With/Out Water

Architecture within a water-food nexus in Khulna, Bangladesh

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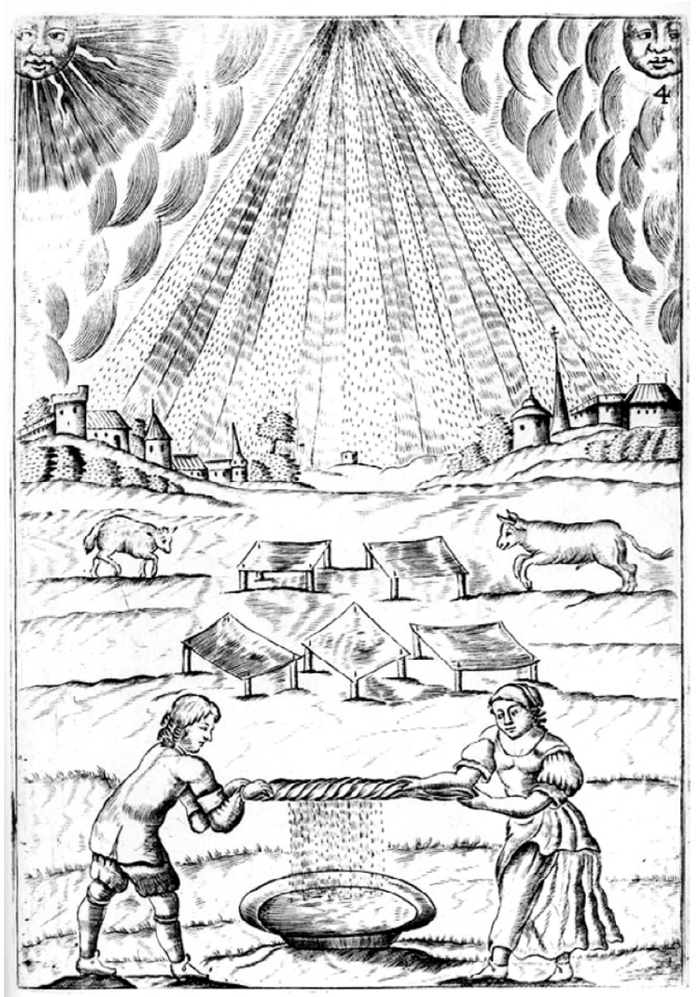


Alchemists
Source: Mutus Liber. Published in France, 1677. Dew harvesting in the 17th century to collect water for use in alchemy

With/Out Water – Architecture within a water-food nexus in Khulna, Bangladesh

Dr Aurel von Richthofen

Studio Brief

Preamble/ Issue

The studio on architecture within a water-food nexus in Khulna, Bangladesh, explores the territorial, spatial, socio-economic and material interrelation of water, food production and urbanisation that are seen as the core of multi-level challenges faced especially by the disadvantaged communities of Khulna. There as in many parts of Bangladesh and South Asia, this nexus has gotten out of balance due to the combined effects of rapid urbanisation, internal as well as international migration and global capitalism, increasing environmental stress and impacting on agriculture and work. The situation in Khulna is further aggravated by the irreversible alterations to the delicate system of ponds, canals and elevated grounds that for centuries, formed a resilient base for water use, food production and settlement in this 'sponge city'.

Programme/ Project

Architectural design is seen as a way to propose sustainable alternatives for Khulna and beyond. The studio will explore the material economy both with regard to the production of food and building materials allows to tackle resource scarcity and waste problems, sanitation and food production and re-value renewable forms of building and energy materials. Water is thereby investigated at material, tectonic, architectural and urban scales. The studio will apply an urban metabolism approach to quantify stocks and flows of material and energy with particular focus on those materials competing for food production, building materials and waste. Students will formulate a design hypothesis in the form of a short written statement supported by maps and diagrams. The preliminary research on water and tectonic systems will lead to a series of architectural elements forming a joint catalogue of approaches to the topic. These contain prototypical codes identifying input parameters, transformation rules and expected output of the architectural elements. This leads to a parametric definition that can be deployed on the site to generate spatial and tectonic diagrams. Prior knowledge of Grasshopper is not a pre-requisite as all necessary skills will be taught in class. The aim is to produce scalable hybrid water-food-architecture design projects. The students will choose their own programme, building typology and tectonic system according to their research findings, design hypothesis as well as their conceptual and parametric architectural elements (See mid-term and final review deliverables).

