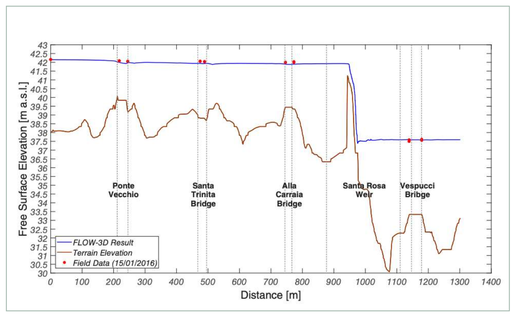


LOCAL RIVER BEHAVIOUR AND BIODIVERSITY

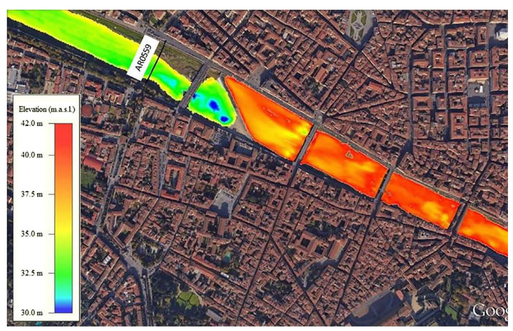




RIVER FLOW ELEVATION AROUND MY SITE



ELEVATION ABOVE SEA LEVEL



FISH SPECIES

Fish species include the Italian barbel, European chub and common carp. During the summer months it is a common sight to see locals lining up along the weir to fish in the early morning and during the evening.



BIRD SPECIES

In the evenings its very common to spot flocks of common starling around my site. I saw and filmed this myself when visiting the site. Other common bird species include pigeons and ducks on the river.



MAMMALS

River rats or nutria such as are the most sighted rodents in and around my site, they usually reside along vegetated river banks and under bridges.



RIVER REEDS

Common reeds grow along the banks of my site greatly contributing to the biodiversity.



WHITE WILLOW

White willow thrives on the water's edge helping to stabilise the Arno's banks.



ARNO RIVER

VEGETATION

RIVER FLOW

RIVER BANKS

MOSS GROWTH

There is a lot of moss growth on the brick river wall stretching across the south side of my site.

SURROUNDING ARCHITECTURAL & LOCAL MATERIAL RESEARCH



SANDSTONE WEATHERING

Sandstone plinths are common on the ground floors of these buildings and often express years of weathering between water and stone.

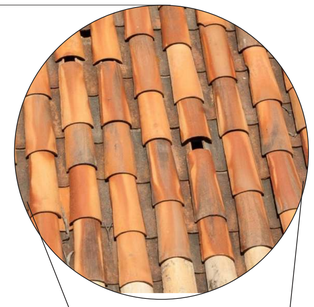


SANDSTONE BUILDING BASE

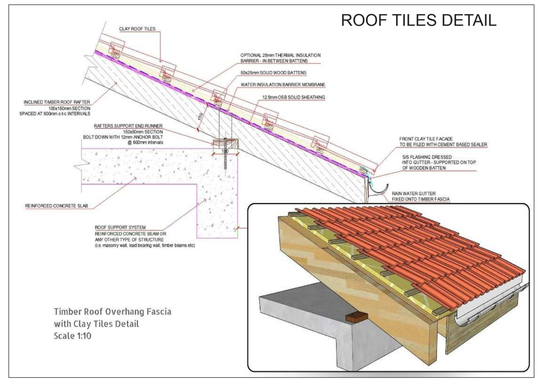
Heavily rusticated sandstone bases to buildings often extrude out at the base of a cleaner uniformed masonry facade. This transition defines a material hierarchy, expressing weight and anchoring the building to the ground.

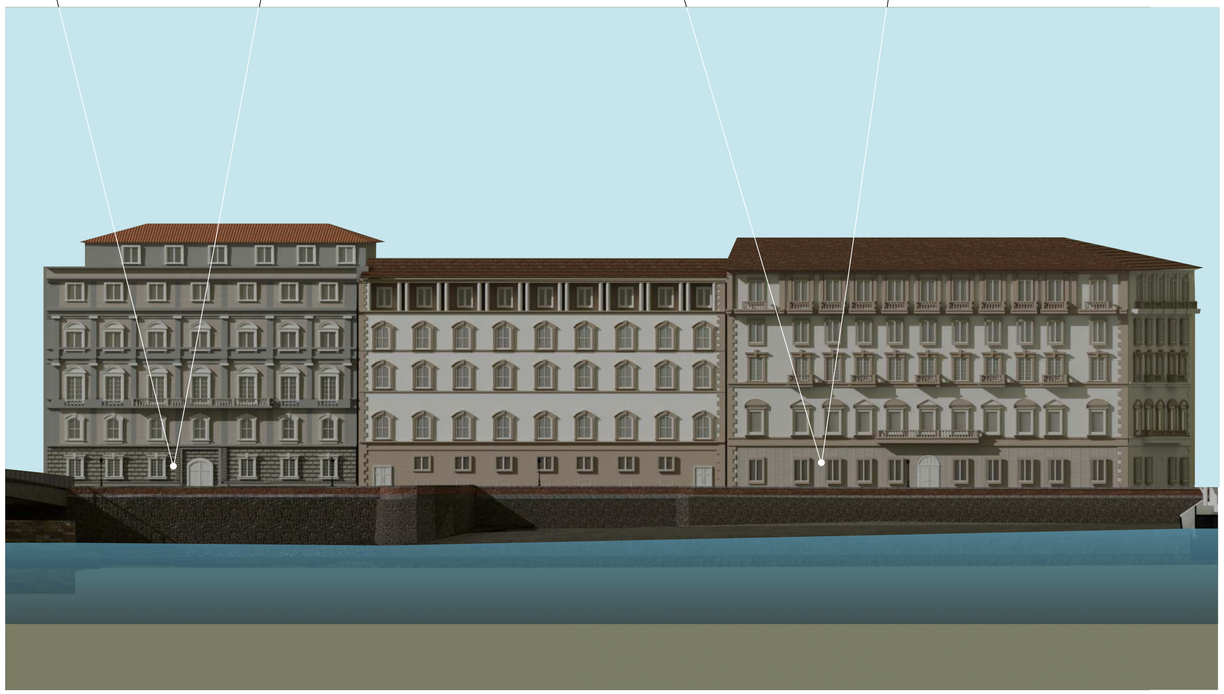
TERRACOTTA ROOF TILES

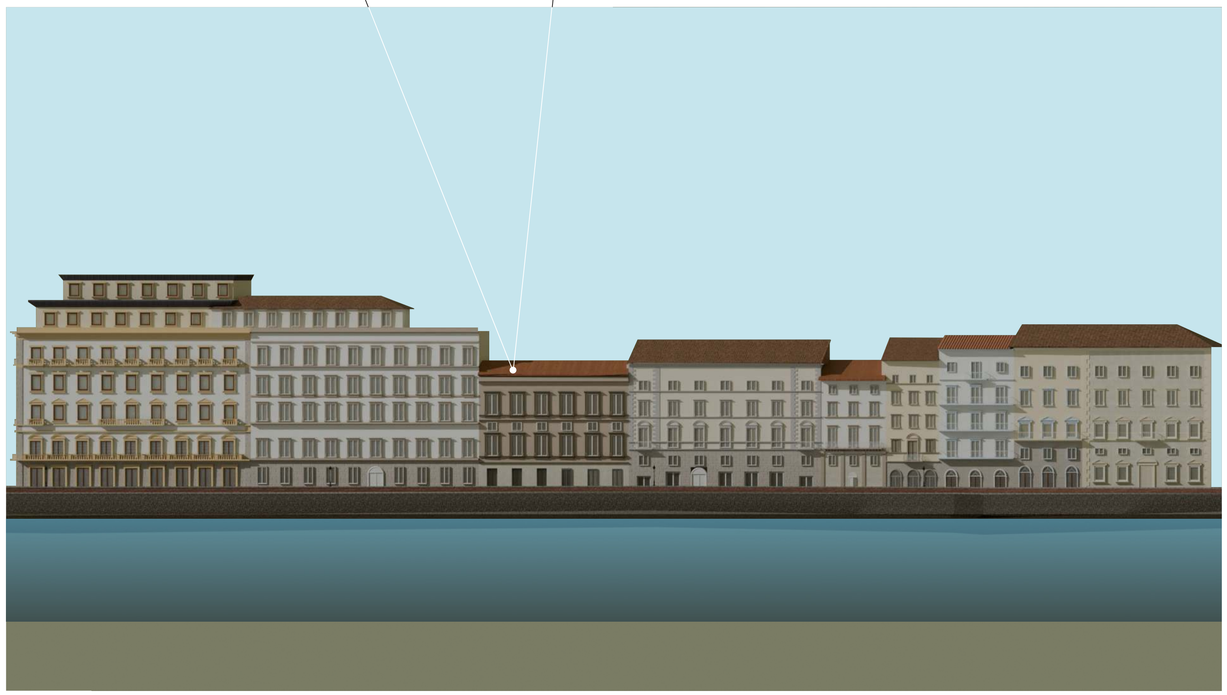
Terracotta roof tiles define the skyline and material continuity of Florence's historic fabric, emphasizing repetition and warm tonal consistency.



ROOF TILES DETAIL







DOOR DESIGN

It is common to see elaborately designed timber doors on the streets surrounding the river. These act as key elements defining the local architecture. They are often set within thick, pale masonry frames creating a nice material contrast and adding nuance to building facades.



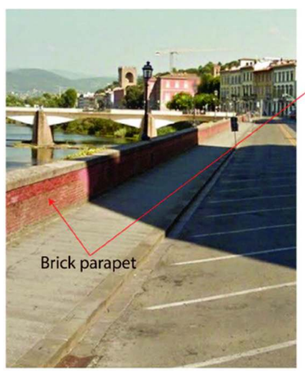


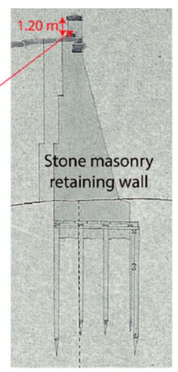
RIVER WALL

The river wall condition shows staining, water marks, and material decay, indicating long-term hydraulic impact on vertical surfaces. The brick parapet and stone retaining wall detail demonstrate layered construction and foundation strategies, suggesting how new interventions might anchor into or sit against the existing structure.

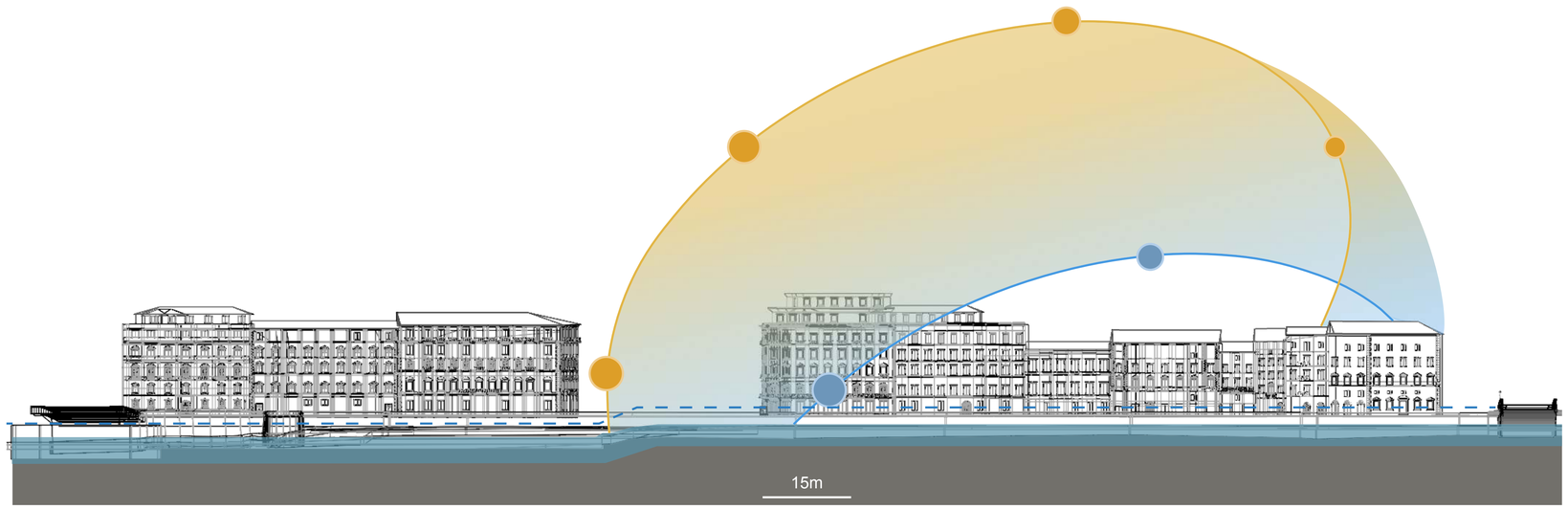


RETAINING WALL DETAIL

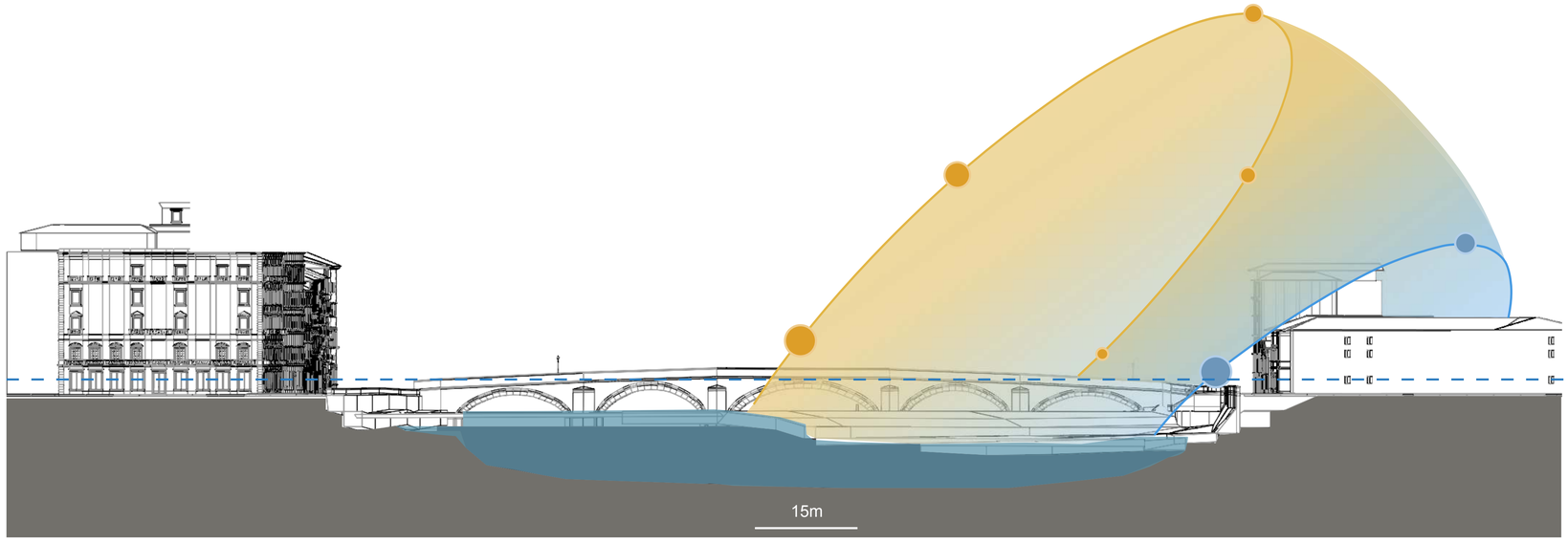




RIVER SECTION A



RIVER SECTION B



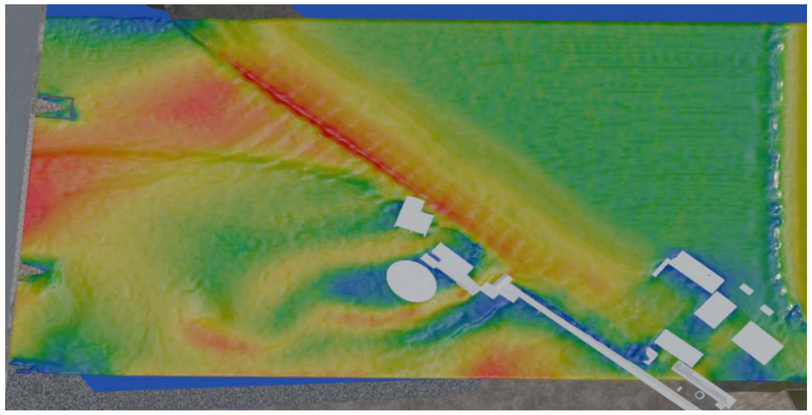
Summer Solstice

Winter Solstice

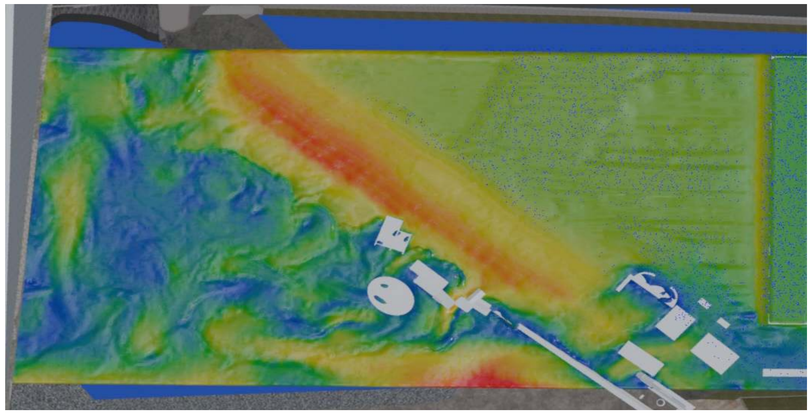
Regular River Height

Extreme Flood Height

SIMULATING THE ARNO'S FLOW OVER MY SITE



Regular flow with early building geometry



Flood scenario with early building geometry

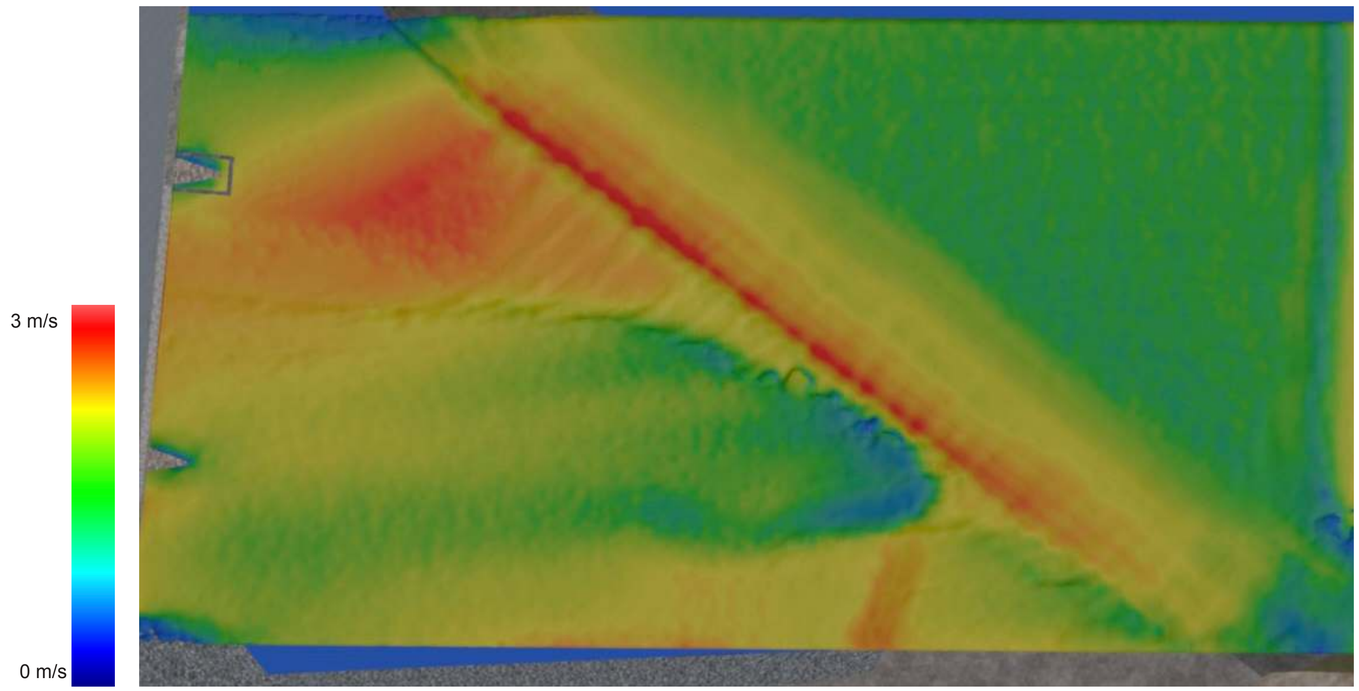
In order to further explore the Arno's behaviour in my site I decided to model a digital simulation of it's flow. I did this by talking the core geometries from my site models then constructing a complementary flow source in blender. I then ran this flow simulation over the geometry using real world scale, gravity and regular flow velocity in order to inform this. I then shaded the flow geometry in correspondence to its velocity, red being fastest, green being moderate and blue being slow flow speeds.

Comparing the results of my simulation model with google earth satellite imagery of the weir shows a general success in my model as white water (indicating more turbulent and faster water)seemingly corresponds to the red regions of my flow shader.

SATELLITE IMAGERY OF MY SITE



RIVER VELOCITY MAP OF MY SITE (M/S)



FLOOD RISK FREQUENCY SURROUNDING MY SITE

By looking at the progression of water spread through the city in 1966 I was able to distinguish segments of the flood plain which would correspond to overall flood aggression and duration. I then researched how often flood events of this scale are experienced in and around the Arno. Matching these two pieces of information I was able to devise an approximation of flood frequency in Florence.

REGULAR

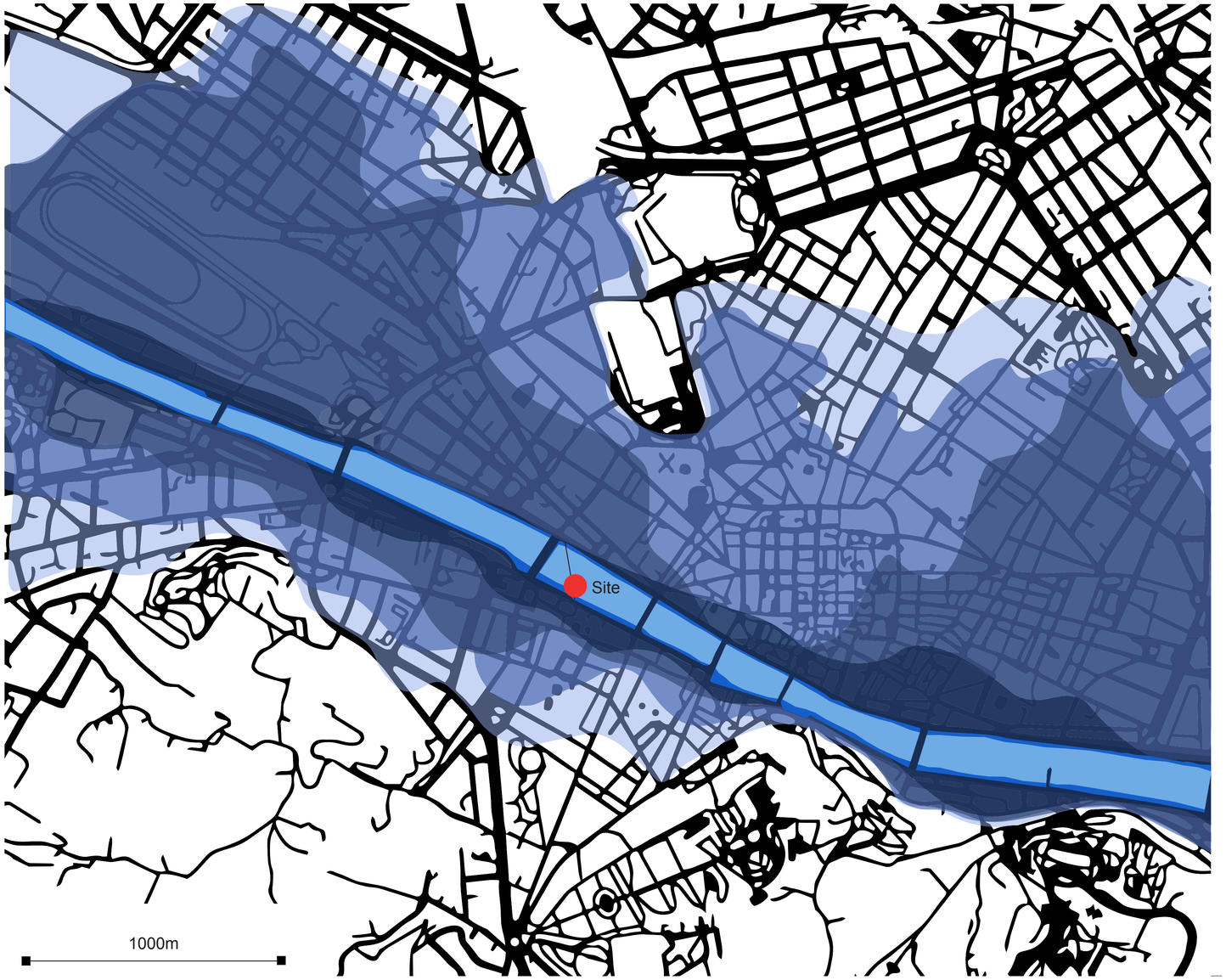
10 YEARS

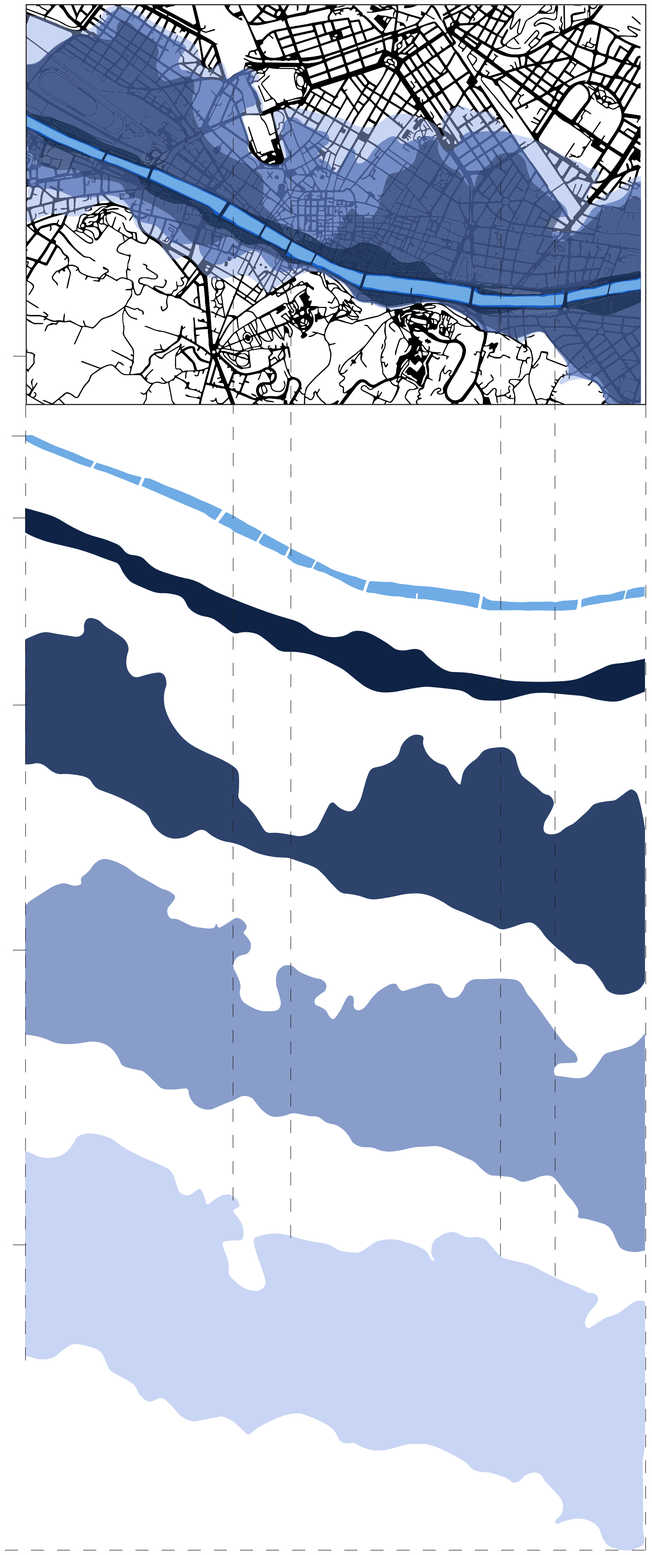
50 YEARS

100 YEARS

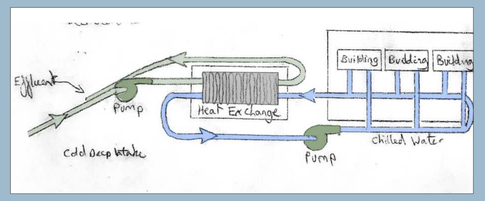
1966 EXTREME CASE

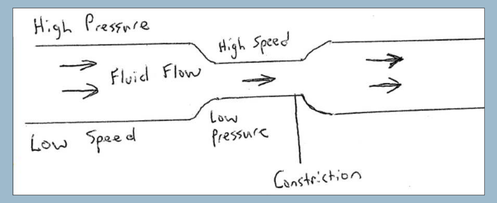
FLOOD FREQUENCY



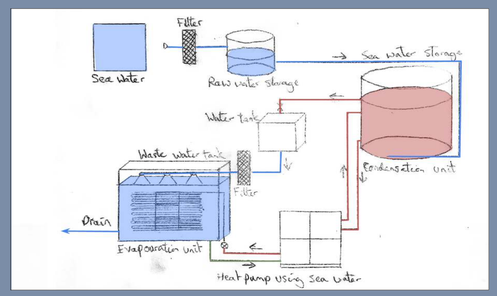


2 ENVIRONMENTAL STRATEGIES


Effluent
Pump
Heat Exchange
Building
Building
Building
chilled Water
Pump
cold deep intake

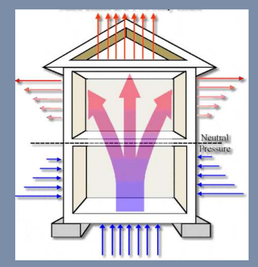

High Pressure
High Speed
Fluid Flow
Low Speed
Low Pressure
Constriction

3.

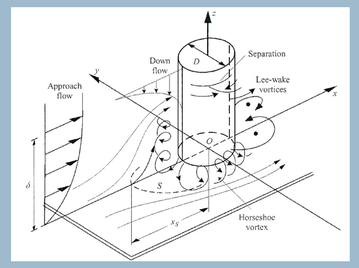

Filter
Sea water
Raw water storage
Sea water storage
Water tank
Waste water tank
Filter
Condensation unit
Drain
Evaporation unit
Heat pump using sea water

4.

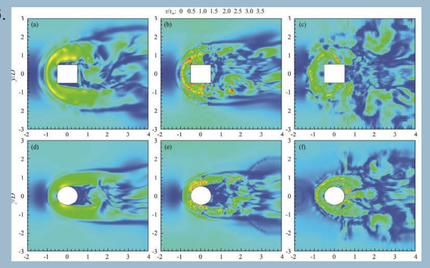
4.


Neutral Pressure

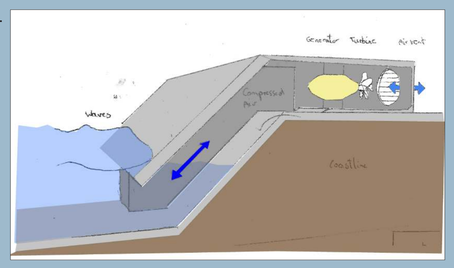
5.


