



PHILIA CHUA

Bio-designer | Researcher | Architectural Designer

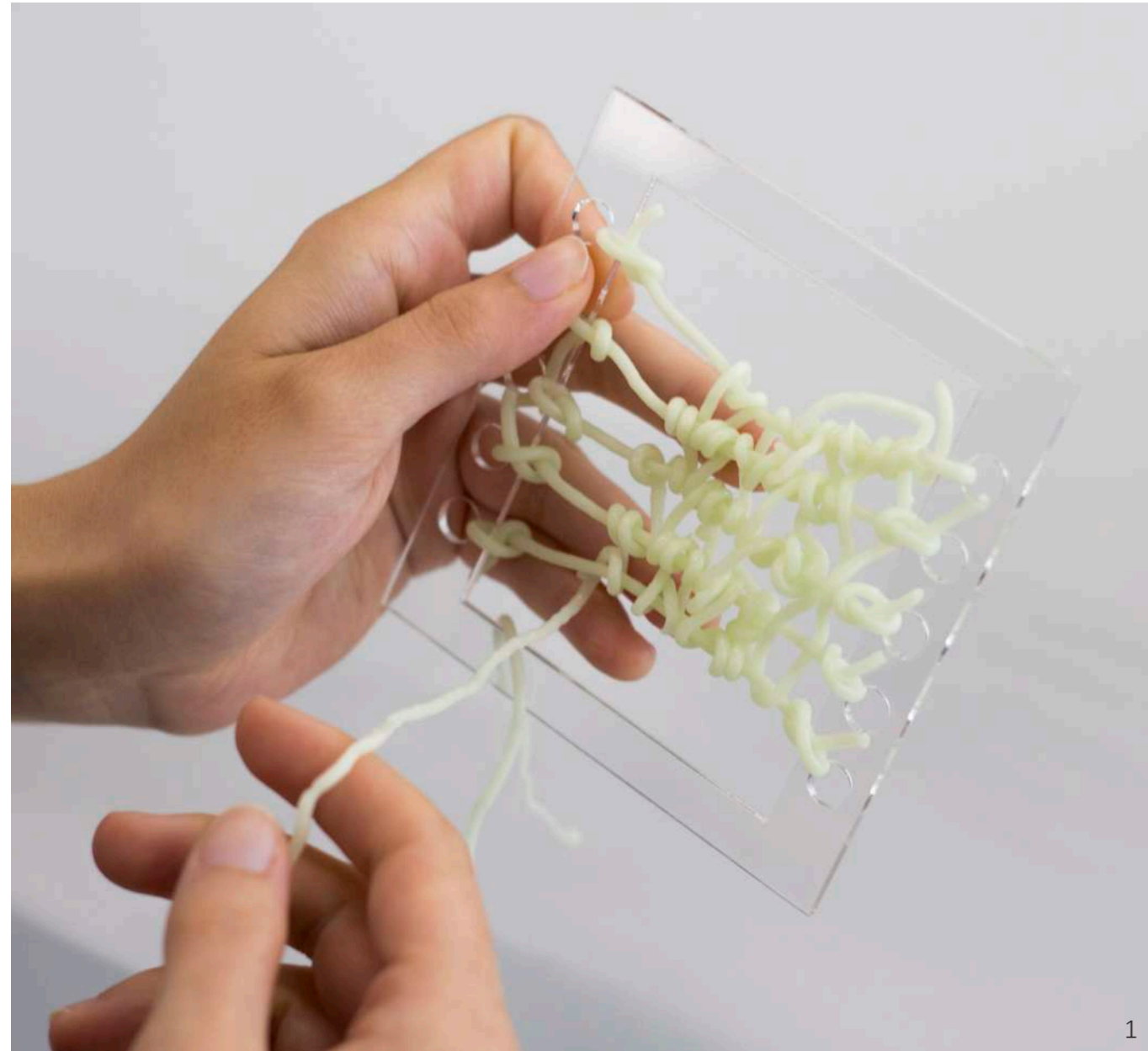


Waterbound 1.0

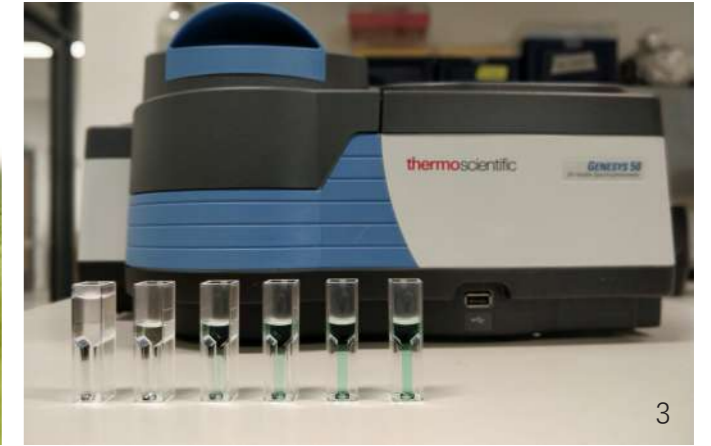
Year 1 Collaborative Project | Teammates: Ebyan Rezgui, Ophelie Tousignant
MArch in Bio-Integrated Design, UCL

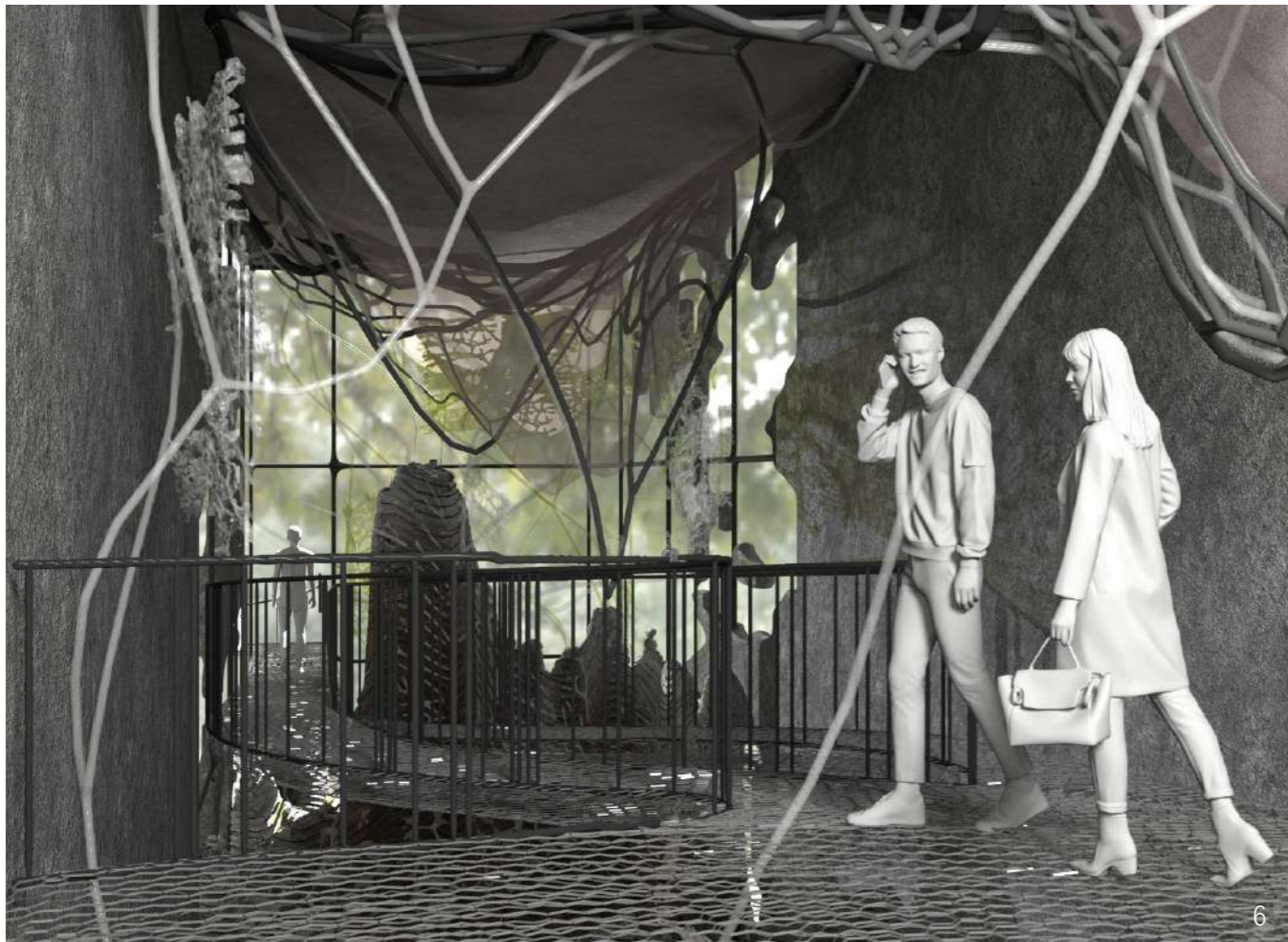
As urban floods continue to threaten the livelihood of communities, inefficient sewage management further increases pollution rates, as aquatic pollutants from urban areas are mixed into floodwaters and overflow into natural waterways. Waterbound 1.0 is a water bioremediating intervention designed to fit into the vacant basements of Pittsburgh's Uptown neighborhood. Live algae and bacteria cells immobilized within a functionally graded clay/hydrogel material allow this structure to remediate urban stormwater and prevent frequent floods, all while integrating itself into the urban fabric as a thought-provoking green space. Using a combination of robotic extrusion and community-fabricated woven hydrogels, this intervention transforms into a makerspace during the drier months, and comes back every year for Pittsburgh's rainy season.

1. Hydrogel strands infused with algal cells, 2. Immobilised co-culture within hydrogel beads, 3. Spectrophotometer analysis for nickel solutions, 4. Robotic extrusion of clay-hydrogel composite, 5.6.7. Robotically-extruded landscape for retention and bioremediation of urban floodwaters within the basements of vacant lots



Bioremediation of urban floodwaters using algal-bacterial consortia, immobilised within robotically extruded clay-hydrogel composite material.