Sites

Each student will identify a site of intervention suitable to develop an architectural design at the intersection of the water-food nexus. Site and programme are interlinked. Desk-studies and mapping exercises form a first layer of site interpretation. The optional site visit during the recess break will allow to test, calibrate and further inform the design. The studio will go on an optional seminar trip to Khulna, Dhaka and the Sundarbans in Bangladesh during recess week. During this exploratory trip, participants will meet activist, visit sites, monuments and natural parks to better understand the challenges of the studio. Students that do not join the trip are not disadvantaged in the studio as all material will be shared. As for safety, please follow the travel advice of the Ministry of Foreign Affairs:
https://www1.mfa.gov.sg/countries-regions/b/bangladesh/travel-page
(See separate trip documentation).

Learning Objectives

Students will develop advanced research and design skills. They will explore the nexus of architecture and water in light of depleting resources and sustainable design. They will re-evaluate the resource water as the base for agriculture and food production, construction material, constituent of social rituals and domestic hygiene, energy source and energy storage and mitigation of climate change. Students will develop adapted construction techniques, building typologies and urban configurations. The studio aims to base most design decisions in evidence drawn from scientific development and careful contextual analysis. To this end, students will develop novel forms of architectural inquiry including analytic drawing, large scale model-making and parametric design. The studio will follow the methodology of architectural and urban elements. This method demands explicit formulation of design intent, translation into proto-code and parametric definition and allows objective assessment of design outcomes. The students will also work across different scales and produce a catalogue of site specific responses.

References:

Architectural Theory

Banham, Reyner. The Architecture of the Well-Tempered Environment. 2nd ed. Chicago: University of Chicago Press, 1984.

Bertuzzo, Elisa T. “During the Urban Revolution : ‘Conjunctures’ on the Streets of Dhaka.” In Urban Revolution Now: Henri Lefebvre in Social Research and Architecture, edited by Łukasz Stanek, Christian Schmid, and Ákos Moravánszky. Burlington: Ashgate Pub, 2014.

Maki, Fuhimiko. Investigations in Collective Form. Special Publication 2. St. Louis: The School of Architecture, Washington University, 1972.

Orff, Kate. Toward an Urban Ecology. New York, New York: The Monacelli Press, 2016.

Ovink, Henk, and Jelte Boeijenga. Too Big: Rebuild By Design ; New Approaches to Climate Change. Rotterdam: nai010 publishers, 2018.

Philippe Rahm architectes. Architectural Climates. S.l.: Lars Muller Publishers, 2018.

Ruby, Ilka, Andreas Ruby, Nathalie Janson, Holcim Foundation for Sustainable Construction, and Indian Institute of Technology, eds. The Economy of Sustainable Construction: 4th International Holcim Forum, IIT Bombay, Mumbai, India 2013. Berlin: Ruby Press, 2013.

Sennett, Richard. “The Open City.” In Towards an Urban Age. Berlin, 2006. https://lsecities.net/media/objects/articles/the-open-city/en-gb/.

Waldheim, Charles. Landscape as Urbanism: A General Theory, 2016.

Guidelines and Parametric Tools

ABC Waters Design Guidelines. 4th ed. Singapore: Public Utilities Board, 2018. https://www.pub.gov.sg/Documents/ABC_Waters_Design_Guidelines.pdf.

Food and Agriculture Organization of the United Nations, ed. The State of the World’s Land and Water Resources for Food and Agriculture: Managing Systems at Risk. 1st ed. Milton Park, Abingdon ; New York, NY: Earthscan, 2011.

———. “The Water-Energy-Food Nexus A New Approach in Support of Food Security and Sustainable Agriculture.” Rome: Food and Agriculture Organization of the United Nations, 2014.

Richthofen, Aurel von, ed. Urban Elements - Advanced Studies in Urban Design. Singapore: Singapore ETH Centre, 2018. https://doi.org/10.3929/ethz-b-000270354.

———. “With/Out Water - Studio Report.” Report. Singapore: National University of Singapore, February 5, 2018. https://doi.org/10.3929/ethz-b-000280046.