Approach flow
Down flow
Separation
Lee-wake vortices
Horseshoe vortex

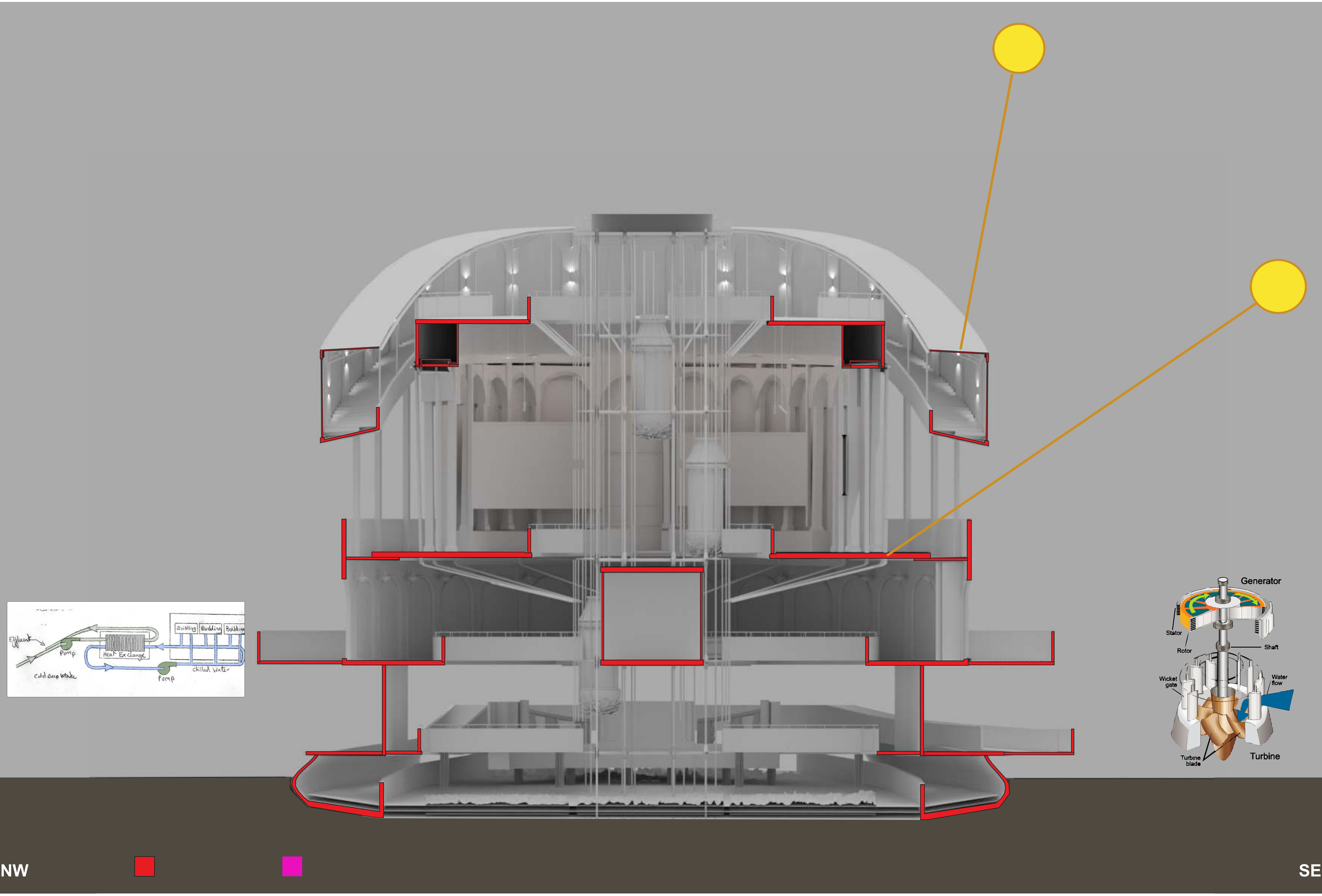
6.



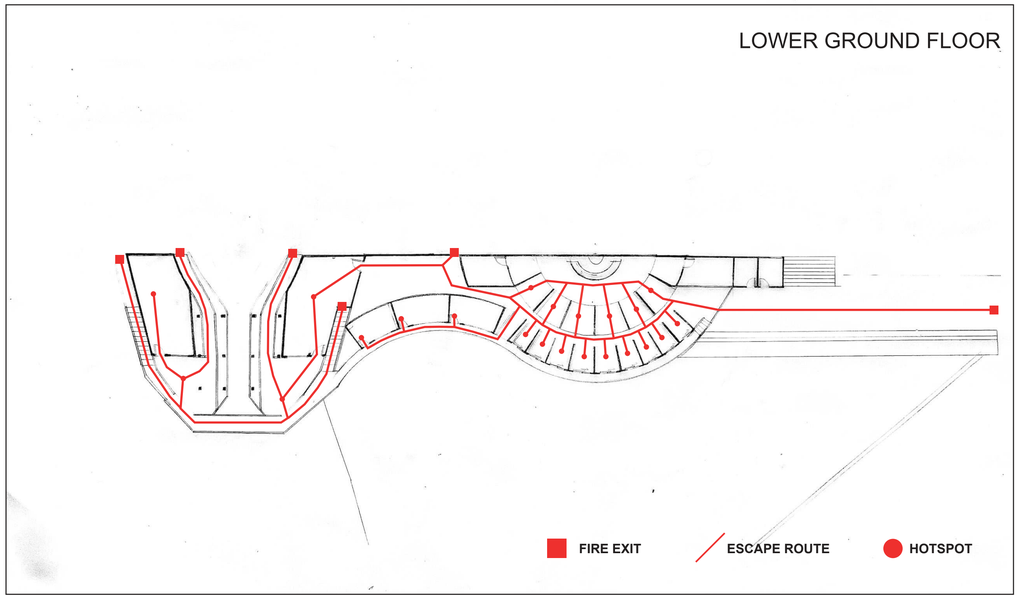
7.

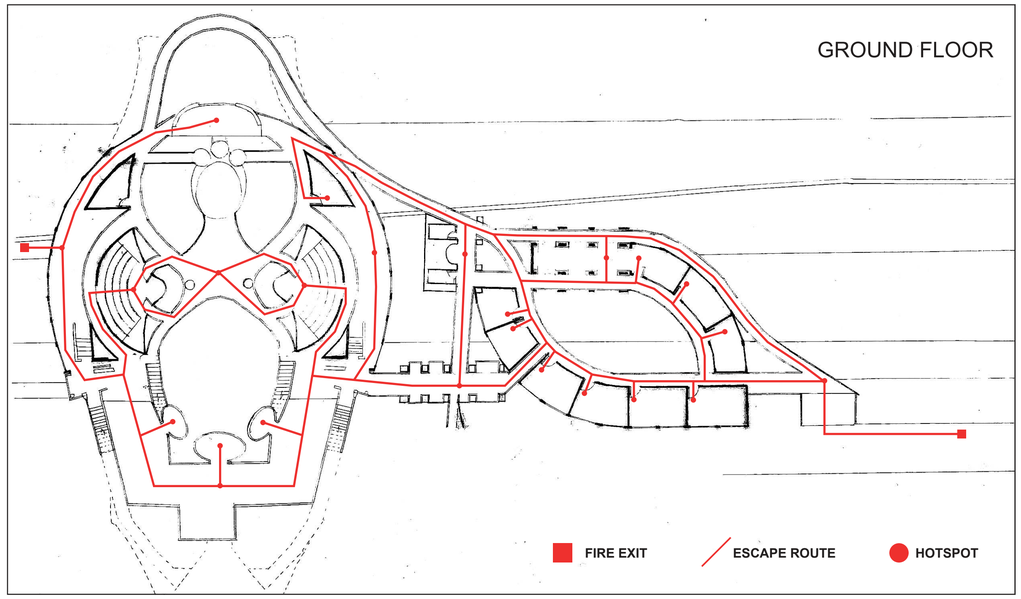

Generator
Turbine
Air vent
Compressed air
Waves
Coastline

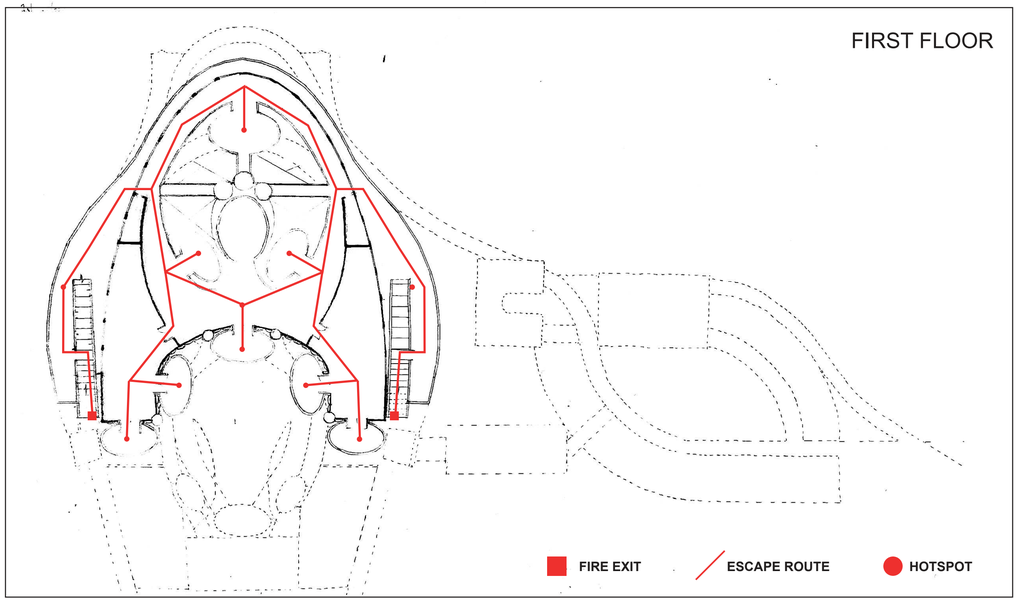
7.

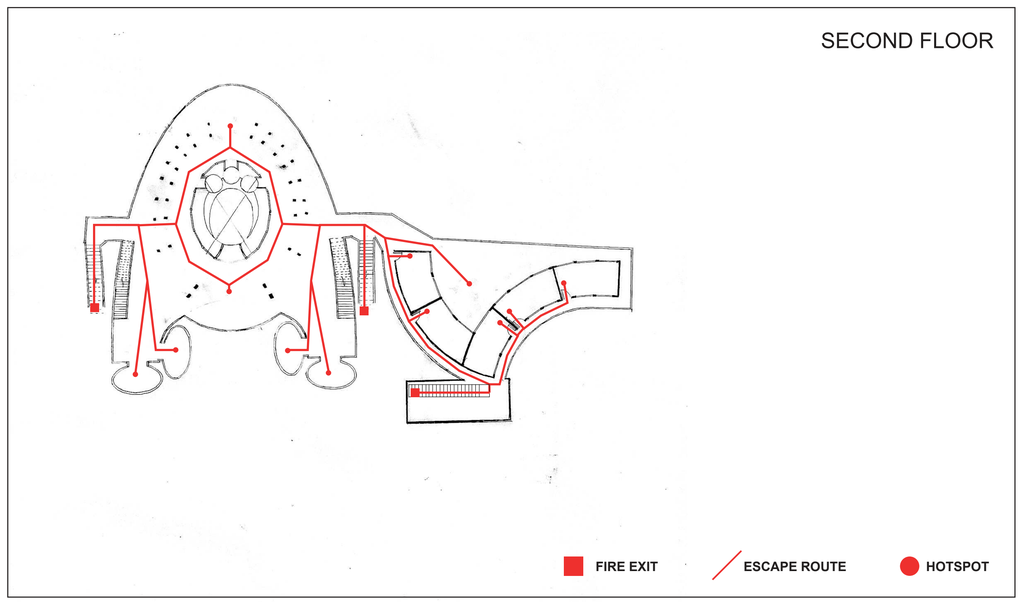

Effluent
Pump
Heat Exchange
Building
Building
Building
Cold deep intake
Pump
chilled water
Generator
Stator
Rotor
Shaft
Wicket gate
Water flow
Turbine blade
Turbine
NW
SE

FIRE ESCAPE ROUTES



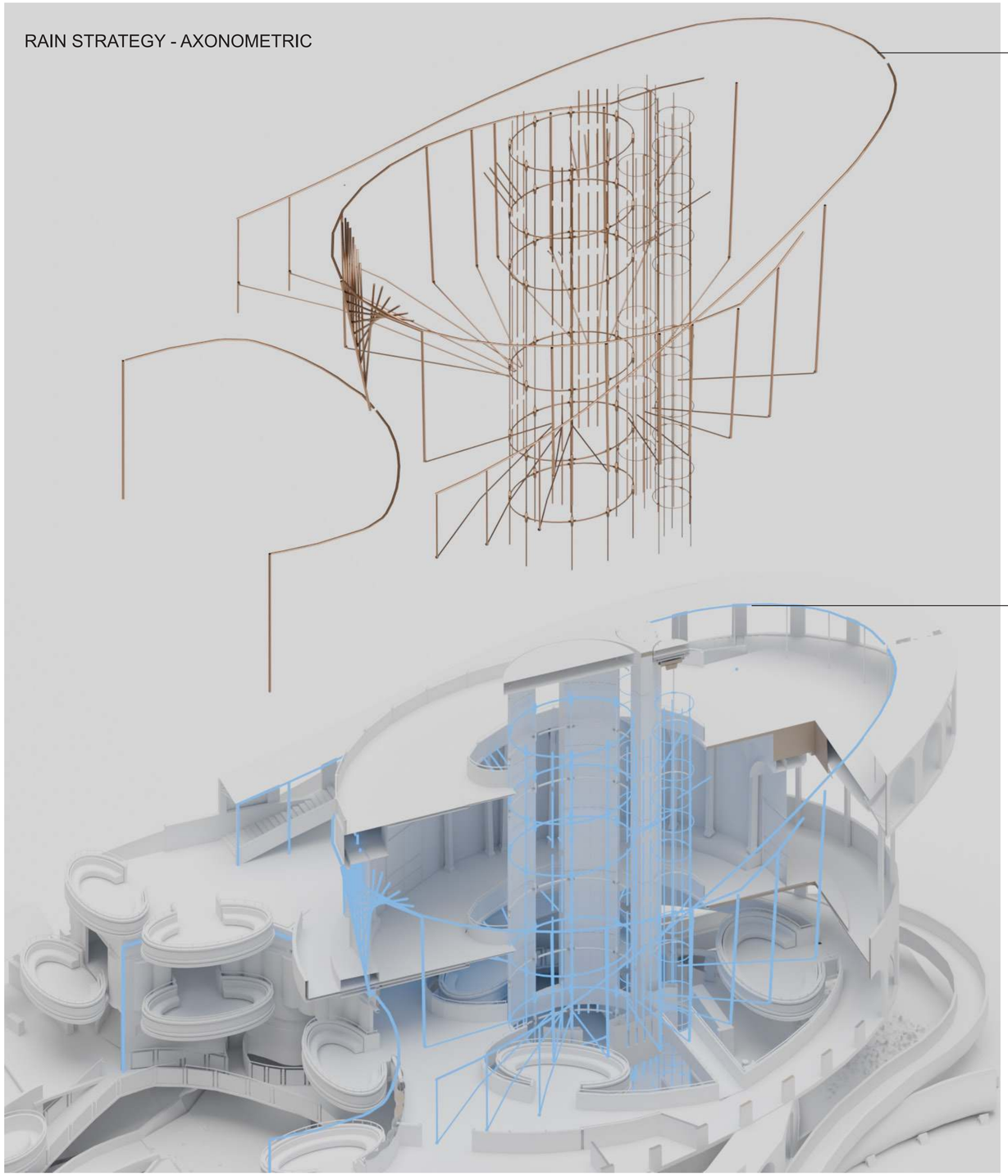






RAINWATER HARVESTING FOR FIRE MITIGATION

RAIN STRATEGY - AXONOMETRIC



COPPER GUTTER NETWORK

I designed a gutter network complimentary to my structure of my building in order to create an intricate rainwater collection system.

There are approximately 80-100 rainy days a year in Florence with an average of 700-900mm of rainfall a years.

Storing and reusing this water is vital for sustainable building practices and can also be used to prevent fires in the building.

Given my art restoration building programme, flammable chemicals are often used so it's this would be a key element of my building's fire safety.

RAIN FLOW - FIRE SPRINKLER SYSTEM

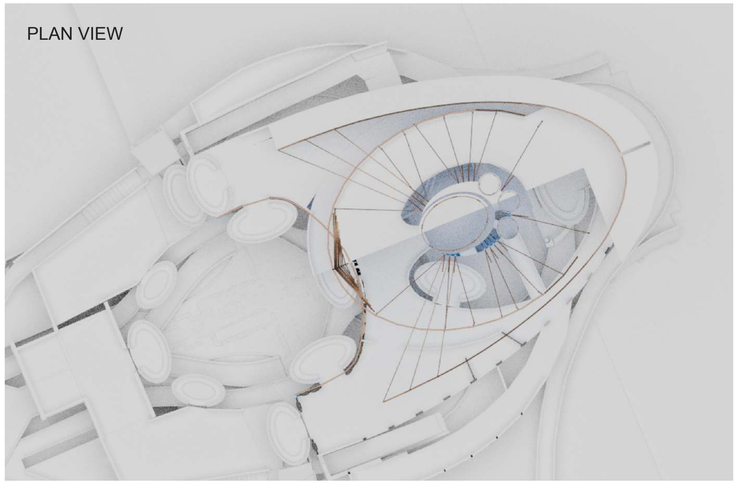
My design involves using a copper gutter networks to collecting rainfall and store this water next to sprinkler systems.

I will also use small water pumps energised by micro weir turbines to draw in river water from below.

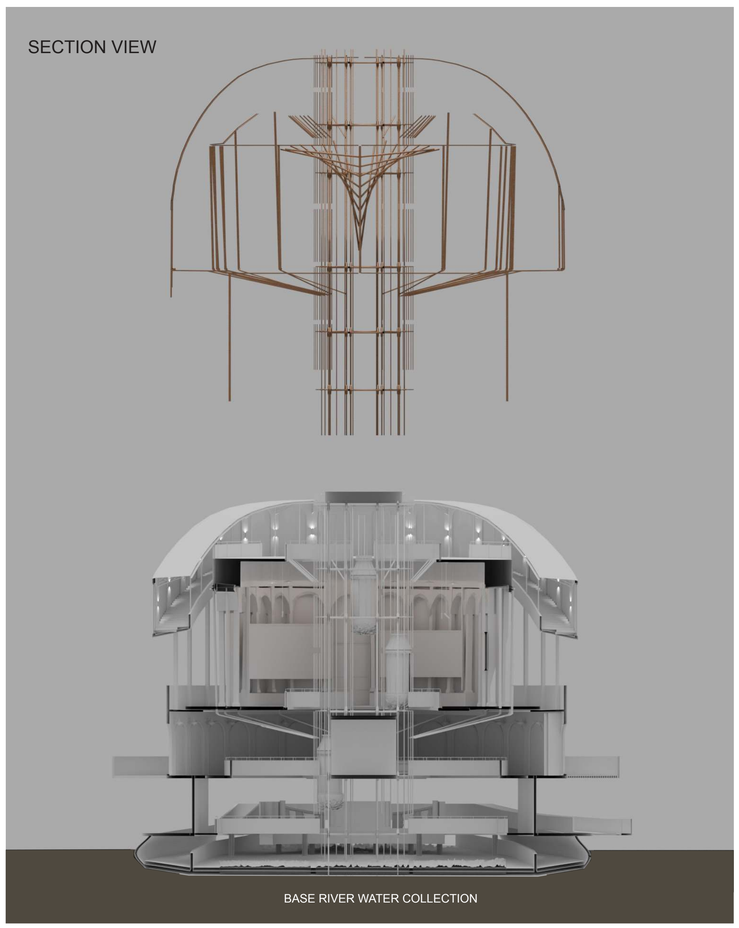
Some of the collected water will be stored next to a series of fire sprinkler systems in the case of an emergency.



PLAN VIEW

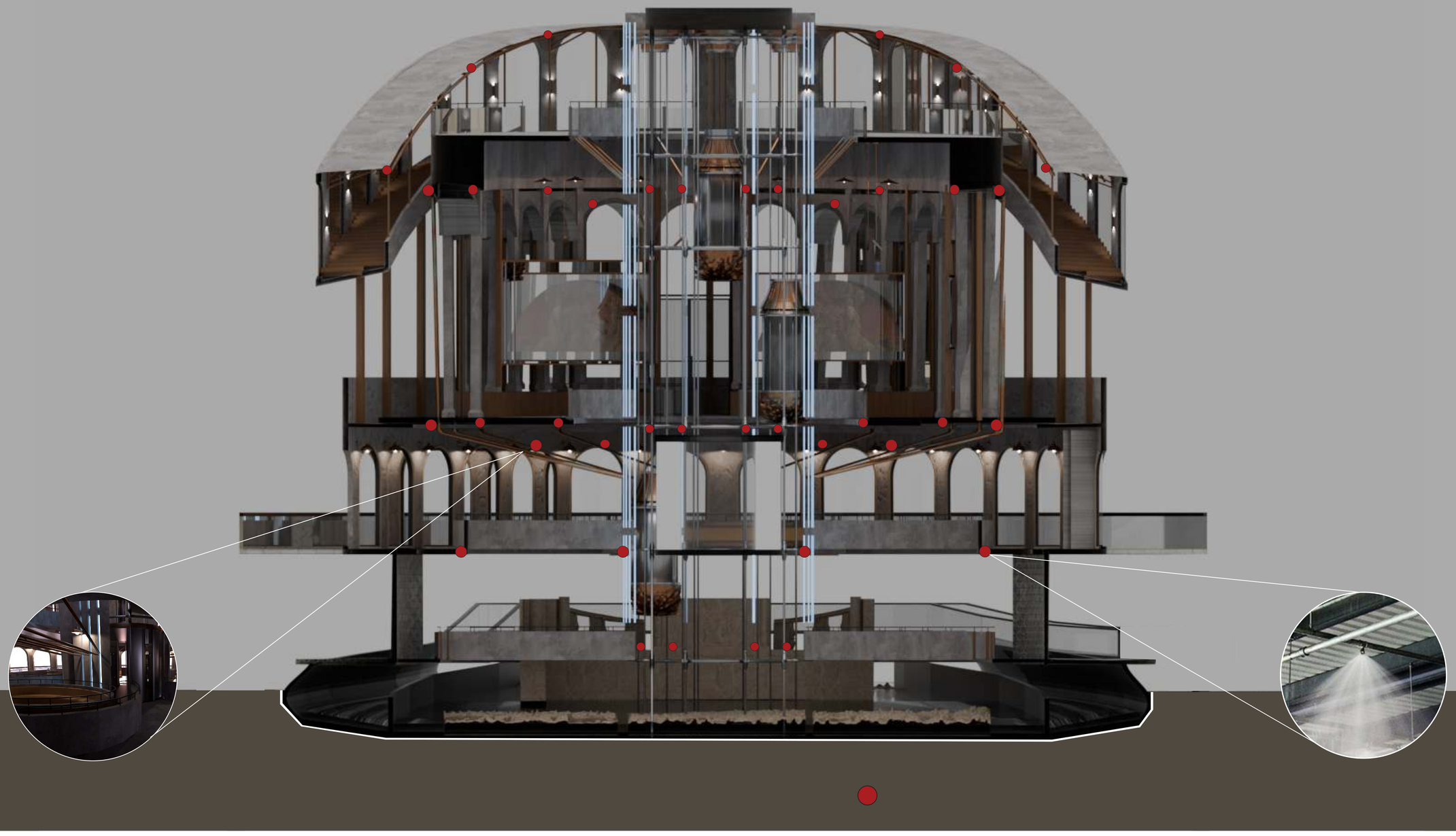


SECTION VIEW



BASE RIVER WATER COLLECTION

FIRE STRATEGY SECTION

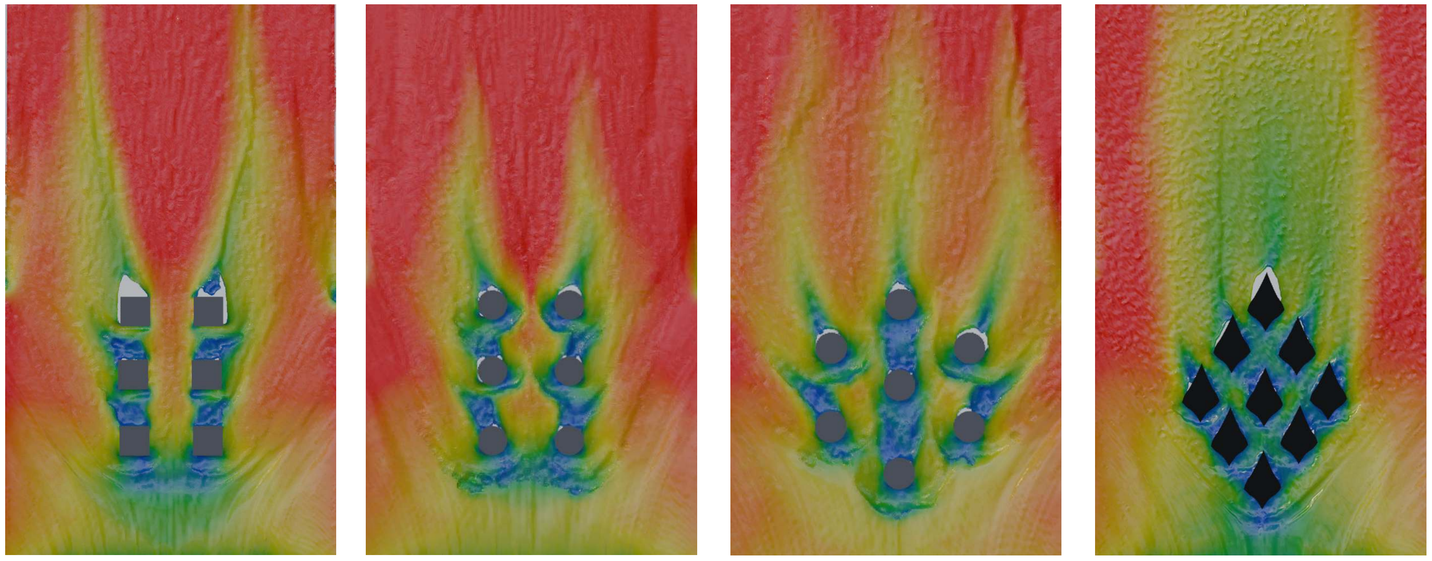


3 STRUCTURAL STRATEGIES

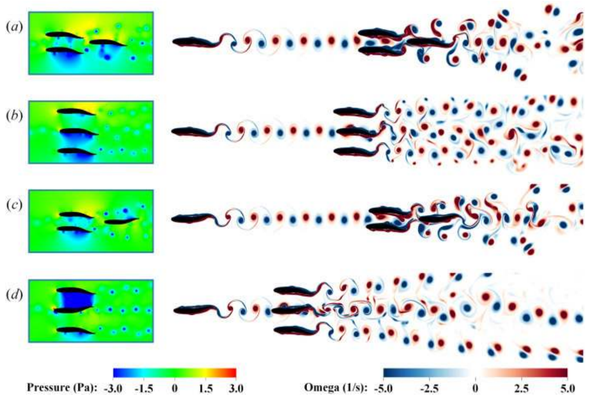
HYDRODYNAMIC PILE DESIGN

0 m/s

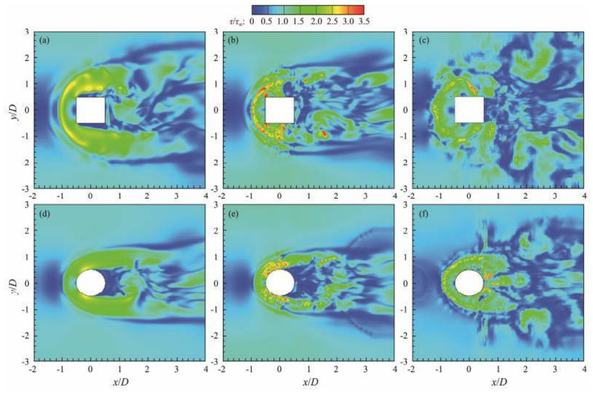
3 m/s



RECTANGULAR PILES	CIRCULAR PILES	HEXAGONAL FORMATION PILES	HYDRODYNAMIC FORMING
Standard rectangular piling proved to be the least hydrodynamic form in my testing. My hydrodynamic test indicates turbulent flow after the pile formation.	Employing circular piles in the same formation slightly reduced downstream turbulence as you can the yellow/green water blending into the red more quickly.	Employing a hexagonal formation spread the turbulence over a wider area, slightly reducing its intensity downstream.	I decided to position and form pile shapes after being inspired by fish school hydrodynamics. This greatly improved downstream flow consistency, greatly reducing the river turbulence my building would be exposed to.

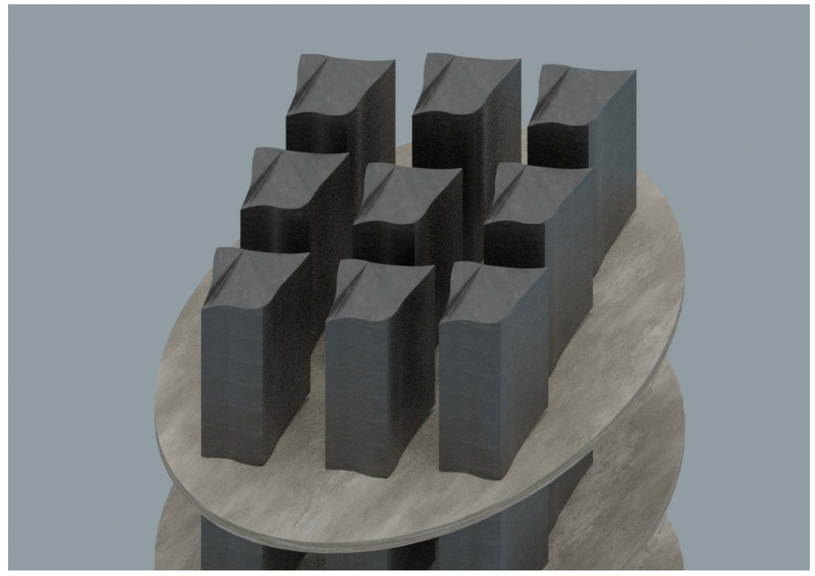


Hydrodynamics of fish schooling - used to inform my design



More detailed hydrodynamic pile tests done by scientists

Renders of pile design

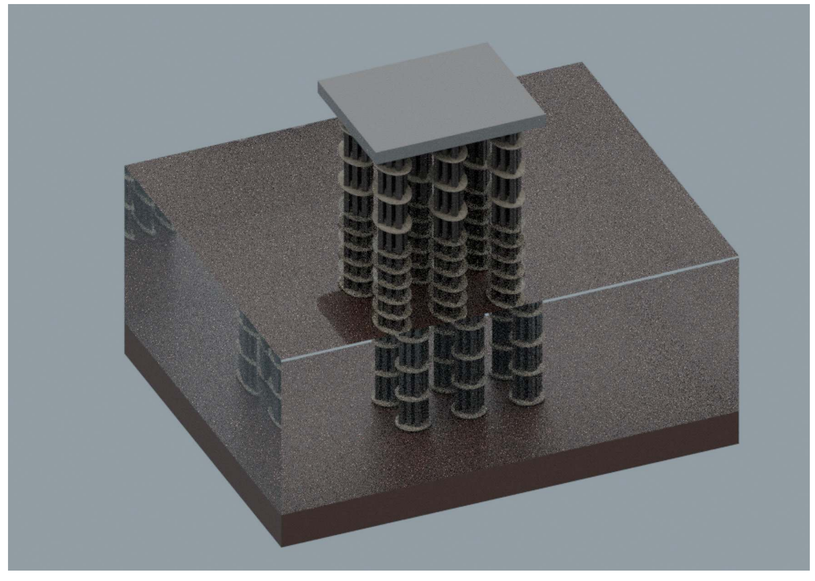


From my hydrodynamic tests I design this pile formation in blender. The piles consist of hydrodynamic steel beams bound together by circular concrete slabs

This will be key for my technical question and reduce the impact of piles in context of my river art formation.

This design is vital to retain consistent water flow over my artificial riverbed designs, allowing river artwork to persist without structural interruption.

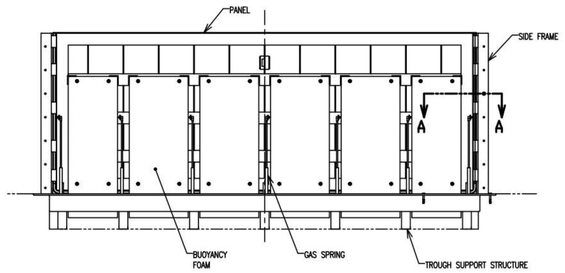
These piles will only be employed in and around the central artificial water way of my building.