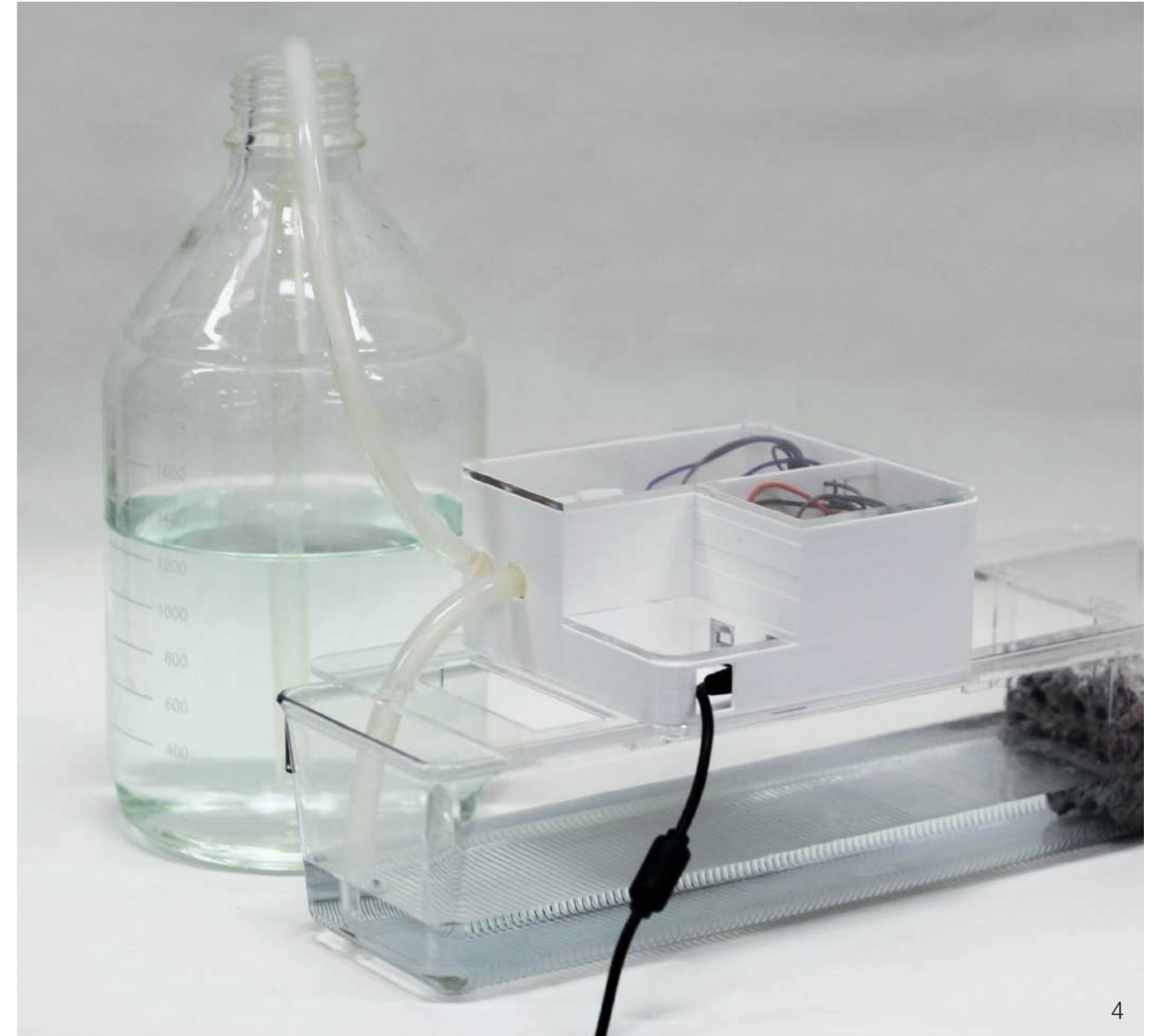
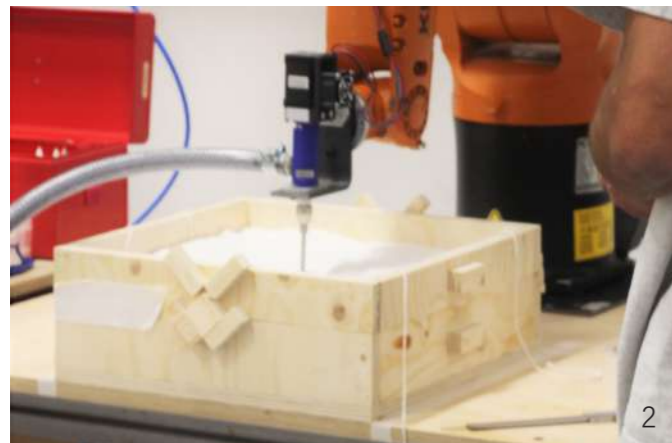




Waterbound 2.0

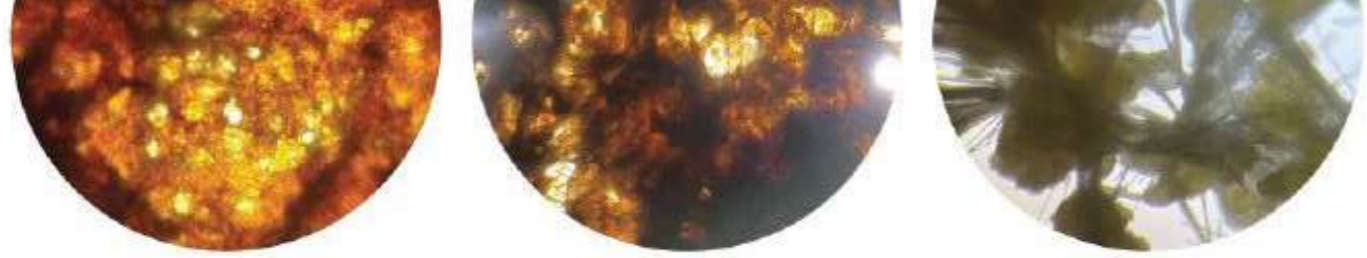
Year 2 Collaborative Project | Teammates: Ebyan Rezgui, Ophelie Tousignant
MArch in Bio-Integrated Design, UCL

Decentralised synthetic reef infused with bacteria for the bioremediation of urban flood waters and revival of waterways.



Building upon the project aims of Waterbound 1.0, Waterbound 2.0 continues to address the issue of heavy metal contamination within urban floodwaters and waterways, whilst introducing improvements towards the bioremediation system. A functionally-graded chitosan composite is proposed, with a varying range of structural and water absorption qualities. Bacteria is infused within the composite, facilitating the solidification process and further increasing the bioremediation capacity of the material. Computational simulation and analysis was used to generate 3-dimensional reef-like geometries with high surface area. Multiple test sites were identified to address site-specific challenges in order to develop a resilient design strategy. The final proposed intervention is scalable and could be applied in urban waterways globally.

1. 1-to-1 scale prototype of synthetic reef, 2. Robotic suspension printing process, 3. Sample of non-planar suspension printing, 4. Water tank setup to determine the bioremediation efficiency of material samples, 5. Material samples at varying pH, 6.7. Synthetic reefs for bioremediation of urban flood waters and waterways



5



6



7

Computational Explorations & Simulations

Year 1&2 Research
MArch in Bio-Integrated Design, UCL

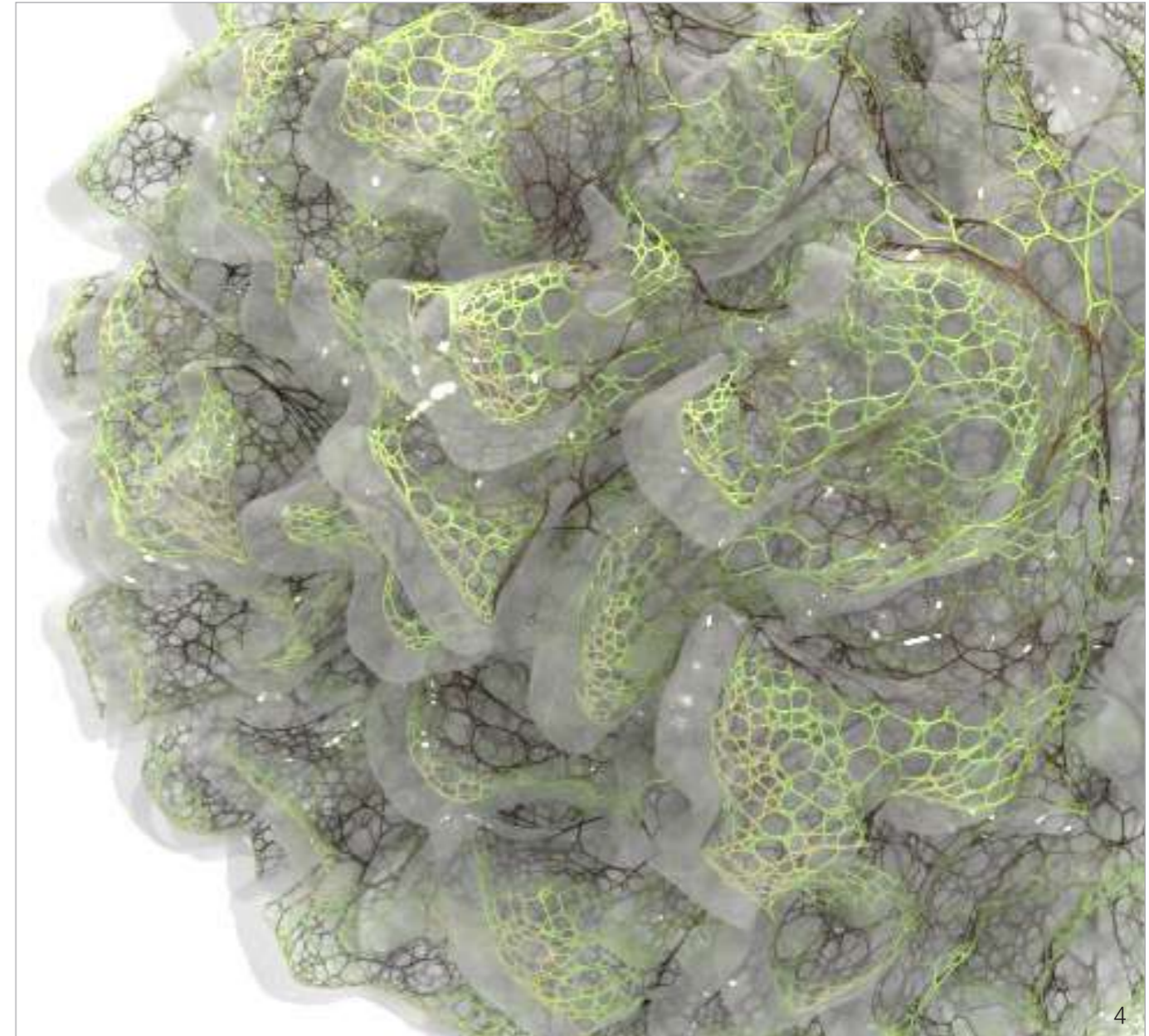
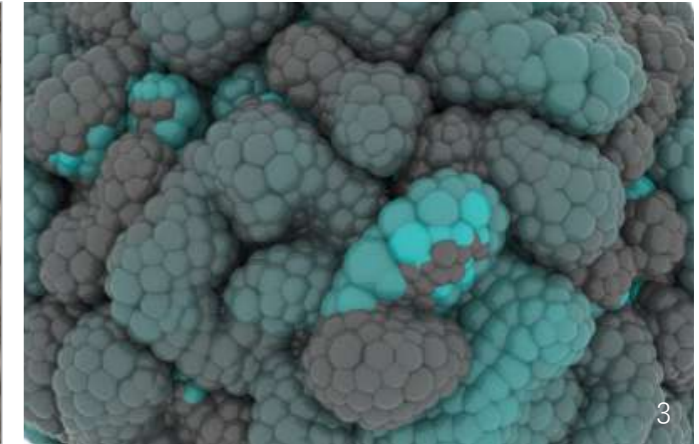
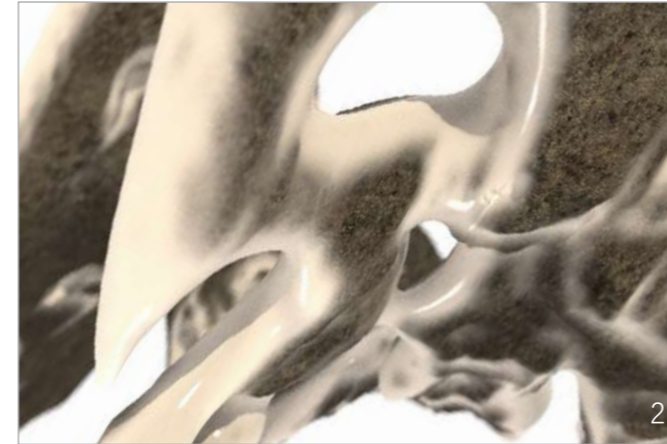
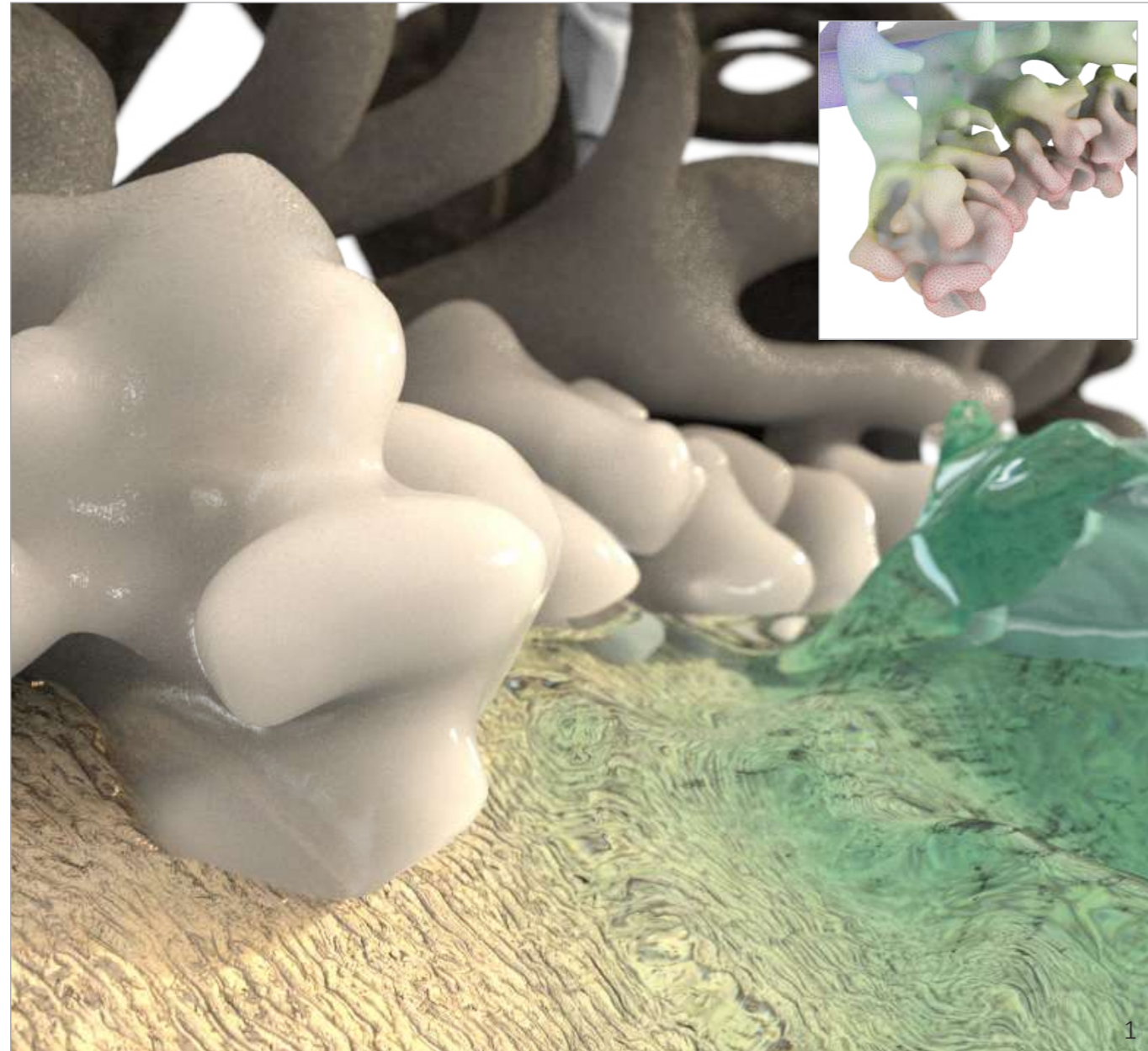
Generating geometries and site-specific design outputs based on computational scripts, lab data and environmental simulations.