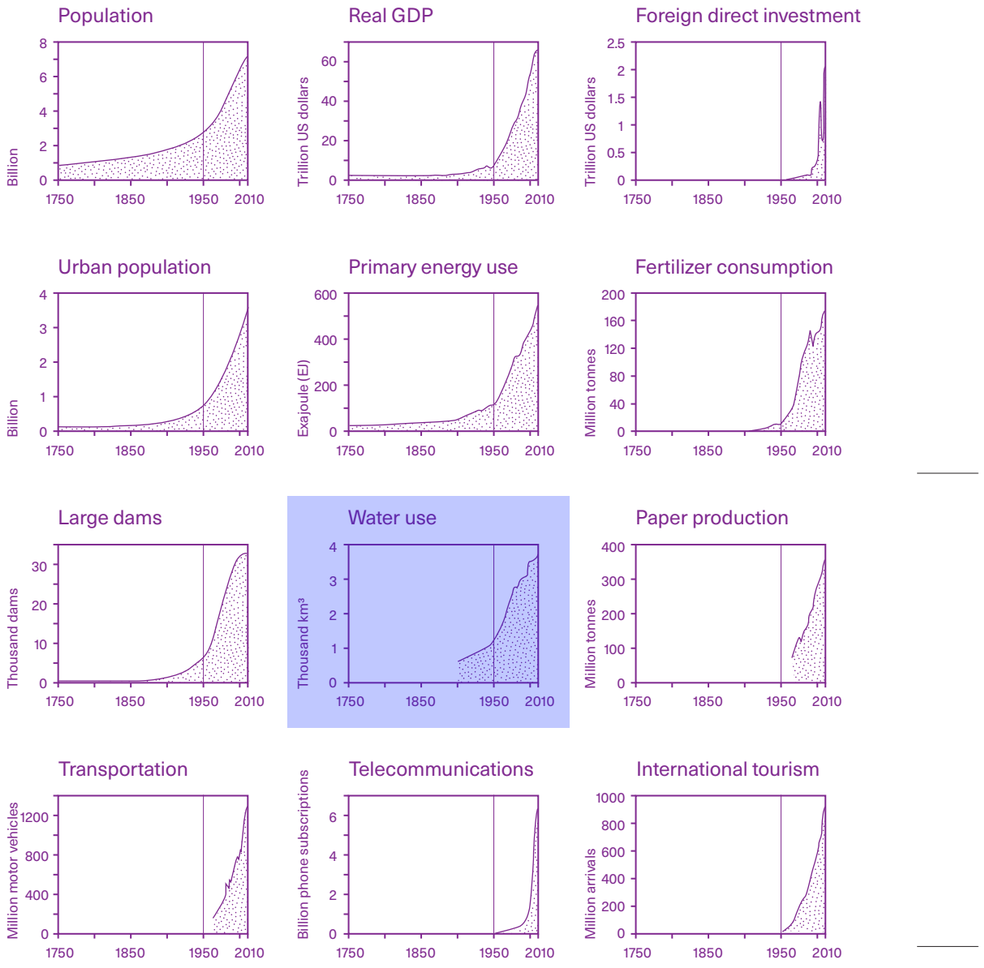
Richthofen, Aurel von, Katja Knecht, Yufan Miao, and Reinhard König. “The ‘Urban Elements’ Method for Teaching Parametric Urban Design to Professionals.” Frontiers of Architectural Research 7, no. 3 (October 11, 2018). https://doi.org/10.1016/j.foar.2018.08.002.

Water as Leverage Initiative. “Water as Leverage - Call for Action.” Netherlands Enterprise Agency, 2018.