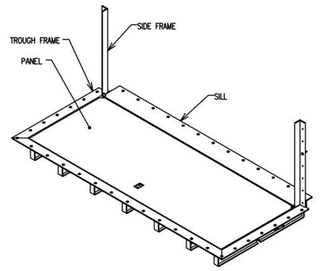
DETAIL OF STEEL WATERWAY OVER EXISTING WEIR

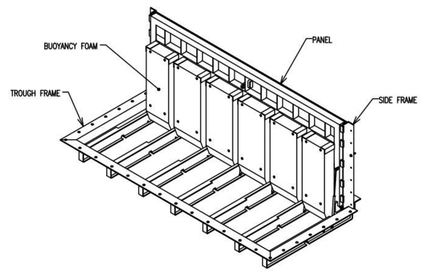
This detail shows the arrangement and connection of the designed sandstone river bed slabs to the central steel waterway of my building which connects to the partially excavated Santa Rosa Weir.

I did lots of research on existing smaller scale fish pathways over existing concrete weir's to explore realistic structural connections between steel and older concrete. It also features a flip up steel floodgate to control river flow through the building.



6



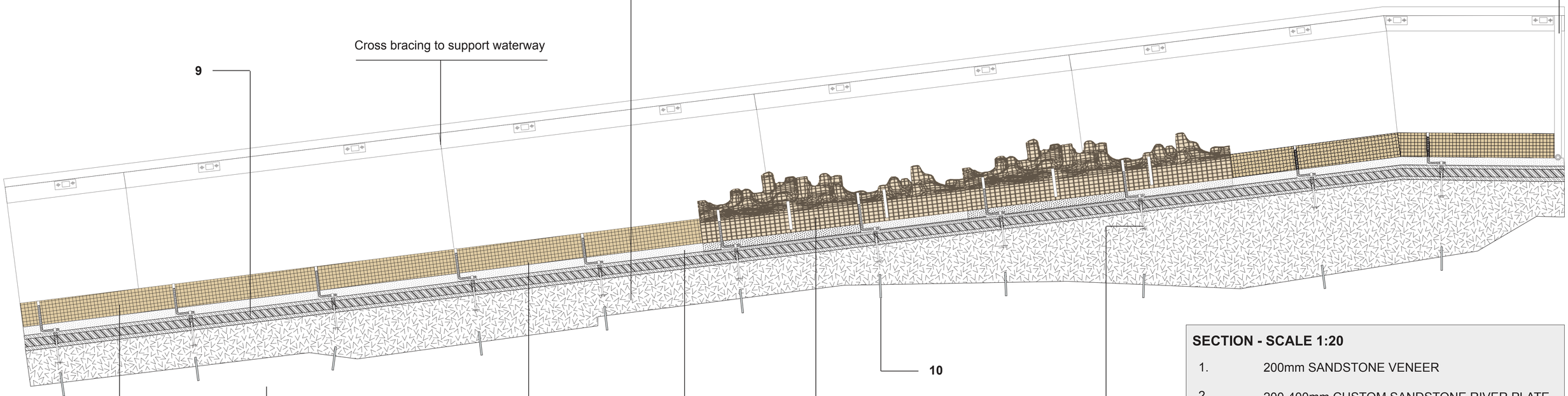


Minimum 300mm thick mass concrete infill forms founding level for steel base plates. Excavate existing structure, as necessary, to achieve minimum thickness.

5

Cross bracing to support waterway

9



1

4

Slope to complement weir's structure

7- 8

10

3

2

Sandstone plates fabricated to form painted images from the white water flowing above them. Custom made in accordance to my tech research question.

SECTION - SCALE 1:20

1.	200mm SANDSTONE VENEER
2.	200-400mm CUSTOM SANDSTONE RIVER PLATE
3.	STONE FLOOR TIE
4.	EXISTING CONCRETE WEIR
5.	300mm (min) BASE CONCRETE INFILL
6.	FLIP UP STEEL FLOODGATE
7.	50mm DRAINAGE MAT
8.	50mm AIR SPACE FOR DISCHARGE DRAINAGE
9.	150mm STEEL PLATING
10.	STAINLESS STEEL DOWELS

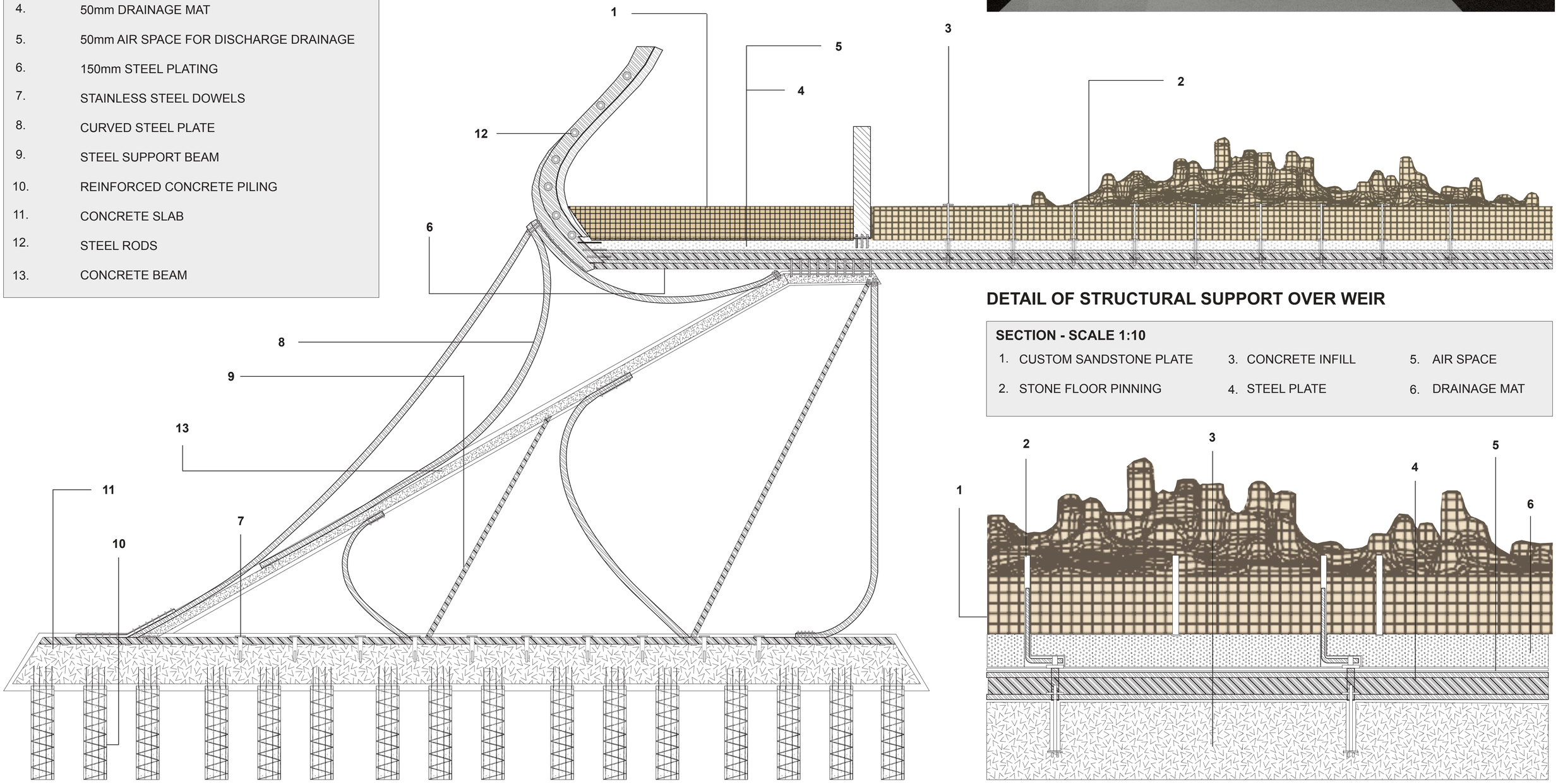
DETAIL OF STRUCTURAL SUPPORT OVER RIVER

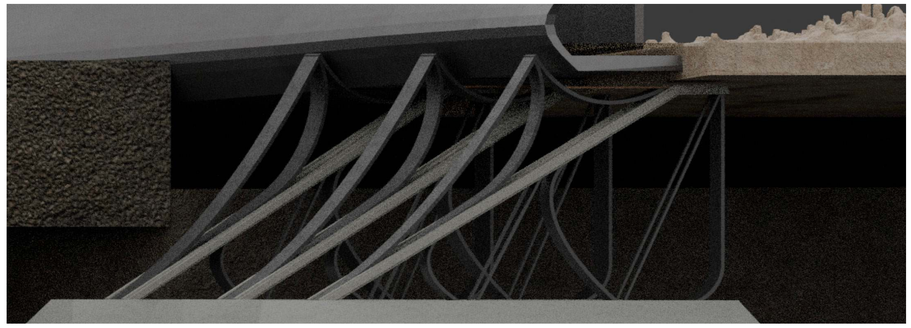
SECTION - SCALE 1:15

1. 200mm SANDSTONE VENEER
2. 200-400mm CUSTOM SANDSTONE RIVER PLATE
3. STONE FLOOR PINNING
4. 50mm DRAINAGE MAT
5. 50mm AIR SPACE FOR DISCHARGE DRAINAGE
6. 150mm STEEL PLATING
7. STAINLESS STEEL DOWELS
8. CURVED STEEL PLATE
9. STEEL SUPPORT BEAM
10. REINFORCED CONCRETE PILING
11. CONCRETE SLAB
12. STEEL RODS
13. CONCRETE BEAM

My building's central waterway extends beyond its primary connection to Santa Rosa weir, therefore I had to think of a structural strategy to keep this standing over the waterline with a foundation in the Arno riverbed. I tried to make this piling structurally sound whilst also hydrodynamic, hence the use of thin steel beams in order to reduce excessive turbulent water pressure on the existing concrete weir downstream.

The configuration of beams begins with a narrow top and expands to a wider base. This is an effort to spread the building weight over a larger surface area and to make a more consistent river bed for to promote wildlife growth.



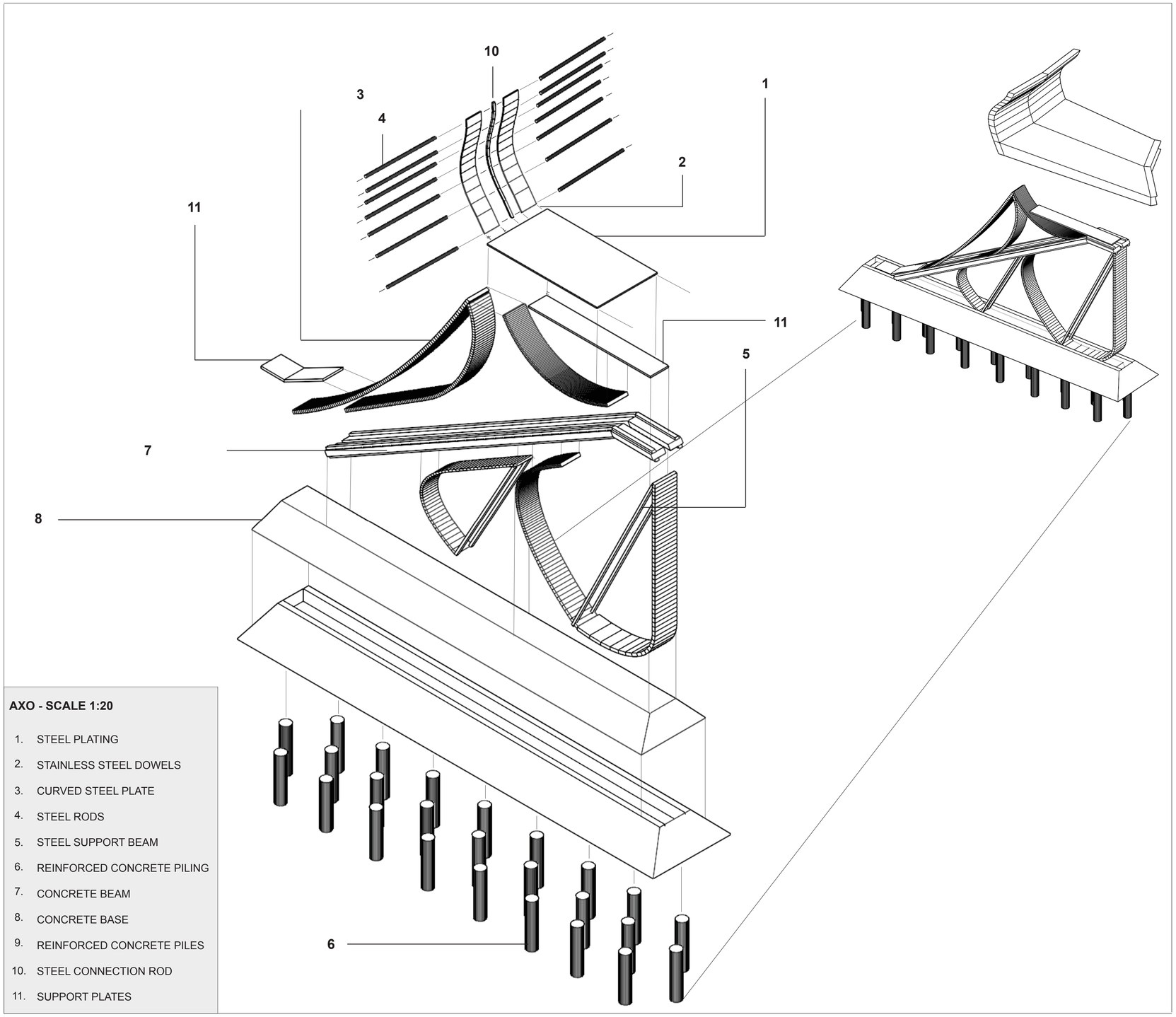


DETAIL OF STRUCTURAL SUPPORT OVER WEIR

SECTION - SCALE 1:10

1. CUSTOM SANDSTONE PLATE
2. STONE FLOOR PINNING
3. CONCRETE INFILL
4. STEEL PLATE
5. AIR SPACE
6. DRAINAGE MAT

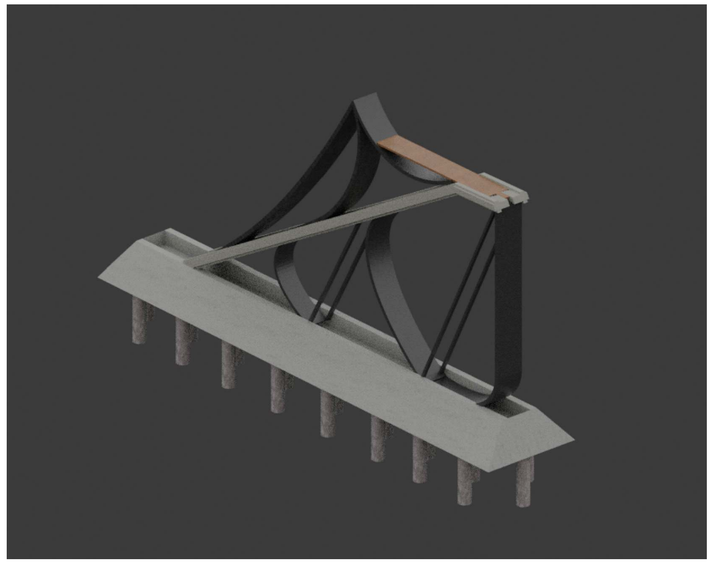
EXPLODED AXO OF STRUCTURAL SUPPORT DETAIL



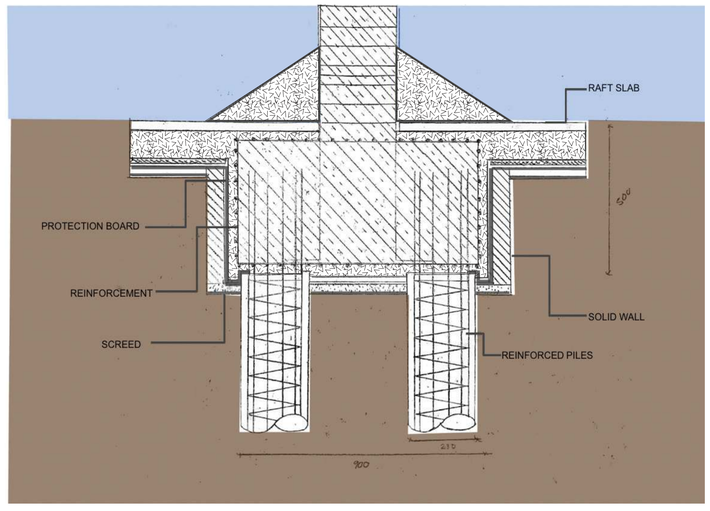
AXO - SCALE 1:20

1. STEEL PLATING
2. STAINLESS STEEL DOWELS
3. CURVED STEEL PLATE
4. STEEL RODS
5. STEEL SUPPORT BEAM
6. REINFORCED CONCRETE PILING
7. CONCRETE BEAM
8. CONCRETE BASE
9. REINFORCED CONCRETE PILES
10. STEEL CONNECTION ROD
11. SUPPORT PLATES

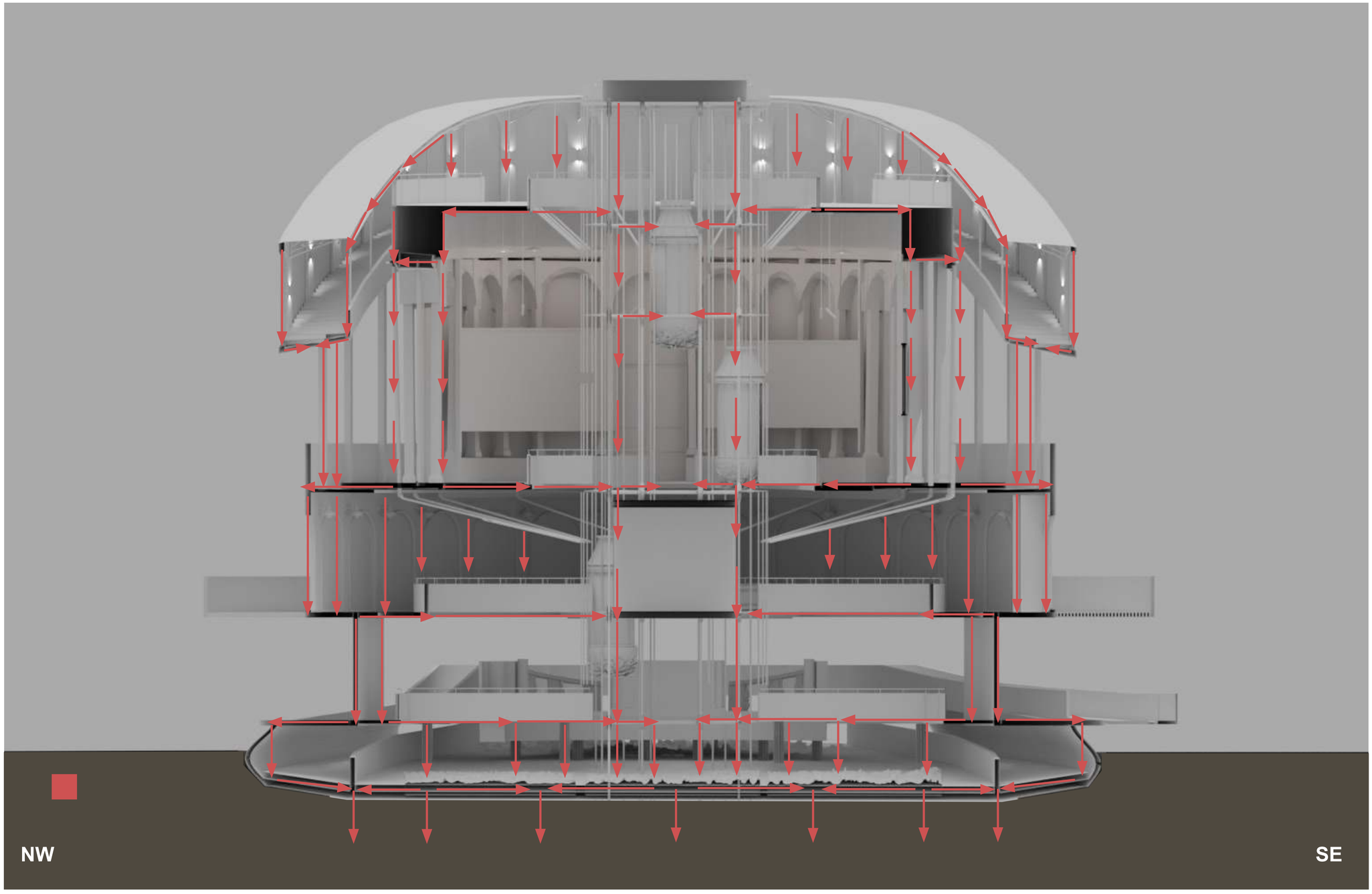
ASSEMBLED STRUCTURAL SUPPORT



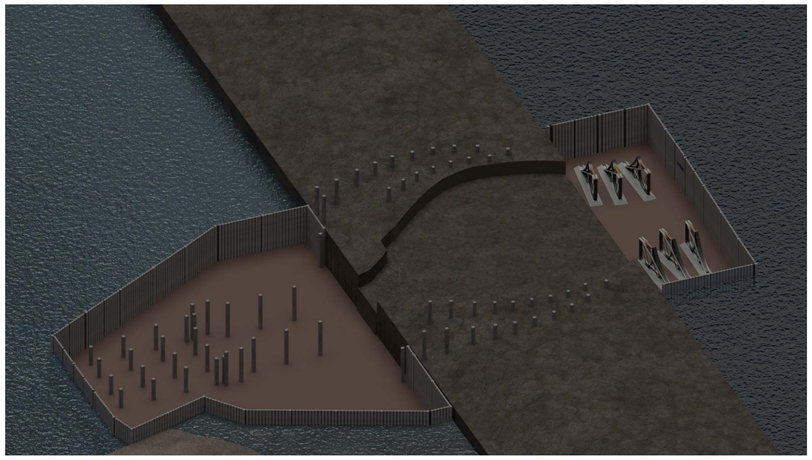
SUBMERGED FOUNDATION PILE CAP DETAIL



LOAD PATH DIAGRAM

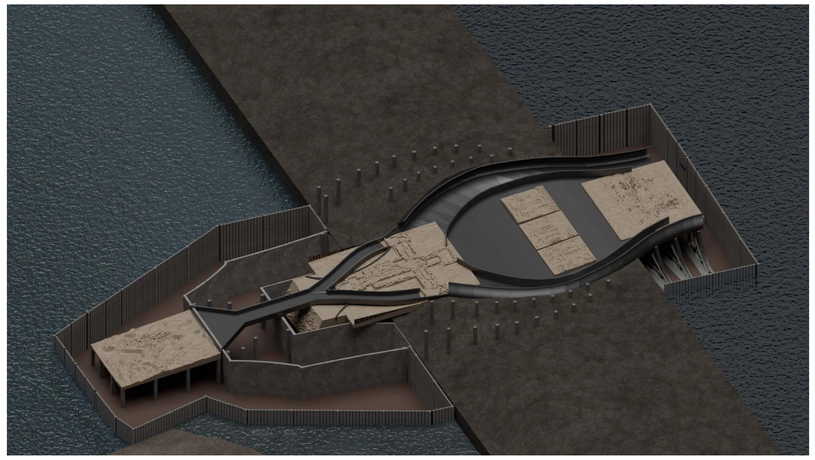


BUILDING CONSTRUCTION PROCESS



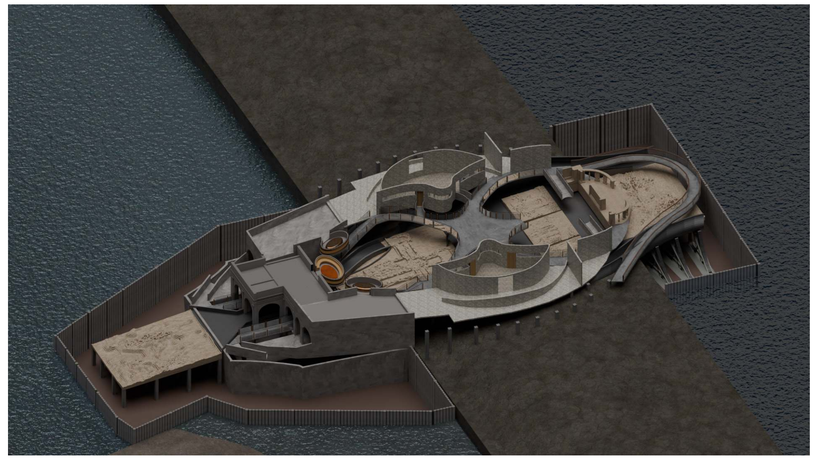
MONTHS 1-6 : TEMPORARY RIVER WORKS, ACCESS AND PARTIAL EXCAVATION

Install local coffer-dams only around the central construction strip, leaving water flowing either side of the weir. Set up barge access, temporary platforms, crane positions, and monitoring for river level, vibration, and weir movement. Set up piles within coffer-dam regions, carry out detailed scanning of the existing concrete, then saw-cut and excavate only the section where the new steel waterway will sit.



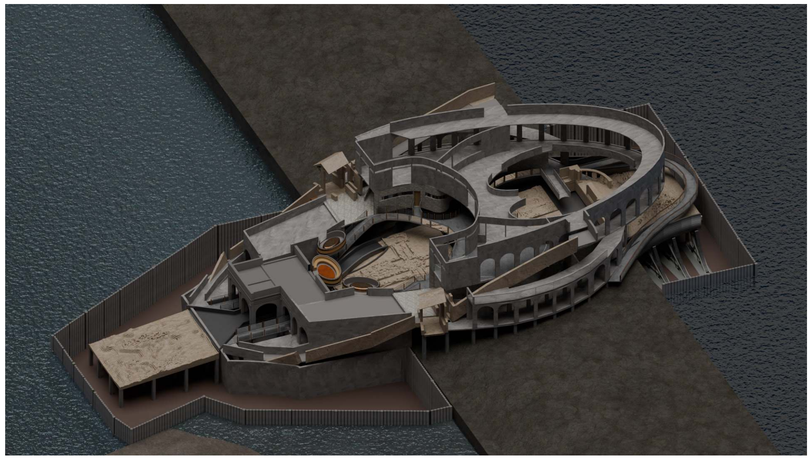
MONTHS 6-10 : INSTALLING CENTRAL WATERWAY

Work in short bays to avoid weakening the weir. Remove damaged concrete and prepare anchor pockets. Install micro-piles to support the new waterway and building loads without relying entirely on the old structure. Add waterproofing, scour protection, and stainless/galvanised connection plates. Bring in prefabricated artificial sandstone river beds.



MONTHS 10-15 : INTRODUCING PRE-CAST CONCRETE

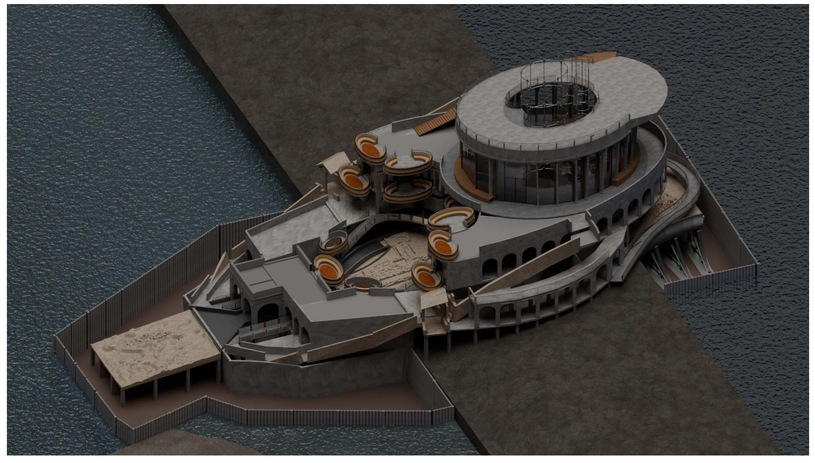
Begin construction of the concrete superstructure primarily bringing in pre-cast elements from off site using a series of barges and cranes. Introduce temporary bracing frames to stabilise curved geometry during assembly. At this stage, the building is structurally incomplete but self-supporting in segments. Loads are kept directly over new supports, not spanning yet.



MONTHS 15 - 20 : MERGING SELF SUPPORTED CONCRETE SYSTEMS

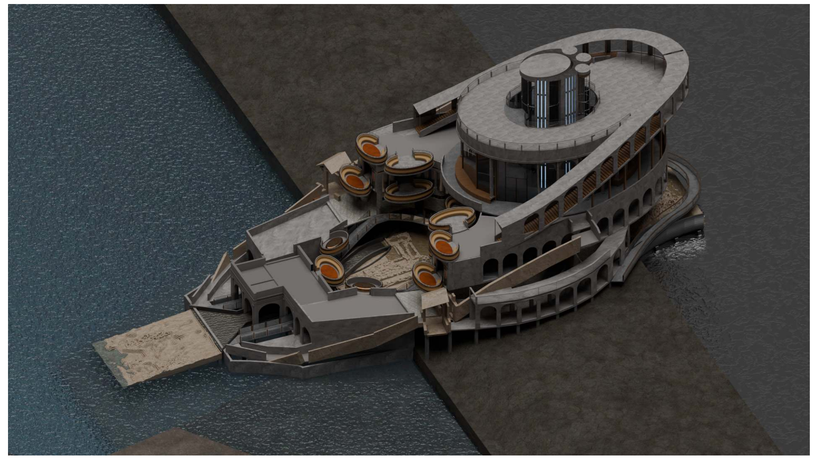
Complete the continuous ring geometry of the main structure and install curved pre-cast wall sections and stitch them with in situ pours. Construct intermediate floors and ramps linking levels. Build the central circular drum which is likely cast in situ for structural continuity.
This will act as a primary stabilising core. Introduce cantilevered sections gradually and integrate permanent lateral based around a central core

At this stage the structure transitions from segmented pieces to a continuous load-sharing system.



MONTHS 20 - 25 : EXTEND VERTICAL STRUCTURE

Now the building gains its core massing and vertical hierarchy. This will focus on the installation of light weight concrete as much as possible to reduce the extremity of vertical load systems. Most temporary bracing and scaffolding will be removed as the building becomes structurally stable.



MONTHS 25 - 30 : COMPLETION

The building is structurally complete, now it becomes inhabitable and hydraulically integrated. Façade systems, glazing, and external cladding will be installed. Complete internal partitions and finishes. Form public access points and connections to riverbanks whilst gradually removing temporary river intervention structures.

Inspect for structural integrity and river safety before opening to the public.

SUSTAINABLE MATERIAL SOURCING

PRE-CAST CUSTOM CONCRETE

Baraclit's Tuscan-based prefabrication minimises transport impact while enabling high-precision, low-waste production of large structural elements. Their systems are well suited to repetitive and curved components, allowing efficient assembly of the building's primary concrete framework.

LOW CARBON CONCRETE

Italcementi employs Low-carbon cement technologies to reduce the embodied emissions of in-situ structural elements, particularly in high-load zones such as cores and transfer beams. This approach maintains structural performance while significantly lowering the environmental impact of the building's most material-intensive components.
.

LARGE GLASS PANELS

Vetreria Bagni provides locally fabricated custom glass elements, reducing transport emissions while supporting regional production. Their ability to produce bespoke glazing solutions makes them suitable for complex geometries and integration within large-scale architectural systems.
.

SANDSTONE ELEMENTS

Pietra Serena Conti is a company which provides locally quarried blue sandstone. This is a low-transport material that directly connects the project to Florence's historic construction palette. They Its longevity and minimal processing requirements make it a highly sustainable choice for exposed and public-facing elements.

