

1:1 Interactive Architecture Prototype

Urban Furniture

MSc Arch Elective Seminar (AR0122), 2021, Tutor: Henriette Bier, Max Latour, Vera Laszlo

Group 1

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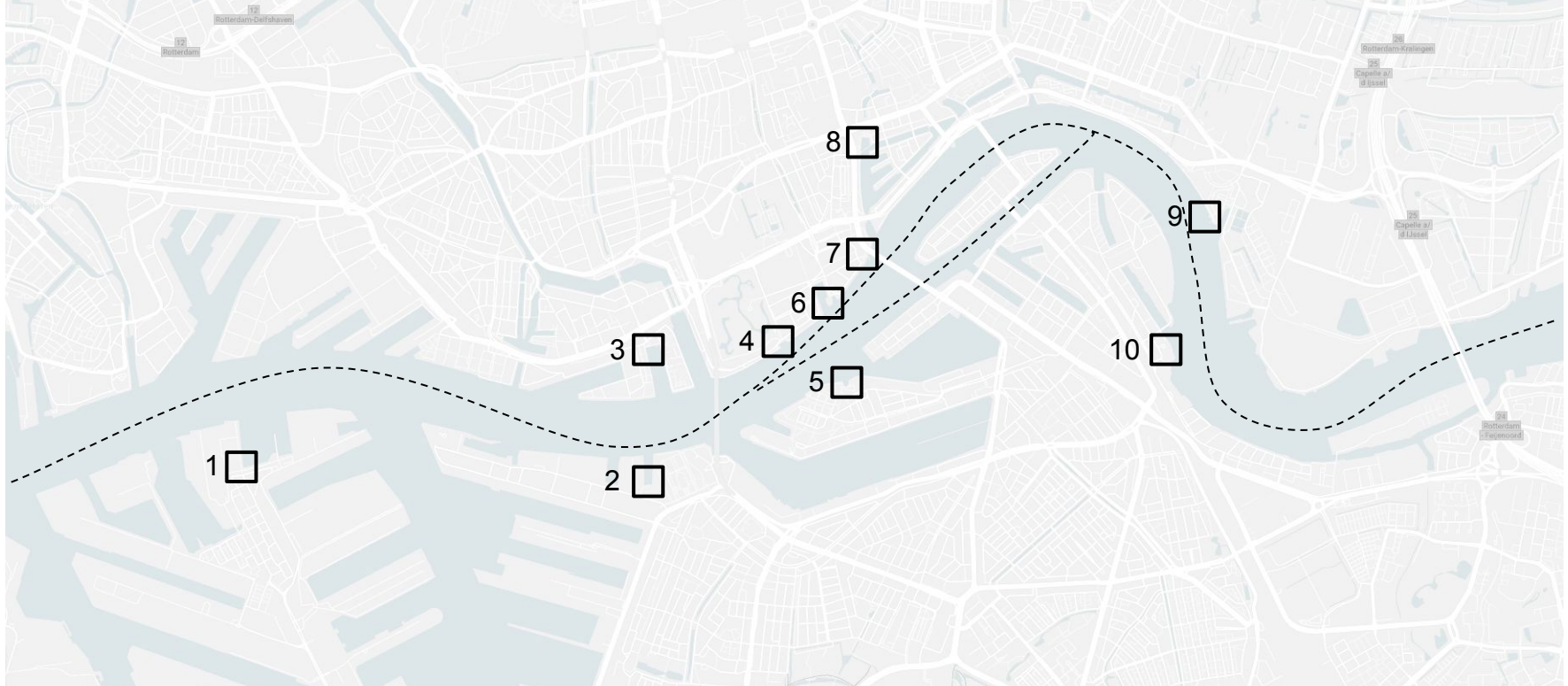
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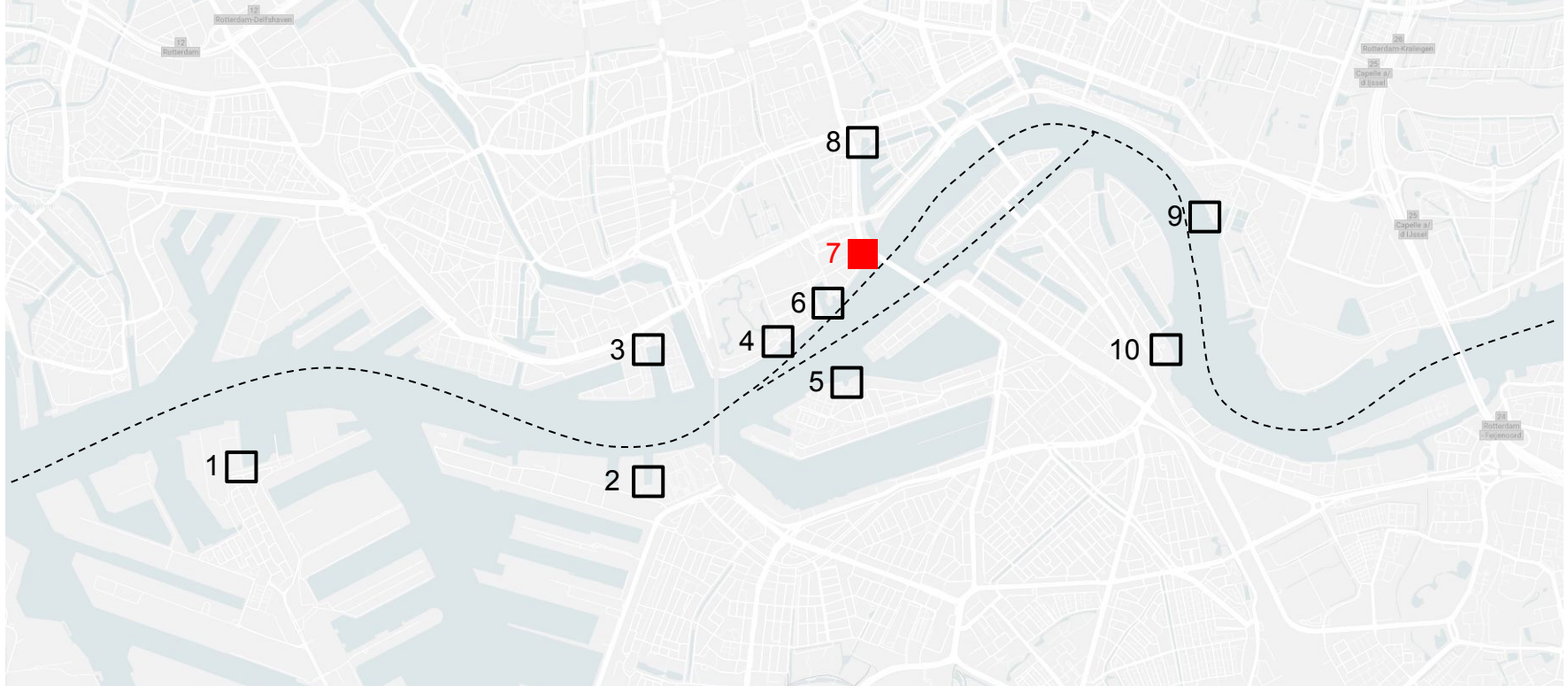
Michael Tong (5240913)