Reference Projects

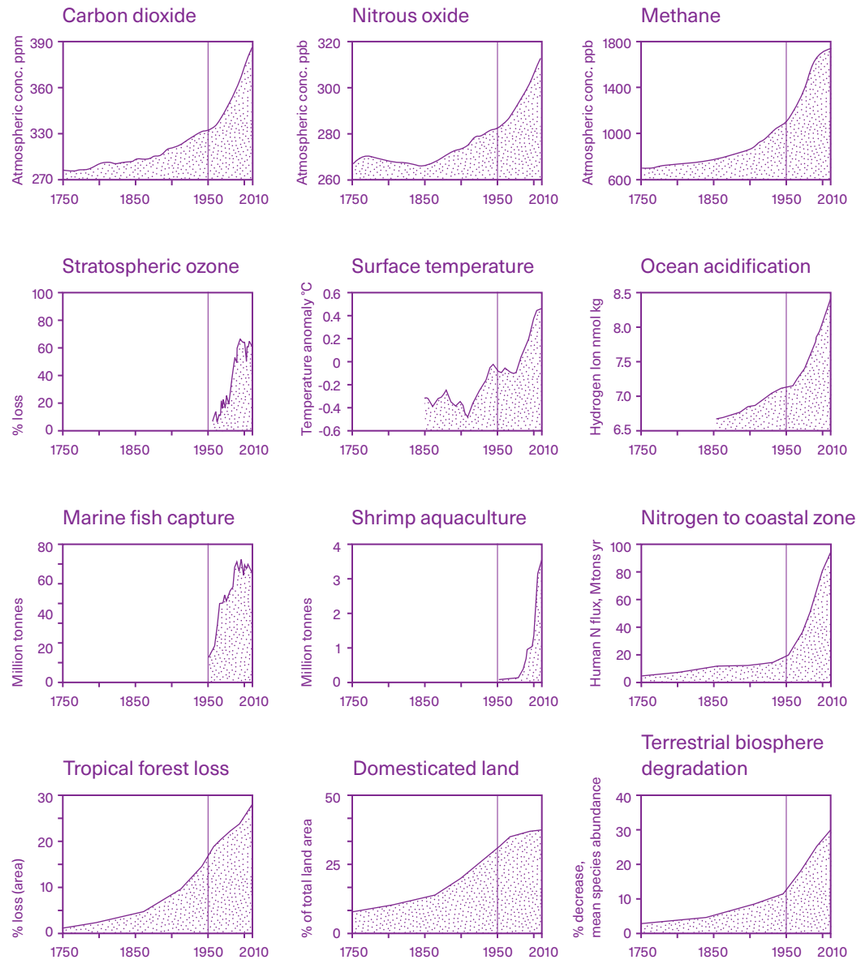
Jade Eco Park - Philippe Rahm architects, 2011-18
Flussbad Berlin - Realities United 2011
2G Competition - Venice Lagoon Park, 2007
Masdar City – Foster and Partner, 2007-14
City in the Desert – OMA, 2006
Agadir Convention Centre – OMA, 1990
Agricultural City – Kisho Kurokawa 1960
Habitat Marocain - André Studer 1953
Jodorowsky’s Dune, 1970s
Umlauftanks II Berlin - Ludwig Leo 1996
The blur building – Diller and Scofidio 2002
School Building Bangladesch, Eike Roswag

Indicators



Indicia 01 - Indicators
Source: Future Cities Laboratory, 2017

Fig. 1 Trends from 1750 to 2010 in globally aggregated indicators for socio-economic development.



Activities Overview

The studio will take place on Thursdays from 9 am – 12:30 pm and from 1:30 pm to 6 pm in the studio space allocated at NUS.

A typical studio day will be structured like this:

9:00 – 10:00	Input guest lecture followed by discussion of weekly readings
10:00 – 12:30	Desk-critique and work in progress review of individual projects
12:30 – 13:30	Lunch break
13:30 – 15:00	Teaching of parametric software and representational tools
15:00 – 17:00	Individual student work
17:00 – 18:00	Pin-up and short review across the studio

The assessment criteria for the studio are:

- Activity and intelligence in participation in class.
- Motivation to explore and learn new concepts and representational tools in class.
- Depth of research on the topic of the studio and contribution to the elements catalogue
- Clarity of the site analysis and mapping
- Representational rigor and innovation
- Development of an architectural hypothesis around the topic
- Interim and final presentation

The final grade is composed as such:

- 10 % Participation in class (throughout the studio)
- 30 % Design research and hypothesis (interim review 1)
- 30 % Design development (throughout the studio)
- 30 % Design project and presentation (final review)

Total 100%

The deliverables for each review will be announced in class.

Notes on the studio

All graphic representation in form of diagrams, images and drawings need to follow the studio format. An advanced knowledge of graphic design software including Adobe, AutoCad, Revit, Rhino 3D is expected. Further knowledge of parametric design software such as Grasshopper will be taught in class. All models to be fabricated using grey cardboard, laser-cut acrylic or 3D printing. All work is to be kept in studio all time. Graphic representations and models form the base of the discussion in studio and need to be prepared timely. The studio will compile an A4 sized studio report including all material produced for interim and final reviews of all students by the end of the course. The printed and bound version and soft copy Indesign file will be submitted prior to release of the grades.