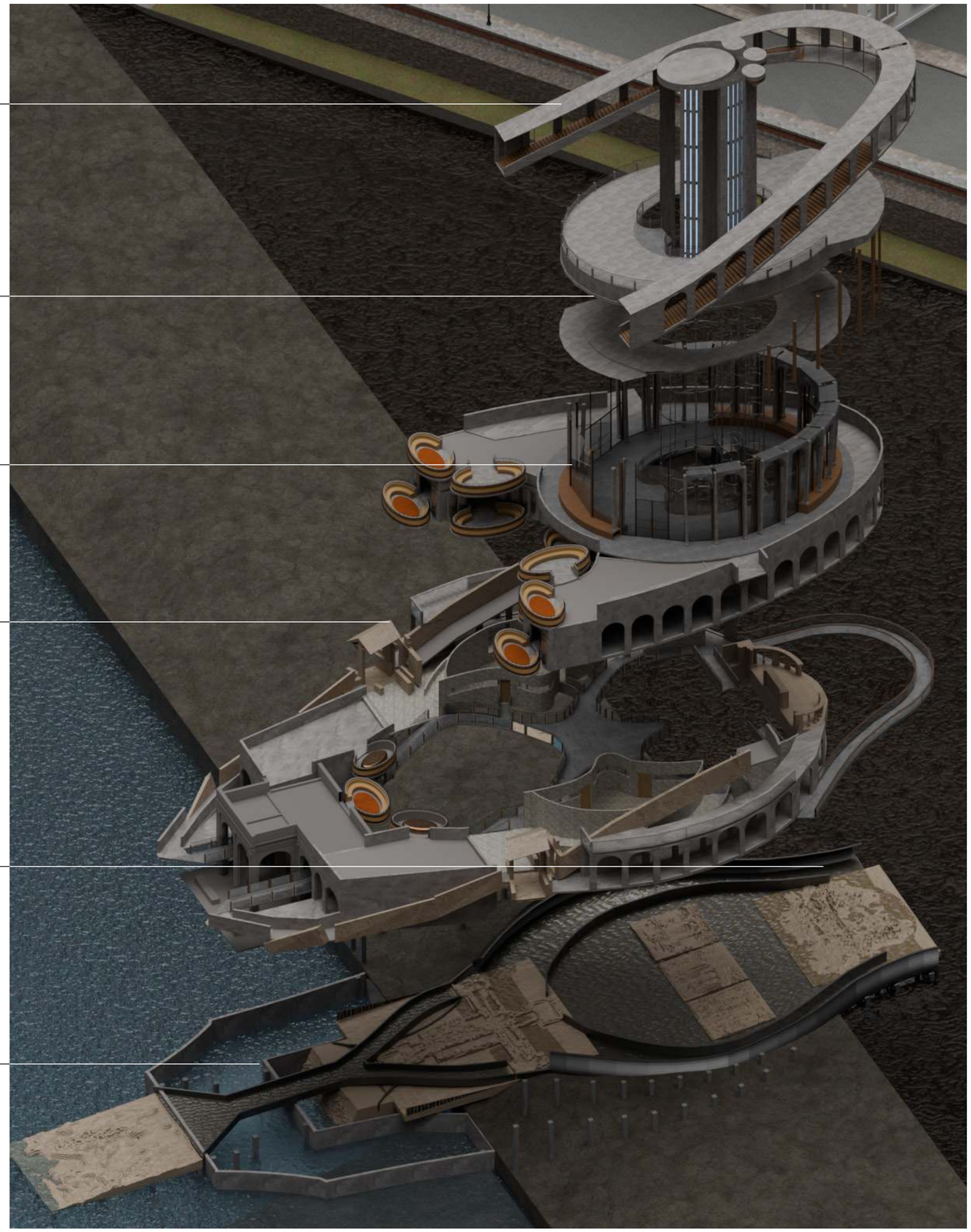
The company provide hand sculpted custom architectural elements allowing for my custom sandstone riverbed slabs to be constructed close to my site. This is key for the architectural implementation of my technical research. Sandstone becomes a key materials as it is more vulnerable to river degradation, something I experiment with more in later slides.

STEEL ELEMENTS

Cimolai's advanced fabrication of curved steel components enables precise prefabrication, reducing on-site waste and construction time. Steel's high recyclability and adaptability make it ideal for complex structural geometries within large-scale infrastructure-based architecture.
.

RIVER CONSTRUCTION SPECIALISTS

The Trevi Group's micro-pile and ground engineering systems minimise excavation and disturbance to the riverbed, preserving the integrity of the existing weir. This targeted intervention reduces material use and enables the building to be anchored efficiently within a sensitive hydraulic environment.
.



4 TECHNICAL INVESTIGATION

PAINTING WITH FLOOD WATER

To start my technical research I wanted to explore the effect river water had on materials of the painted world. The natural place to start was research canvas and how flood water impacts its surface. Doing this would allow me to get a closer insight to how specific artworks were damaged during the floods of 1966. I researched the potential contents of Arno flood water an made a mixture comprised of blender soil, vegetable oil (to mimic flood contamination, tea bags (to exaggerate flood lines) and crushed charcoal to mimic road tarmac.

I then cut out sheets of canvas and layered them with an increasing amount of gesso (painting primer), to explore how differing paint layers might be impacted by water. I then suspended each one of these canvas sheets into a bucket filled with this flood water, slowly sucking out the content of the buckets at random intervals to mimic variable flood heights. The results were striking, with the water producing textured and even artistic surfaces from plain white canvases. **This planted the idea of allowing the destructive river processes to produce the art itself.**

FLOOD WATER INGREDIENTS



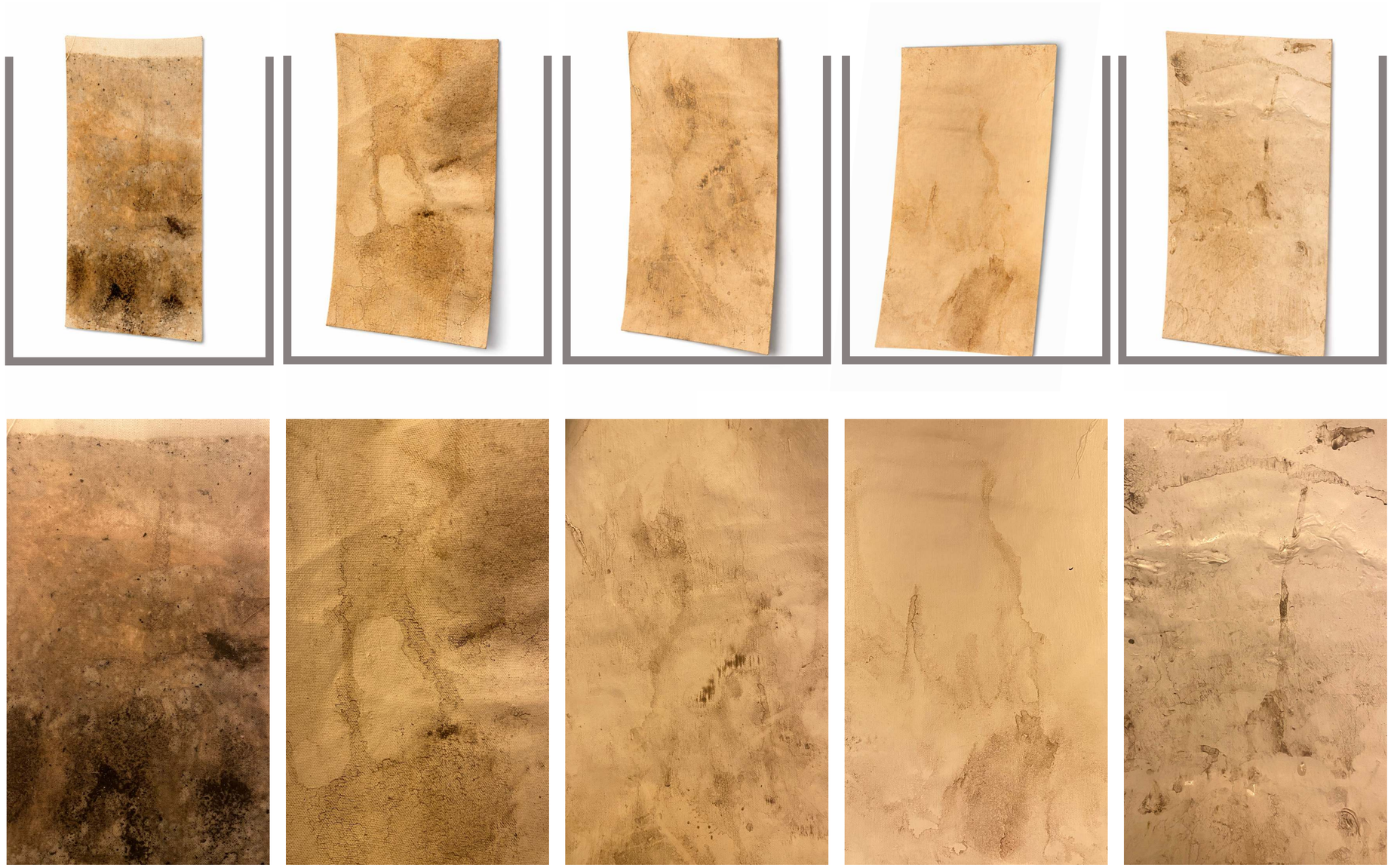
FLOOD WATER MIXTURE



PRIMER CANVAS



RECEDING WATER LEVEL



0 1 2 4

GESSO (PRIMER) LAYERS

FLOOD WATER PAINTING - CANVAS





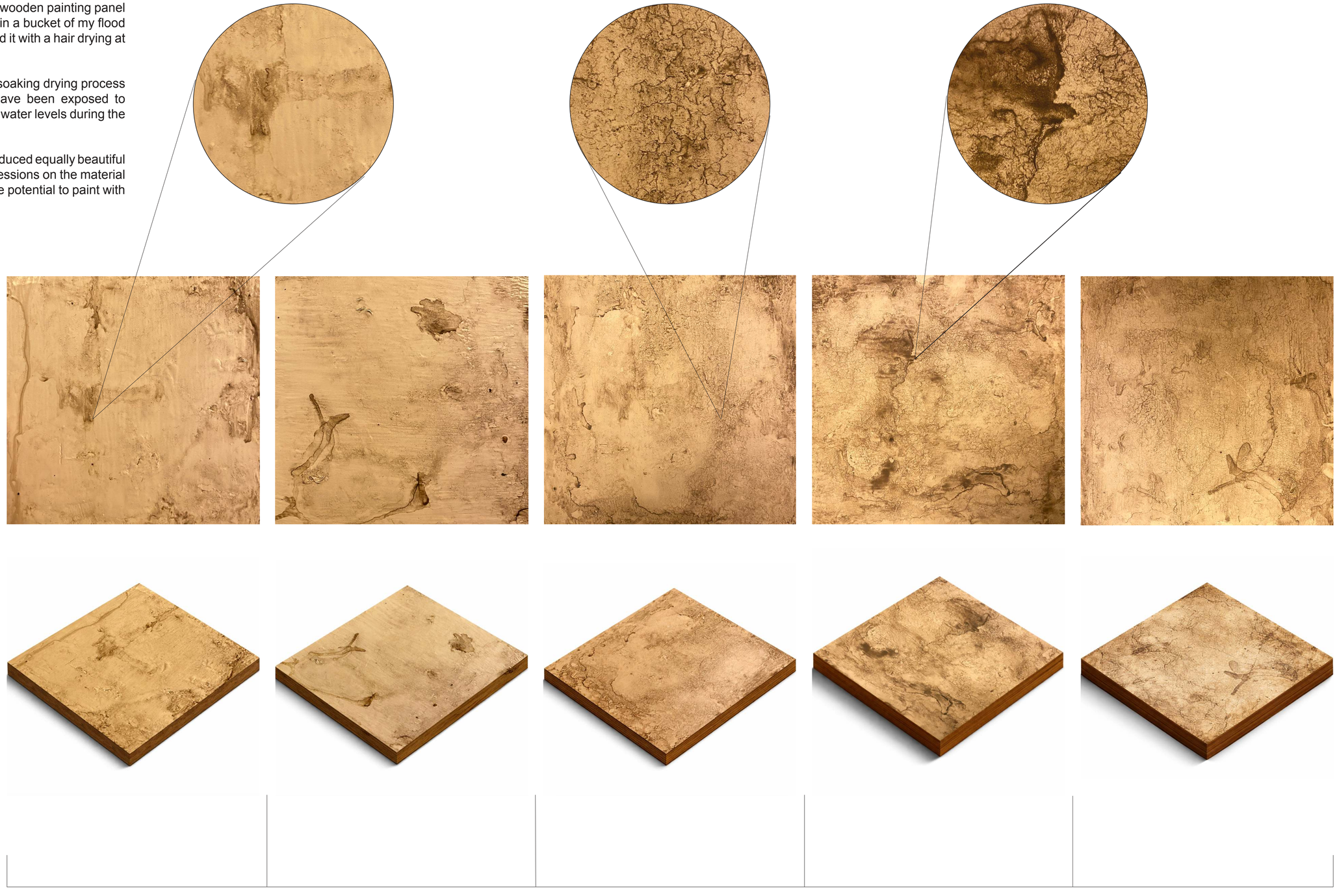
SOAKING AND DRYING WOODEN PANELS

ALLOWING THE SAME FLOOD WATER MIXTURE TO PAINT ON A DIFFERENT ARTISTIC SURFACE

For this test I primed a wooden painting panel with gesso. I soaked it in a bucket of my flood water mixture then dried it with a hair drying at random intervals.

This was to mimic the soaking drying process that paintings might have been exposed to during the inconsistent water levels during the 1966 flooding.

I found that this test produced equally beautiful cracked, textured impressions on the material once again showing the potential to paint with river processes.



DRYING CYCLE 1

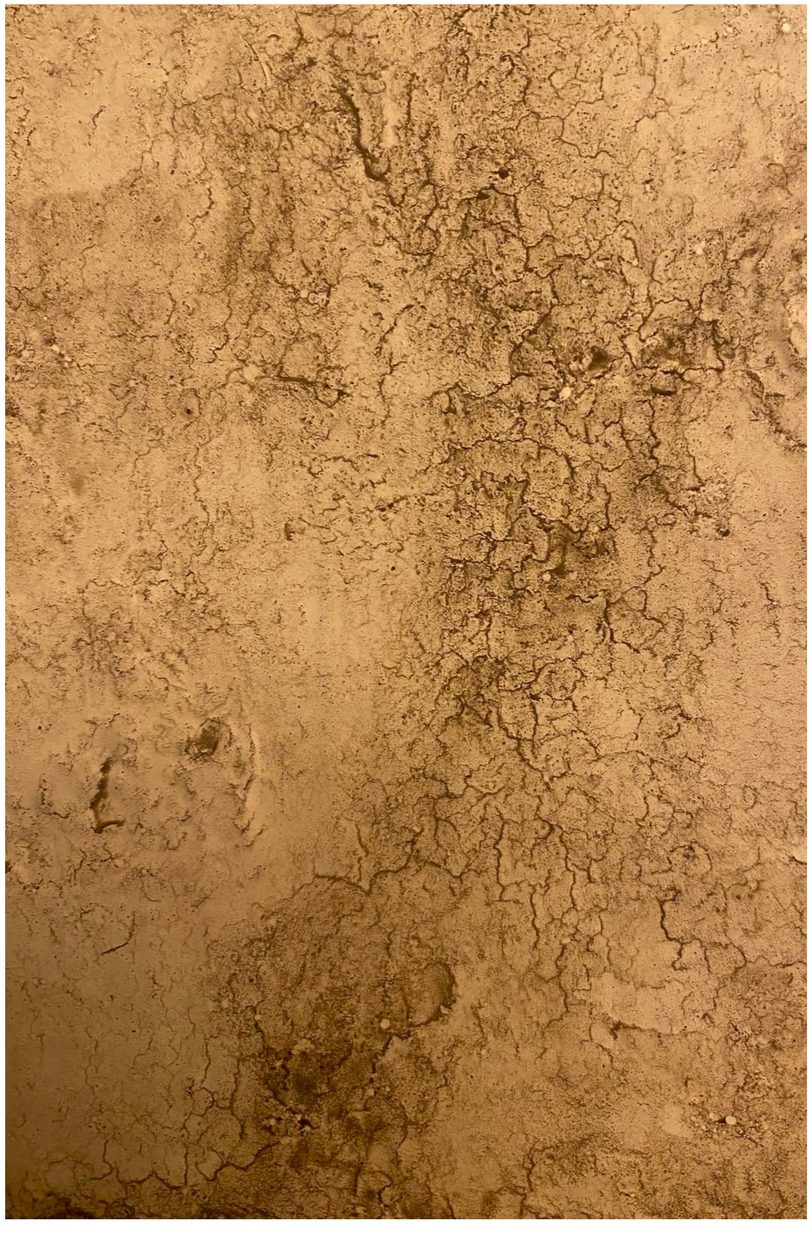
DRYING CYCLE 2

DRYING CYCLE 3

DRYING CYCLE 4

DRYING CYCLE 5

FLOOD WATER PAINTING - WOOD







HYDRAULIC IMAGE TRANSLATION THROUGH PROCEDURAL RIVERBED DESIGN

TECHNICAL QUESTION : IS IT POSSIBLE TO SCULPT THE ARNO'S FLOW INTO THE FORM OF ARTWORK LOST IN THE 1966 FLOOD?

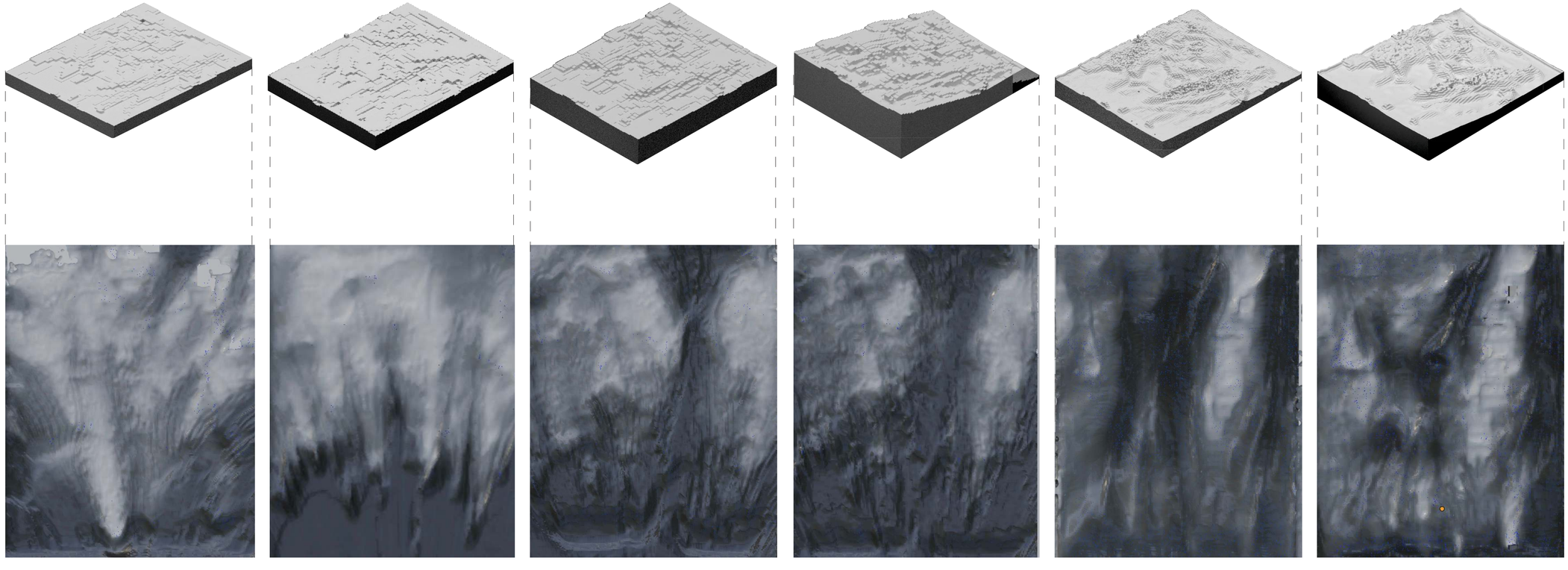
RIVER = ARTIST

ARCHITECTURE = EASEL

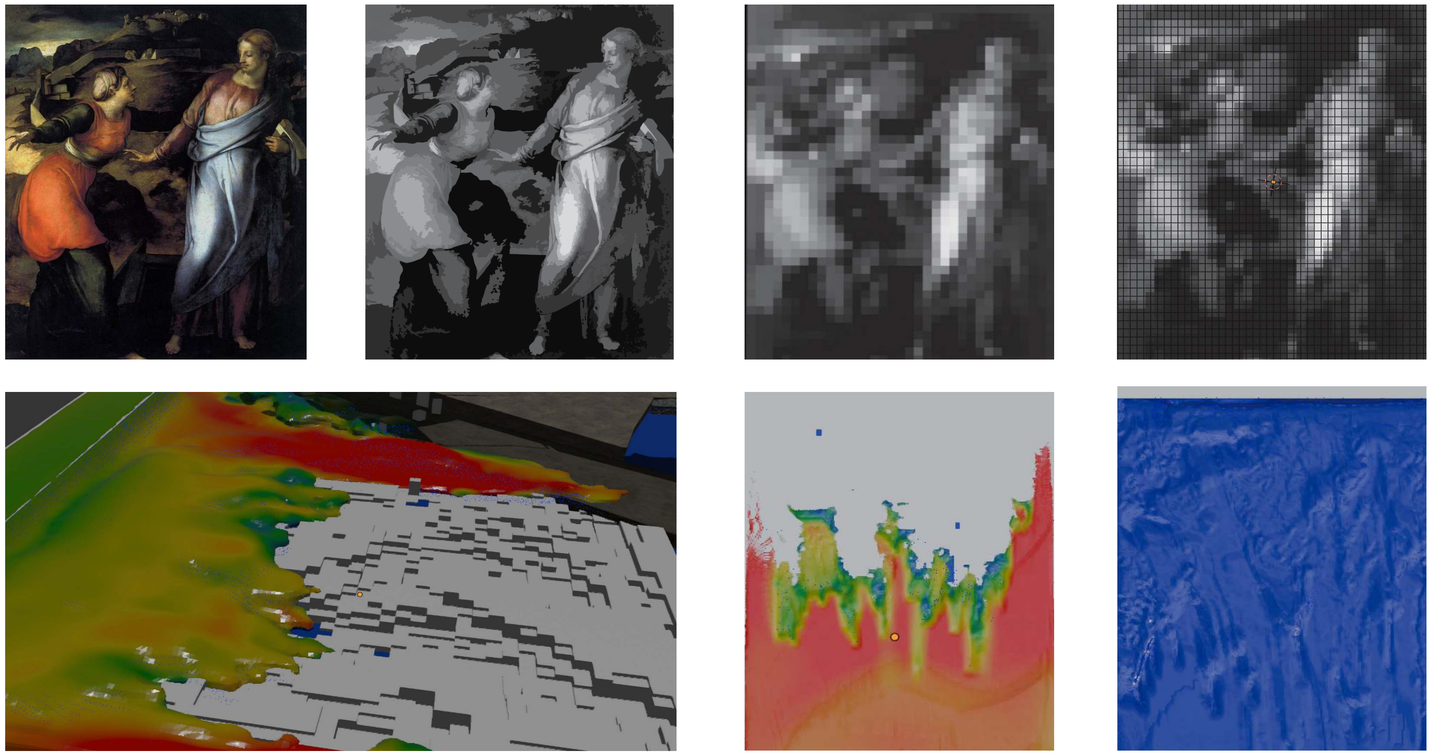
STONE = CANVAS

WATER = PAINTBRUSH

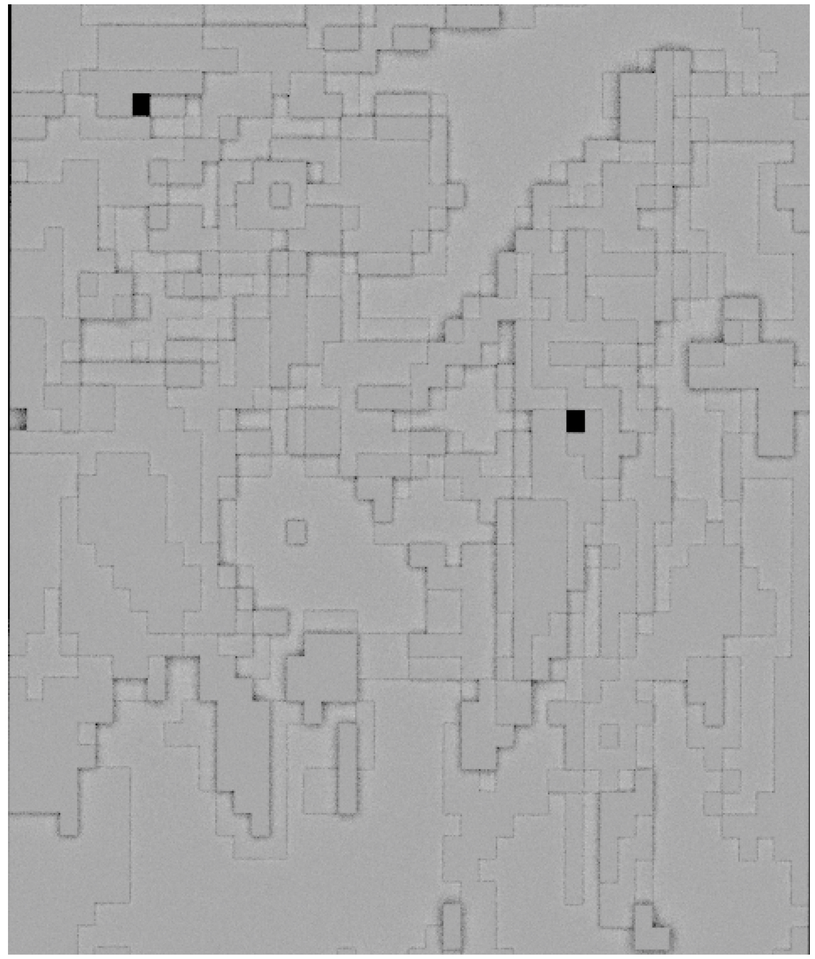
ITERATIVE PROGRESSION



CONCEPT FOR HYDRAULIC PAINTING RECREATION



Initial tests



First artificial river bed iteration

I started by choosing a painting damaged in the 1966 flood (Noli Me Tangere by Pontormo). I then converted this image into black and white in order to get a better read of tonal shifts. My aim was mimic tonal variation in the painting with turbulent water from the river. I then pixelated the image to create more drastic tonal changes so that mistakes in iterations would become more obvious.

I planned to use an artificial riverbed to induce variable levels of white water to correspond to the lighter tones within the painting. **Ironically I'm attempting to break the surface of the Arno's flow to recreate a painting that was broken by the flow of very same water.**

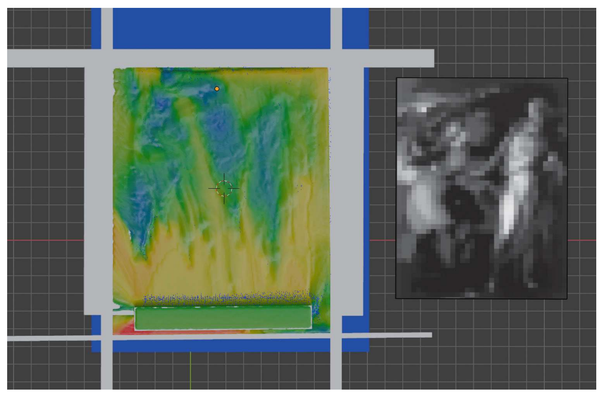
I started by using the same blender shader I used to measure the velocity of the Arno's flow (seen in earlier environmental slides). I constructed a flow pool in blender, placing my river beds at the center of this pouring with the pixelated painting visible at all times to compare river flow with my final goal.

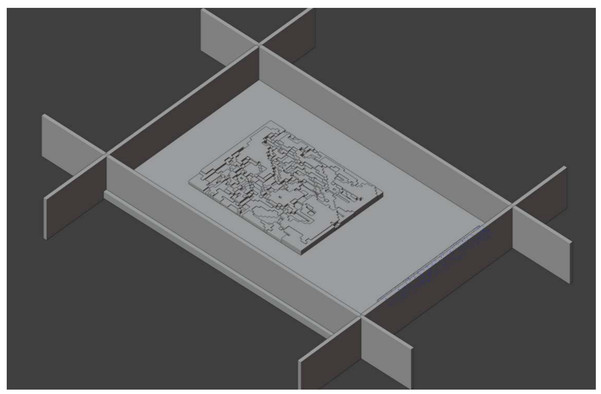
When I saw very reactive changes in river velocity over initial riverbed surfaces I knew that my idea was plausible and that it had enough weight to drive my tests forward.

The simulation was scaled to fit my building size and flow poured over each iteration had initial velocity to match the average Arno river velocity at that point over the Santa Rosa Weir.

Blender Set up



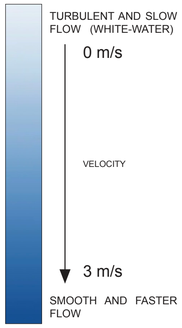


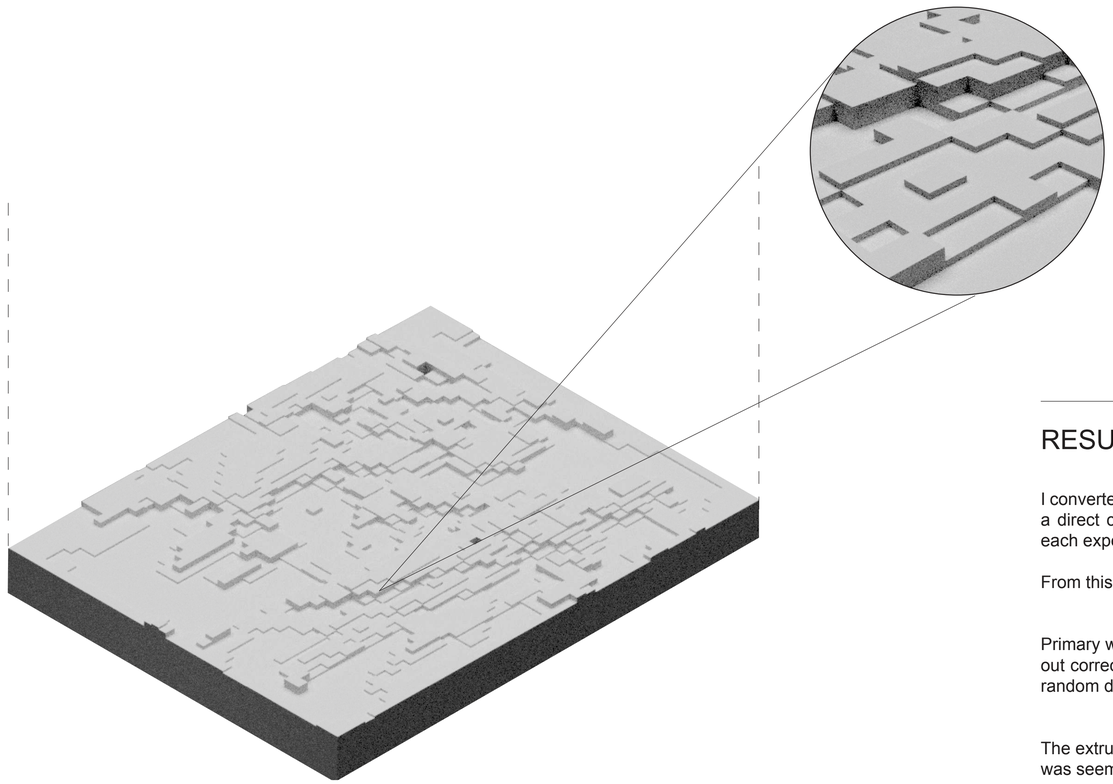


ITERATION 1

OBJECTIVES :

1. GENERATE PROPORTIONALITY BETWEEN WATER VELOCITY AND IMAGE TONALITY.
2. TEST IF THE VELOCITY SHADER WORKS.
2. GENERATE VISUAL FLOW LANGUAGE





METHOD :

For my first attempt I manually mapped out 7 different tonal values from the black and white painting.

I then extruded these different tones at equal intervals, the brightest tones being extruded furthest.

I used Manning's equation as a starting point, with water depth being a key factor affecting flow speeds.



RESULTS :

I converted my water shader to black and white in order to have a direct comparison to the tonality of the original image after each experiment.

From this experiment the shader seemed to work well.

Primary were pretty poor with the flow speeds initially mapping out correctly at the base of the image, but later washing out in random directions.

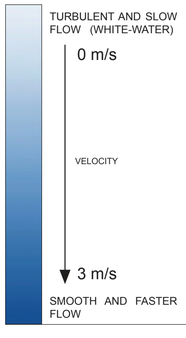
The extrusions weren't aggressive enough and the waters flow was seemingly too uniform in key areas.