Site

Ferry Terminals, Nieuwe Maas, Rotterdam



Willemsplein, Nieuwe Maas, Rotterdam



Ferry Terminals, Nieuwe Maas, Rotterdam



1. RDM



2. St. Janshaven



3. St. Jobshaven



4. Veerhaven



5. Katendrecht



6. Erasmusbrug



7. Willemsplein



8. Leuvehaven

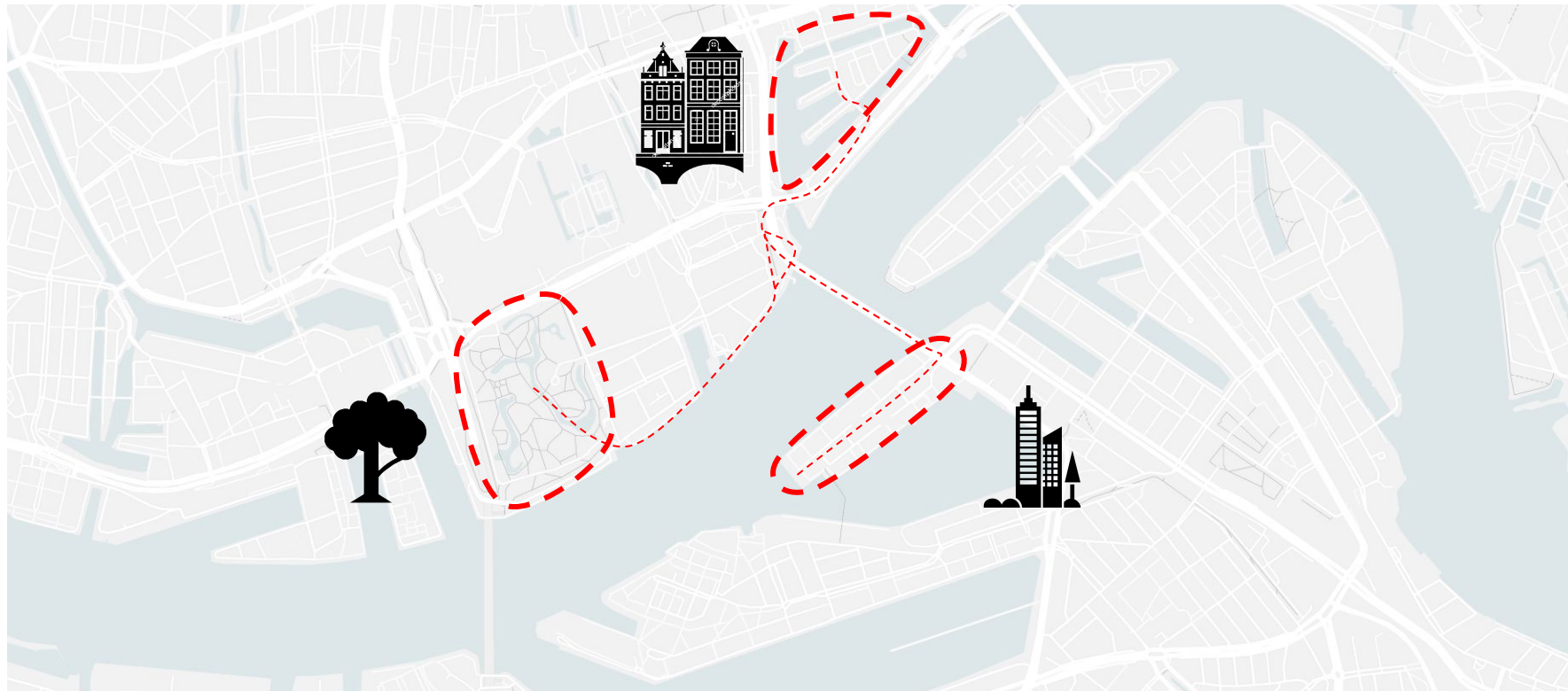


9. Plantagelaan

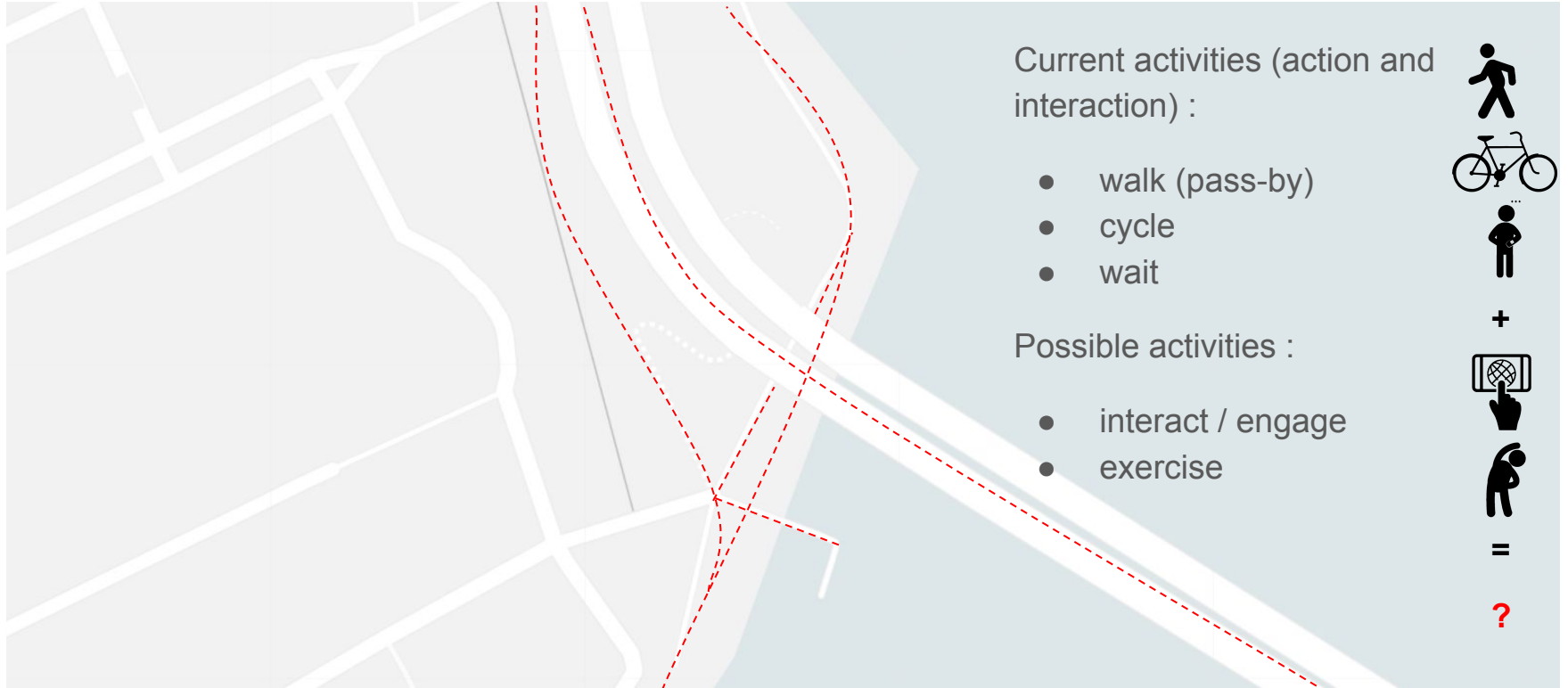


10. Piekstraat

7. Willemsplein, Nieuwe Maas, Rotterdam



Willemsplein Activities Mapping



7. Willemsplein, Nieuwe Maas, Rotterdam



Waterbus Sustainability Strategy

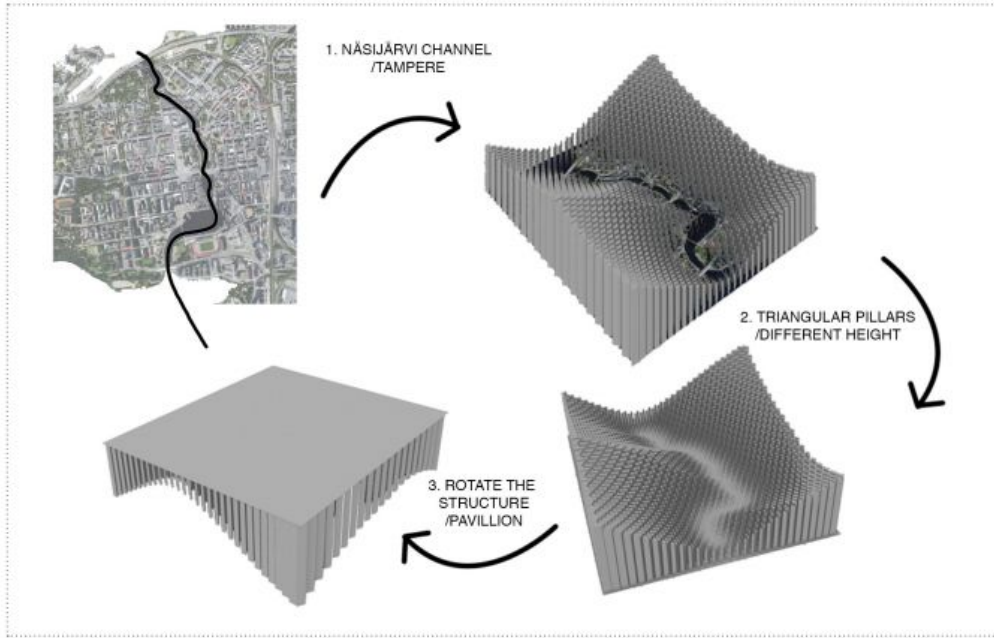


- battery-operated passenger ferry since 2018
- to operate for sixteen hours per day and be charged two times an hour
- high-end lithium battery with a long lifespan
- do we want to power HVAC capacity from the batteries? Or do we want to include another power source
- -> dedicated seat heating and cooling,

→ less operational costs + zero carbon emissions

Precedents

River Inspired Shape



Form to Challenge Interaction



- Body challenging
- body activated /
body responsive

Form Inspiration



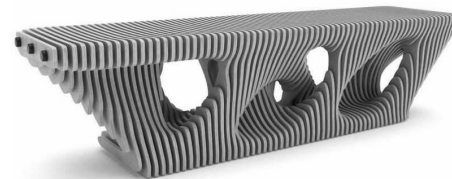
Wolkenteppich © Philipp Podesser



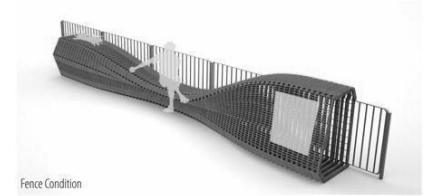
Lounge Furniture "Layers of Tribes" © Philipp Podesser