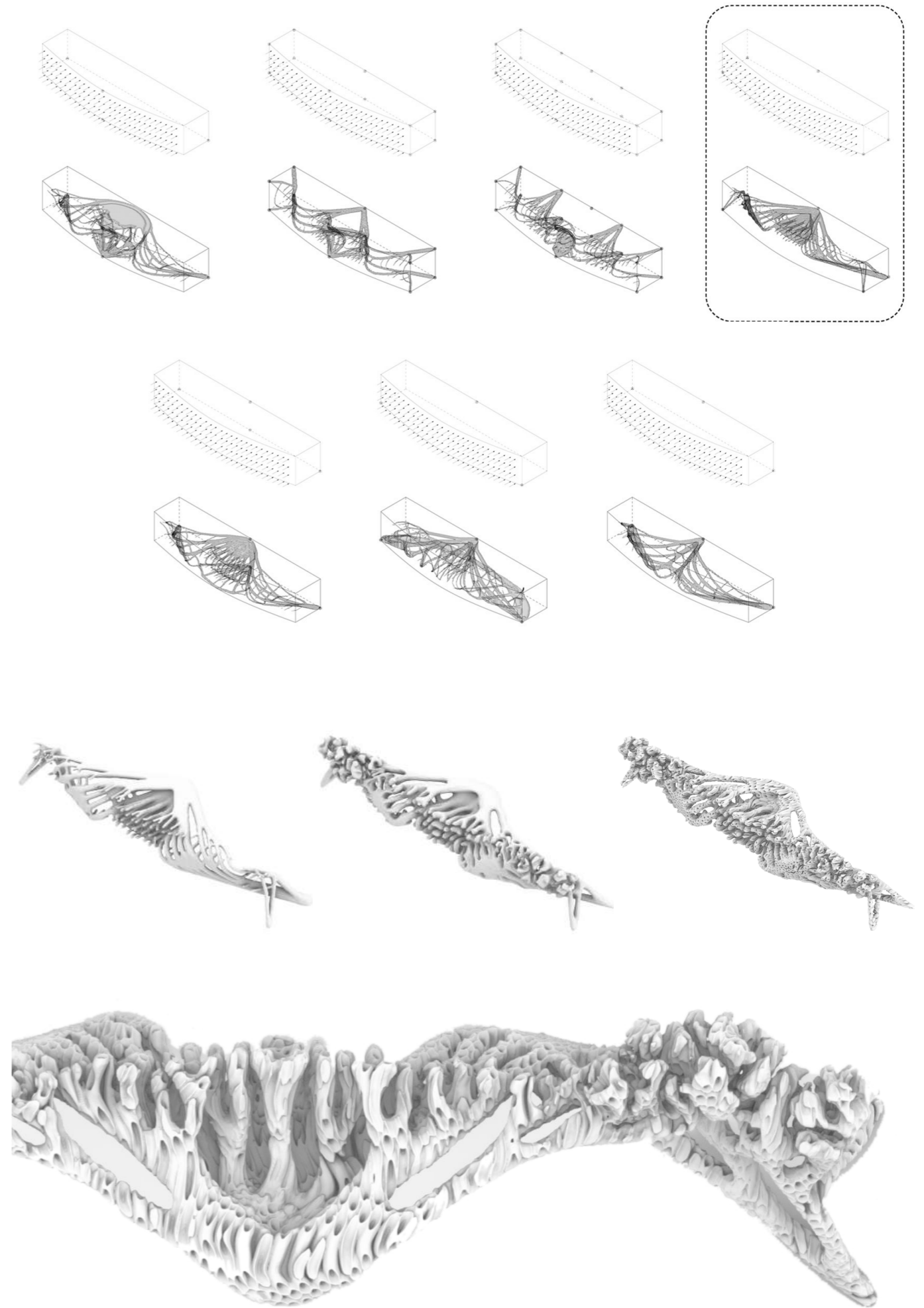
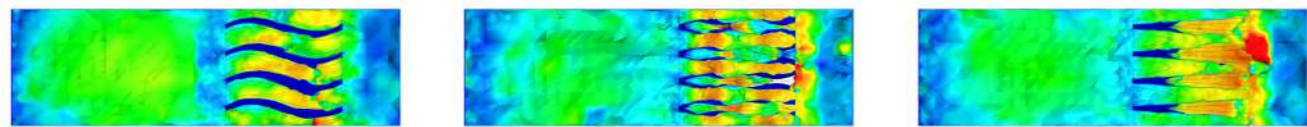
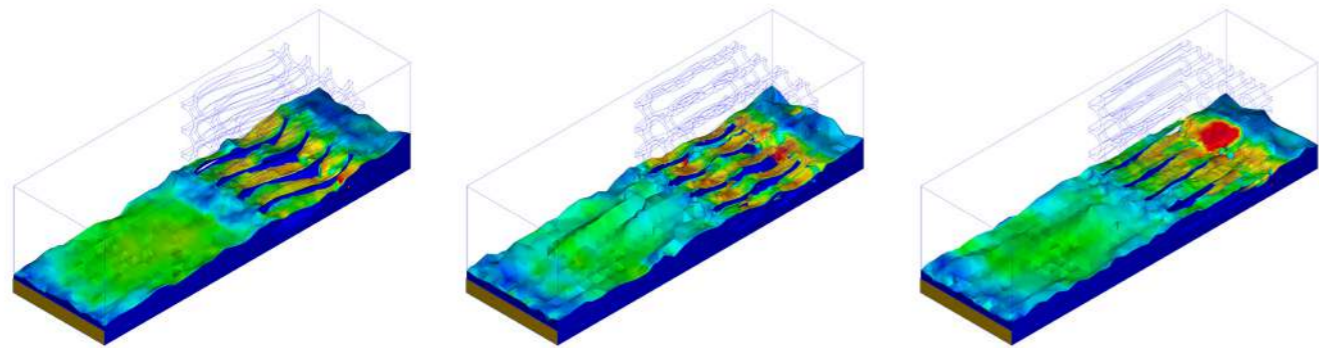
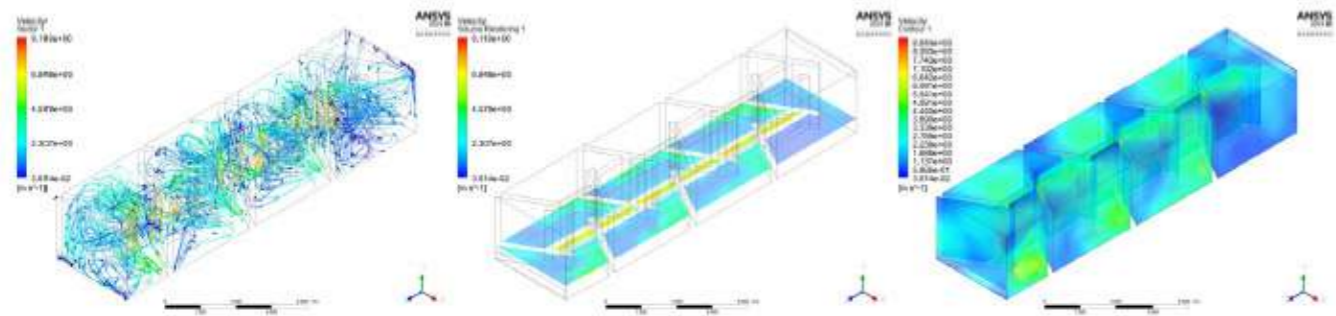
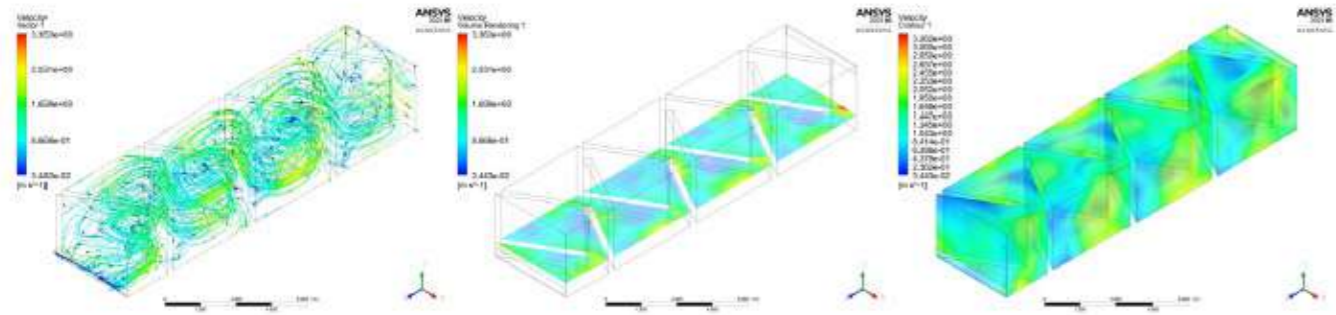
Click here to watch the full video: https://youtu.be/M_vRgMBL0yA



In conjunction with the scientific and fabrication explorations for Waterbound, numerous computational studies and simulations were conducted to bridge the gaps between environmental/lab data and physical prototyping. The software Grasshopper in Rhinoceros was used to conduct topology optimisation for load distribution from water impact. Houdini was used to generate emergent geometries through morphogenetical explorations and create reef-like structures with high surface to volume ratio for increased bioremediation efficiency. Other than that, Ansys and Autodesk CFD was used to assess water movement through porous geometries and simulate river flooding scenarios on chosen test sites.