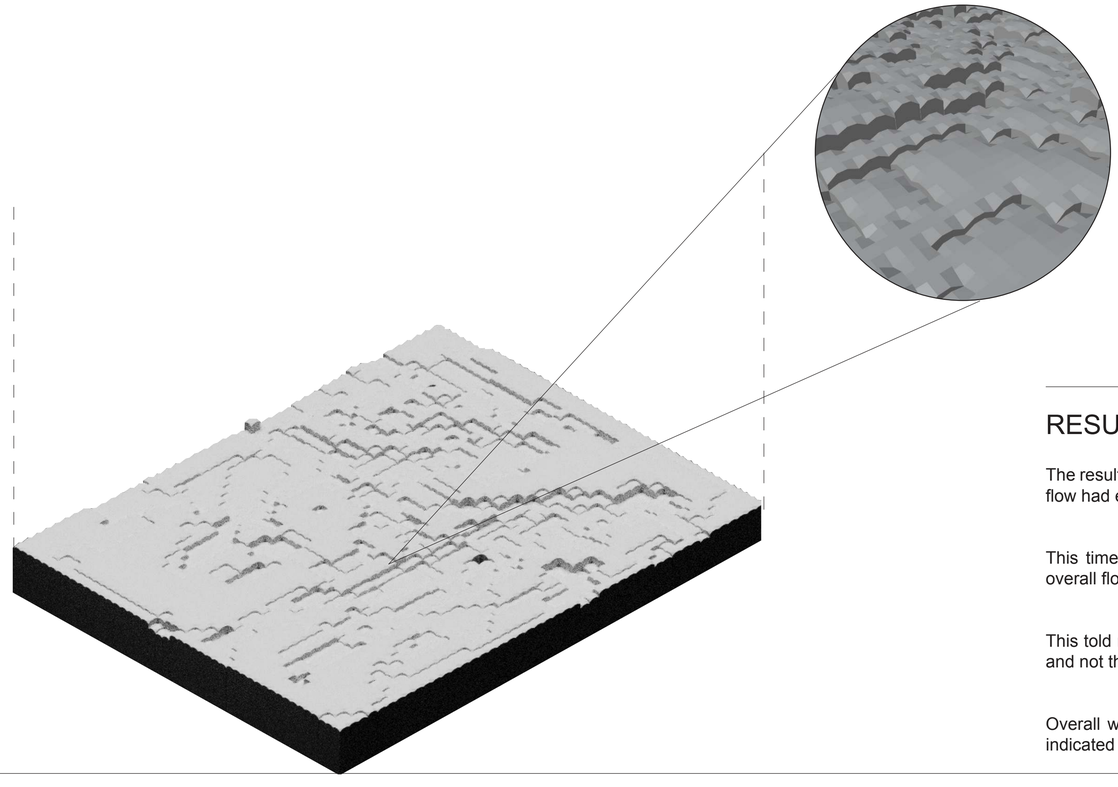


ITERATION 2

OBJECTIVES :

1. CREATE SMOOTHER OVERALL FLOW TO PROMOTE DISCHARGE
2. CURVE EXTRUSION FACES TO PREVENT POOLING



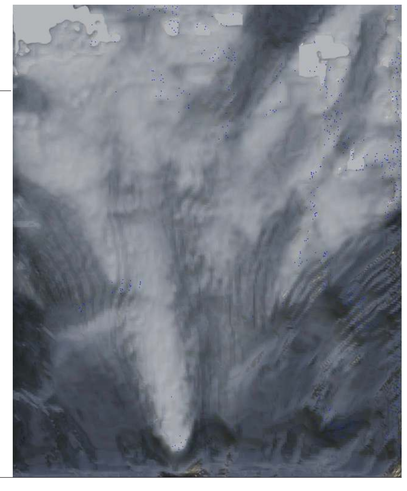


METHOD :

I used the same base template from the previous iteration.

I then added a curve modifier to each of the extrusion faces.

I maintained the overall slope and extrusion intervals .



RESULTS :

The results were even worse than the previous iteration and the flow had even less control.

This time there was no resemblance to the painting and the overall flow spread was bad.

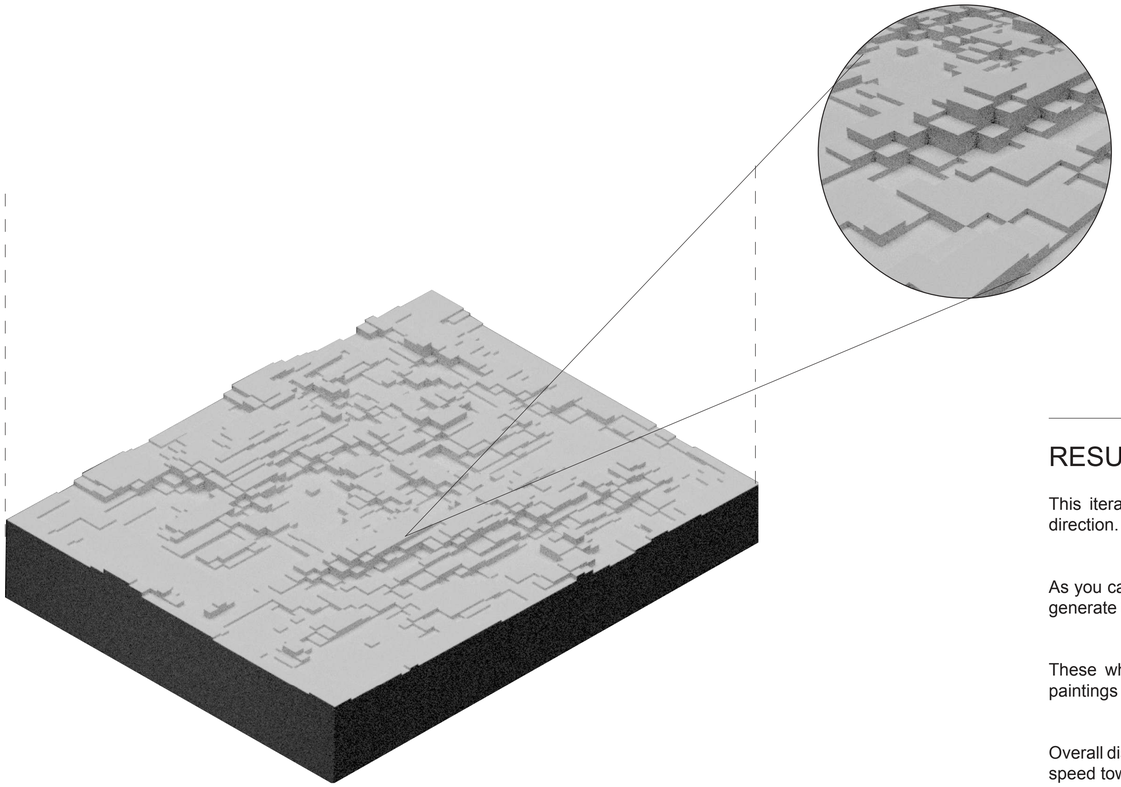
This told me that the problem was my tonal extrusion intervals and not the shape of individual faces.

Overall water flow slowed down as it moved along the plane indicated lack of slope/discharge.

ITERATION 3

OBJECTIVES :

1. GENERATE MORE AGGRESSIVE TONAL SHIFTS
2. PROMOTE OVERALL DISCHARGE



METHOD :

Instead of manual tonal extrusions I developed a string of geometry nodes to correlate image tone with exponential rather than extrusion height.

Lighter tones now popped out more in aim to create more aggressive tonal shifts.

I also added a slight slope to the plane to allow for consistent flow throughout the plane.



RESULTS :

This iteration was largely successful and a step in the right direction.

As you can see from the flow image on the right, I was able to generate to primary figures of lighter tonality.

These white splodges act as the first step in recreating the paintings composition.

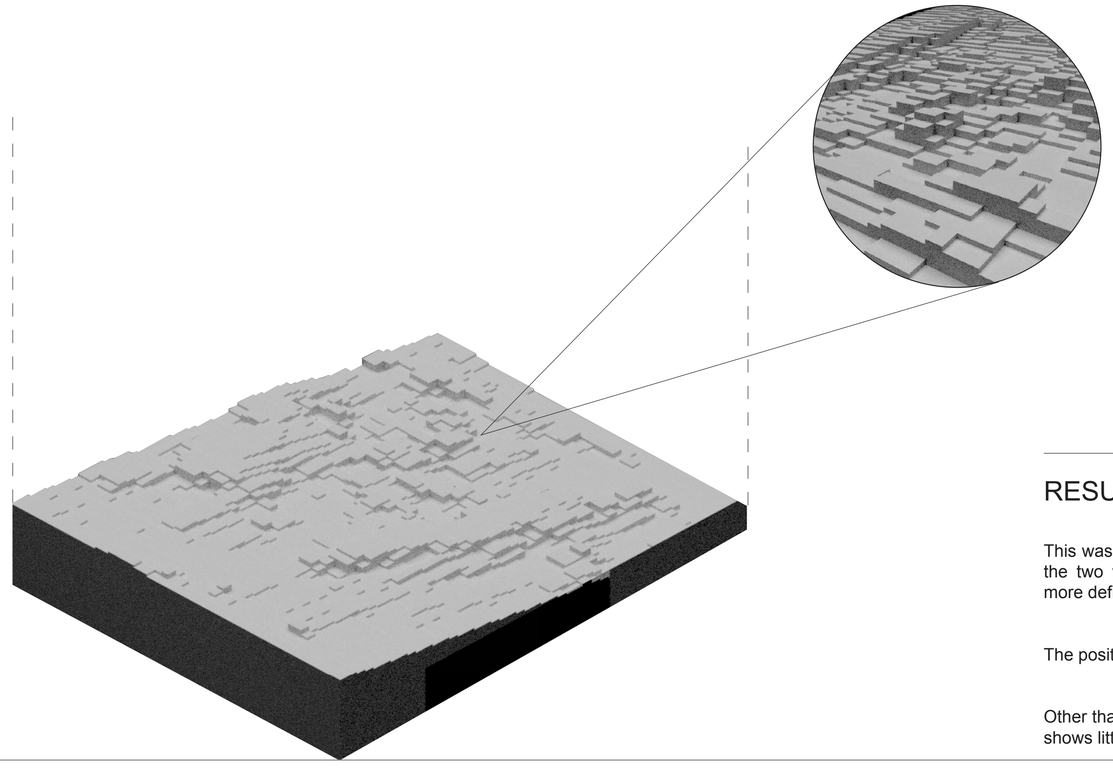
Overall discharge consistency improved but flow still lack overall speed towards the end of the plane.



ITERATION 4

OBJECTIVES :

1. CONCENTRATE IMAGE COMPOSITION
2. AGAIN PROMOTE OVERALL DISCHARGE



METHOD :

I added a steep slope to further increase flow speed through the image and hopefully sharpen composition.

I created a node branch to soften tonal shifts, creating a slightly more curved riverbed plane to improve flow consistency and prevent pooling.



RESULTS :

This was a slight improvement from the previous iteration with the two white splodges definitely sharpening and becoming more defined.

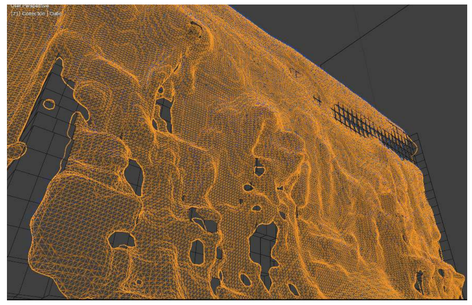
The positioning of the white tones was still quite wrong.

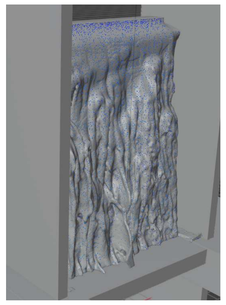
Other than two primary white figures the hydraulic imagery still shows little to no resemblance to the intended painting.

USING GRAVITY TO INFORM DESIGN

OVERALL OBJECTIVES :

1. EXPLORE WATER CATCHMENT AND SPLASH ZONES TO RECREATE IMAGERY
2. EXPERIMENT WITH THE IDEA OF WATER TERRACING AND ITS INFLUENCE ON FLOW VELOCITY
3. SEE IF THIS CAN INFORM RIVER BED DESIGN IN ANY WAY









ITERATION 1



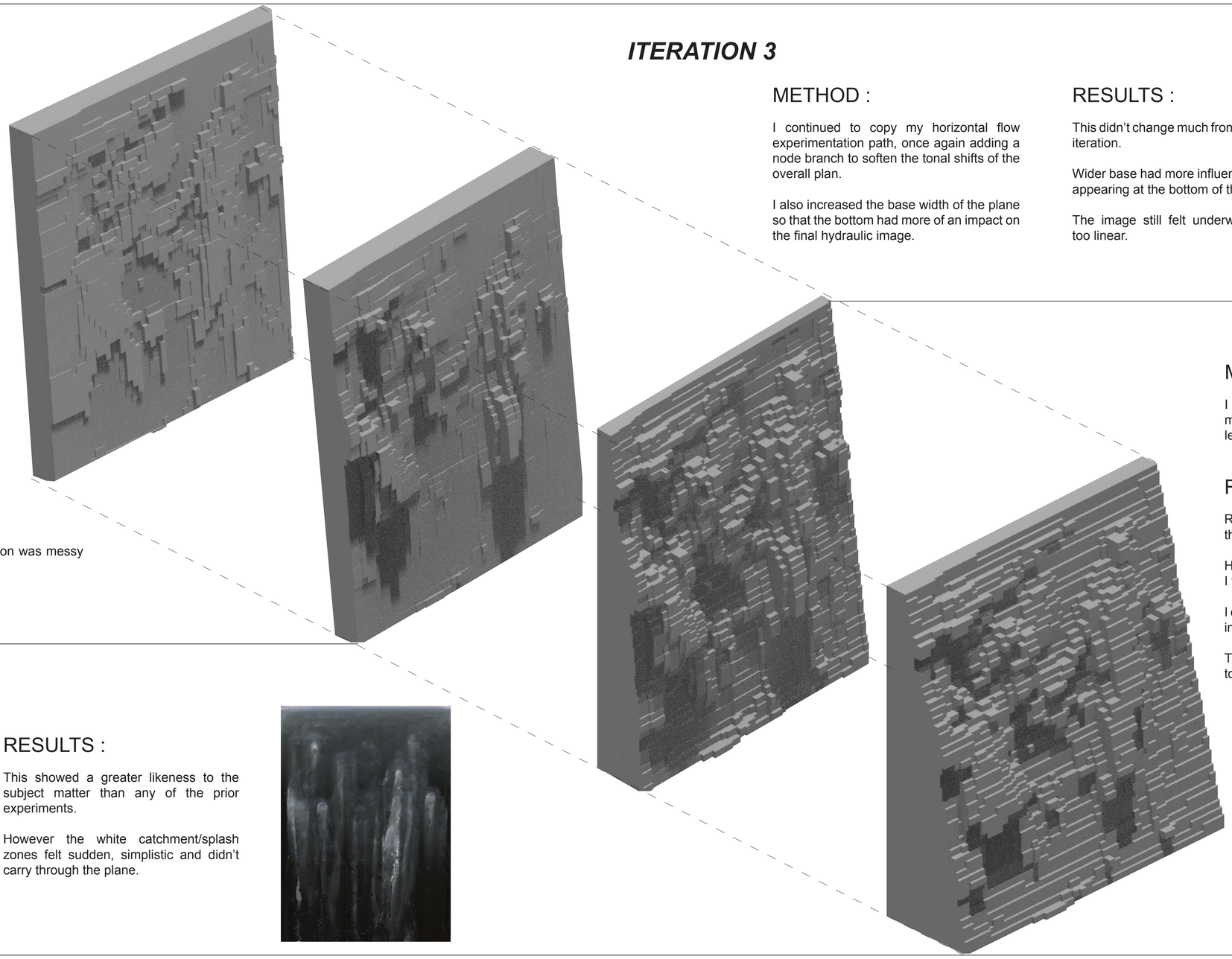
METHOD :

My first iteration for the water wall exploration was the very similar to my first for the horizontal flow.

This consisted of manual extrusions dictated by separated tonal values.

RESULTS :

Like the results of my horizontal flow the first iteration was messy and show no correlation to the subject matter.



ITERATION 2

METHOD :

Once again I scrapped the manual extrusion and experimented with geometry nodes.

I plugged in the same exponential tonal growth nodes as I did with my horizontal experiments.

RESULTS :

This showed a greater likeness to the subject matter than any of the prior experiments.

However the white catchment/splash zones felt sudden, simplistic and didn't carry through the plane.

ITERATION 3

METHOD :

I continued to copy my horizontal flow experimentation path, once again adding a node branch to soften the tonal shifts of the overall plan.

I also increased the base width of the plane so that the bottom had more of an impact on the final hydraulic image.

RESULTS :

This didn't change much from the previous iteration.

Wider base had more influence with white appearing at the bottom of the plane.

The image still felt underwhelming and too linear.



ITERATION 4

METHOD :

I added an overall stepped logic to the node setup meaning that each tonal value had to extrude out to at least as far as the same tonal value in a higher row.

RESULTS :

Results improved and made a ghost like recreation of the original painting.

However the hydraulic imagery lacked the fluid texture I was after and still felt too linear.

I concluded that gravity was having a far too aggressive influence on my final image outcome.

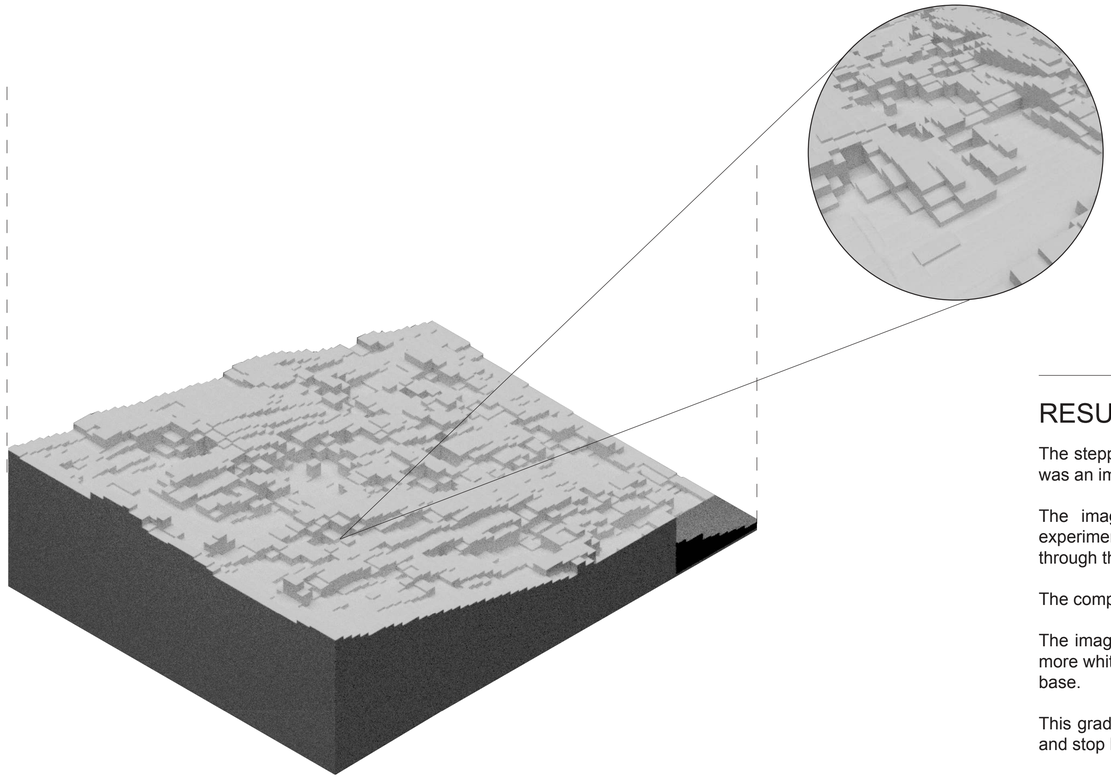
The stepped logic still interested me and prompted me to extend these explorations with lateral flow.

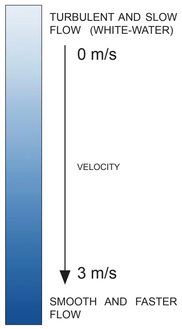


ITERATION 5

OBJECTIVES :

1. TEST VERTICAL STEPPED LOGIC ON LATERAL PLANE





METHOD :

Using the same plane from the final vertical iteration in a lateral flow test.

This involved retaining the stepped extrusion logic from introduced to in the waterfall experimentation.

RESULTS :

The stepped logic definitely improved the image definition and was an improvement from the last lateral test.

The image produced was much richer than the vertical experiments and you can see much more nuanced tonal shifting through the plane.

The composition is also gaining more clarity in this iteration.

The image still suffered from a slowing velocity gradient with more white towards the top of the image and more black at the base.

This gradient suggests that extrusions may be too aggressive and stop halt the overall waterflow.



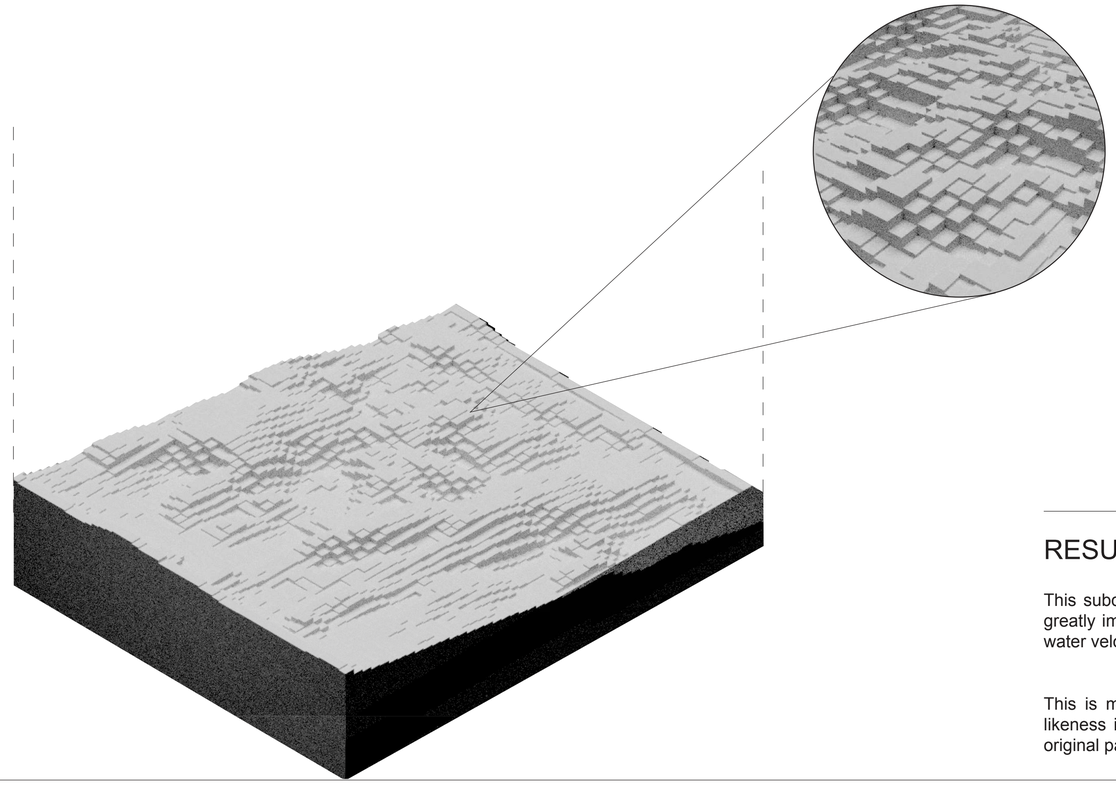


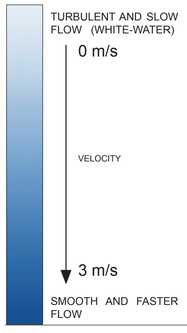
ITERATION 6

OBJECTIVES :

1. SOFTEN OVERALL RIVERBED GEOMETRY TO PROMOTE CONSISTENT VELOCITY

2. SHARPEN IMAGE COMPOSITION





METHOD :

In order to reduce the fall off of water velocity through the plane I decided to subdivide the surface, giving it a more organic look and hoping to allow water to run more smoothly over it.

I also hoped that this would improve composition as there are more faces to influence the image.

RESULTS :

This subdivision was a massive step in my iterative process, greatly improving general composition and no longer allowing water velocity to drastically fall off.

This is my first iteration where you can clearly make out a likeness in correlation between velocity tonal values and the original painting.

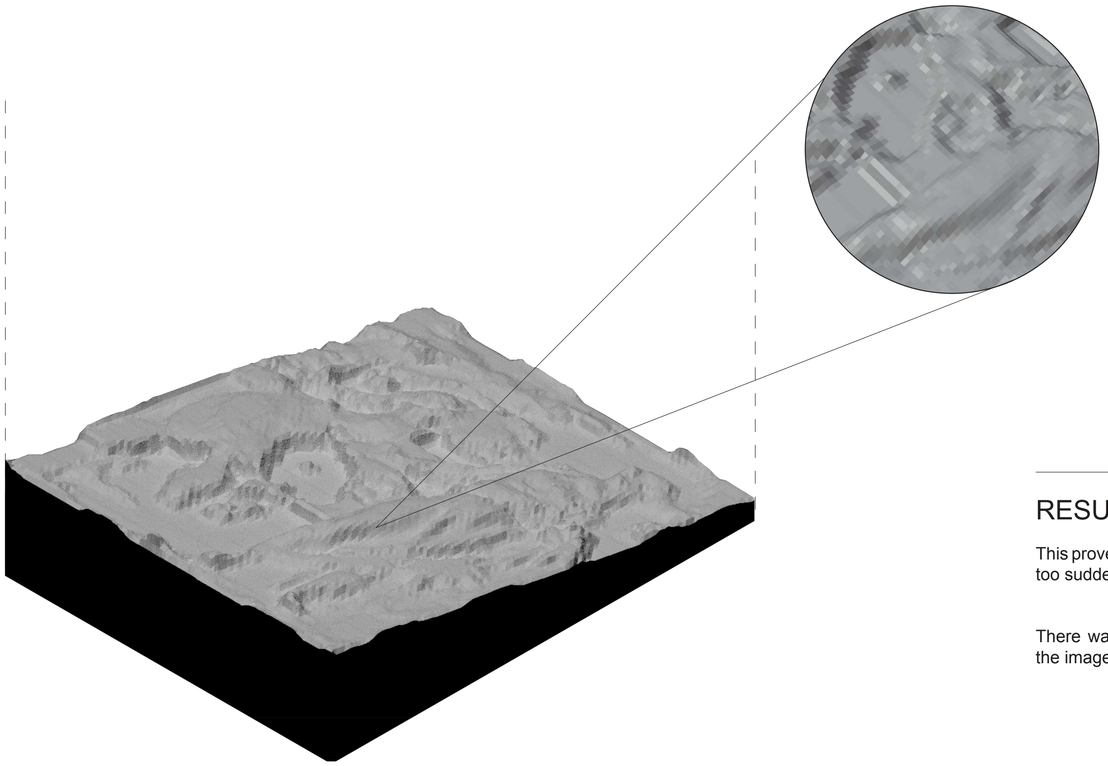


ITERATION 7

OBJECTIVES :

1. TESTING WITH FURTHER SUBDIVISION OF THE SURFACE

2. GIVING THE RIVERBED A MORE ORGANIC LOOK



METHOD :

Instead of extruding from a pixelated image I decided to plug a black and white version of original painted image into my geometry nodes.

I then added subdivisions to make artificial riverbed look as if it had been organically formed by river processes.



RESULTS :

This proved to be moderately successful but tonal shifts became too sudden and mid tones were lost from the image.

There was an overall improvement in general composition of the image but and reduction in textural quality.

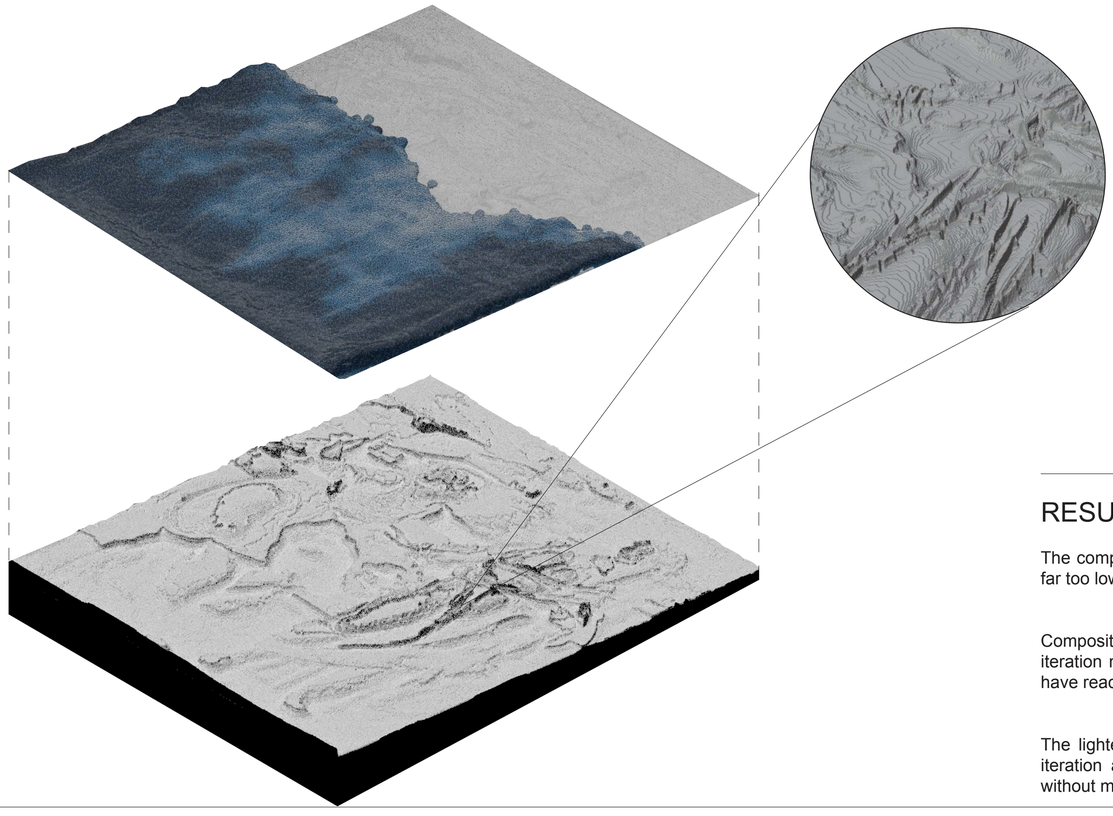


ITERATION 8

OBJECTIVES :

1. TESTING EVEN FURTHER SUBDIVISION

2. ELEVATE TONAL SHIFT ZONES



METHOD :

I decided to add a further layer to my geometry node setup, introducing branch dictated more extreme extrusions for harsh changes in tone.

Looking back at Manning's equation I wanted to create more friction in the most dynamic part of the painting in order to highlight these tonal shifts.

I also once again subdivided the surface and reduced overall extrusion to see if my friction theory worked.



RESULTS :

The composition can be made out but the overall extrusion is far too low to register meaningful tonal highlights.

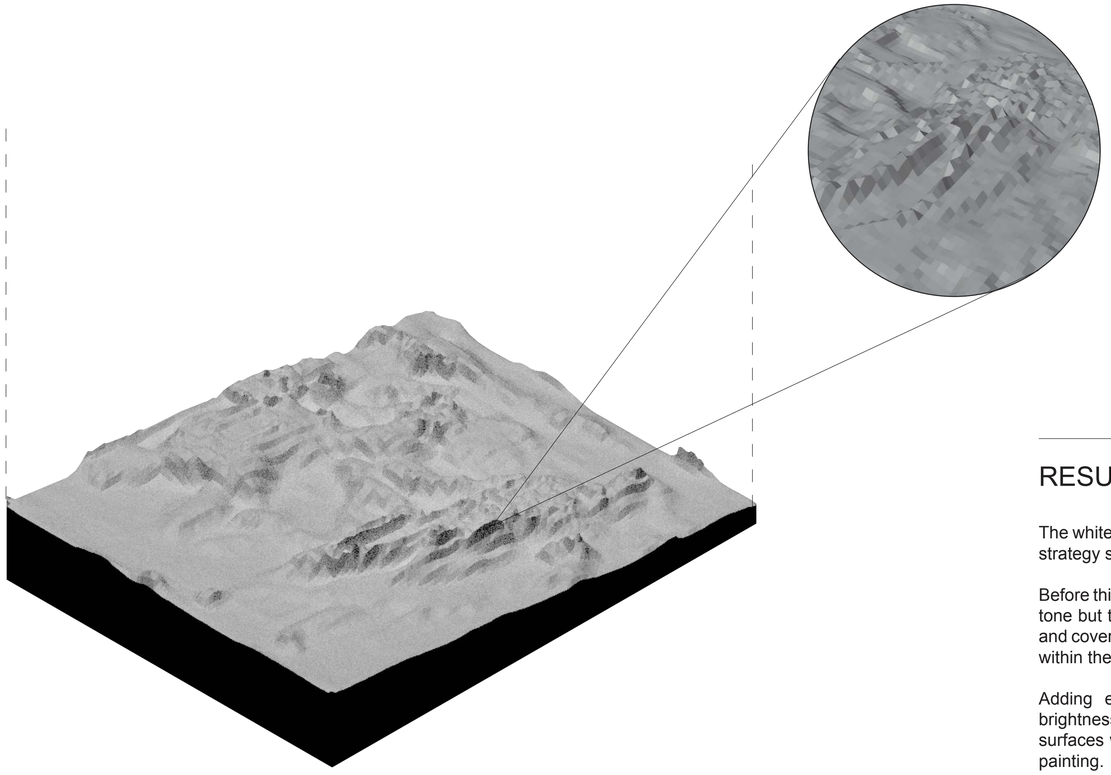
Composition also isn't a massive improvement from the previous iteration making me think that the subdivision strategy might have reach it's limit.