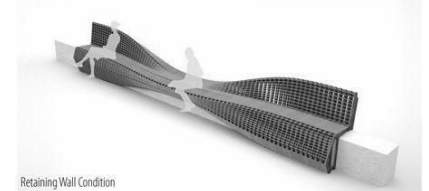
on site



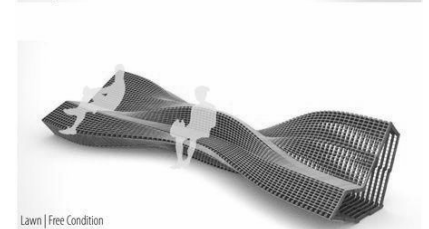
Retaining Wall Condition



Fence Condition



Retaining Wall Condition



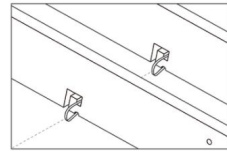
Lawn | Free Condition



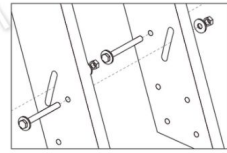
Old Idea New Manifestation



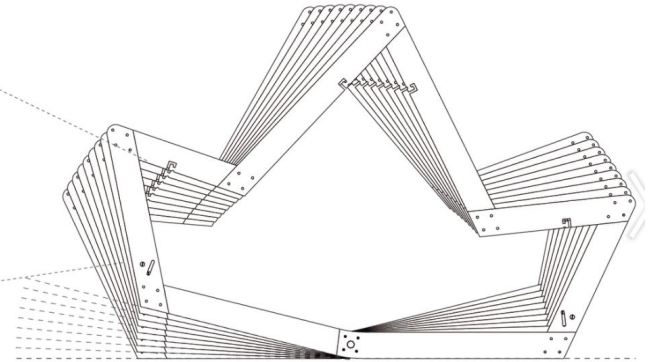
Adaptable Structure



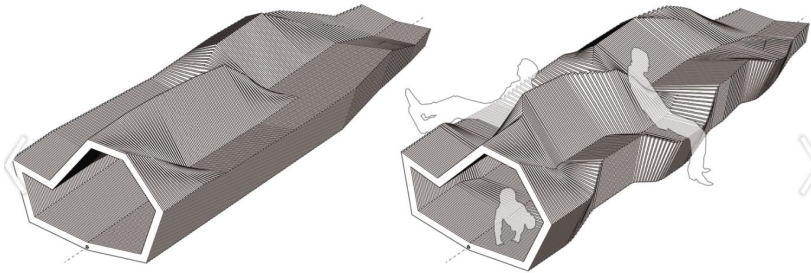
Elastic Band Connection



Sliding Bolt Connection



Activated State Elevation



Passive State Seating

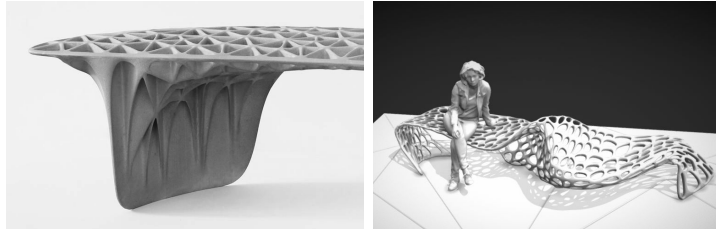
Active State Seating



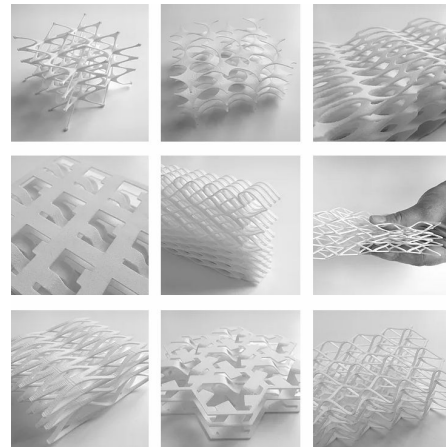
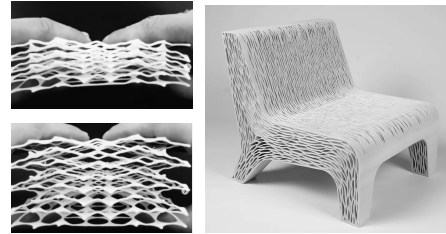
Structure

Voronoi Applied to Bench Design

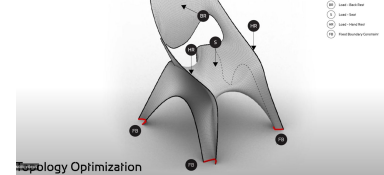
Design & Material Optimisation in Biomimicry



Biomimicry for Flexibility & Strength

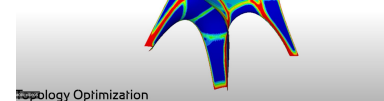


Human Weight:
80 Kg
Material:
RGD | Polyjet



Topology Optimization

Human Weight:
80 Kg
Material:
RGD | Polyjet
Tensile Strength:
50 - 55 MPa
Modulus of Elasticity:
2000 - 3000 MPa
Poisson's Modulus:
2200 - 3200 MPa
Poisson Ratio:
0.35



Topology Optimization

Face Extrude

Minimum

Maximum

Thickness

Minimum

Maximum

Color 1

Red

Green

Blue

Color 2

Red

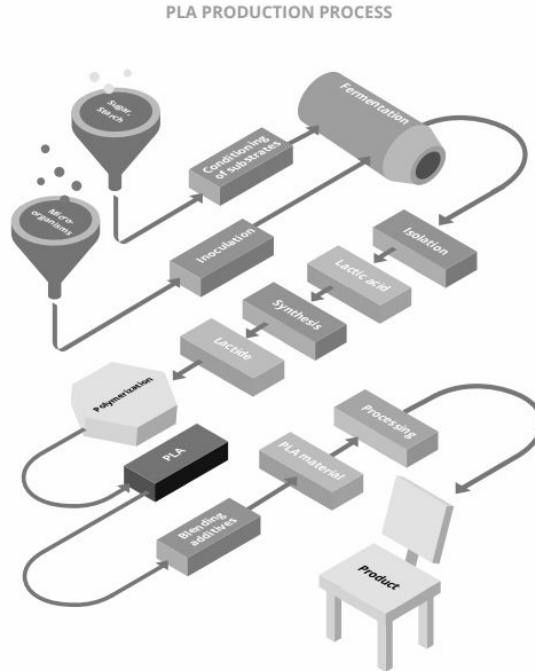
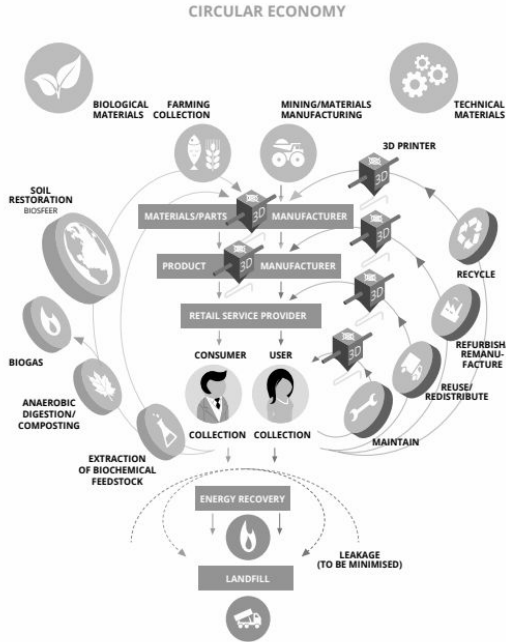
Green

Blue

Parametric Design Tool / color variation

Materialisation

Circular Additive Materials



FOSSIL ABS VERSUS BIO PLA ⁽⁴⁸⁾ (47)

	ABS	PLA
MELTING TEMP.	225 - 250 degree Celsius	190-240 degree Celsius
MOISTURE	ABS with moisture will bubble and sputter when printed, but easy to dry	PLA with moisture will bubble and sputter when printed Not easy to dry, can react with water and at high temperatures will de-polymerize
HEAT	Less deformation due to heating	Product can deform because of heat
SMELL	Plastic styrene smell	Corn like sweet smell
COLOR	Less color brightness	Bright, shiny colors and smooth appearance
HARDNESS	Very sturdy and hard	Less sturdy than ABS
FUMES	Hazardous fumes	Non-hazardous fumes
DETAIL	Higher layer height, less sharper printer corners, needs a heated printer bed for less warping	Higher max printer speed, lower layer height, sharper printed corners, less part warping
LIFETIME	Longer lifetime products	
ENVIRONMENT	Non-biodegradable Made from oil	Biodegradable Made from sugar, corn, soy-beans or maize

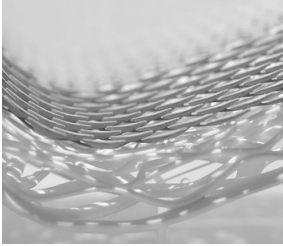
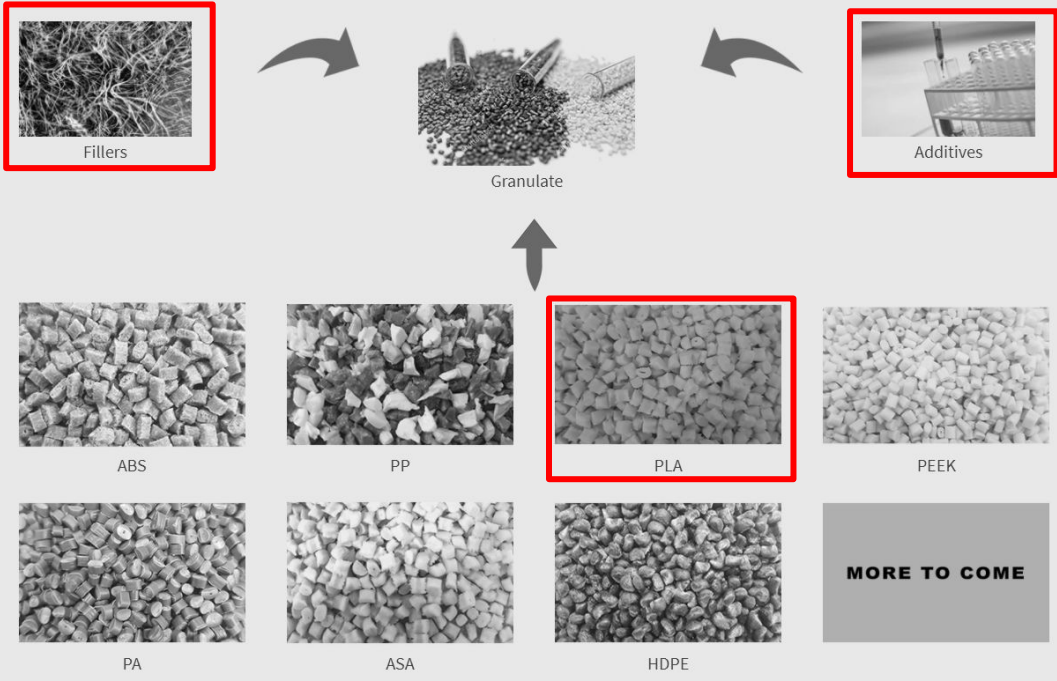
(FUTURE) BIOMATERIALS FOR 3D PRINTING