1. Selective morphing of structures based on water contact zones, 2. Functionally-graded material composition, 3. Exploration of morphogenetical algorithm inspired by works from Andy Lomas, 4. Generating high surface area geometries with Houdini, 5. Ansys and CFD water movement simulations, 6. Grasshopper script to generate topologically-optimised reef structures

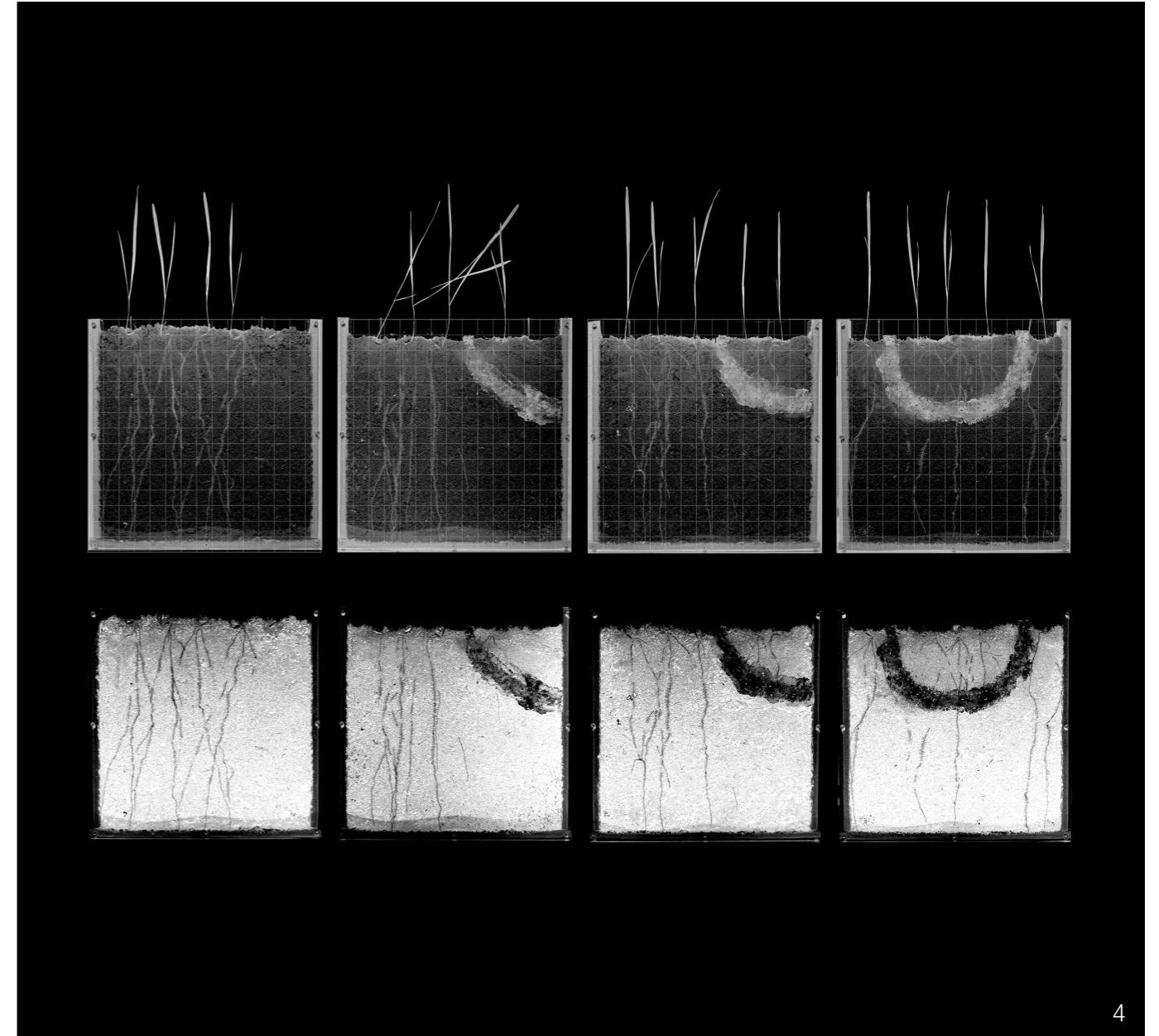




Experimental Explorations

Year 1 Research
MArch in Bio-Integrated Design, UCL

Preliminary experimental setups to observe the relationship between mycelium, soil and plant health.



A strong interest in fungi and mycelium during Year 1 led to experiments and observations around plant rhizosphere microbiome. Rhizotrons were self-assembled and used to observe biodegrading processes of mycelium components and its possible interactions with oat plant roots in soil. Other than that, portions of soil was inoculated with partner fungi spores to further observe the effects of mycorrhizal fungi on the growth and health of plants. As a secondary experiment, a transect study was conducted along a 30m x 1m strip within the ancient woodland of Queen's Wood. Leaves from 7 different plant species along the transect was collected and documented, along with observations recorded regarding their interactions and growth patterns on different portions of the site with varying conditions.

1. Mycelium components grown within custom moulds, 2. Study of mycelium growth within soil, 3. Documentation of plant species and interactions from transect study, 4. Rhizotron observations of oat plant root growth and mycelium components

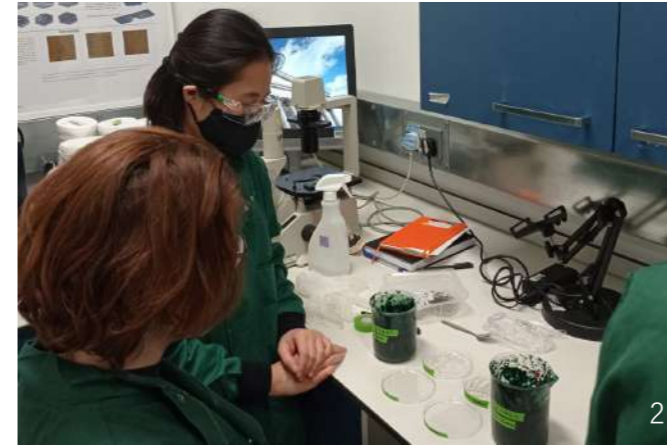
Bio-Design Family Workshop

'Become a Bio-Designer', 2022
In conjunction with the Beatrix Potter Exhibition, V&A Museum

As part of the Beatrix Potter Exhibition at the Victoria and Albert Museum, a 4-day family workshop titled 'Become a Bio-Designer' was hosted to engage children and their parents in designing with nature. An algae-infused food-grade biomaterial with malleable properties was carefully designed and prepared, along with information sheets explaining the capabilities of algae for bioremediation. Children are invited to imagine how algae could be incorporated in future designs and systems for buildings, sculptures, infrastructures, transportation and more. A drawing sheet is provided for them to plan and explain their designs, accompanied by a sculpted model using our algae biomaterial. It was truly inspiring and refreshing to speak to families about the potential of algae and biomaterials, as well as be a part of such an amazing team to educate the next generation of bio-designers.

1. Event team of 'Become a Bio-Designer Family Workshop, 2. Determining composition of algae biomaterial in the lab, 3. Cross-linking station to educate children about the process of immobilisation, 4. Sculptures from children and parents, 5.6.7. Setup and venue of 4-day family workshop

Collaborative experience at V&A Museum to engage with children and parents to explore the future of biomaterials.





5



6



7

Installation at London Design Festival

'Close from Afar', 2020
Organised by Resolve Collective + NOW Gallery

Public installation and community event space exploring the relationship between one another and the materials that bind us.



Led by the Resolve Collective in collaboration with NOW Gallery, students from University of Greenwich assisted them in creating a site-specific event space as part of the London Design Festival. 'Close From Afar' is centred around exploring the relationship between one another as well as the materials that bind us. The public installation consisted of a series of sculptural elements constructed from waste material sourced from the ongoing Design District building site next to the event location. The installation provoked visitors to rethink the reusability of construction waste. A 3-day public programme platforming grassroots creatives from the local area took place within the installation, featuring performances, workshops, screenings and talks that challenge ideas of proximity and distance and how they shape local communities.

1. 3-day public event space for 'Close from Afar', 2. Construction waste from nearby site repurposed within installation, 3. Students and team members from Resolve Collective, 4. Assembly of installation next to construction site where materials are sourced

Community Project for Local School

'MES Pavilion', 2017
In collaboration with SMK Methodist, Malaysia

The installation of the pavilion is part of a community service initiative, contributing to the former high school of a coursemate. The site is located at SMK Methodist in Banting, Malaysia, within an existing neglected herb garden. Prior to the design and construction of the pavilion, interviews were held with students and teachers of the school to understand their needs and hopes for the improvement of the site. A design workshop was also conducted with a group of students for further brainstorming. A study and hangout space is proposed to be built within the garden to benefit the school community. Modular units are proposed to ease future works of extension as suggested by the school principle. The units consist of study pods, vertical gardens with rainwater harvesting system and hammocks.

1. Study pods assembled within herb garden of school courtyard, 2. Ground levelling, brick laying and pad footing process, 3. Main structures of study pods transported and assembled, 4. Study and hangout spaces with vertical garden and simple rainwater harvesting system



Community service initiative to design and construct a study and hangout space within a highschool courtyard.



Sculptural Centerpiece for Art Gallery

'From Impulse to Urban Folly', 2015
In collaboration with SGFA Gallery Residence, Malaysia

Designed by Q. Jade Saw Architect, the installation aims to celebrate sustainability, tradition and modern design through the building of a bamboo pavilion in SGFA's award-winning green space, Gallery Residence. The project took six months to complete from the initial design stage through to the final build and involved the input and collaboration of architects, local artisans, the gallery team and students from Taylor's University. We also collaborated with bamboo craftsmen of the Orang Asli (indigenous tribe in Malaysia), who provided expert knowledge into the preparation and usage of bamboo as a sustainable building material. Prior to the assembly of the installation on site, a workshop was hosted by the Orang Asli to allow us to understand where the bamboo was grown and sourced, as well as educate us about the basics of working with this amazing natural material.