The lightest tones of the image were completely lost in this iteration as water flowed through the surface far too easily without much interruption.

ITERATION 9

OBJECTIVES :

1. BRINGING BACK LIGHTER TONES
2. TAKING A STEP BACK WITH SUBDIVISION
3. USING MANNING'S EQUATION TO INTRODUCE MORE FRICTION TO LIGHTER TONES



METHOD (FRICTION LOGIC) :

I decided to take a step back with subdivision as surface complexity didn't seem to be the problem.

Spiking friction in tonal shifts will elevate the image's outlines but beyond these points water will respond the same to consistent tones regardless of brightness.

Therefore I created an extrusion inconsistency node branch to introduce random spikes and divots when tones spread over a large area in the painting.



RESULTS :

The whiter tones were reintroduced to the image and my friction strategy seems to be successful.

Before this iteration water would slow down as it reaches a white tone but then speed up again if this white tone was consistent and covered a large part of the painting (as there was not friction within the extrusions to stop it.

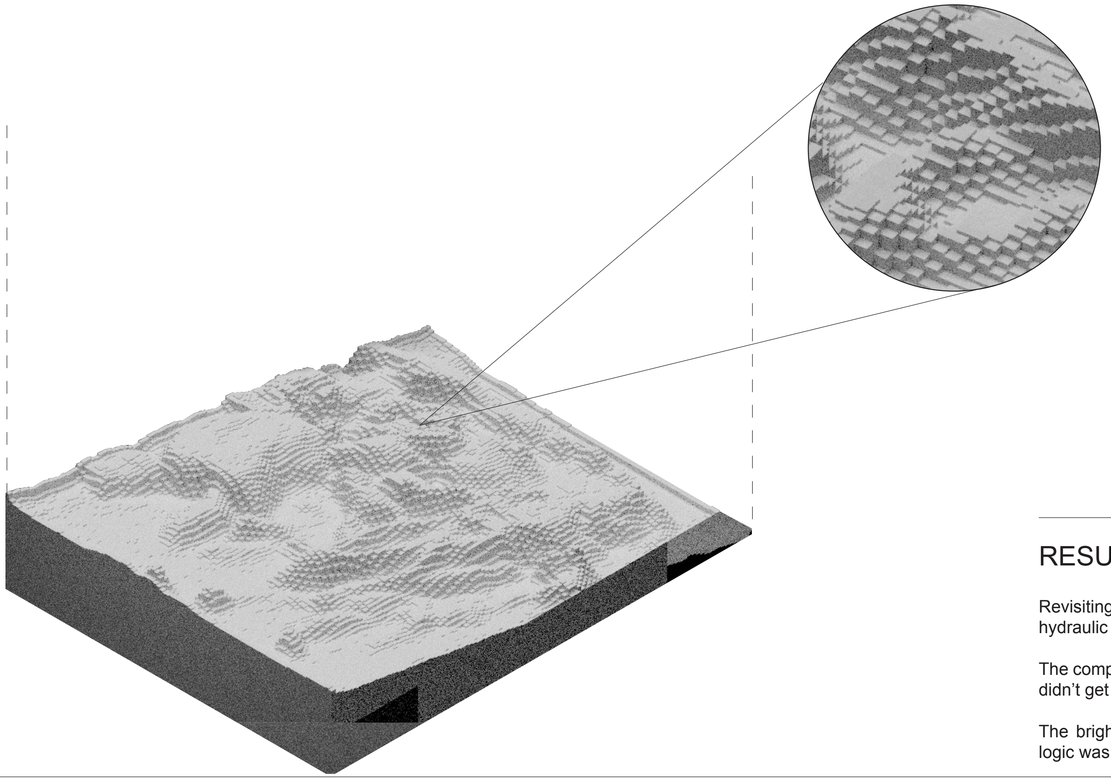
Adding extrusion randomness and correlating this to the brightness of tones prevents from speeding up over flat white surfaces whilst retaining a smooth flow over black parts of the painting.



ITERATION 10

OBJECTIVES :

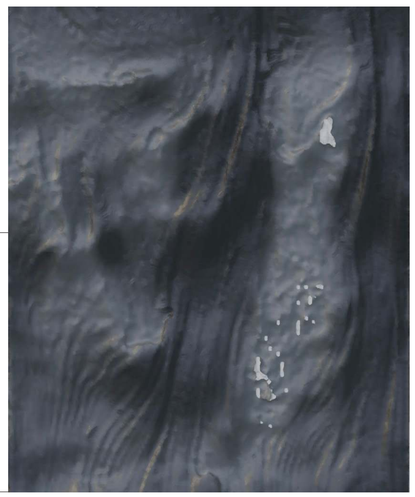
1. FINDING A BALANCE BETWEEN PIXELATED AND ORGANIC EXTRUSIONS



METHOD :

Given the success of the friction logic in the previous iteration I decided to retest iteration 6 to see weather a combination of these ideas would be plausible.

I exaggerated the extrusion behaviour of iteration 6 and the increased the overall curvature of the slope to see if this would sharpen composition even further.



RESULTS :

Revisiting earlier iterations seems to bring a flowed texture the hydraulic art that was missing in more recent iterations.

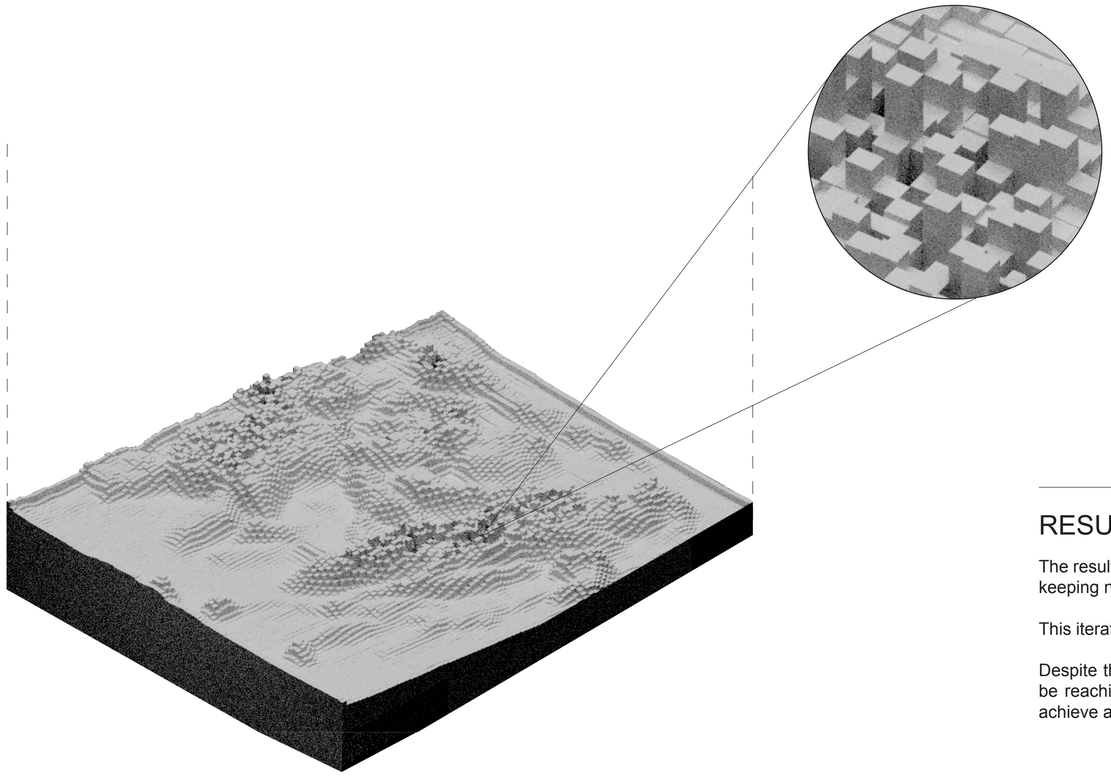
The composition of the image didn't improve much but certainly didn't get much worse.

The brightest tones were once again lost due as the friction logic was neglected.

ITERATION 11

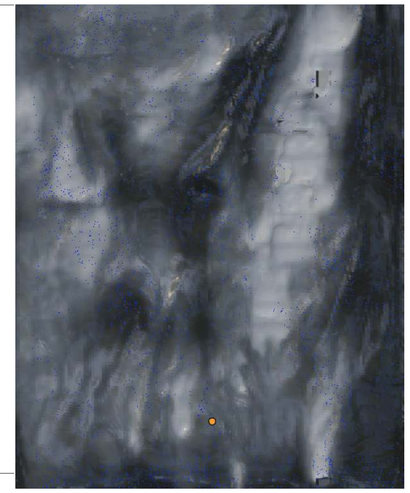
OBJECTIVES :

1. INTRODUCING THE FRICTION LOGIC TO PREVIOUS SUCCESSFUL ITERATIONS



METHOD :

I added the friction node branch developed in iteration 9 and as you can see the extruded surfaces correlating to the whiter tones of the paining have far more inconsistencies than surfaces corresponding to dark tones.



RESULTS :

The resulting image regained the bright tonal values whilst also keeping nuanced textures.

This iteration has the most likeness to the original image so far.

Despite the improved likeness the hydraulic image seemed to be reaching it limit and I started to accept that I would never achieve an exact copy of the painting.

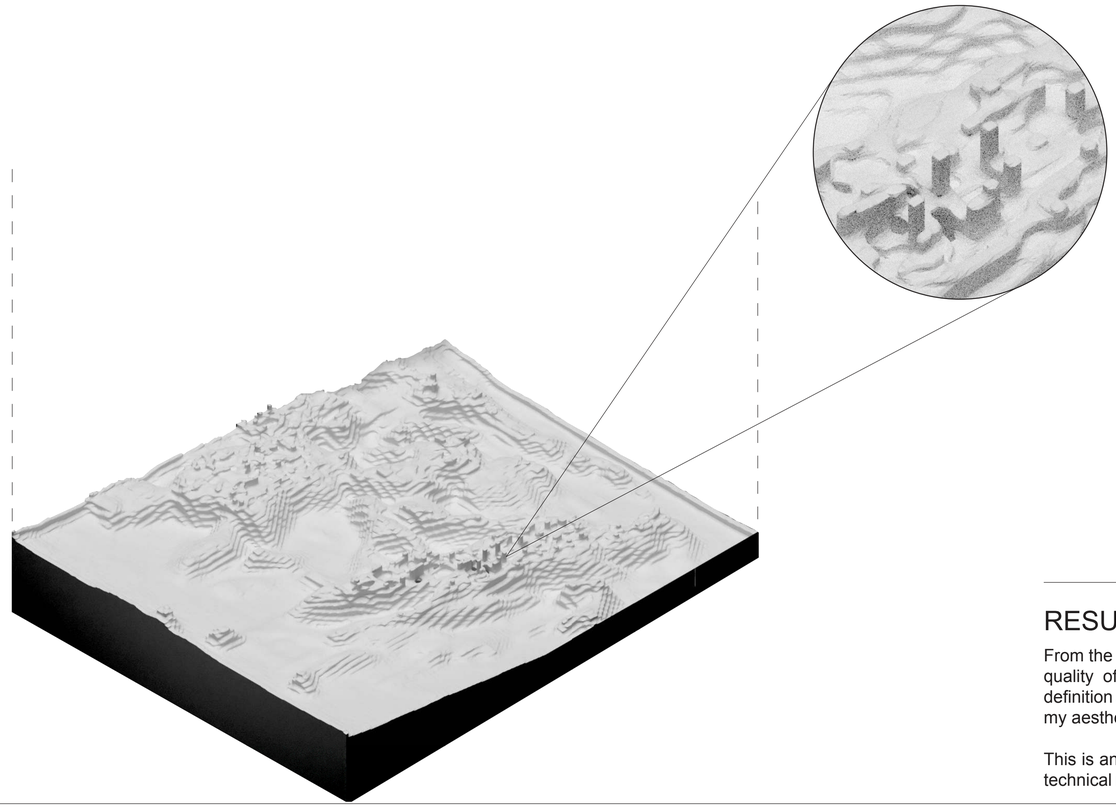


FINAL ITERATION

OBJECTIVES :

1. FINAL AESTHETIC IMPROVEMENTS FOR SUCCESSFUL DESIGN IMPLEMENTATION

2. BALANCING DESIGN AESTHETICS WITH TECHNICAL QUALITY



METHOD :

I added a series of modifiers to improve the overall organic feel to the artificial riverbed form so that it would blend more seamlessly with my architectural language.

I did this while attempting to have little impact on the structural logic of the riverbed and hence the subsequent white-water image it produces



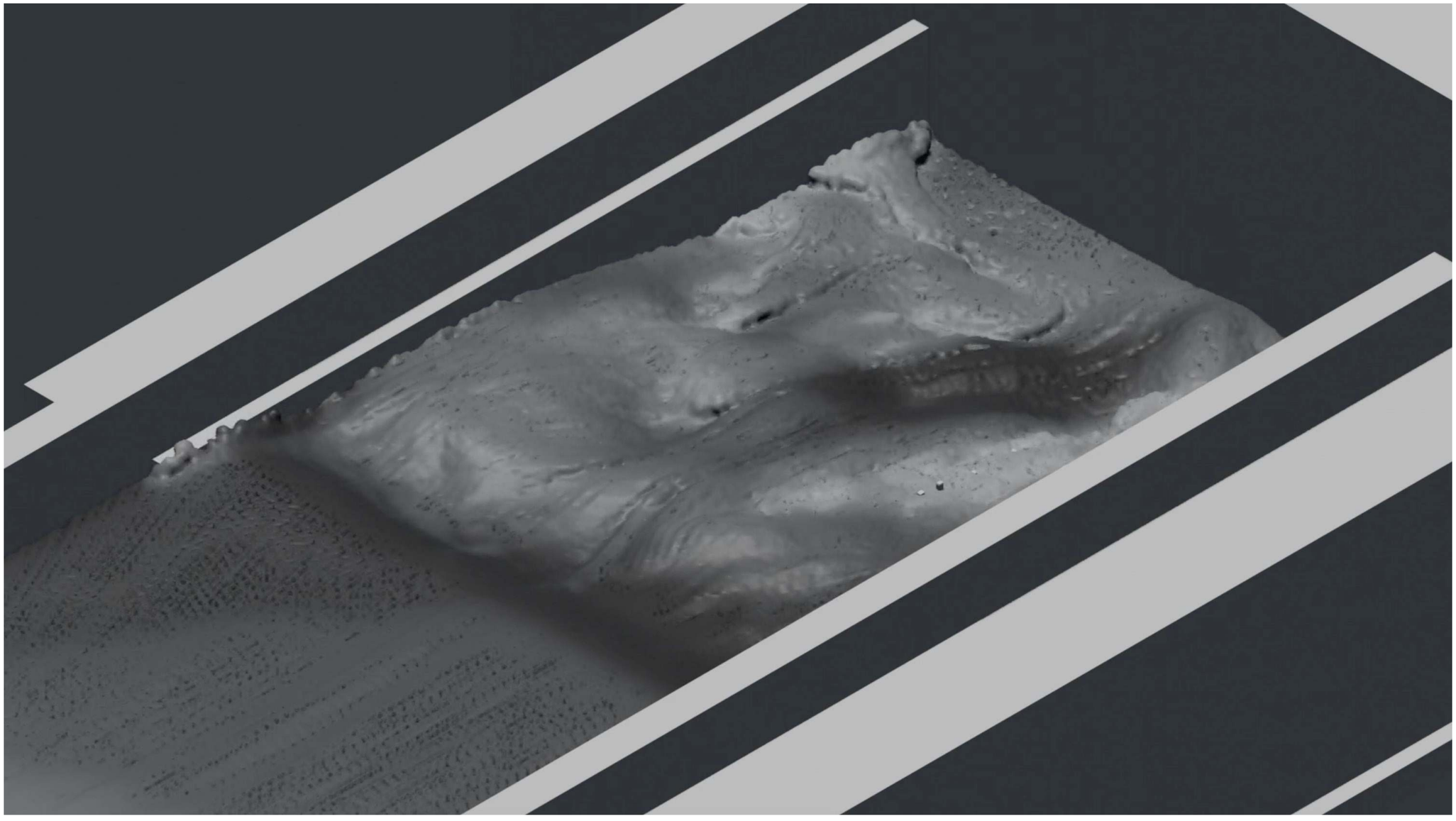
RESULTS :

From the results you can see the final image retains the overall quality of the previous iteration, maybe losing a tiny bit of definition around the head area but other that not suffering from my aesthetic changes.

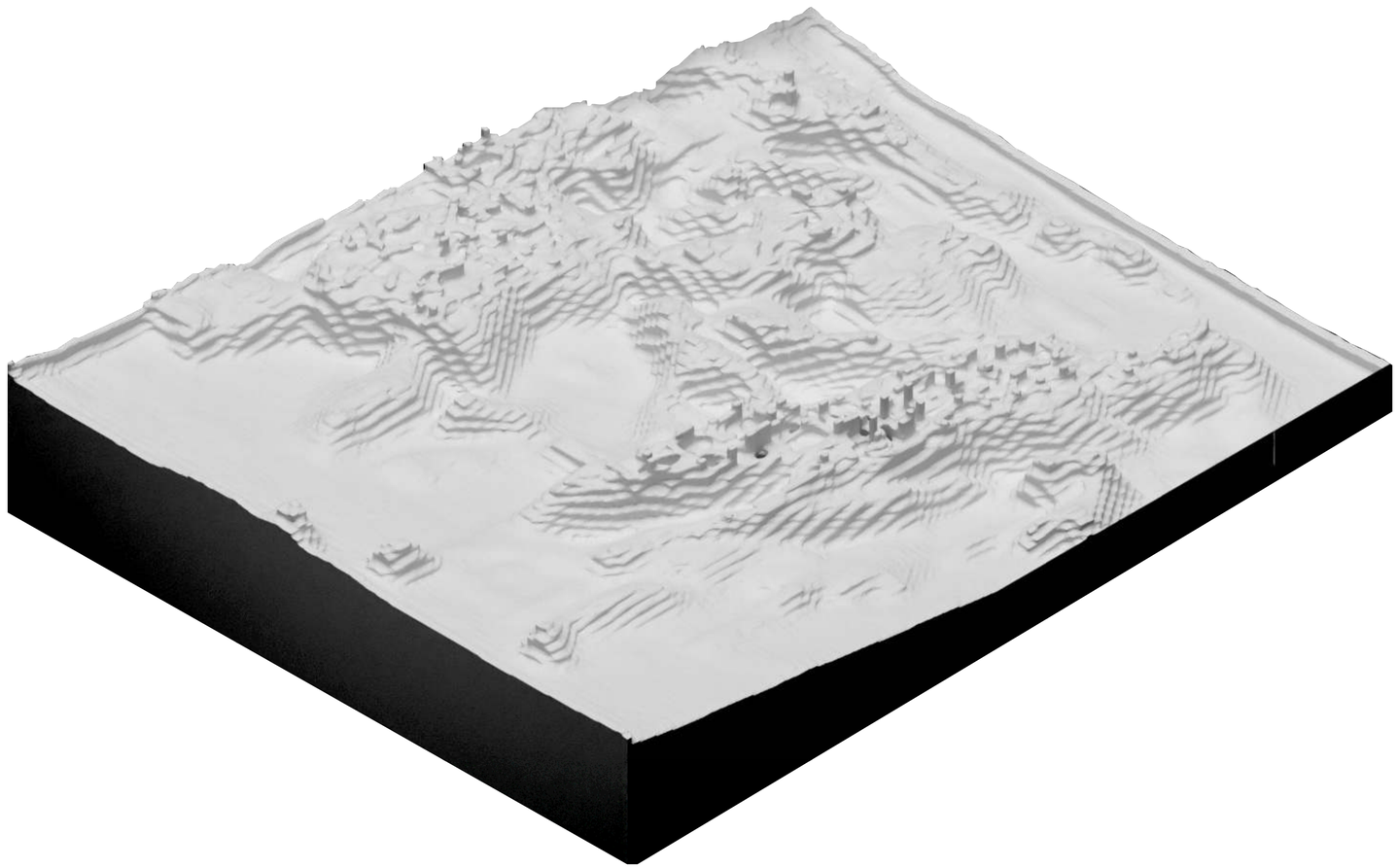
This is an example of balancing aesthetic design qualities with technical research.

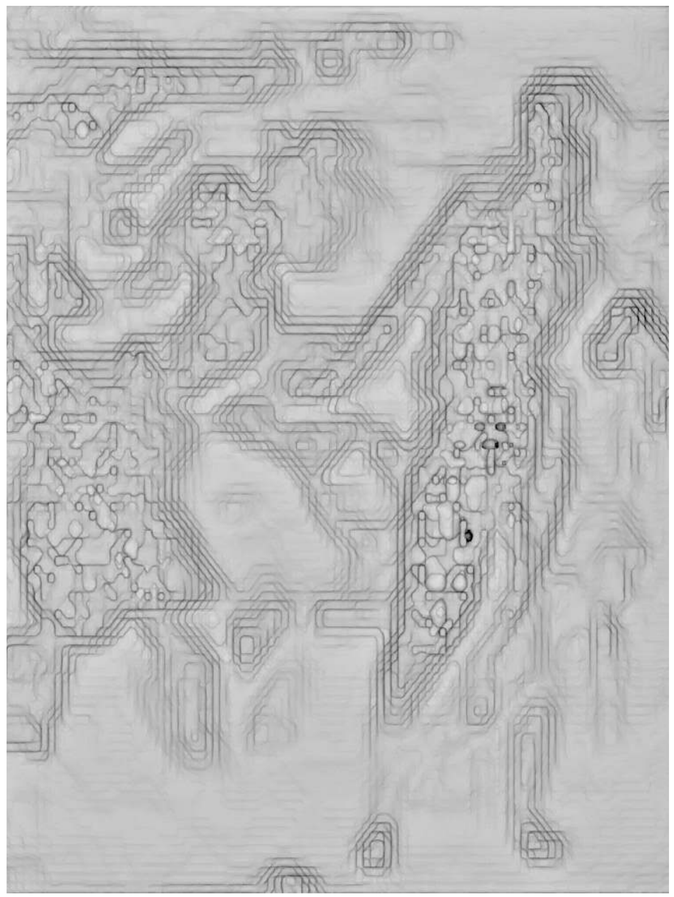
RIVER PAINTING VIDEO

This highlights my digital fluid test setup on blender - please check the video submitted separately.



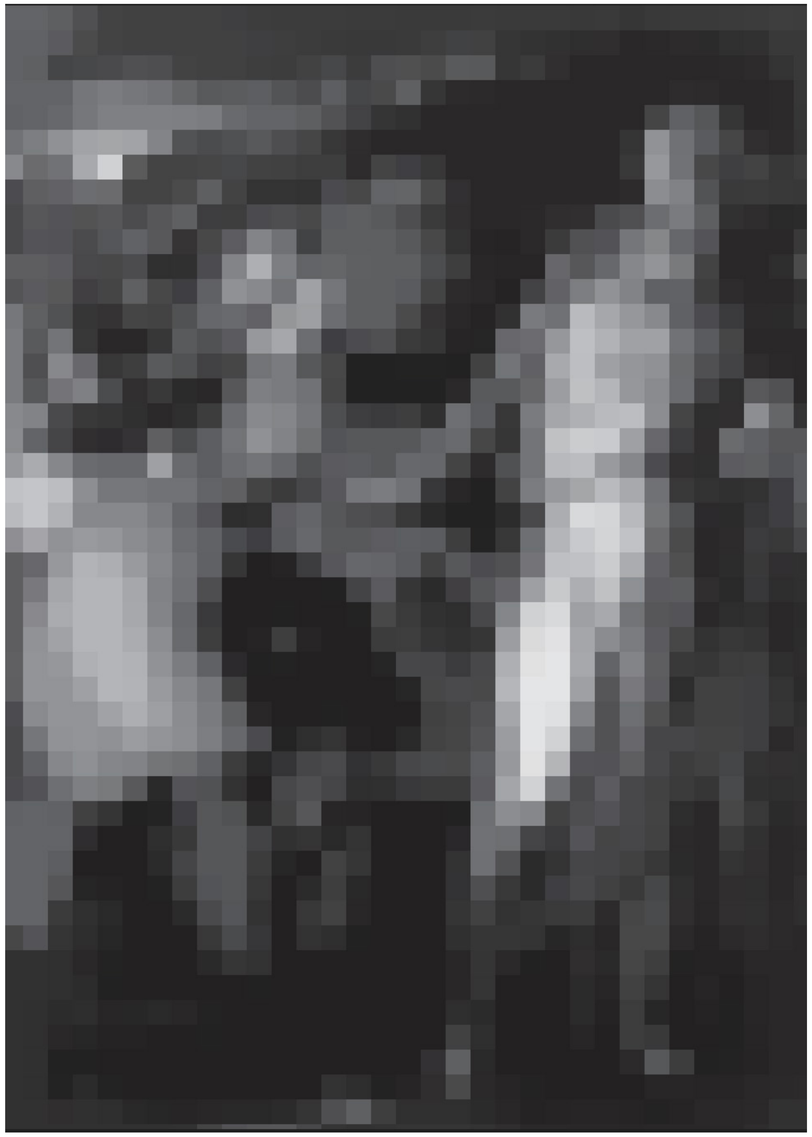
FINAL ARTISTIC RIVERBED





FINAL RESULT

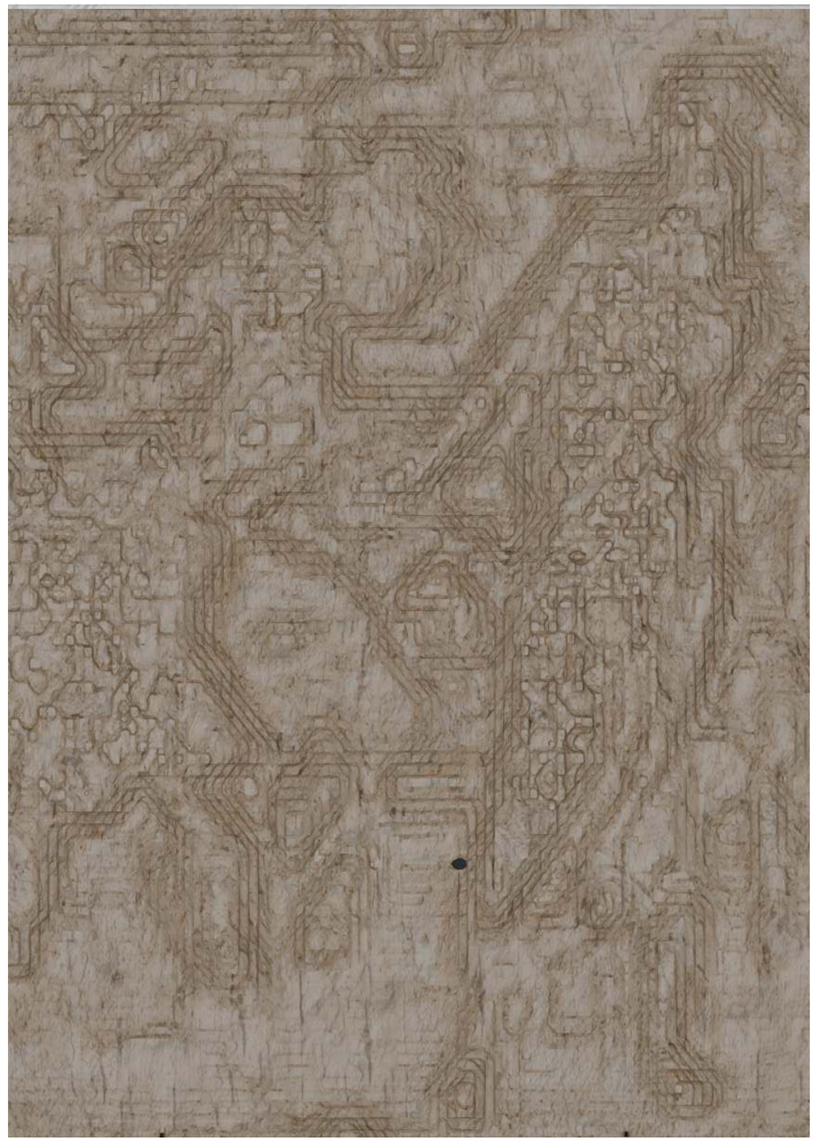
BLUR YOUR EYES :