	PRODUCT MATERIAL	FEATURES
THERMO CHROME PLA	Regular PLA filament with thermo chrome feature	Changes color in response to temperature changes
FLEX PLA OR SOFT PLA ⁽⁵⁹⁾	Regular PLA filament mixed with unknown chemical to make it soft, tough and rubbery	Similar to regular PLA filament, only more flexible
NYLON 11 ⁽⁵⁹⁾	Polyamide 11 (PA11) or Nylon 11 from vegetable oil from castor beans	Reusable, strong and self-lubricating
BIO RUBBER ⁽⁵⁶⁾	TPE; thermoplastic elastomer from Rapeseed Oil	Strong, UV resistant, chemicals and temperature resistant
ARNITEL® ECO ⁽⁵⁷⁾	TPC; thermoplastic co-polyester made partially of rapeseed oil	Flexible, strong, C2C certified
BIOME3D ⁽⁵⁸⁾	Thermoplastic from plant starches	Biodegradable
STRAW BASED ⁽⁵⁹⁾	Straw based plastic made from rice and wheat stalks mixed with plastic and additives	Low cost material
BAMBOO BASED ⁽⁵⁰⁾	Filament made of finely ground bamboo	Low cost material
LAYBRICK ⁽⁶¹⁾	Filament made of finely ground chalk with a polymer binder	Feel like sandstone when printed, no layered look
LAYWOOD ⁽⁵⁹⁾	Filament made of 40% recycled wood with a binding polymer	Wooden look and smell, can also be handled like wood

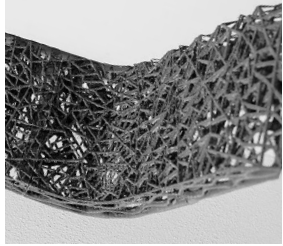
Bio-Polymer Components

3D printing technology is based on thermoplastics. 10XL uses both synthetic polymers as well as bio-based materials for printing. To improve the properties of the base polymer, we add fillers or additives. Glass, carbon, bamboo or stone fillers are used to strengthen your parts.

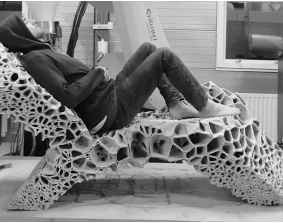
Additives improve UV and chemical resistance, or function as heat stabilizers, antimicrobials and flame retardants.



Structural Granulate:
 BIO-PLASTIC WITH
 CELLULOSE FIBRES
 FROM SAWDUST
 Good printing quality
 Rotterdam produced

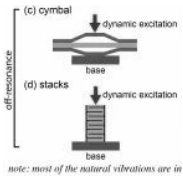


Cladding Filler:
 WOOD/ COCONUT /
 BAMBOO / CORK
 FIBER
 for comfort (softness)
 Den Hague produced

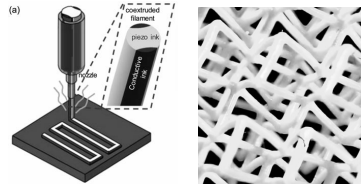


Additive:
 THERMOPLASTIC
 ELASTOMER for
 for flexibility
 (compress / stretch)

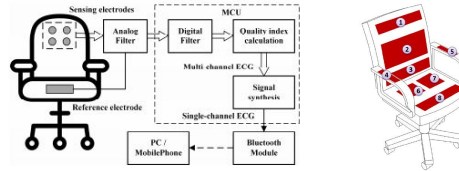
3D Printed Piezoelectric for Electricity Generation



Piezoelectric



3D Printed



Piezoelectric Chair

Compressive-mode piezoelectric energy harvester to Harness energy from deformation and stretching excitations.

The energy is to be used for:

- lighting responsive to user flow
- integration with the Waterbus sustainability scheme

Flexible piezoelectric composite for 3D printing materials that can be customized to:

- **convert movement, impact and stress into electrical energy**
- **Here, the structure itself is the sensor—it can monitor itself**

By programming the 3D active topology, you can achieve pretty much **any combination of piezoelectric coefficients within a material**, and use them as **sensors** that are not only flexible and strong, but also **respond to pressure, vibrations and impacts via electric signals** that tell the location, magnitude and direction of the impacts within any location of these materials.

Watch: [Engineers pioneer 3D printed piezoelectric materials for smart infrastructure \(3dprintingmedia.network\)](#)

Piezoelectric Cells

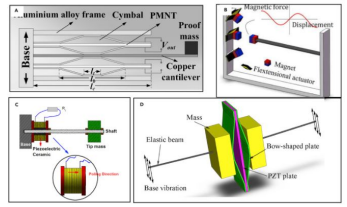
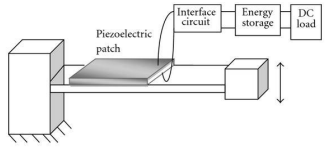
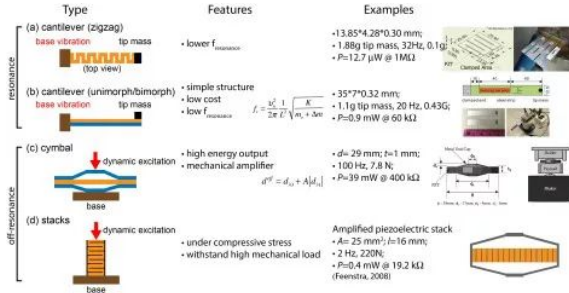


Figure 13: New PEHs Working in the Tension or Compression Mode

Piezoelectric Seat

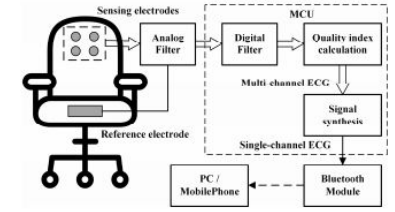
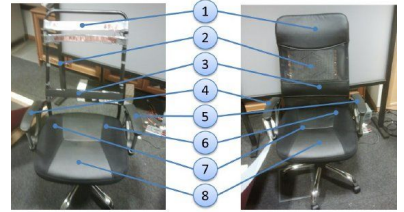
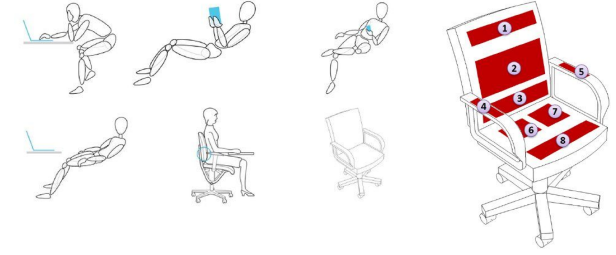


Figure 5. Systemic diagram.

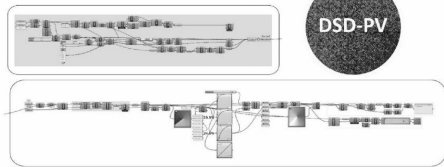
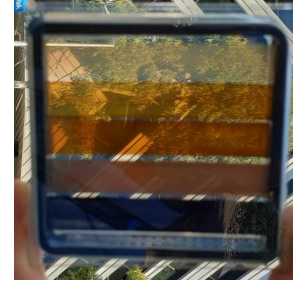
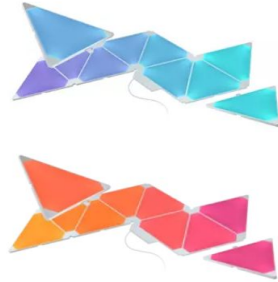
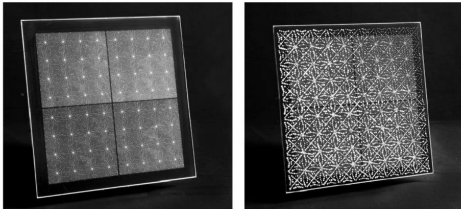


Different configurations of piezoelectric energy harvesters and their features

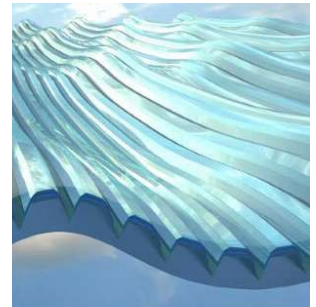
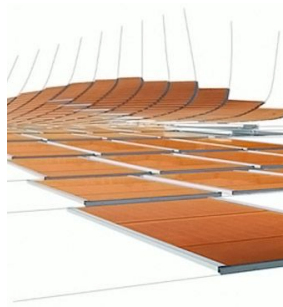
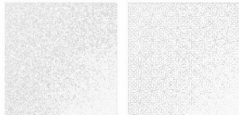
3D Printed Solar-Powered AI System ?

3D Printed Solar?