1. 'From Impulse to Urban Folly' Bamboo Pavilion showcased at the Gallery Residence, 2. Tying of bamboo using traditional methods, 3. Shaping and anchoring bamboo structure according to design, 4. Testing the stability of the anchored form



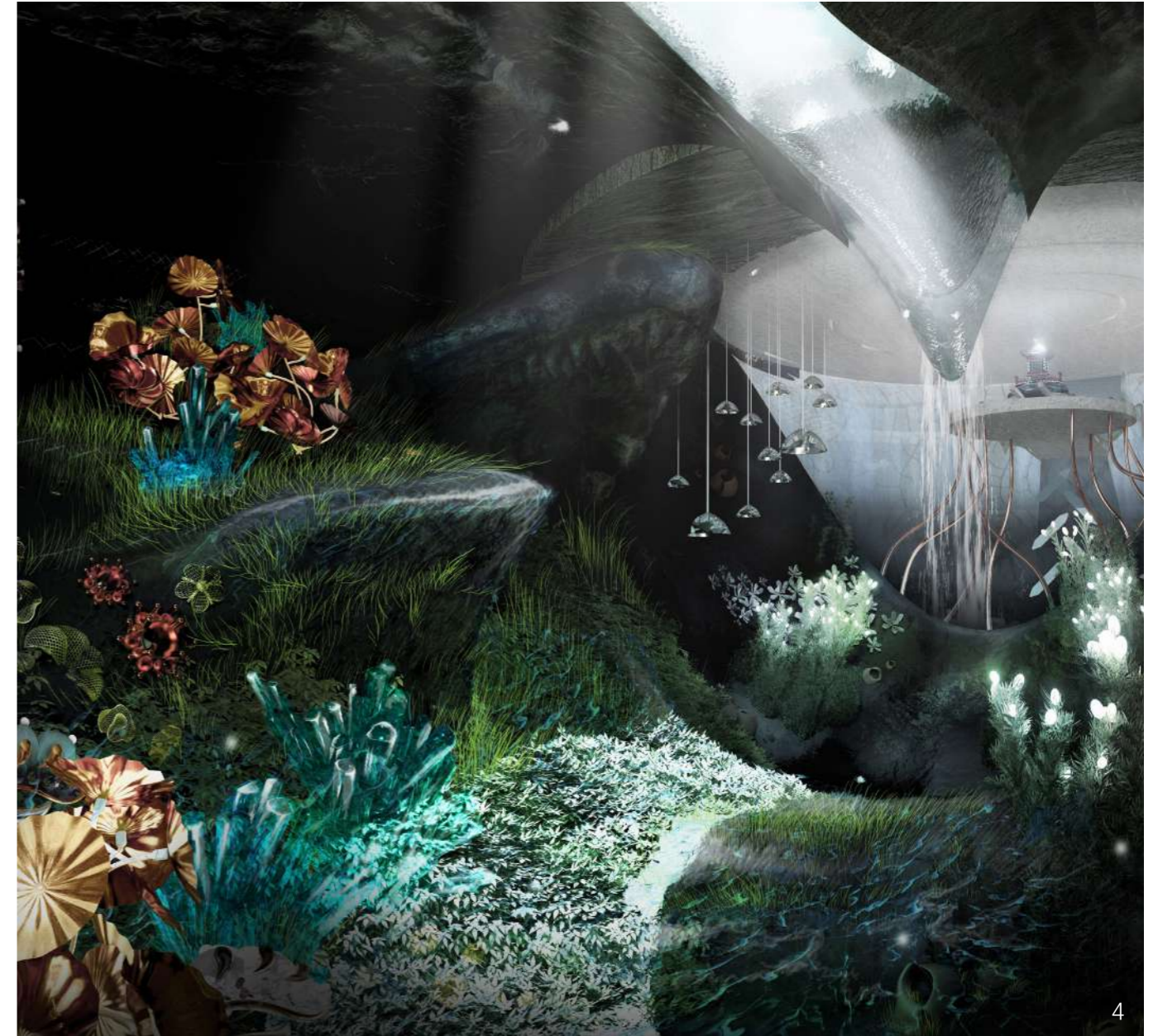
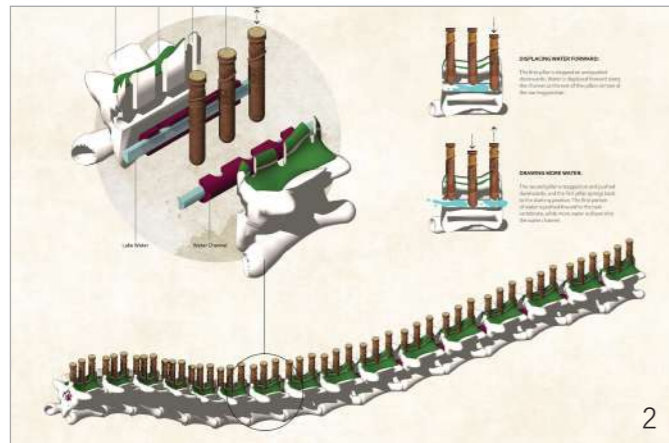
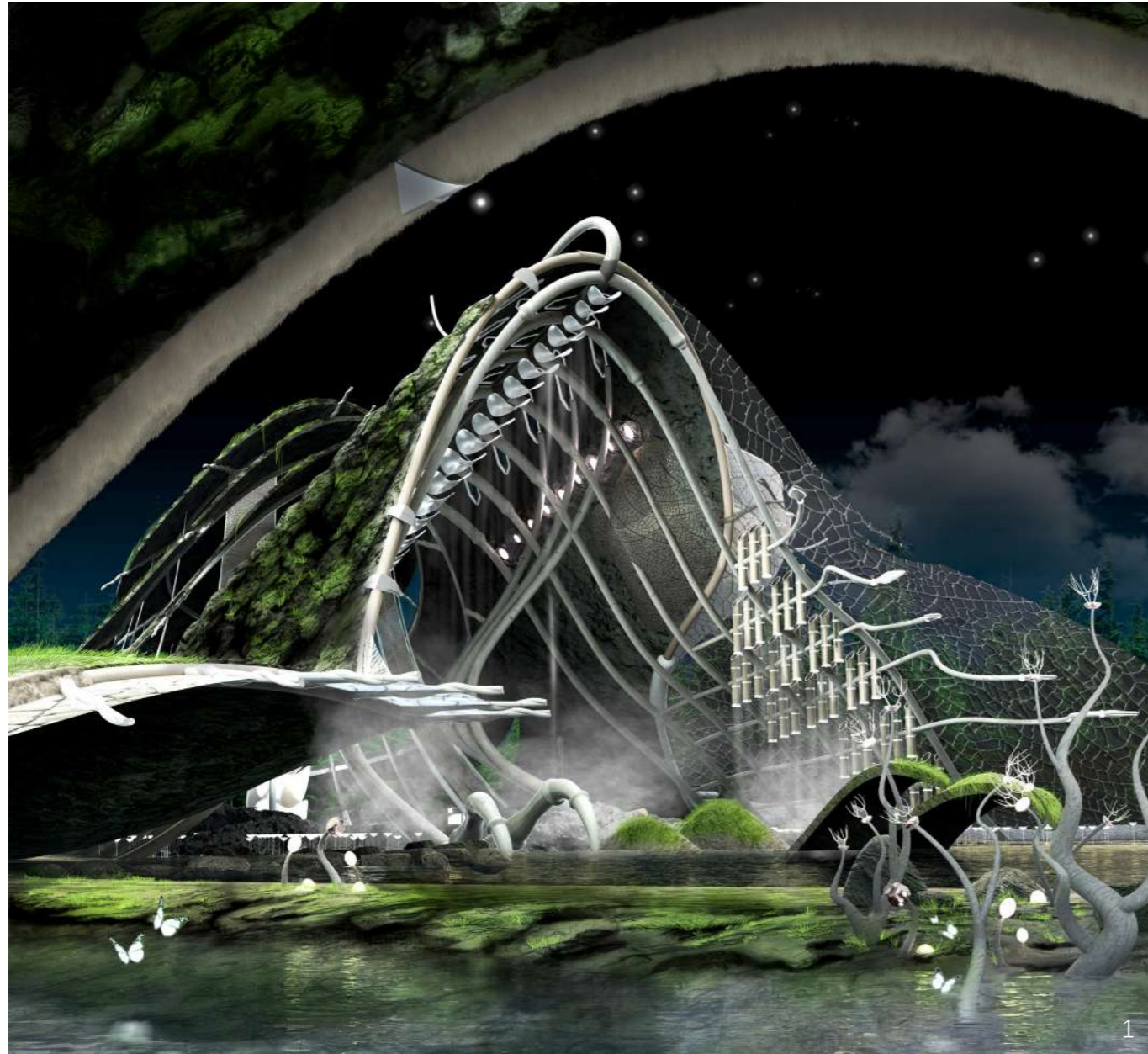
Understanding and working with bamboo through the guidance of local craftsmen to create a sculptural centerpiece.



The Myth of Aokigahara Jukai

Year 2 Final Project
MArch in Architecture, University of Greenwich

Exploring the multifaceted relationship between nature and narrative architecture through the mythical perspective of Shinto.

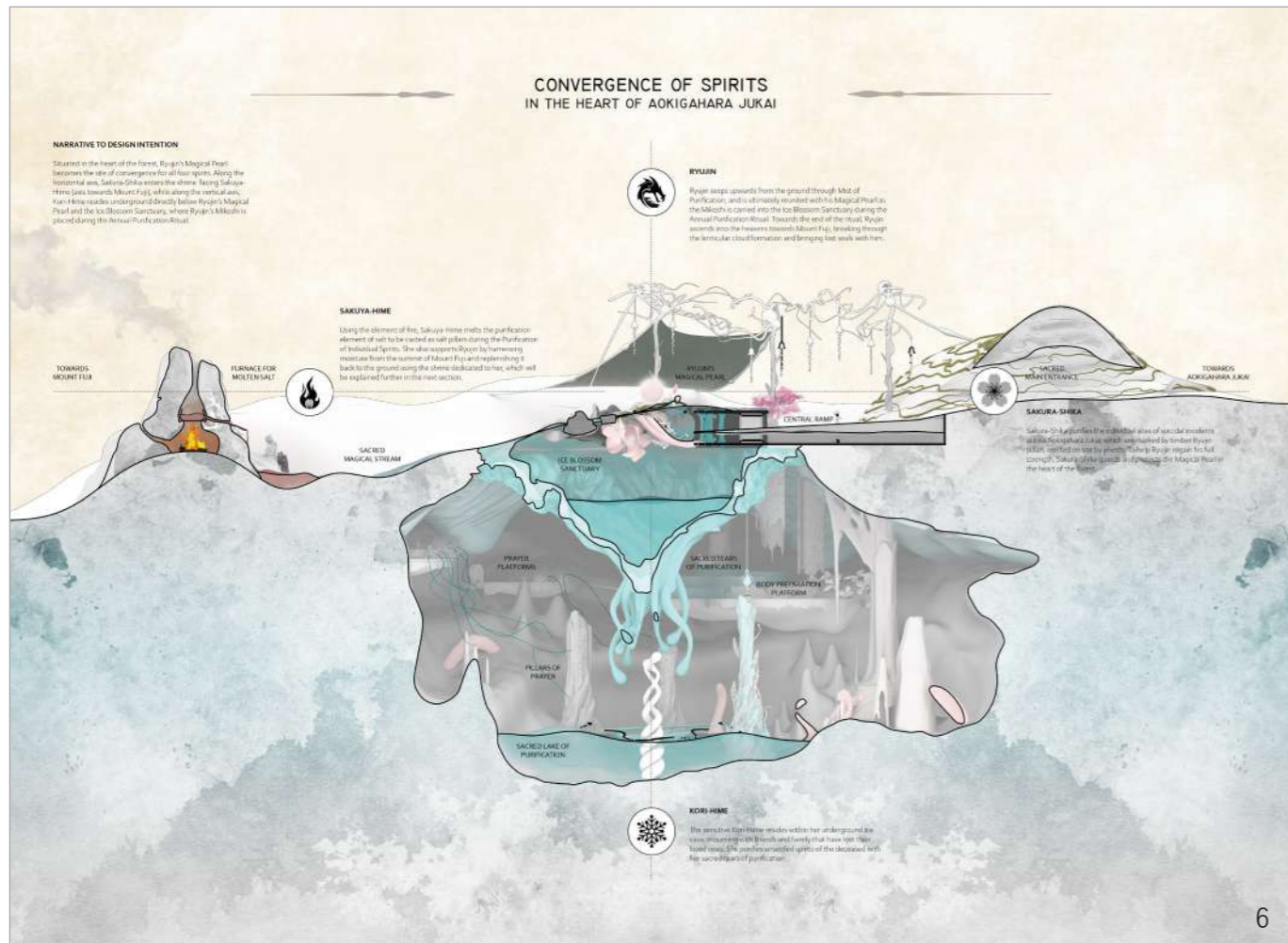


As the number of suicide cases in modern day Japan continue to rise, this project seeks to use the power of storytelling to change the perspective of people towards one of the most famous suicide destinations in the world - Aokigahara Jukai. A magical narrative is introduced, allowing visitors to experience the forest from the mythical perspective of Shinto, the indigenous religion of Japan. Six shrines are designed to honor the four spirits of Aokigahara Jukai and act as sacred sites where the human, natural and spiritual realm converge. As death is seen as a form of pollution in Shinto belief, purification rituals using traditional purification elements of water, fire, salt and smoke are created to restore the balance of the forest. The shrines are designed to integrate with natural features of the forest and the narrative, respecting the landscape and the Myth of Aokigahara Jukai.