REFERENCE IMAGE



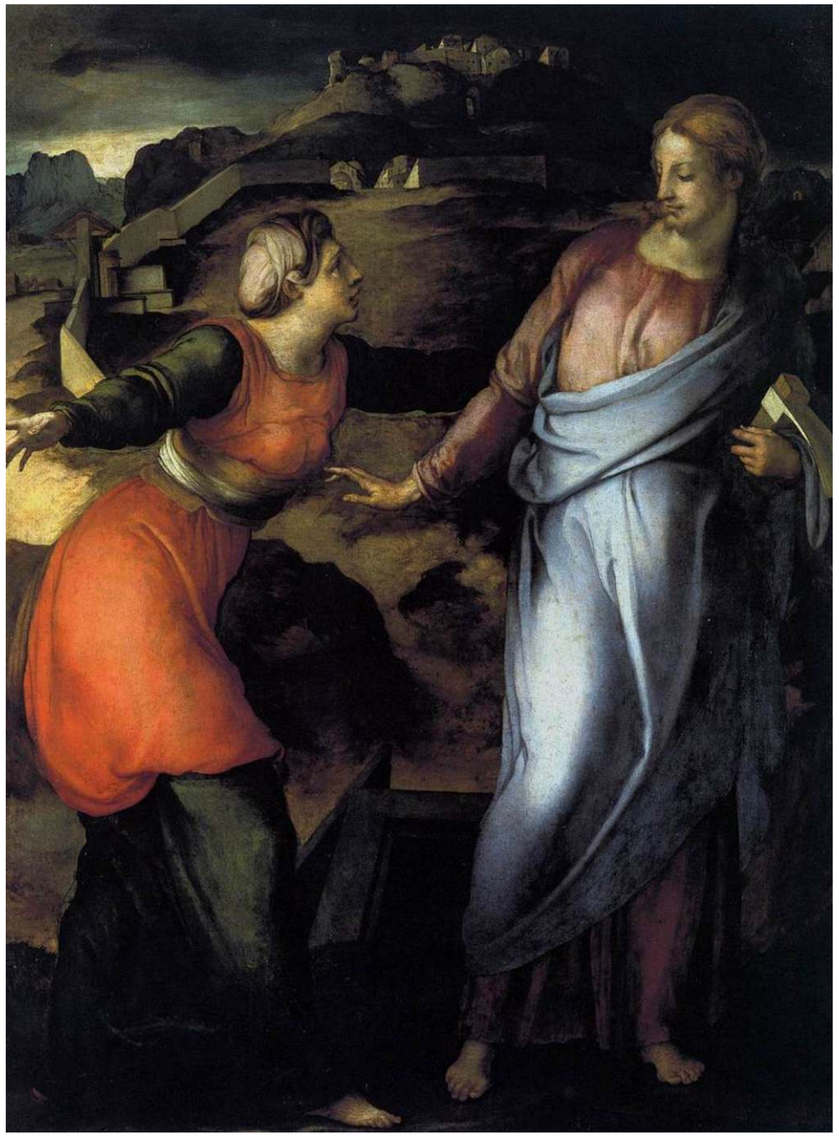
RIVER HYDRAULIC ART RECREATION



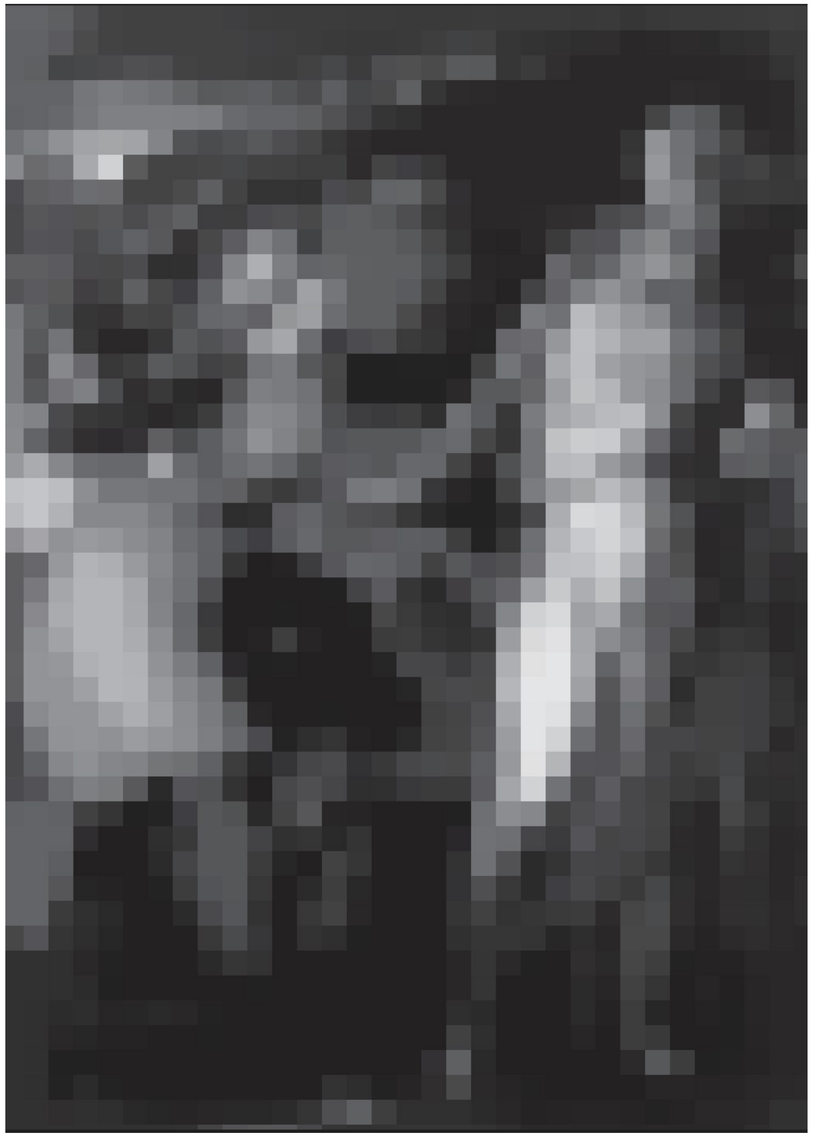
SANDSTONE RIVER BED

FINAL RESULT

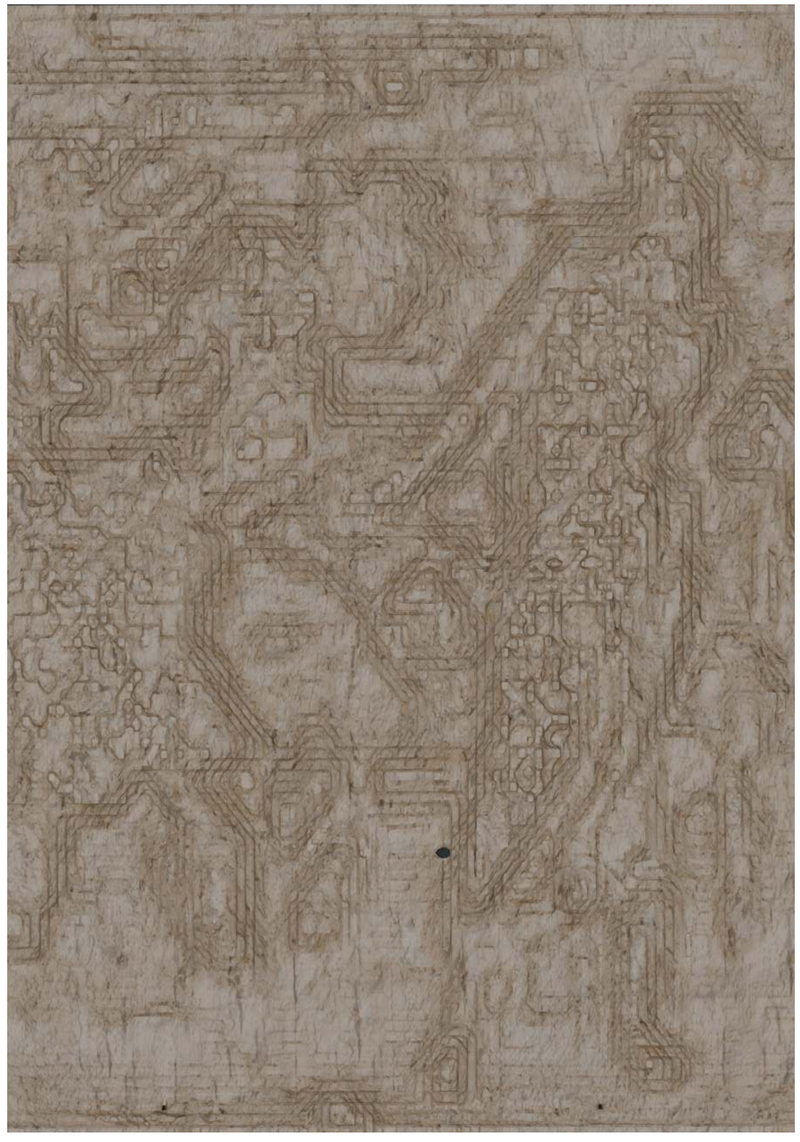
BLUR YOUR EYES :



REFERENCE PAINTING



SIMPLIFIED IMAGE GOAL



RIVER IMPRESSION OF IMAGERY

5 MATERIAL EXTENSION OF INVESTIGATION

PHYSICAL WATER DEGRADATION TESTS - SANDSTONE RESEARCH

I wanted to test the possibility for using sandstone as the material for my river beds and to start exploring how the sandstone would start to erode as a result of the Arno's flow. Therefore the natural material to test this on a small scale was plaster. I started by casting serrated sandstone texture onto small blocks of plaster.

I then jet washed these plaster blocks to see what affect it would have on the surface. To my surprise exposing these blocks to highly pressure water produce a series of jagged points all angled in the same direction as the jet washer application.

This experiment produced interesting and an entirely new way to view water erosion. The test prompted me to carry out more plaster tests under jet washer pressures.

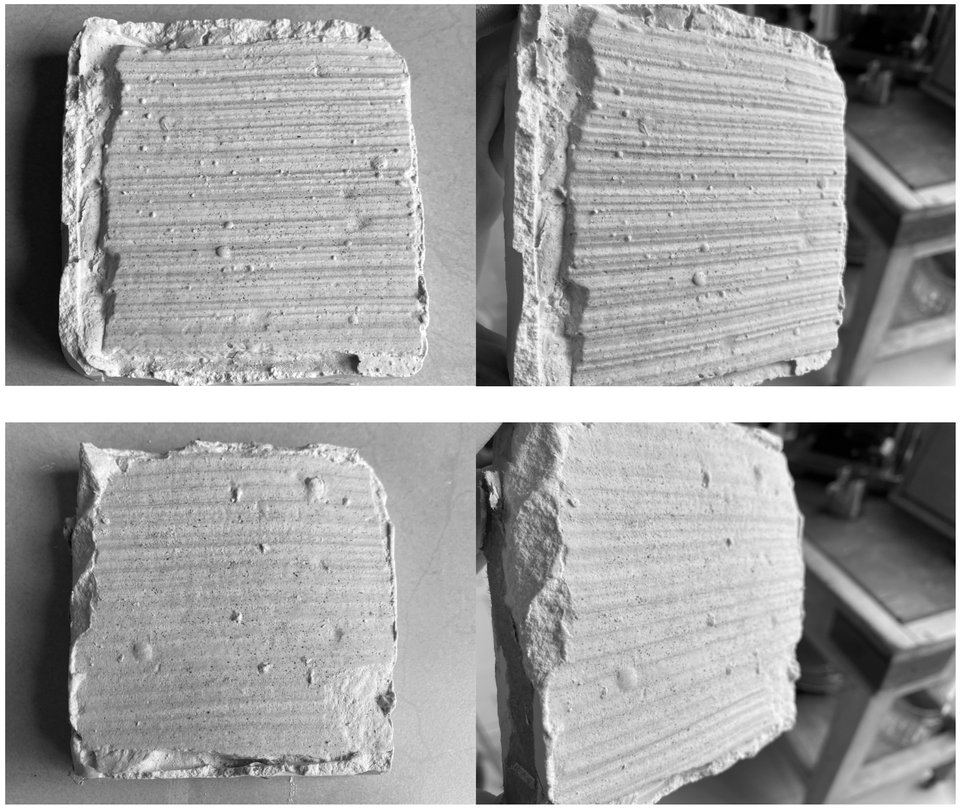


Original Sandstone Slab

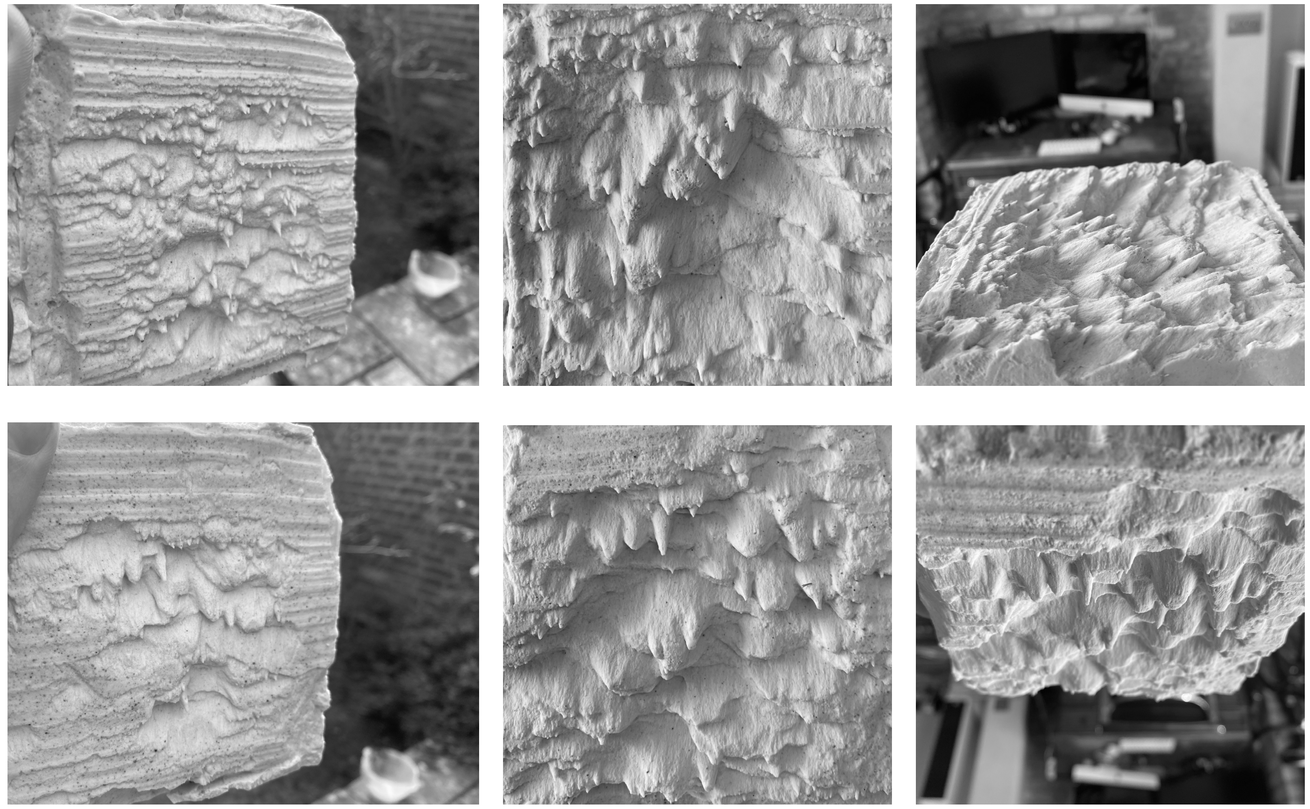


K-Archer K3 Power Control Jet Washer

CASTS OF SANDSTONE



JET WASHER RESULT

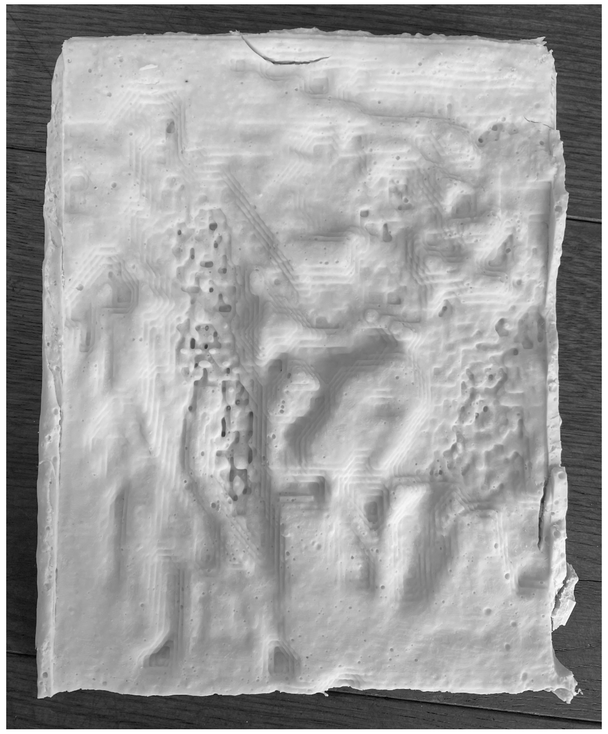


3D PRINT & PLASTER CAST OF FINAL RIVERBED GEOMETRY

3D PRINT



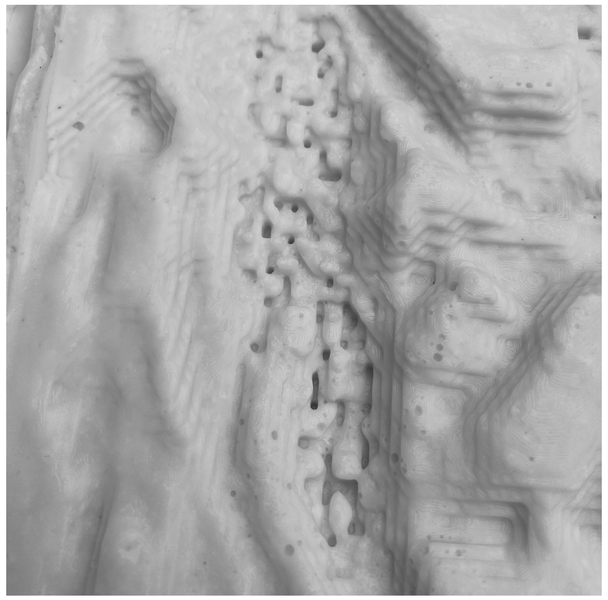
ALGINATE

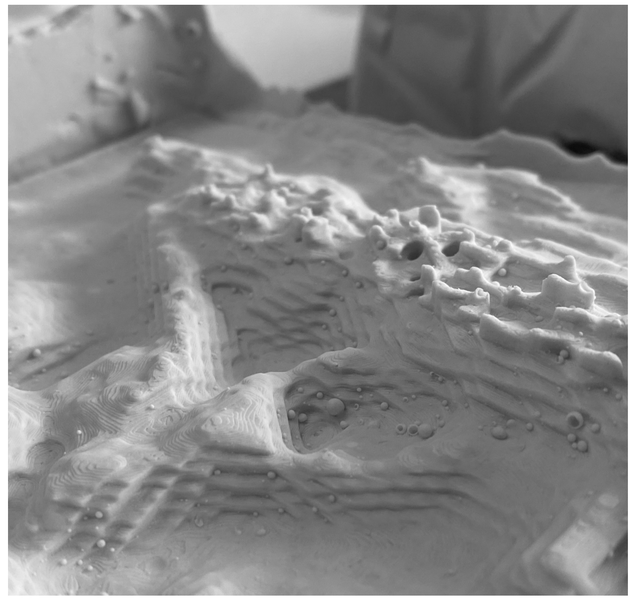


PLASTER CAST



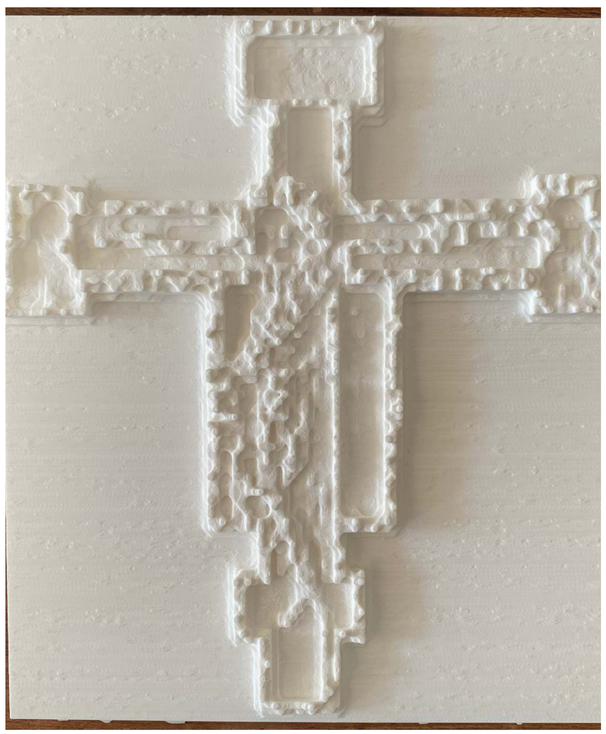






PLASTER CASTS OF ALTERNATE RIVERBED GEOMETRY (CIMABUE'S CRUCIFIX)

3D PRINT



ALGINATE



PLASTER CAST

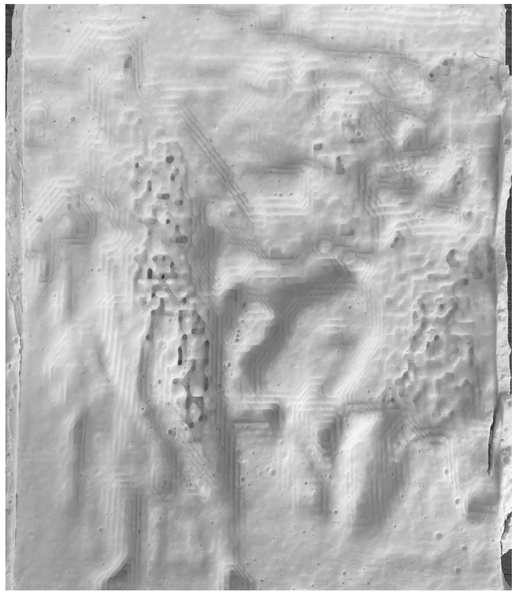








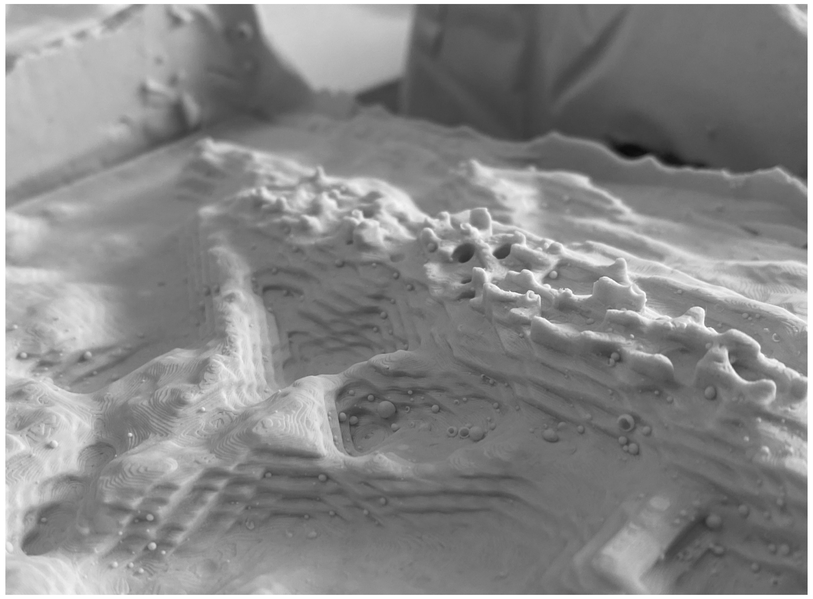
NOLI ME TANGERE - PONTORMO



Alginate negative



Plaster cast from negative



CRUCIFIX - CIMABUE



Alginate negative



Plaster cast from negative

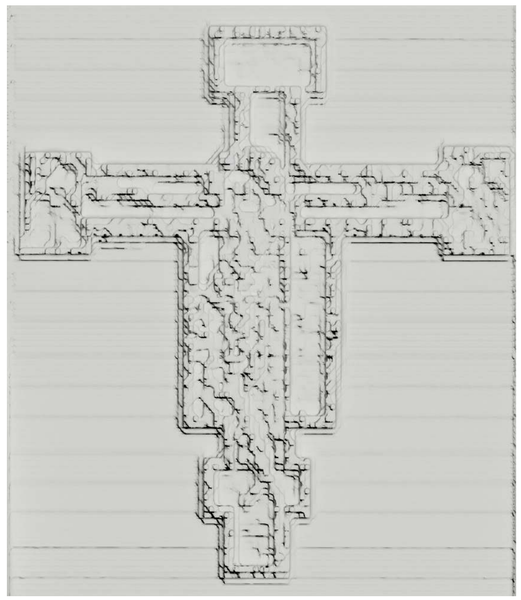


DEPOSITION PATTERNS TO PREDICT EROSION ZONES



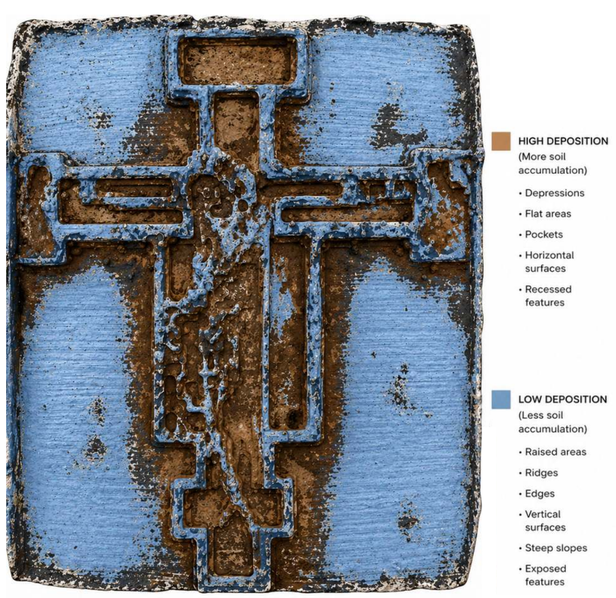
Blended flood water mix

Cimabue 3d print geometry



Cimabue flood water deposition pattern



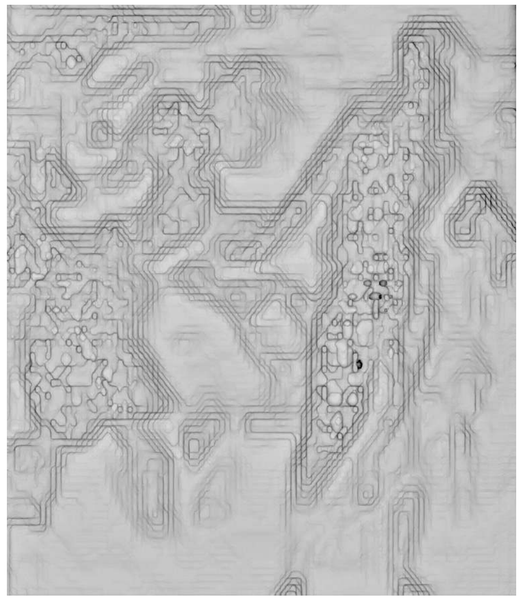


I created a new flood water mixture using soil, water and kitchen blender. I then poured this flood water over my plaster casts to see where soil would be deposited on the river bed. This gave me some idea of where which parts of the plaster face would be most exposed to river erosion.

Areas with more deposition generally correspond to slower water speeds and slower velocity generally corresponds to lower material erosion.

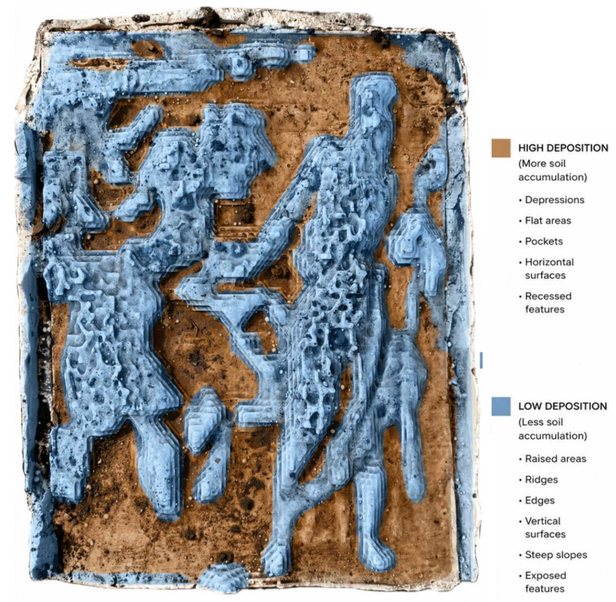
From the images darker colours indicate more soil accumulation and slower water speeds and lighter untouched part of the plaster indicate the opposite.

Pontormo 3d print geometry



Pontormo flood water deposition pattern





JET WASH EROSION TEST - MORPHING ARTWORKS

I wanted erosion and degradation to play a role in the scaling up of my river bed design. This was important as I wanted the Arno's force to be felt by the architecture and I also wanted the river's impressions of the artworks to be forever morphing and changing.

Every time someone visited the building I wanted their experience of the river's art to be change in order to maintain interest an curiosity about both the architecture and the Arno's art.

Therefore jet washing plaster casts of my 3d printed designs would allow me to understand these water erosional processes better. **The end goal was to justify and predict the use of sandstone at a larger scale.**

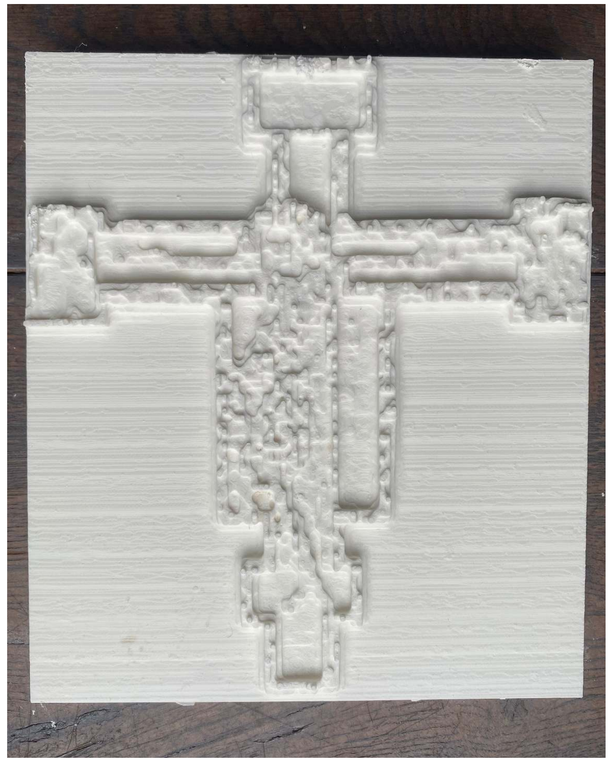








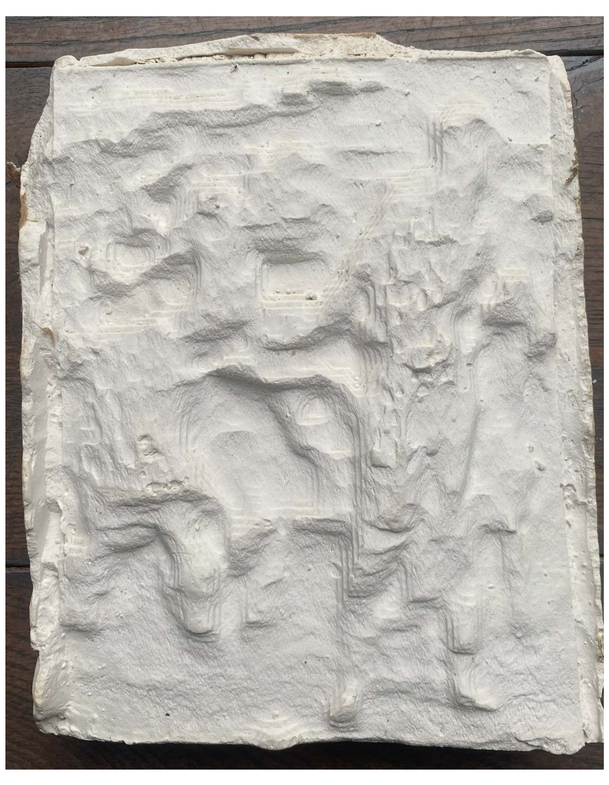
BEFORE



AFTER







PREDICTING BUILDING SCALE SANDSTONE EROSION

CALCULATIONS TO EQUIVOCATE JET WASHER DEGRADATION ON PLASTER TO ARNO DEGRADATION ON SANDSTONE

JET WASHER TEST :

Roughly 4mm of erosion in 1 minute of jet wash application

Plaster erosion rate : 4mm/min

CONVERTING JET PRESSURE TO RIVER FORCE:

K3 K Archer Jet washer : 12Mpa
Angle of application/angle of weir: 15 degrees
Only the normal component of the jet contributes to erosion:

12 MPa x sin(15) ≈ 3.1 MPa

Typical Arno velocity around site - 0.6m/s

Dynamic pressure of river:

q = 1/2pv^2 = 0.5 x 1000 x 0.6^2 = 180 Pa

3,100,000/180 = **17,200 times less pressure**

TIME SCALING:

The jet washer is 17,000 times more aggressive than the river, therefore one minute of jet washing is equivalent to 1,200 minutes (12 days) of river action.

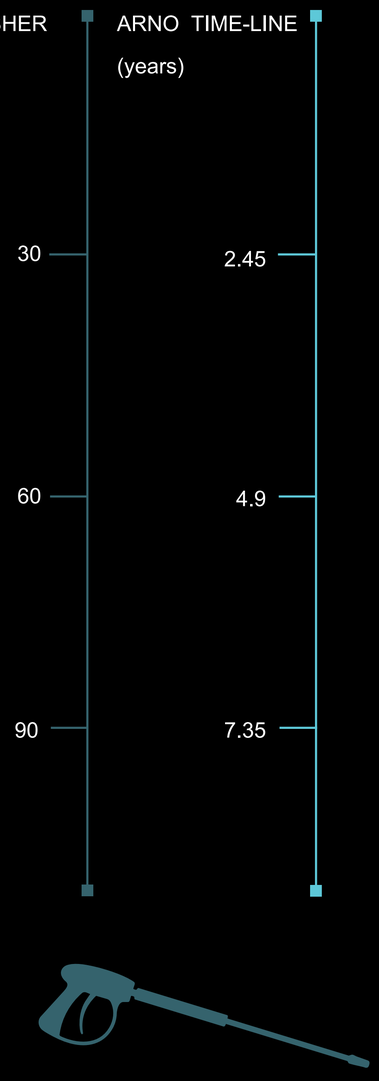
4mm of experiment scale plaster erosion will take 12 days in the river Arno.

MATERIAL CHANGE:

Plaster has a typical strength ratio of 3-5 Mpa
Sandstone has a typical strength ration of 20-30Mpa therefore sandstone is roughly 6 times more resistant and 12 days turns into 72 days.