PROVIDING A COLORED DESIGN LAYER IN A BALANCED COVERAGE RATIO

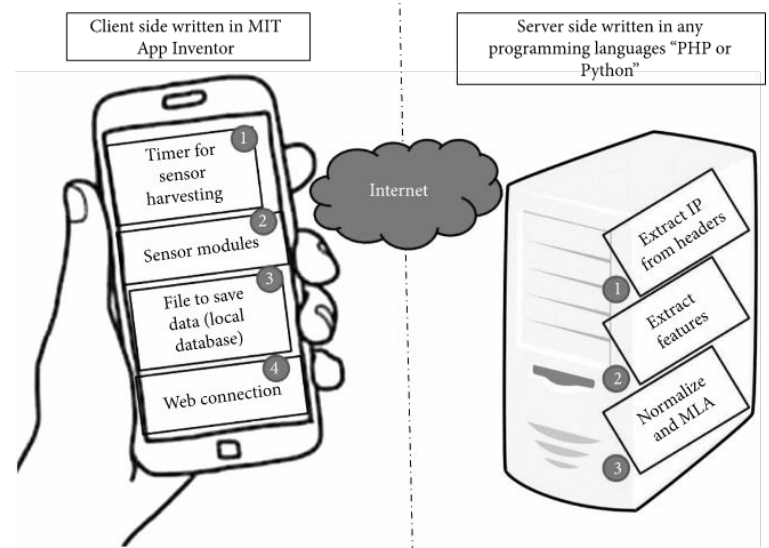
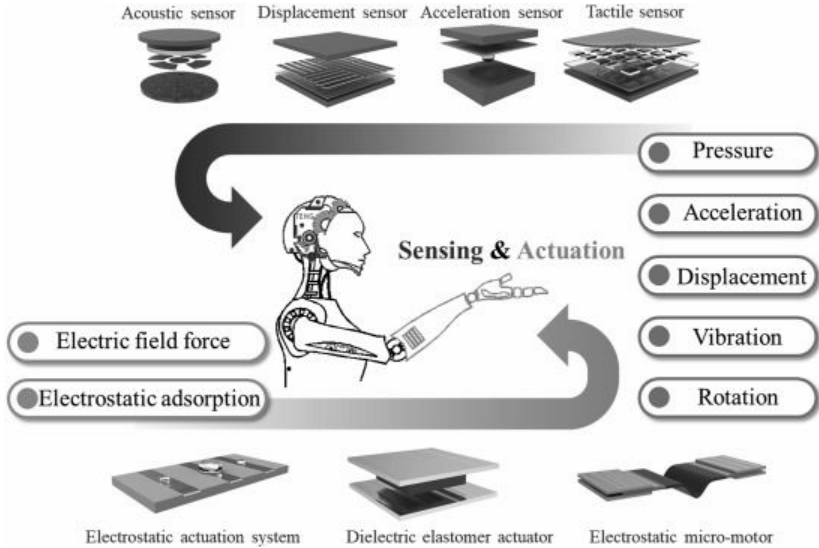


PRINT COVERAGE AND OUTPUT IS CONTROLLED THROUGH DESIGN SOFTWARE



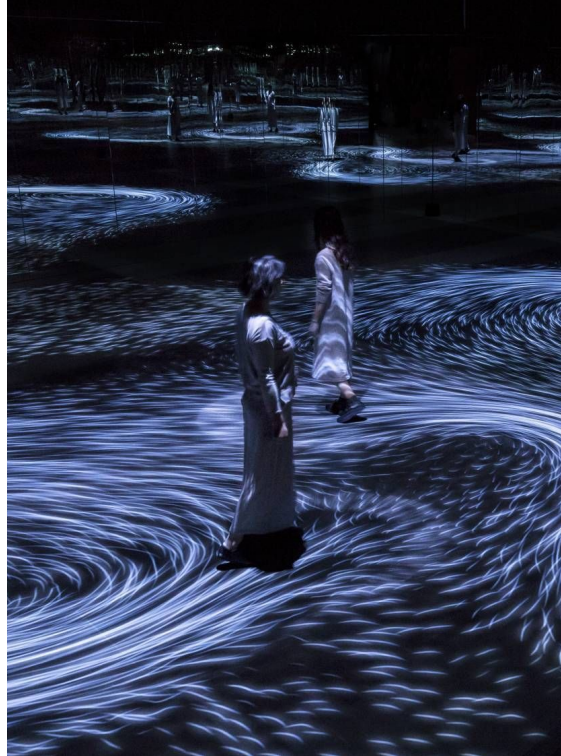
Sensors

Piezoelectric Sensor



Actuators

Interactive Lights



Sensor: pressure / light - realises how many people are seated.

Actuator: the lights running along the structure moves around the person like water.

Actuator: the pressure point sends a signal to an app / google maps that lets users know how many people are at the previous terminal / how full the ferry is.

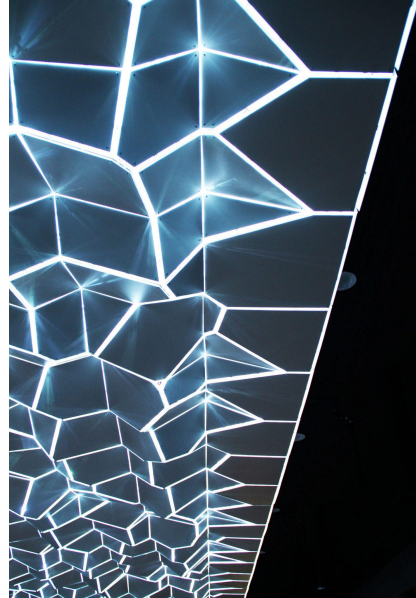
Function: to see the capacity of the ferry.

Other potential features:

- changes color depending on how many users there are waiting
- light flashes when ferry is approaching
- collects data on how often people use, what times, to go where and it sells data for marketing - find investors

Function: Beautification / tourist interaction.

Interactive light / sound



Rise Los Angeles, CA 2014

The ceiling installation extends the typical training soundtrack found in high-impact workouts into an immersive spatial environment. Once the workout begins and the lights are turned down the installation comes alive through a large array of internal LEDs. At first glance, the installation appears to just be a rocky surface, but the precise gaps between the panels allow the reflected light from the LEDs to pass through in irregular ways to create an animated surface that ranges between simple fades to a field of lighting. **The LEDs are programmed with various behaviors to accompany the different soundtracks played during workouts.** The installation serves as both a sculptural ceiling under normal conditions and a high-intensity interactive light field during workout sessions.

Ideas for our design:

- Light reacts to the movement of passers-by
- Light reacts to ambient noise
- **Light flashes when waterbus arrives**

Time Constraints

Limitations

- what she said

Concept

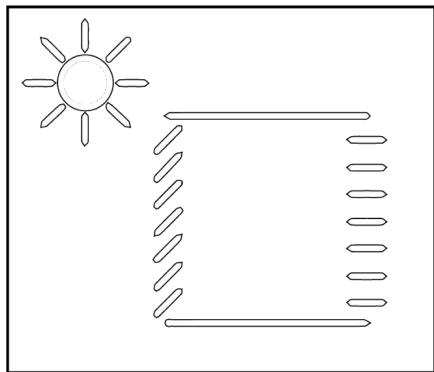
Project title

- 3 modules to achieve river inspired form with branches
- the river mimicking is not limited to the plan but should also be seen in elevation make bubble diagram?
- achieving the river shape in elevation and plan should allow to create seating at different heights / shelter
- the river shapes informs the shape of the bench in ELEVATION
-

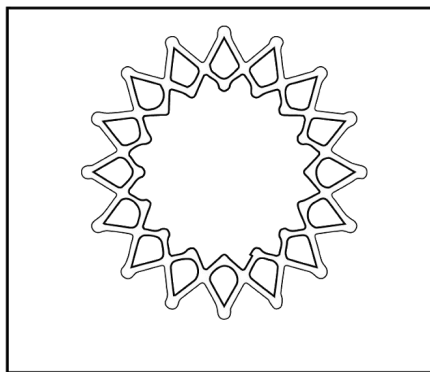
- Network of modular urban furniture placed along the river at each Waterbus terminal, configuration according to peculiarity of the stop.
- Design detailed for Willemsplein Terminal for its key location: historic - new; multi-modal intersection; proximity to big park; number of users.
- To provide better shelter and (un?)comfortable seating with element of playfulness to revive a gray & static zone and to change the sedentary lifestyles promoted by the built environment.
- To allow stations to inform each other about the number of users at each station + Sensor Unit will allow Urban Furniture Network owner to get feedback from each installation.