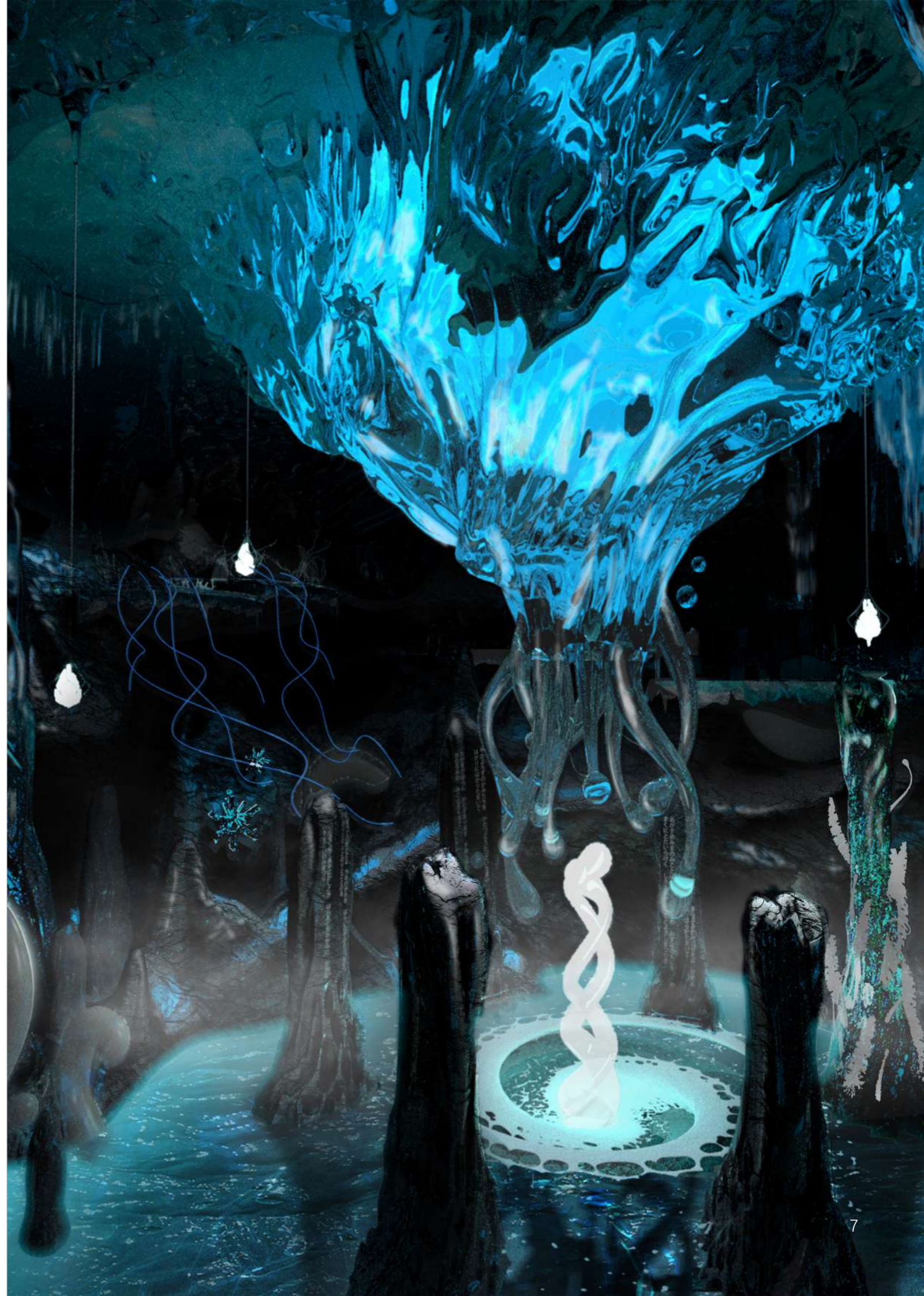
1. Ryujin Water Dragon Shrine, 2. Mechanism of water channel, 3. Purification ritual and activation of water channel across the forest, 4. Underground Den of Ryujin Water Dragon Spirit, 5. Sakura-Shika Guardian Deer Shrine, 6. Section of Shrines within the heart of the forest, 7. Underground Shrine of Kori-Hime Spirit



5



6



7

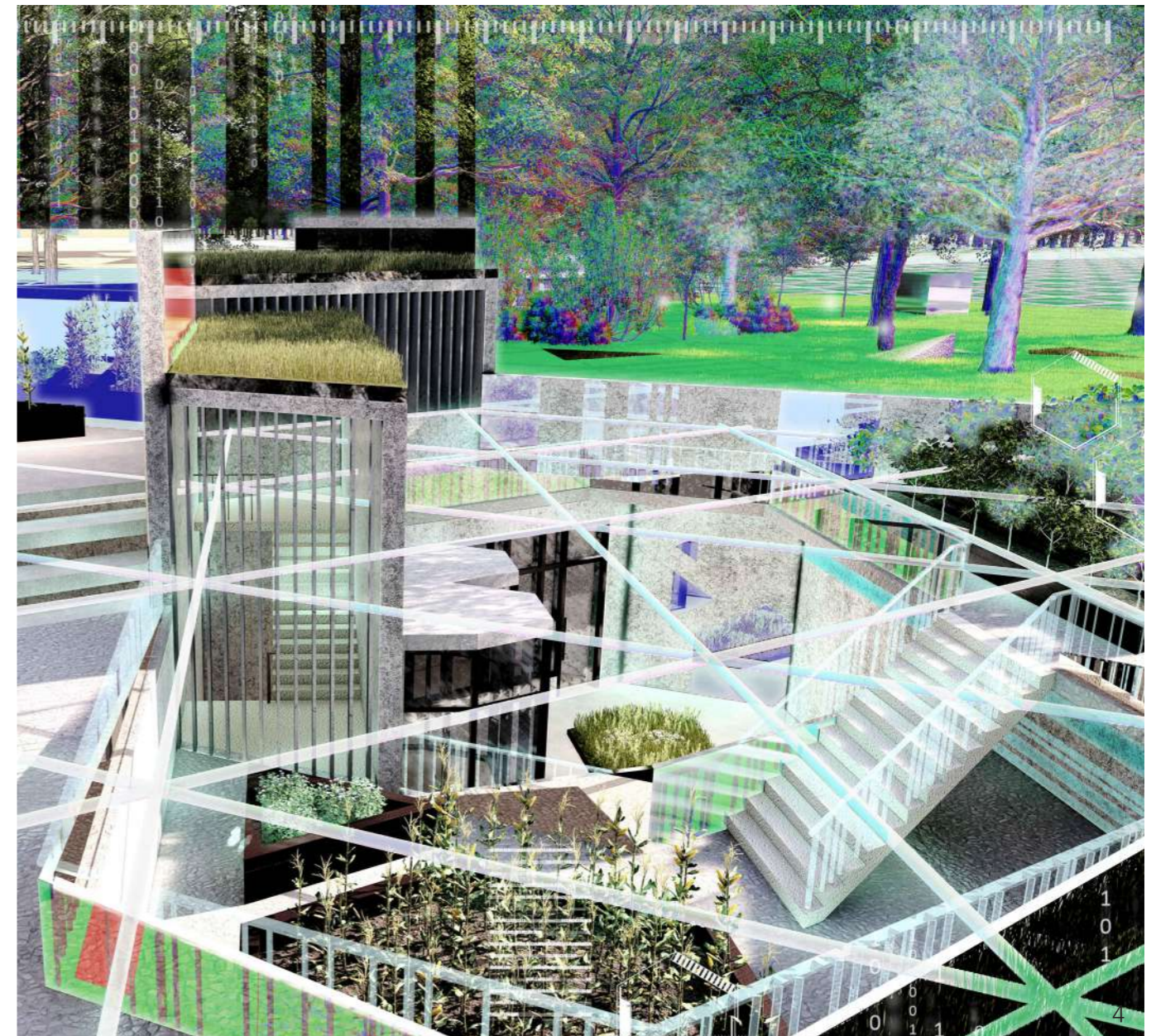
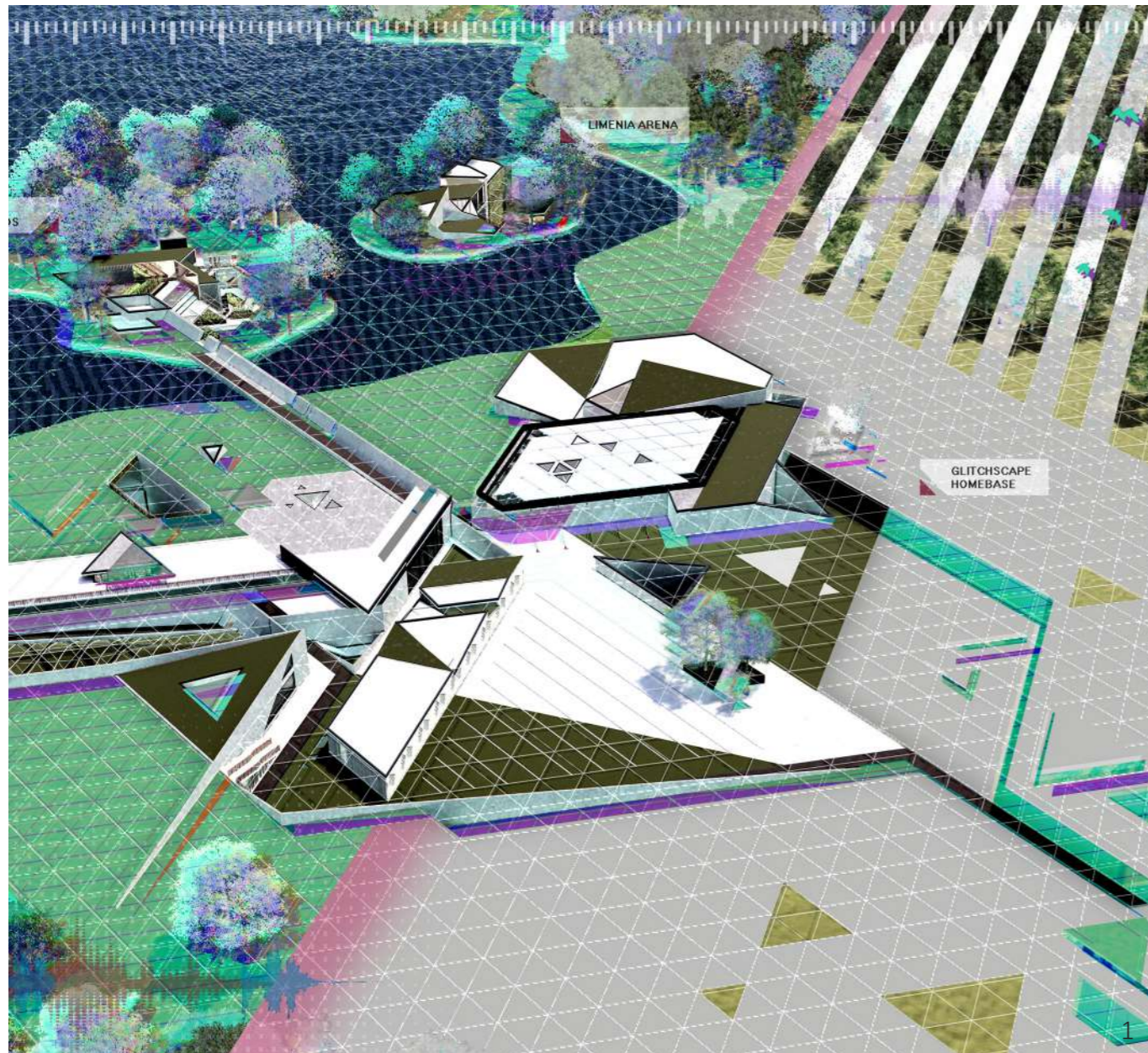
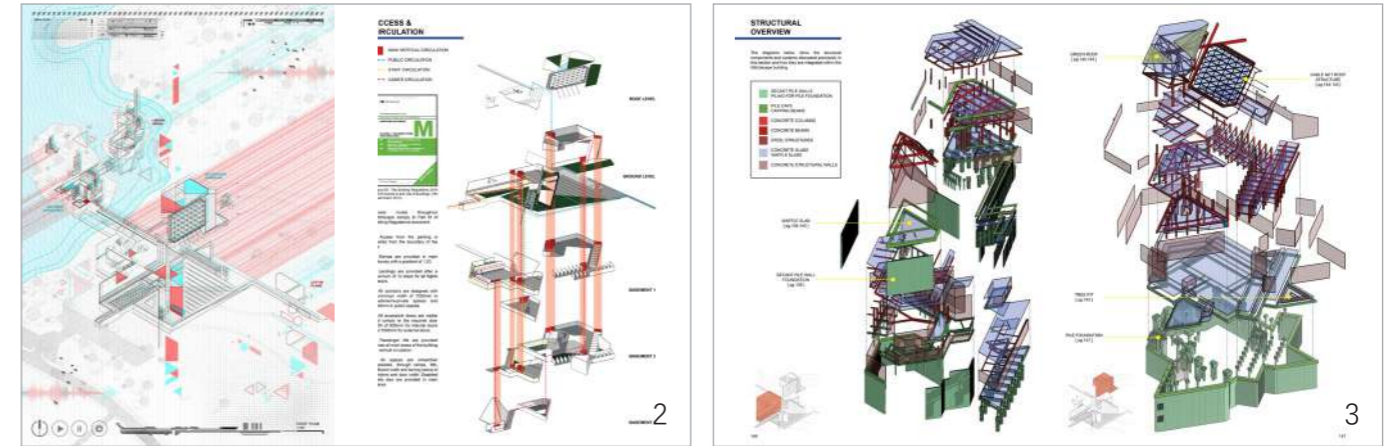
An Escape to Reality