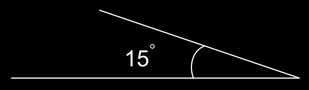
GEOMETRY SCALING:

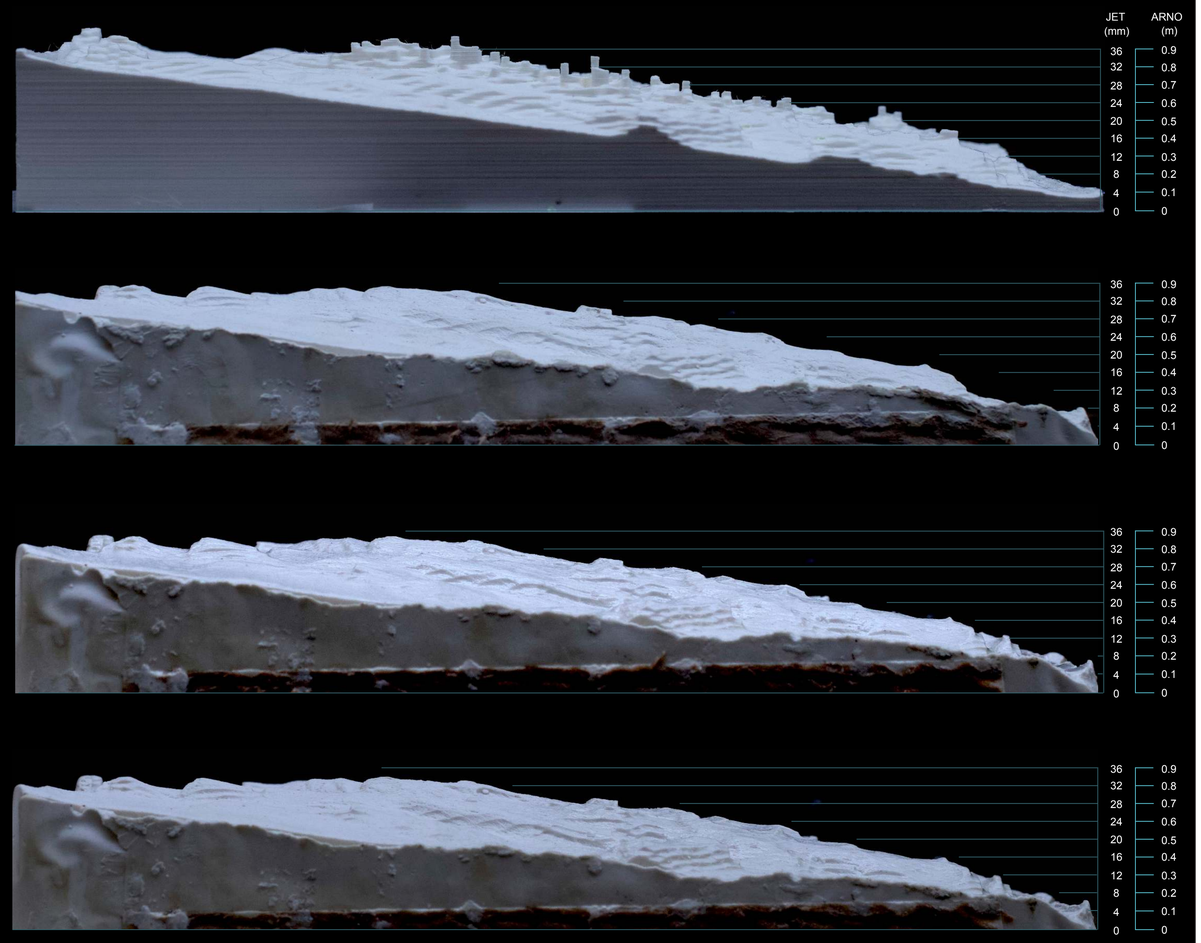
The real geometry is 25 times large so 4mm of erosion will be equivalent to 100mm.
Time scales also linearly so 72 days will now become 1800 days of consistent river flow which is roughly :
4.9 years to erode 100mm of sandstone - 18 days per mm of real world erosion.



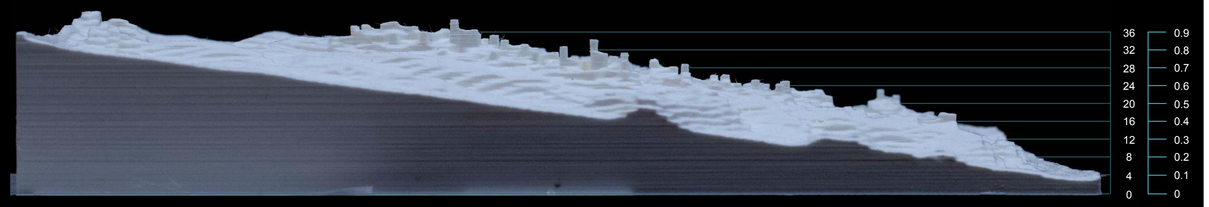
EROSION RATE:

1 MINUTES OF JET WASHING OVER PLASTER IS ROUGHLY EQUIVALENT TO 5 YEARS OF THE RIVER ARNO FLOWING OVER SCALED UP SANDSTONE



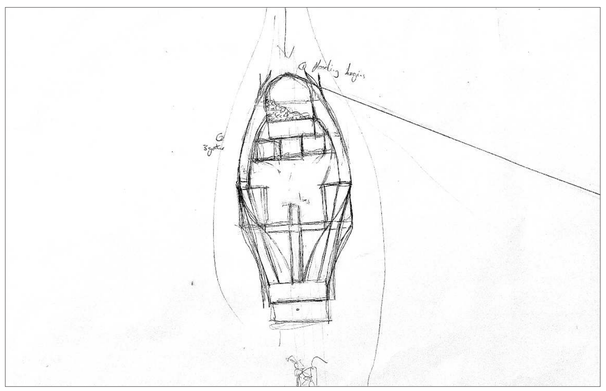


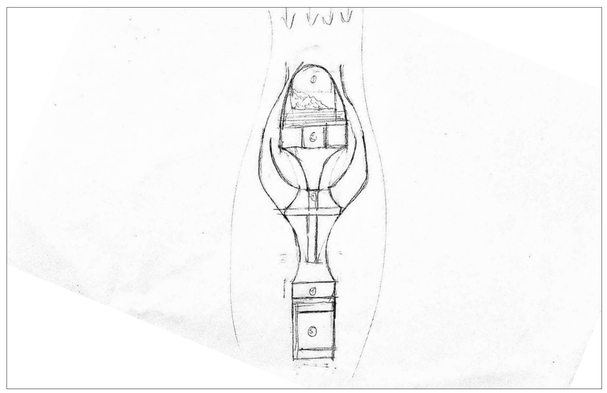
OVERALL DEGRADATION

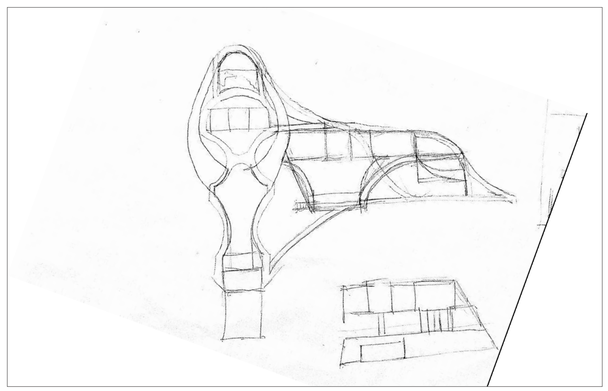


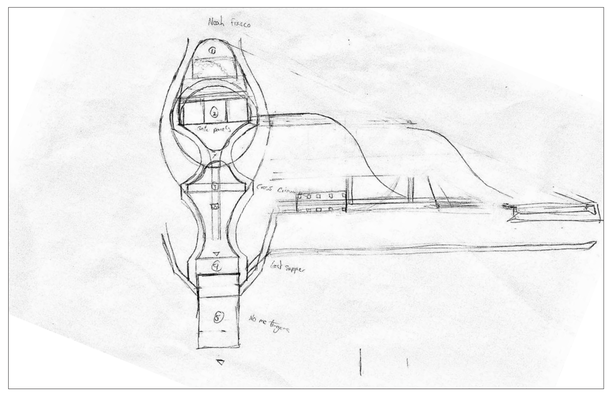
6 ARCHITECTURAL APPLICATION

TECHNICAL RESEARCH - CORE DESIGN IMPLEMENTATION



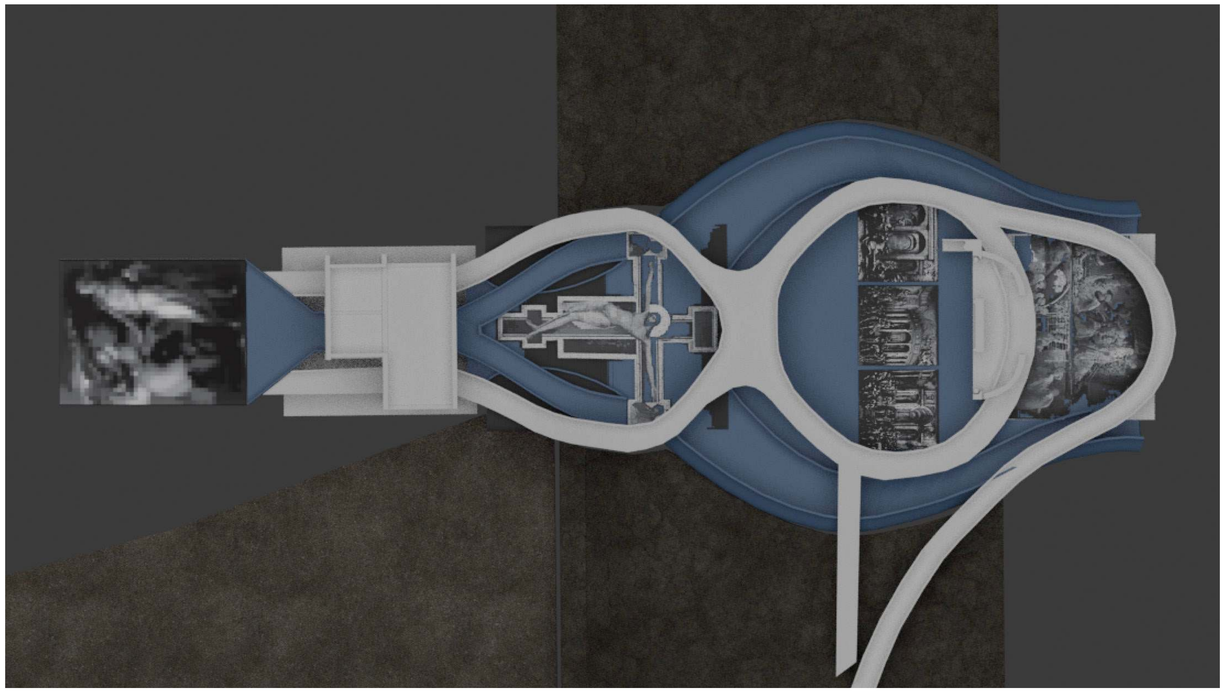


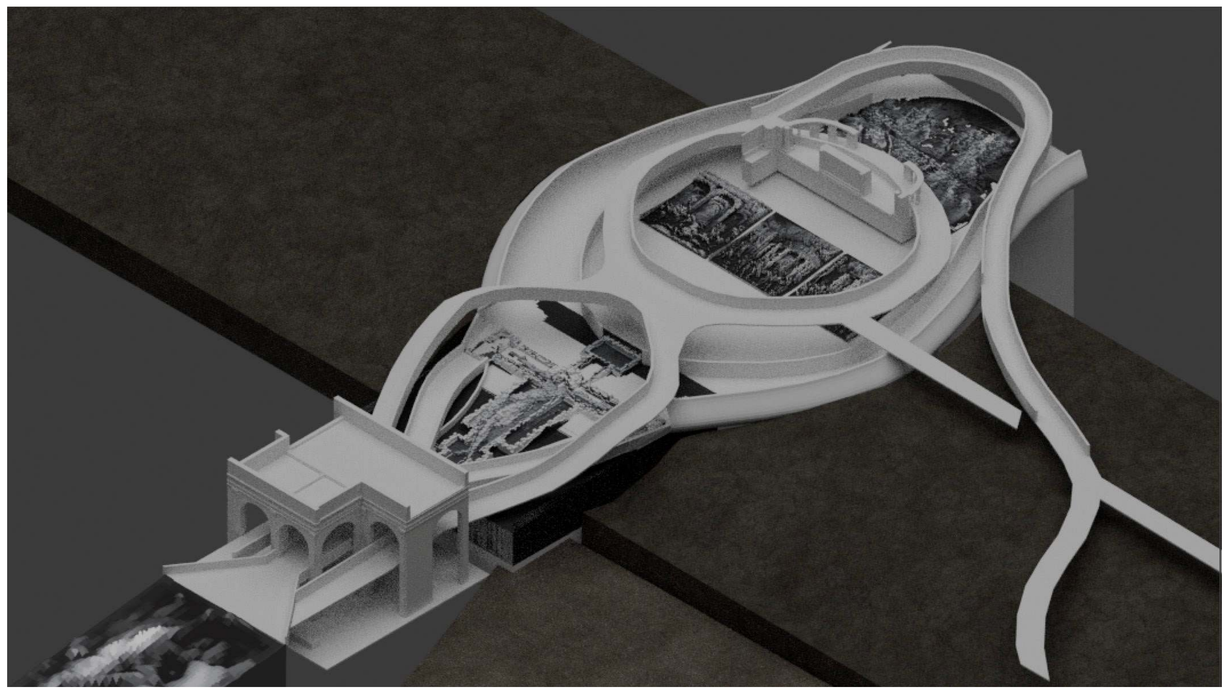




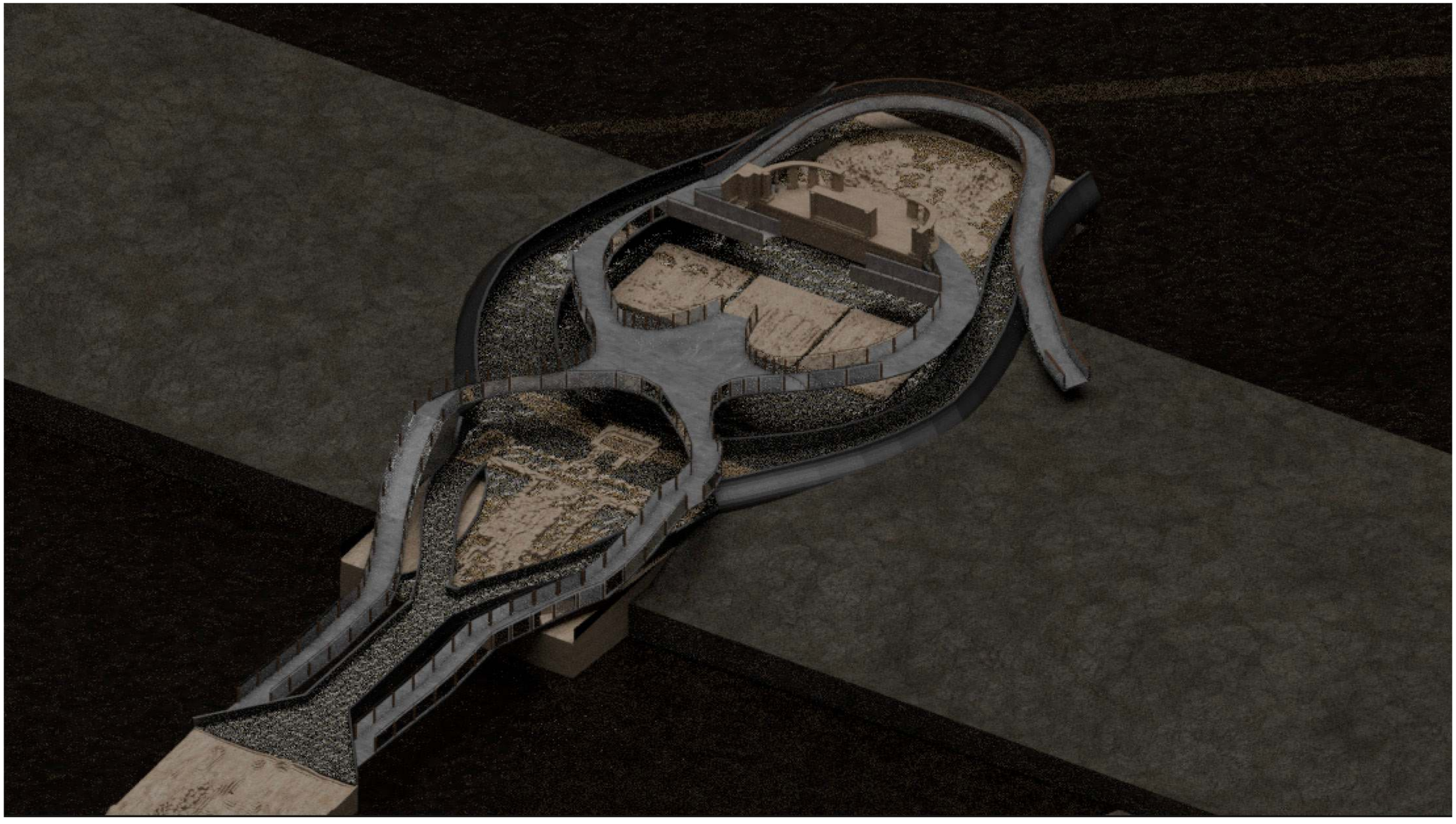
Design drawings dictated by technical research

Ground floor resulting from tech research

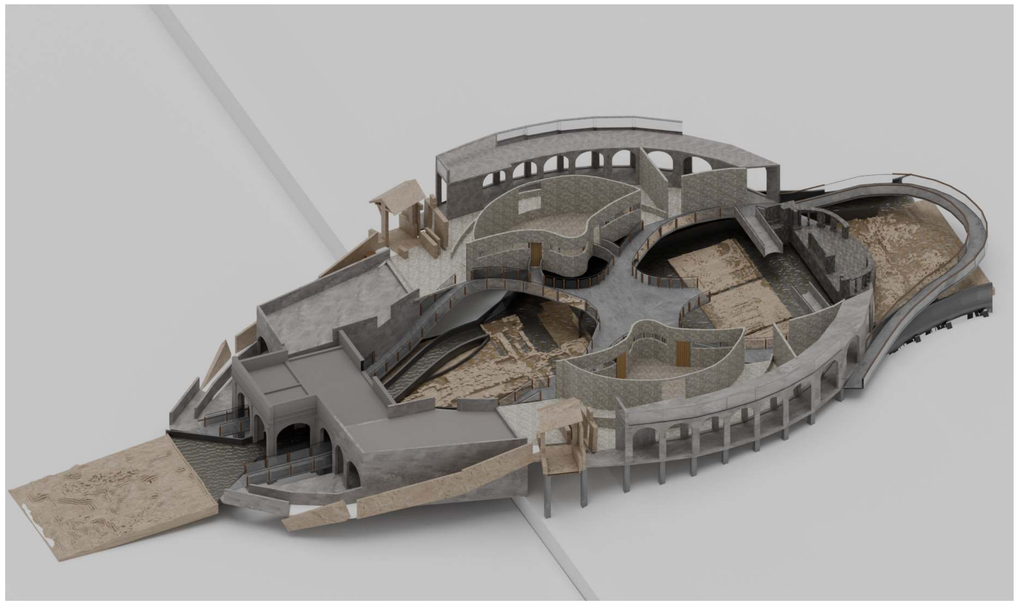




BUILDING GROUND FLOOR - MUSEUM SPACE TO VIEW RIVER ART



REVOLVING BUILDING AROUND TECHNICAL VIEWPOINTS



I expanded the same logic used for Pontormo’s painting to other pieces of art damaged during the floods of 1966. I then applied the same extrusion logic developed in my technical research to each one of these artworks, creating a series of 6 sandstone slabs

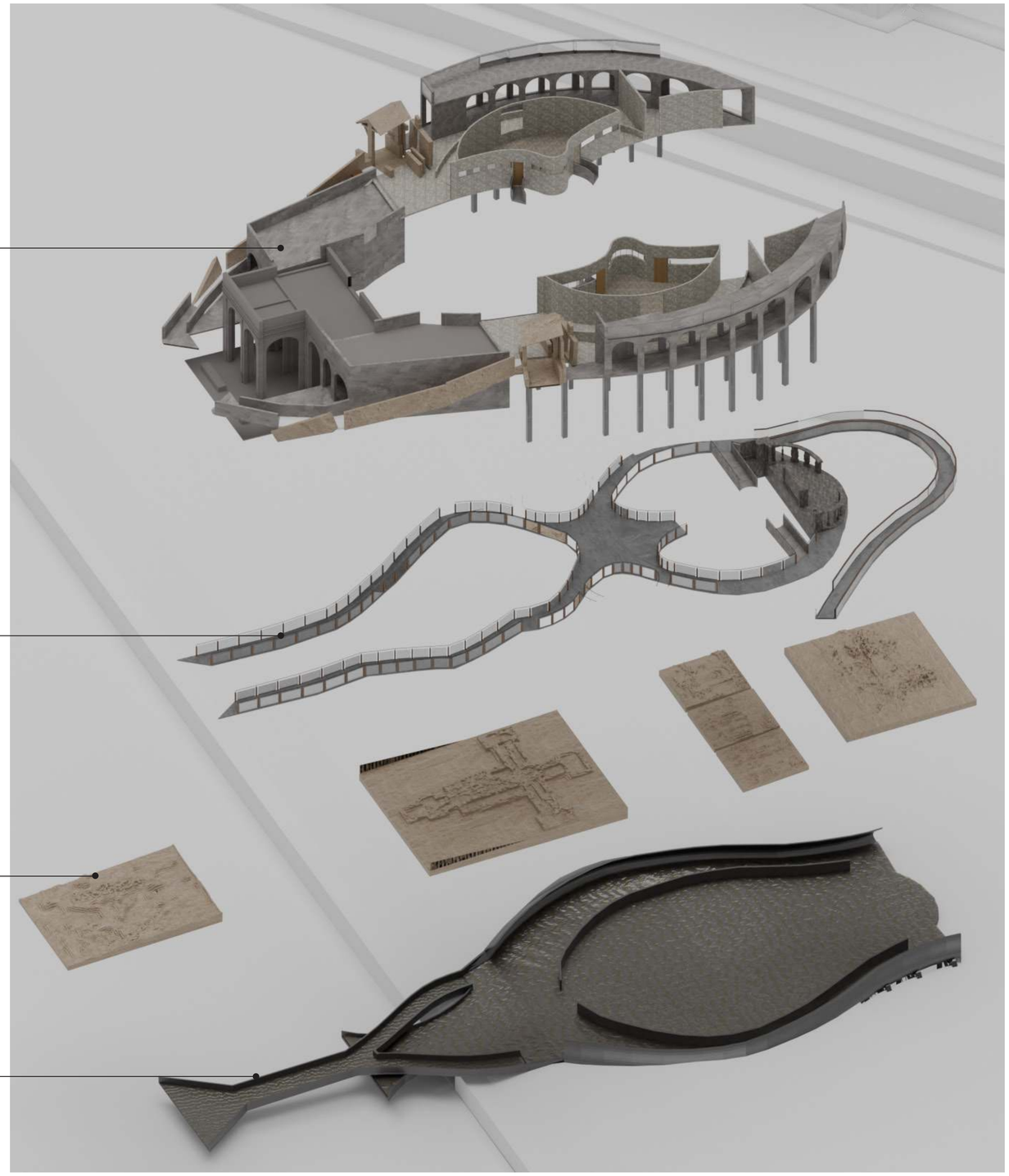
With each slab corresponding to a individual pieces of damaged art in 1966 I choreographed the placement of these ‘riverbeds’ through the center of my building. I then built a waterway around this arrangement allowing water to flow complementary to the artwork.

In many ways the organisation of these sandstone slabs dictated the architectural plan for my building as the spatial organisation is designed with the view of this artistic water channel as a first priority.

I designed the ground floor to become a museum of the Arno’s flow, attempting at all times to allow the river to become the artist, the architecture the easel, the sandstone the canvas and the water the paintbrush. These were the core goals set out at the start of my technical research and in turn have become the heart of my building’s design.

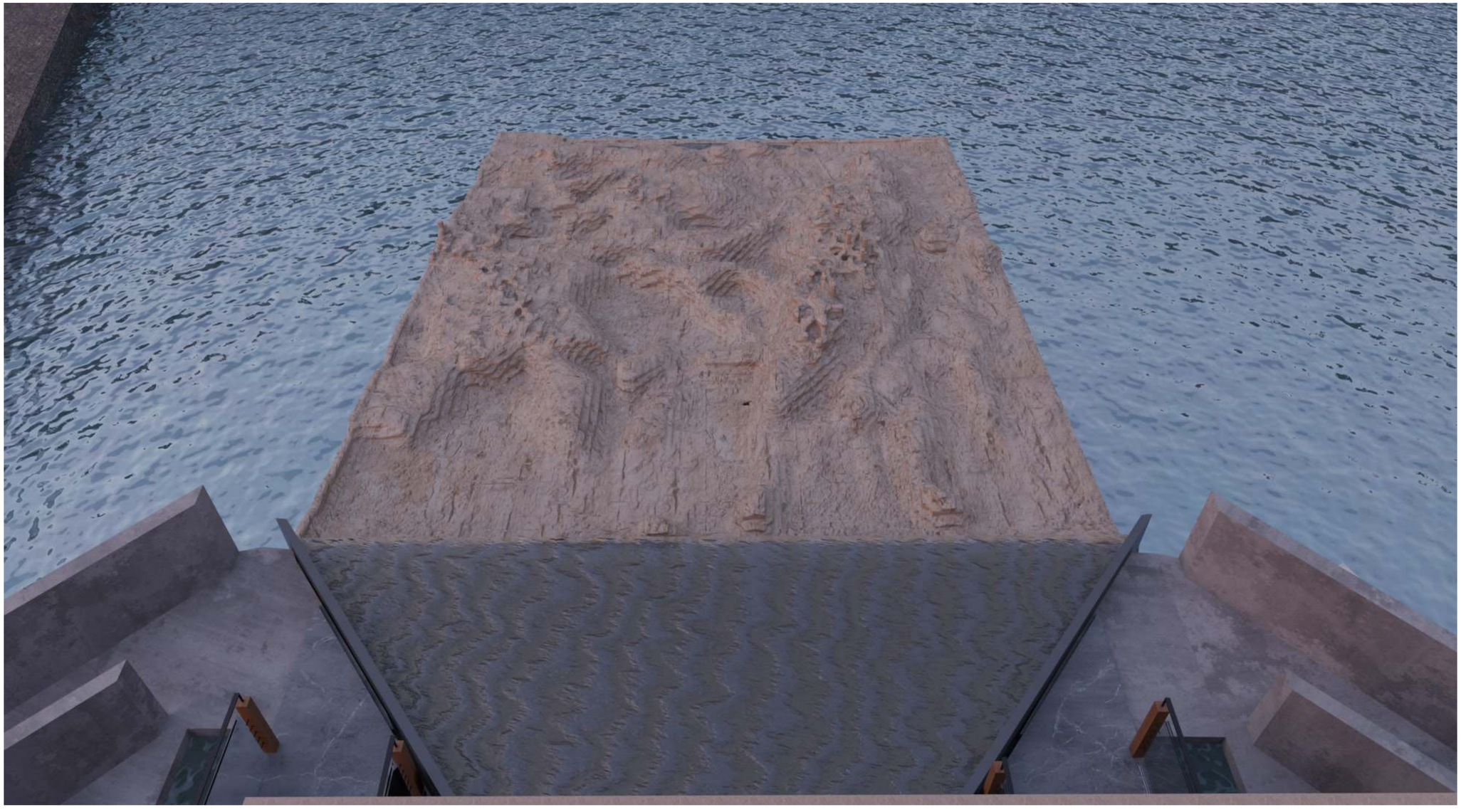
The view of the river’s art isn’t only limited to the ground floor of my building, extending vertically through the building all the way up to the top balcony. This can be seen in renders in the following pages.

The exploded axonometric hopefully visualises the extent of which the core design of my building revolves around my technical research.



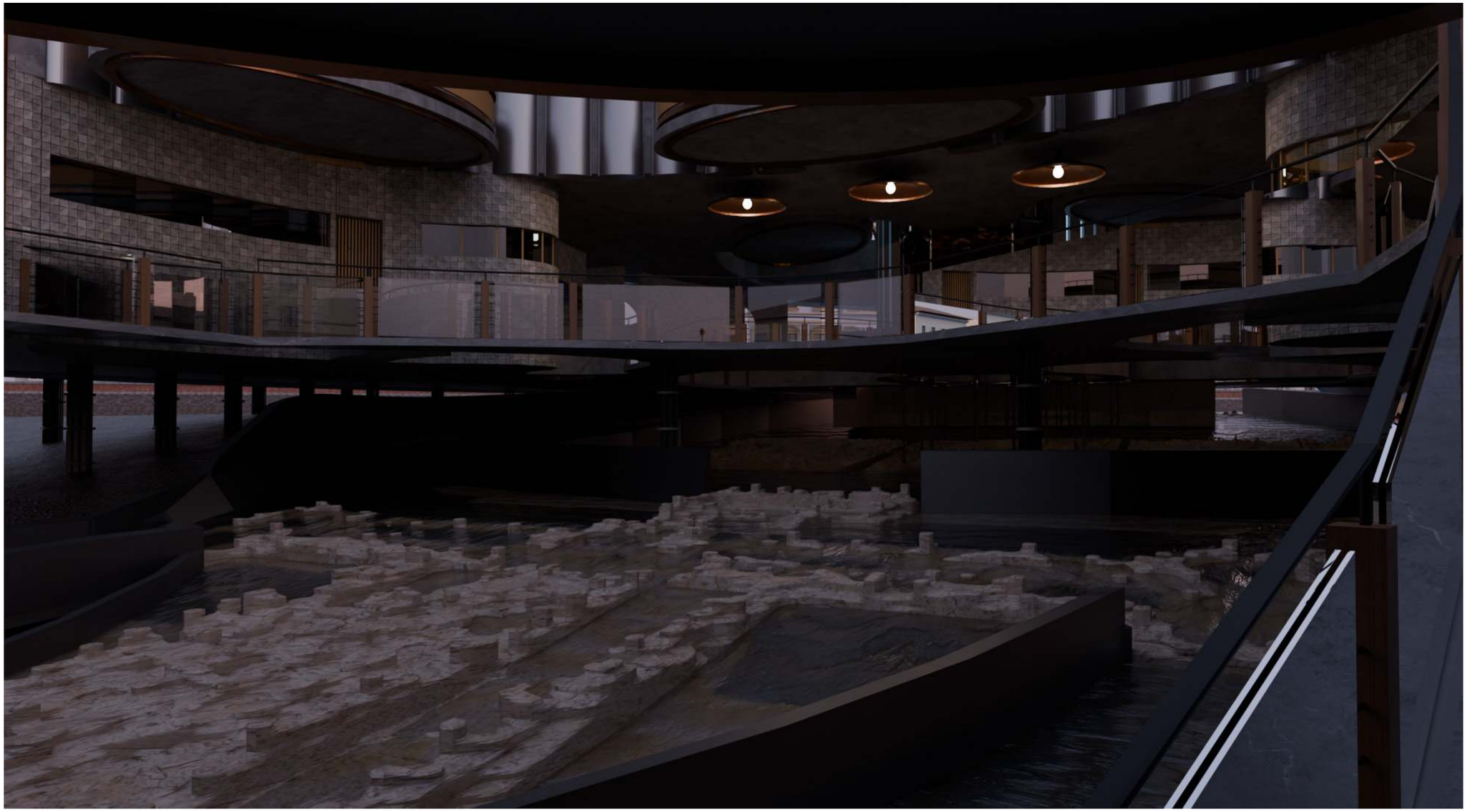
BALCONY VIEW

THE ARNO’S IMPRESSION OF PONTORMO’S NOLI ME TANGERE



GROUND FLOOR MUSEUM SPACE

THE ARNO’S IMPRESSION OF CIMABUE’S CRUCIFIX



TOP BALCONY VIEW

THE ARNO’S IMPRESSION OF CIMABUE’S CRUCIFIX



7 CONCLUSION

FINDINGS

The investigations demonstrate that river hydrodynamics can be used as a controlled design tool to generate visual and spatial outcomes within architecture. The translation of tonal imagery into water velocity proved feasible through iterative testing, with surface geometry, slope, and friction identified as the key parameters influencing flow behaviour. The results highlight that while exact image replication is unattainable, recognisable compositions can emerge through calibrated manipulation of turbulence and discharge. Additionally, material testing confirmed that erosion and deposition are predictable to a degree and can be embedded as part of an evolving architectural expression.

METHODOLOGY

A digital and physical testing workflow was established, linking computational fluid simulations with real-world material experiments. Geometry node systems were used to correlate painted tonal values with riverbed extrusion, while iterative adjustments to slope, subdivision, and friction logic refined flow control. This was supported by plaster casting, jet wash erosion tests, and deposition studies, enabling a scaled understanding of how the Arno’s force interacts with material surfaces over time.

EFFECT ON PROPOSED SPACES

The technical investigation directly informed the spatial organisation of the building, with the artificial riverbed becoming the central generator of plan and section. The ground floor operates as an open hydraulic landscape, allowing water to flow through and be observed as a dynamic exhibition. Vertical circulation and viewing platforms extend this experience, enabling occupants to engage with the river’s evolving artwork from multiple levels. As a result, the building shifts from a static museum to an immersive environment where natural processes actively produce the exhibited content, reinforcing the relationship between visitor, architecture, and river.

WIDER IMPACT

With increasing environmental uncertainty and rising flood risks, architecture must evolve to work with dynamic natural systems rather than against them. This project demonstrates that rivers can be reframed as productive and creative agents, capable of shaping both space and experience. By combining technical investigation with cultural narrative I hope this work has demonstrated a small way in which architecture can flip a historical fear of hazardous river forces into potential for communal intrigue and a desire to live closer to water.

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