Design Development

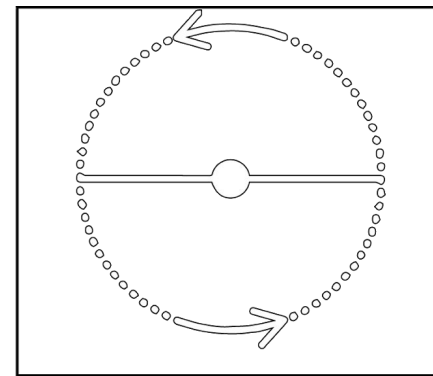
Overall Approach



Responsive



Kinetic



Transformable

Overall Concept: Shapes of the River



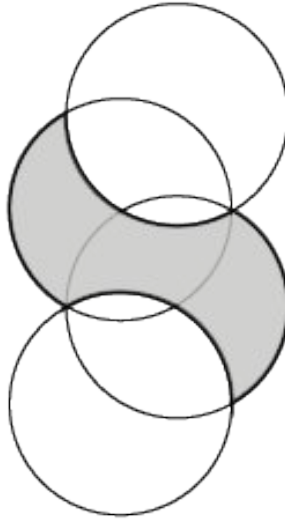
Overall Concept: Modular Assembly



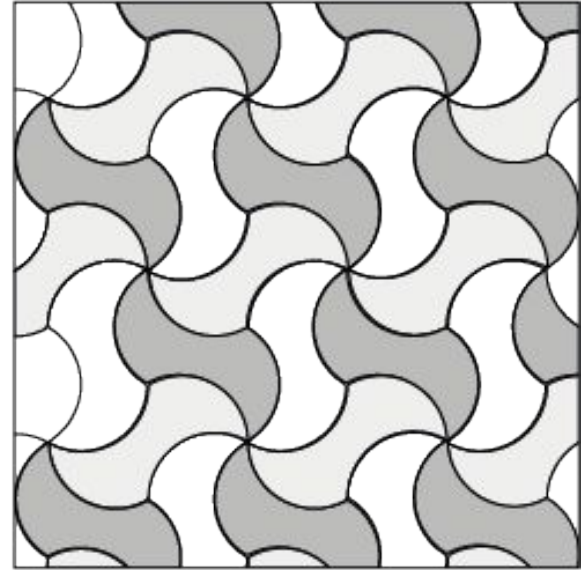
Design 1: Concept



Symbolic

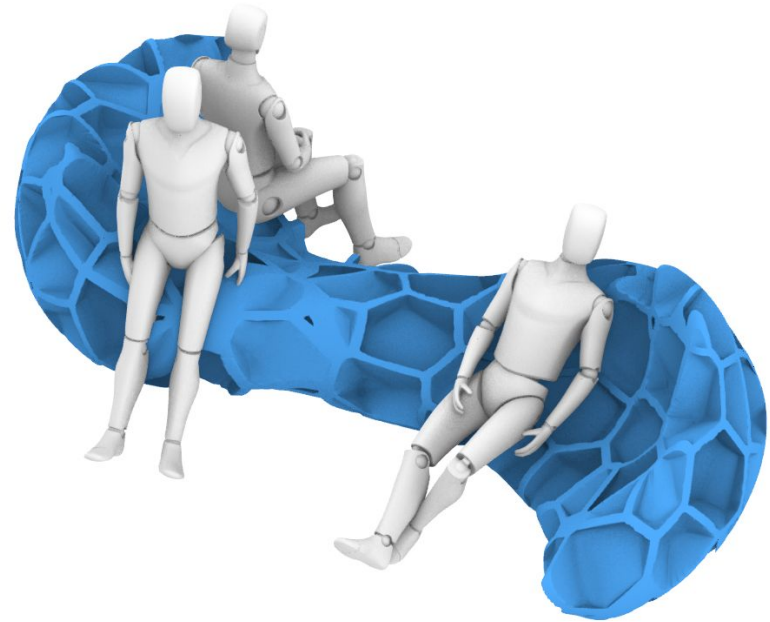
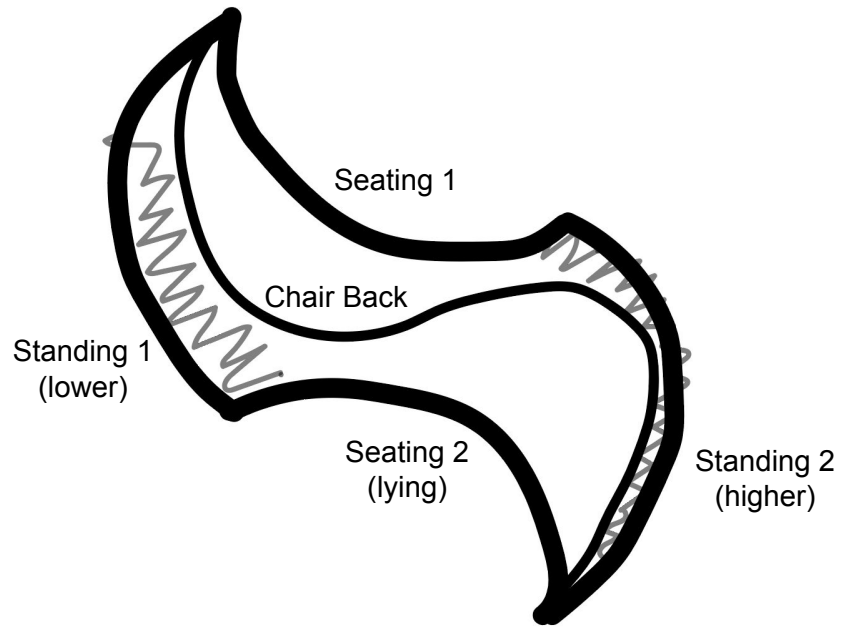


Modular

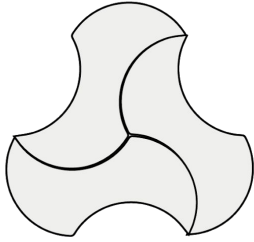


Pattern Based

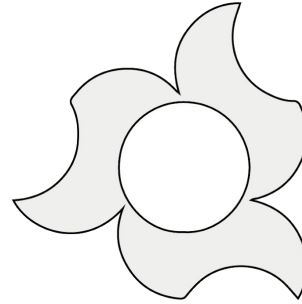
Design 1: Module



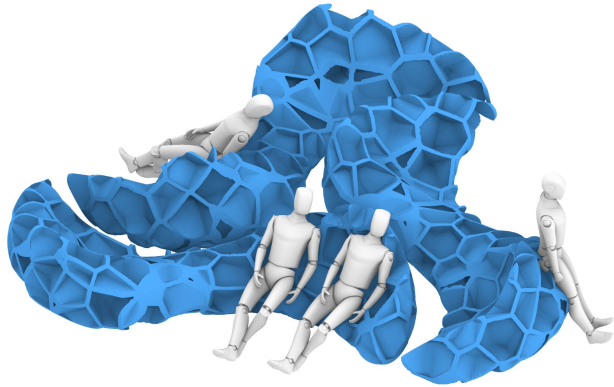
Design 1: Combinations



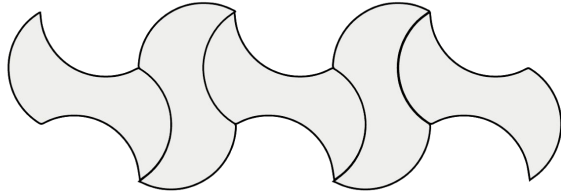
Compact seating
that offers views
to different sceneries



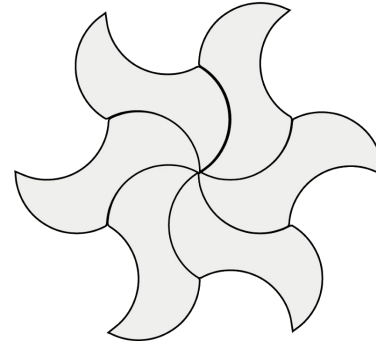
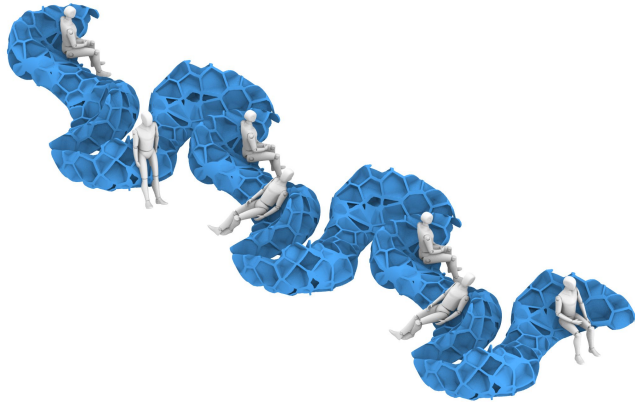
Forming a safe, collective
space in the middle (for
example kids)



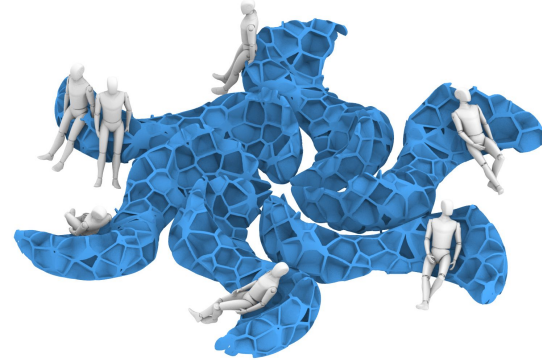
Design 1: Combinations



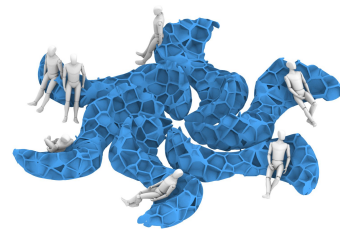
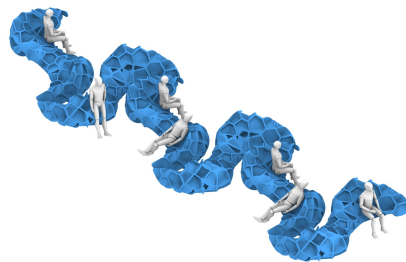
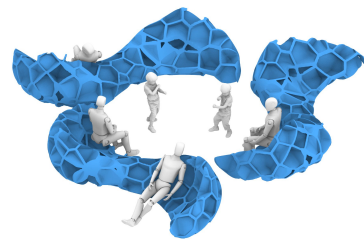
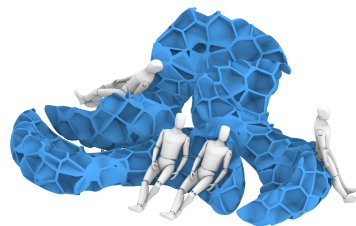
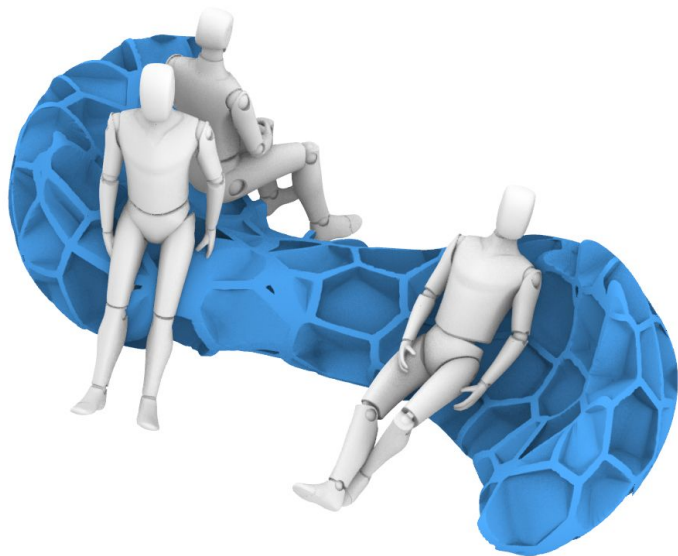
Linear form along
the river offering
more exposure to
the surrounding