Year 1 Final Project
MArch in Architecture, University of Greenwich

Addressing the social issue of gaming addiction through gamification of an existing treatment program within an architectural glitchescape.

Responding towards rising social issues among the youth, this project proposes an experimental treatment program for gamers who suffer from video game addiction. Set in the outskirts of Greater London away from the hustle and bustle of the city, gamers are introduced to a world where virtual landscapes merge into the natural. Three buildings are scattered across a natural landscape within an isometric grid to provide different venues to treat users via gamification of an existing psychological program - using games to cure the gamer. Through challenges and levels which require the gamers to complete tasks and unlock skills both within the real and the virtual world, the project aims to show them what the real world has to offer, encouraging them to be their ideal self in the real world, and providing them 'An Escape to Reality'.

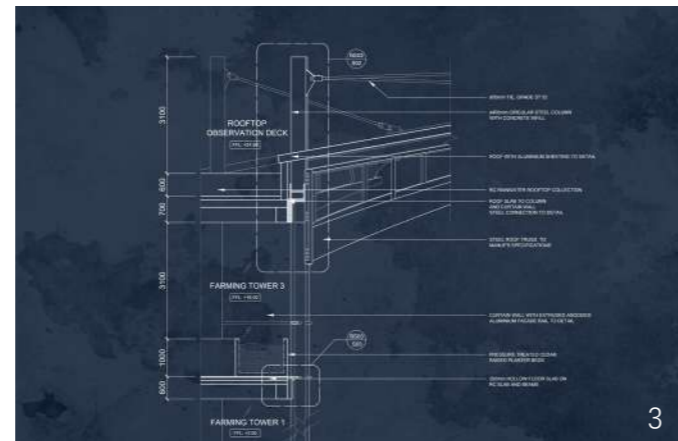
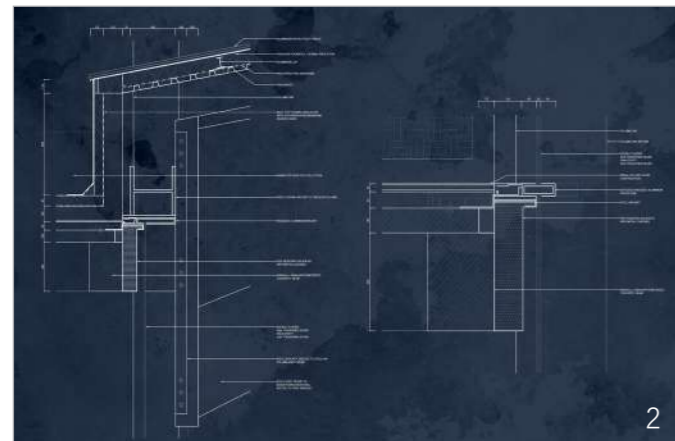
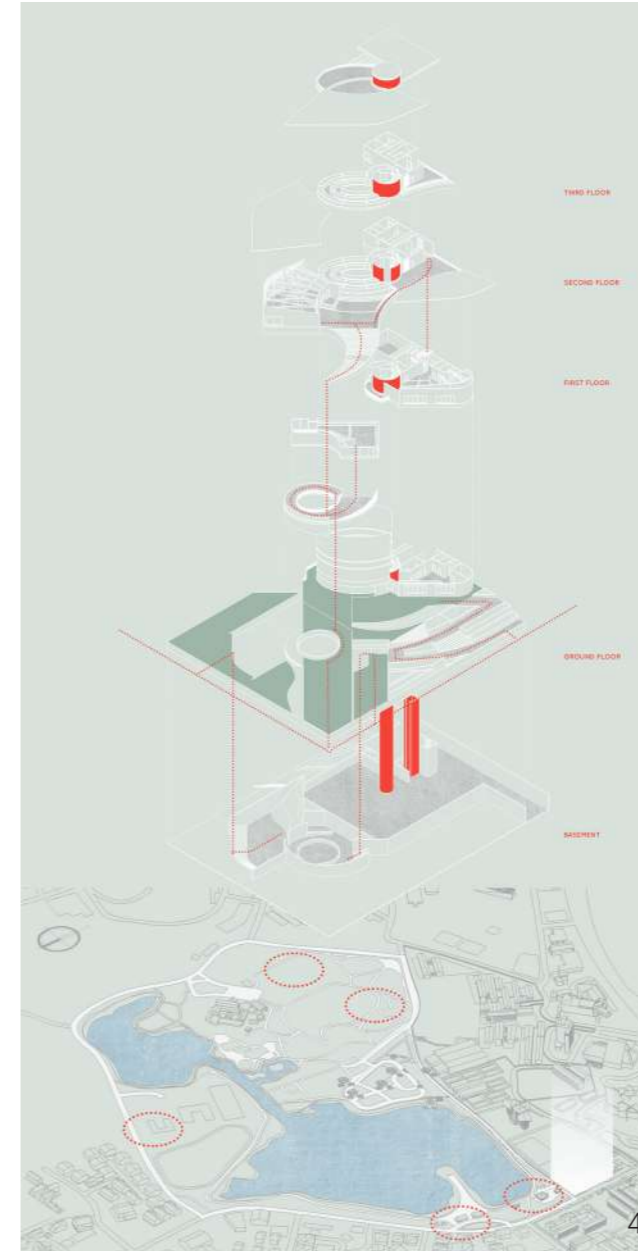
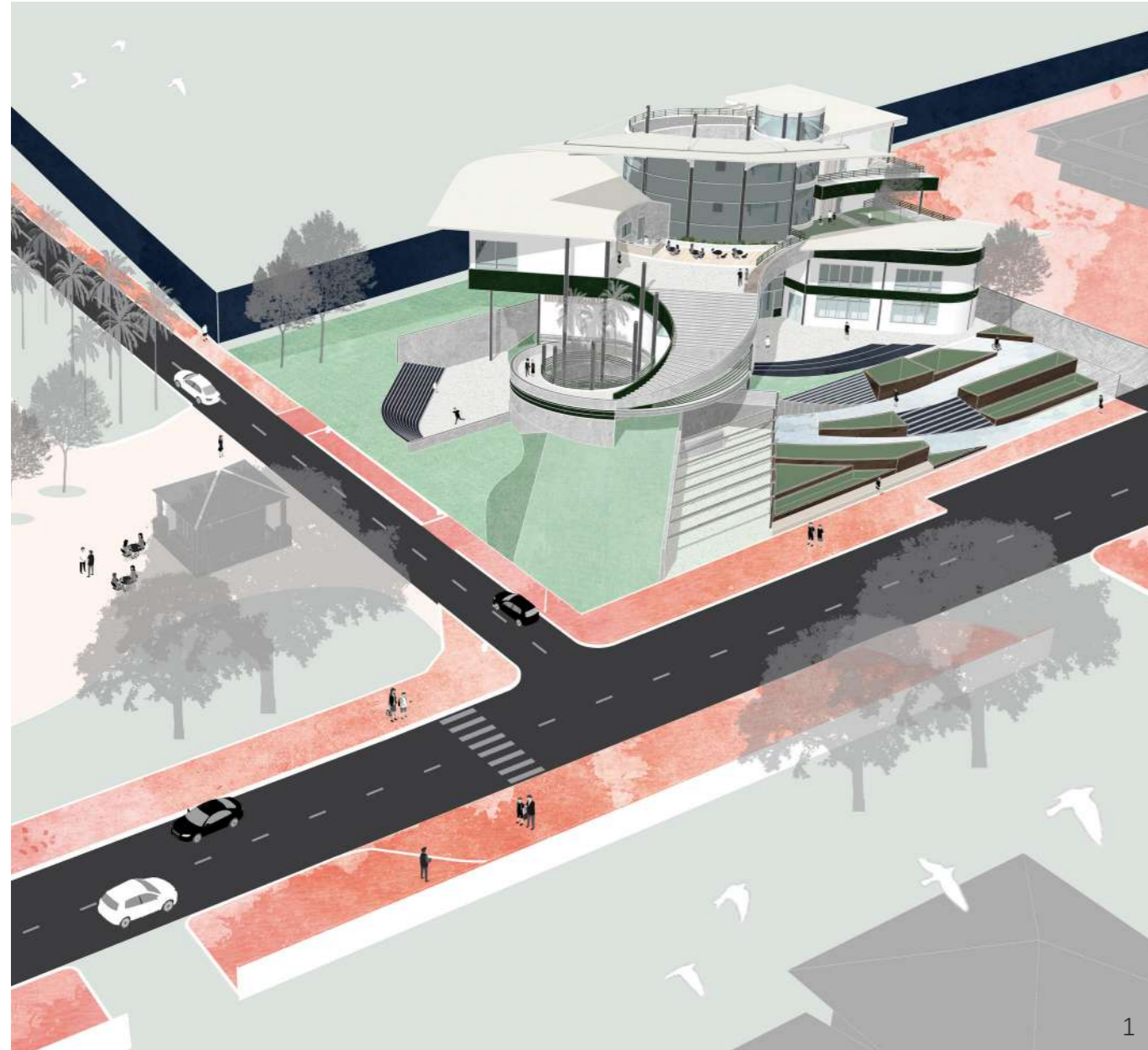
1. Aerial view of proposal, 2. Roof plan and circulation diagram, 3. Structural overview of Glitchscape Homepage, 4. Communal gardening area of Distortia Woodlands



Food and Hangout Centre

Year 3 Final Project
BArch in Architecture, Taylor's University

Engaging the local community with the concept of farm-to-plate through farming towers and healthy food options at the heart of the city.



The project site for a proposed Food and Hangout Centre is located at a corner lot flanked by Jalan Kuantan and Jalan Tembeling, with the famous Titiwangsa Lake towards the North East, and the Kuala Lumpur city skyline in the background. Taman Tasik Titiwangsa presents itself as a hotspot for neighbourhood recreational activities, filled with people who seek to workout either alone or with family and friends. The project seeks to provide healthy food options for the existing community and the general public, encouraging a healthy diet as a response to the increasing rate of diabetes cases among the local population. A central farming tower, communal farming areas, produce markets and experimental kitchens are incorporated to highlight the concept of farm-to-plate as visitors dine in restaurants. Outdoor fitness areas and plazas open up towards the park and main road to encourage smooth circulatory flow into the public event spaces.

1. Aerial view of Food and Hangout Centre, 2,3. Roof and floor connection details, 4. Exploded axonometric and main circulatory pathways, 5,6. Elevation views of proposal

Elderly Care Centre

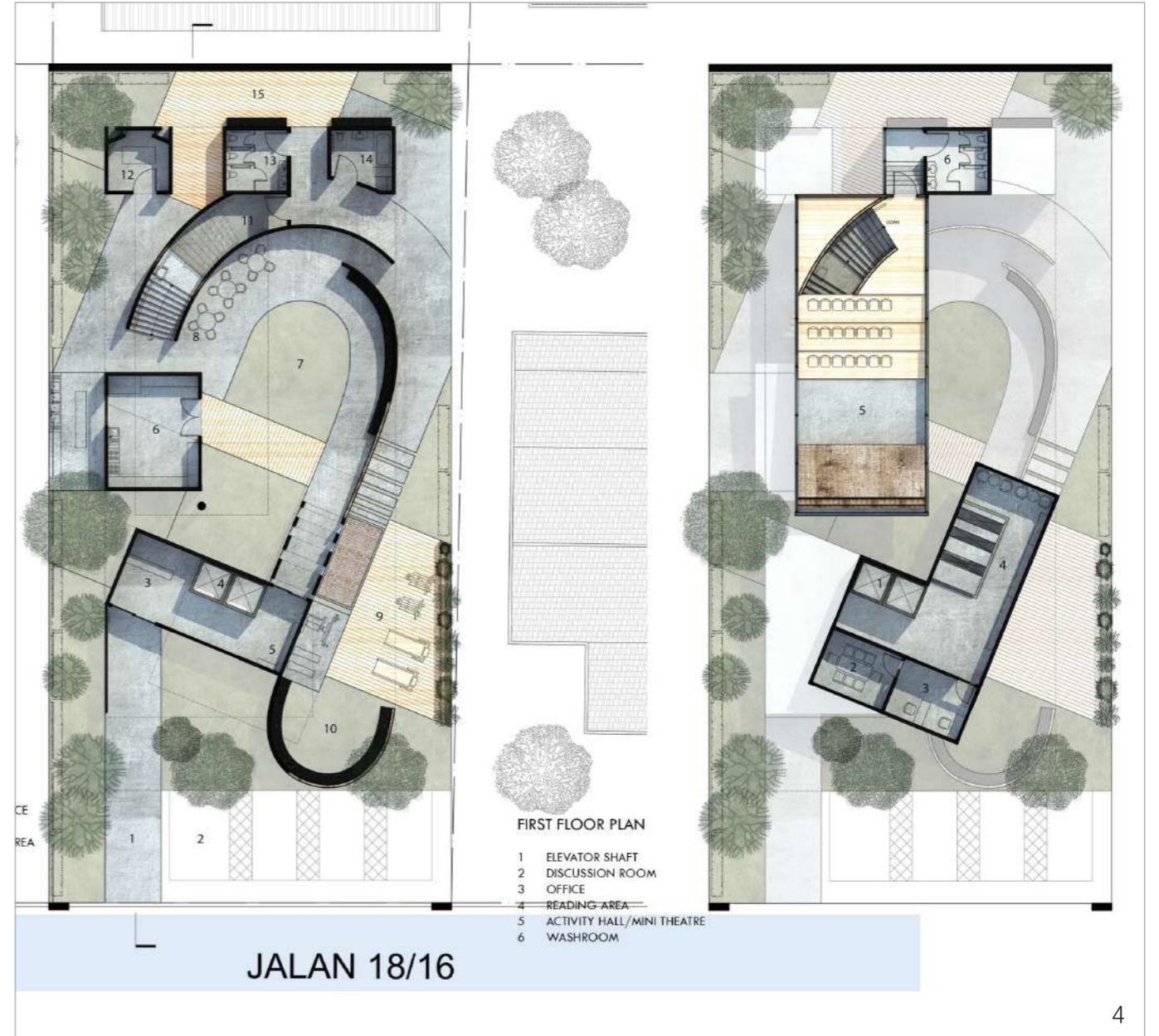
Year 2 Final Project
BArch in Architecture, Taylor's University

The project site for a proposed Elderly Care Centre is located in the residential area of Taman Kanagapuram, with many bungalows in the area being converted into private elderly care homes in recent years. Three main communities live within this neighborhood: the elderly from the elderly homes, the adults and families as residents, and the youth who studies in the few schools nearby. The proposed Elderly Care Centre aims to integrate the three communities through interactive programs, to break barriers between the residents and the existing care centres and to nurture a better future for the community as a whole. The design is informed by the poetic 'breaking' of spaces, form and fenestration. A clustered building typology was explored, with a rotated 45 degree grid implemented to align with the sun path. As curved walls cut through rigid forms, new circulatory pathways and visual connections are formed, further enhancing communal integration.

1. Entrance approach towards proposed Elderly Care Centre, 2. Section view, 3. Reading area and courtyard, 4. Ground and First Floor Plans



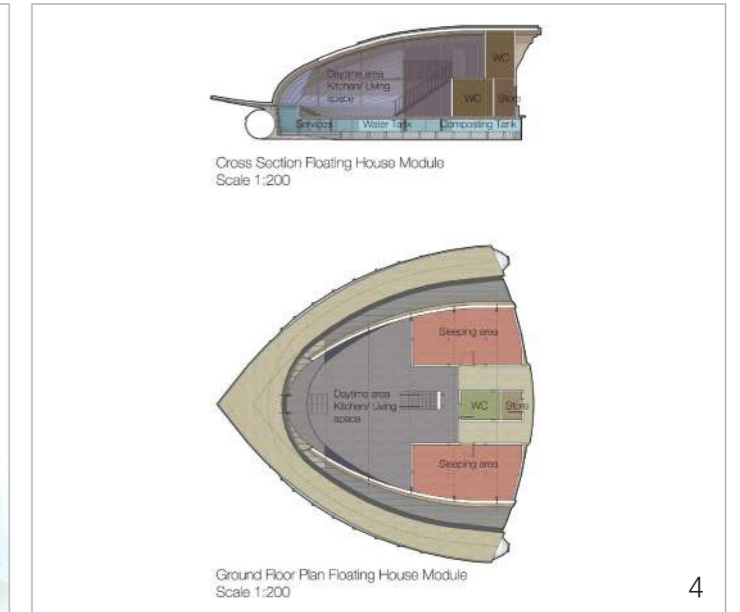
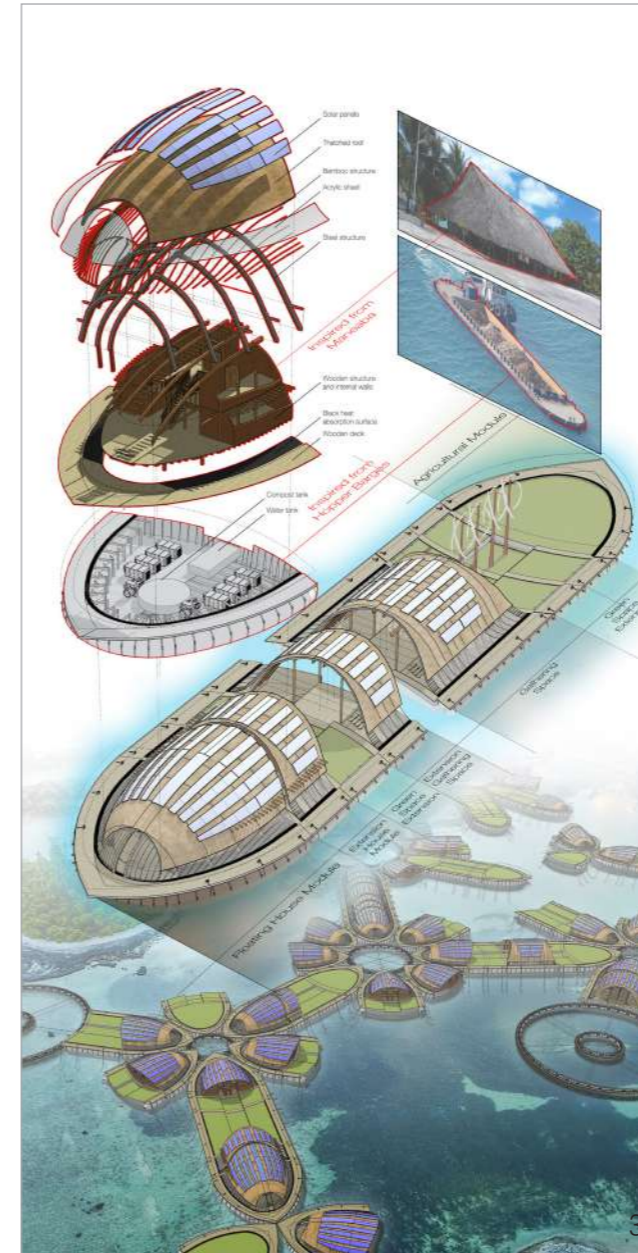
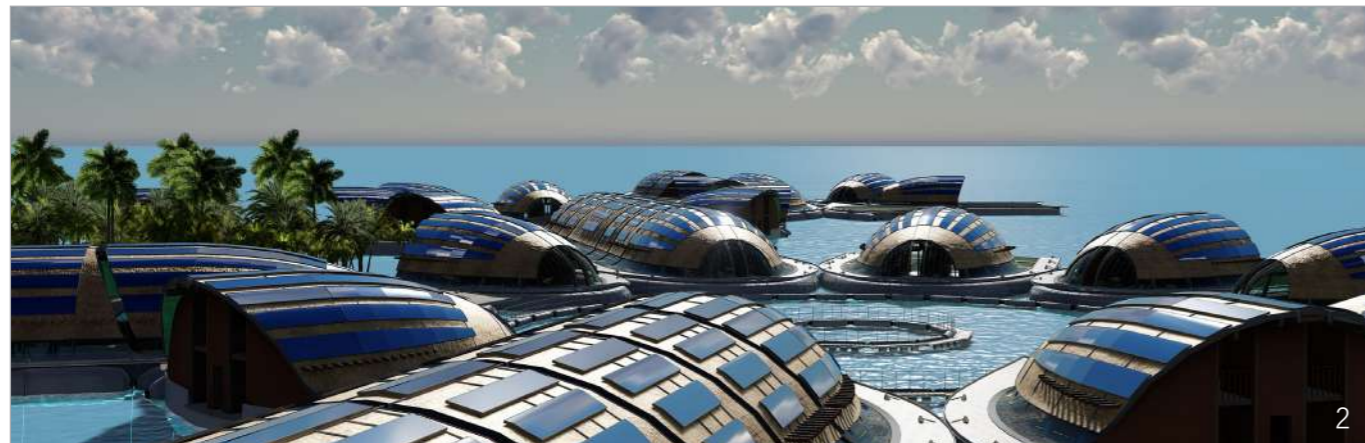
Integrating elders, families and youths within a clustered building typology forming multiple interconnected breakout spaces.



Kiribati Floating Houses

Tarawa, Kiribati
Young Architects Competitions

Floating modular houses powered by renewable energy as a more resilient model for coastal living.



Due to rising sea levels, the livelihood of coastal communities are greatly impacted. The capital of Tarawa, located only 2m above sea level faces the threat of flooding, decreasing vegetation and drinking water. The Kiribati Floating Houses competition aims to give a future to the populations of Kiribati. Cantiere delle Marche promoted such initiative to design a resilient Kiribati. Its purpose is to create a new dwelling model in order to globally tackle the challenges of the rise in ocean levels and climate change. The design for the proposed floating houses is inspired by vernacular traditional boats used by the locals, called 'Te Waa'. The masterplan consists of interchangeable modules (including bedrooms, gathering spaces, fish farms and agricultural land) powered by renewable energy, forming interconnected boats that accommodate continuous expansion as the community continues to grow.

1. The Gathering of 'Te Waa', 2. Usage of renewable energy seamless integrated, 3. Exploded axonometric view, 4. Plans and Sections, 5. Entrance into house module



✉ info@philiachua.com ☎ +44 (0) 7709265367

📷 [philia.chua](https://www.instagram.com/philia.chua)

🌐 www.linkedin.com/in/philia-chua-813198135