Interconnected
seating that can be
used as a platform
for activities



Design 1: Visions

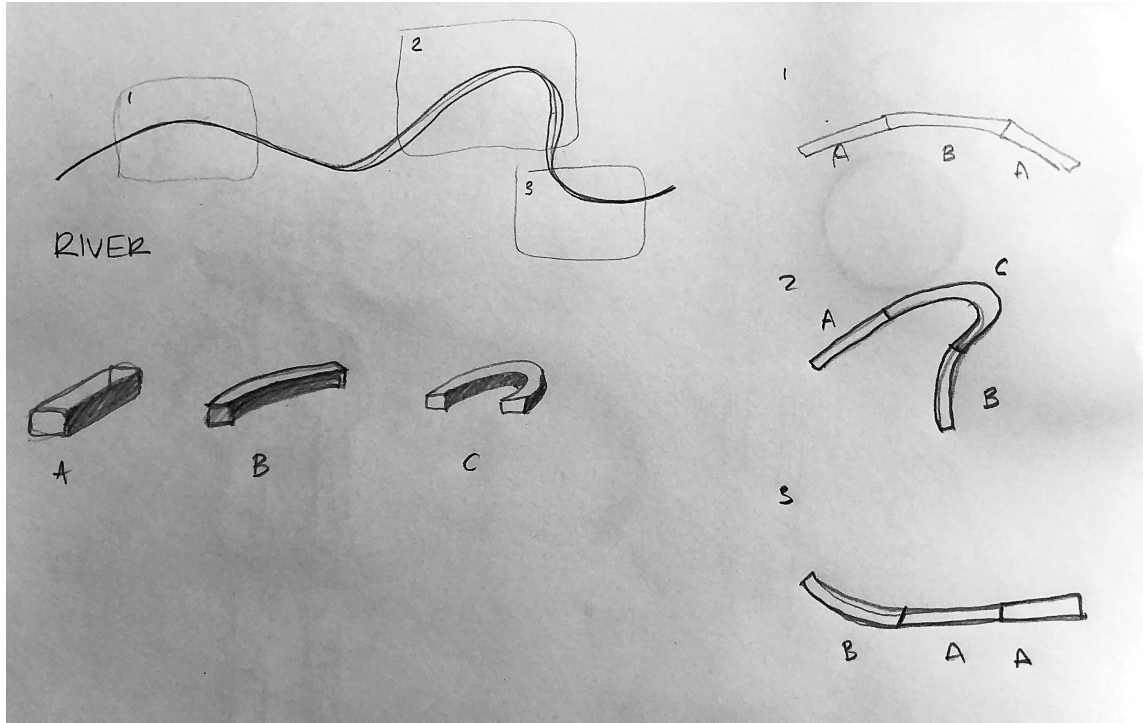


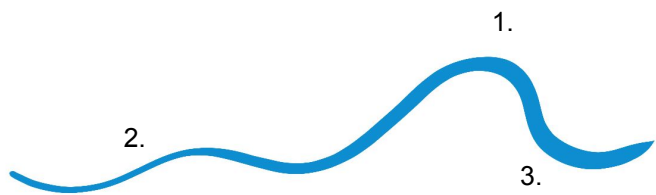
Design 2



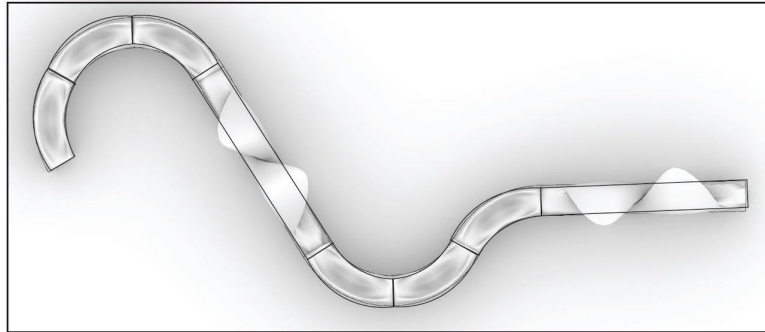
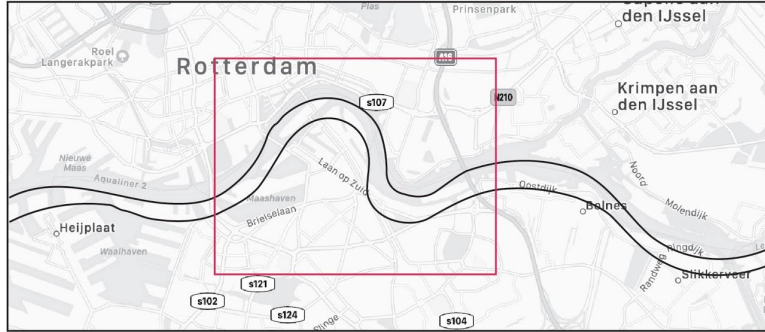
Design 2:

Plan





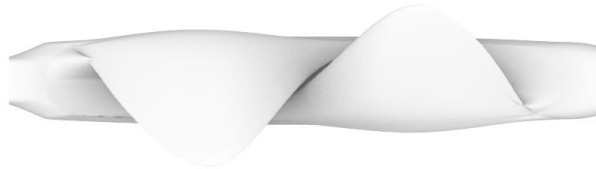
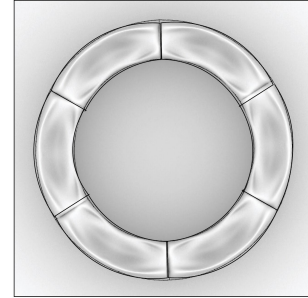
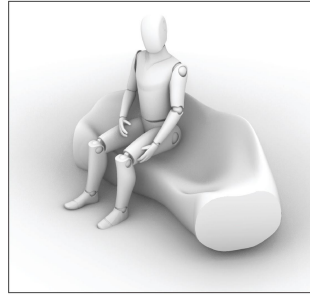
Design 3: Concept



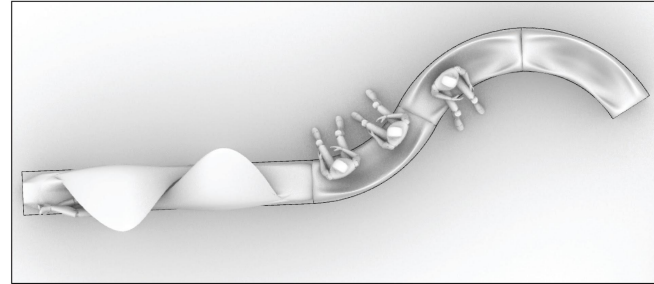
Design 3: Module



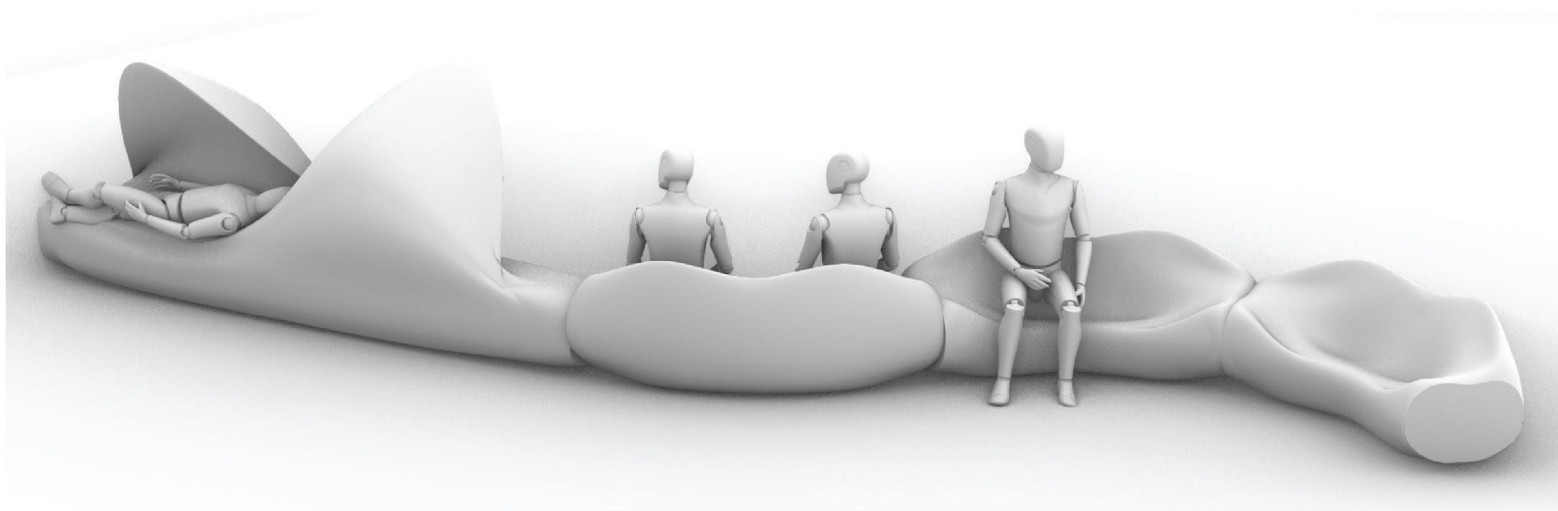
Module 1
Seating for 1 or 2 people



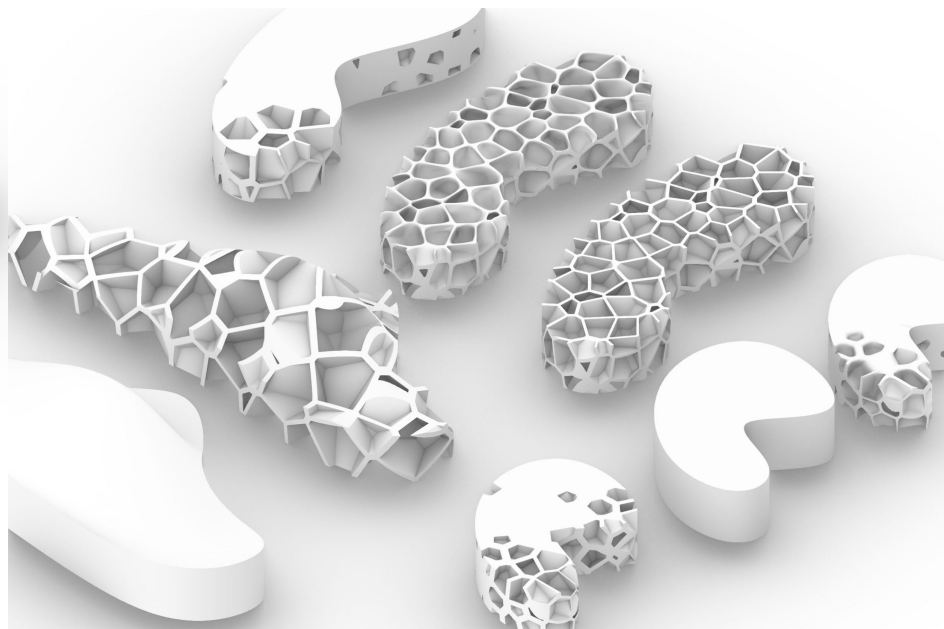
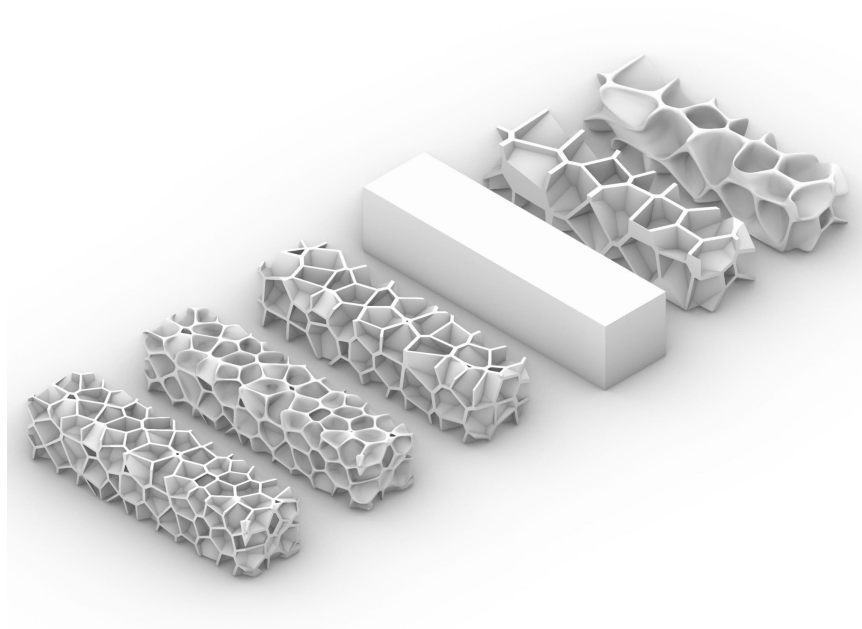
Module 2
Seating with shelter



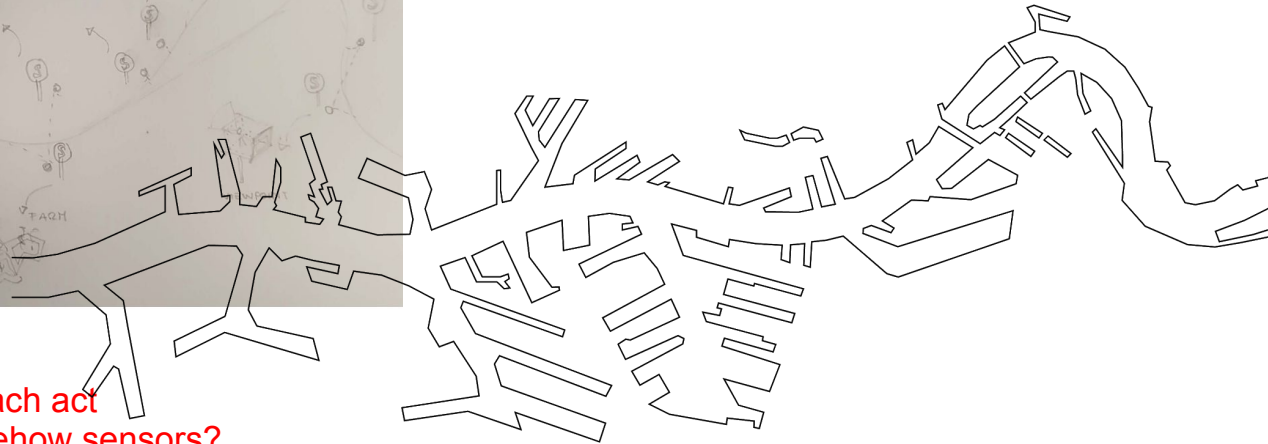
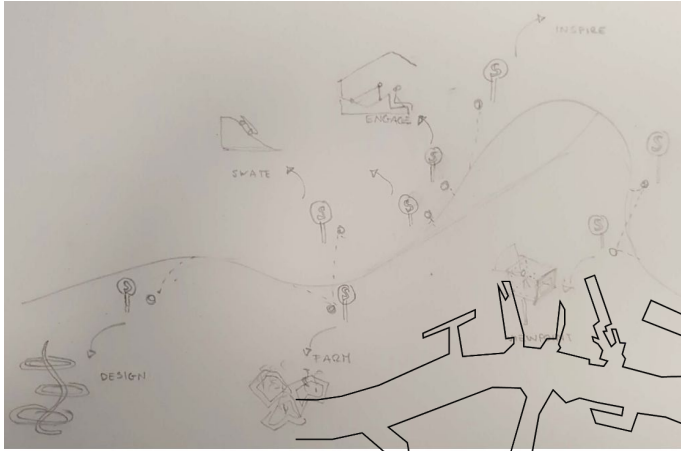
Design 3: Vision



Voronoi

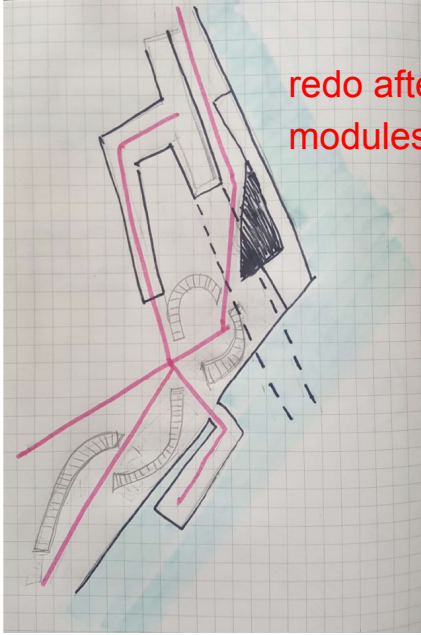


The Network

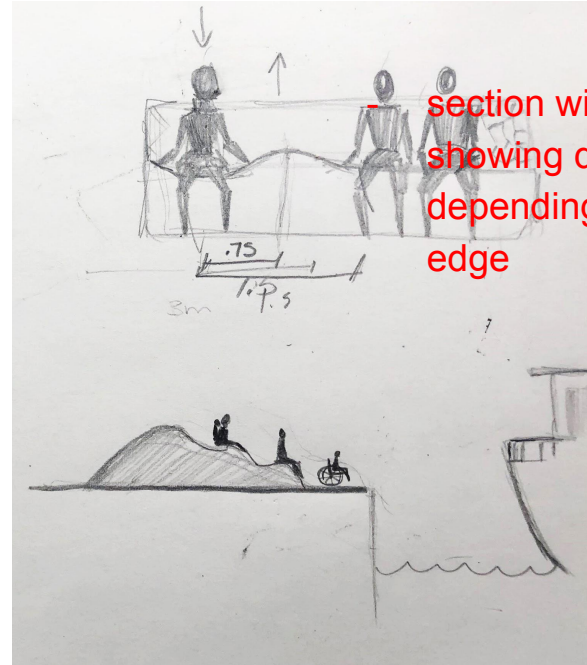


- picto for each act
- show somehow sensors?

Site Plan



redo after figure out 3
modules of furniture

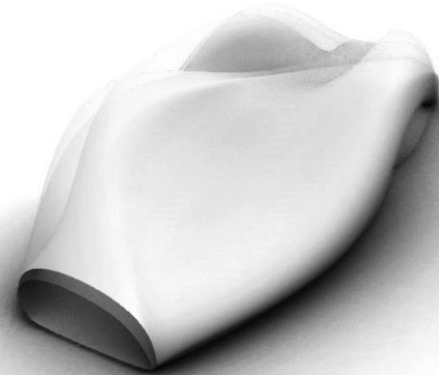


section with the furniture
showing different hights
depending on poximity to water
edge

The Individual Object

A modular furniture system inspired by the motion of the river that promotes the freedom of movement of our bodies. The furniture system challenges the user to find new ways of seating and expressing the body. The furniture also undulates like waves, and has a kinetic shading system to provide shade when needed.

3 components



The Object

- provides seating for ferry terminal
- seating for adjacent office areas
- shelter for people waiting for the ferry
- art piece / beautification of the local area



Concept Design

Questions

Question

- Do we need to put the finish on the furniture, or just the 3D print bio-polymer only?
- How do we integrate the sensors with the voronoi structure if it is with empty cells?

Group Meeting Notes

- 3 modules to achieve river inspired form with branches
- the river mimicking is not limited to the plan but should also be seen in elevation
- achieving the river shape in elevation and plan should allow to create seating at different heights / shelter
- the river shapes informs the shape of the bench in ELEVATION
-