Studio dates

Week 1: Th. 17. Jan. 2019
Studio start, introduction lecture by Aurel von Richthofen, Senior Researcher, Education Research Programme FCL – Architecture With/OutWater
Grasshopper 'intro' workshop
Assignment: organise the research in analytical panels and develop architectural elements relating to the topic of architecture with/out water

Week 2: Th. 24. Jan. 2019
9-11 am Design Lecture 2 @ LR423
Studio review of analytical panels and architectural elements
Grasshopper 'shapes' workshop
Assignment: Rework the architectural element and make a physical model of it

Week 3: Th. 31. Jan 2019
9-11 am Design Lecture 4 @ LR423
Studio review of architectural elements and models
Grasshopper 'vectors' workshop / Mapping workshop
Assignment: Select a site in Khulna and map a 5x5km square. Map buildings, roads, topographic features, vegetation. Add layers of climatic and hydrological information. 1:10.000

Week 4: Th. 7. Feb. 2019
Input Lecture by Jennifer Lee, PhD Researcher, Urban-Rural Systems, FCL – Private Landscapes and Public Waterscapes on the Floodplains of Bangladesh
Studio review of site maps and graphics
Grasshopper 'volumes' workshop
Assignment: Localise the architectural element on the site. Deliverables: Site plan 1:500 or 1:200 with insertion of architectural intervention

Week 5: Th. 14. Feb. 2019
Input Lecture by Yann Folain, WY-TO architects, Singapore – The Lotus project explained. Humanitarian architecture for Tonlé Sap, Cambodia.
Studio review of architectural interventions and site plans
Grasshopper 'fields' workshop
Assignment: Develop architectural drawings for your projects

Week 6: Th. 21. Feb. 2019

Interim Review: Deliverables 4 boards A1 vertical:

1. Panel 1, collective: A1 with 50x50 cm frame of site plan according to style template.

2. Panel 2, collective: A1 with 50x50 cm frame and line drawn illustration. This illustration can be based on sketches, 3D wireframe models in rhino, photoshop illustrations, etc. and should show your imagination of the site and its features. You can use it to illustration spaces, buildings, vegetation, animals and water.

3. Panel 3, individual: A1 with your thesis text 200 words and a title. The thesis explains your approach to the site, the features that you wish to highlight, the This panel also includes illustrations (screenshots with anno-

tations) of the grasshopper ‘hydraulic machines’.

4. Site model, collective, with roads and pathways cut out of white cardboard. Vegetation represented by sponge material.

Assignment: Revised projects based on critique’s inputs.

Recess week 26. Feb. – 2. Mar. 2019
Site visit to Khulna, Bangladesh. No instruction - individual studio production

Week 7: Th. 7. Mar. 2019
Input Lecture by Philipp Urech, PhD Researcher, Ecosystem Services in Urban Landscapes, FCL – Modelling Waterscapes
Studio review of revised projects
Grasshopper clinic based on student projects
Assignment: Develop a second architectural model of the intervention

Week 8: Th. 14. Mar. 2019
Input Lecture by Dr. Naomi Hanakata, Post-Doc Researcher, Grand Projet, FCL
Studio review of architectural projects
Grasshopper clinic based on student projects
Assignment: Develop and revise the projects

Week 9: Th. 21. Mar. 2019
Input Lecture by Kateryna Konieva, Researcher, Big Data-Informed Urban Design and Governance, FCL – Parametric Urban Design for Rural Communities in Ethiopia
Studio review of architectural projects
Grasshopper clinic based on student projects
Assignment: Develop and revise the projects

Week 10: Th. 28. Mar. 2019
Input Lecture by Rinus Vis, NUS Deltares, Singapore
Studio review of architectural projects
Grasshopper clinic based on student projects
Assignment: Water collection (C), storage(S), use(U) and recycle(R) diagram.

Week 12: Th. 4. Apr. 2019
Input Lecture by (tba)
Studio review of Water collection (C), storage(S), use(U) and recycle(R) diagram.
Grasshopper clinic based on student projects
Assignment: Isometric exploded and annotated diagram / Collective Maps

Week 13: Th. 11. Apr. 2019
Input Lecture by (tba)
Studio review isometric exploded and annotated diagram / Collective Maps
Grasshopper clinic based on student projects
Assignment: Abstract site model and revised site map with climatic and hydrological representation

Week 14: Th. 18. Apr. 2019
Input Lecture by (tba)
Studio review of architectural projects
Grasshopper clinic based on student projects
Assignment: Final Presentation Boards and Model

Reading week 23. Apr. – 27. Apr. 2019
No instruction - individual studio production. Submission on 25. Apr. 2019

Fr. 26 APRIL 18

Final Review: 8.30 AM to 1.30 pm
Design research and design studio presentation due.

5. Site Plan: Panel 1, A1 with 50x50 cm frame of site plan and your project according to style template. You can colors to highlight important water, humidity, air, temperature, usage, mobility and vegetation aspects. Use a legend.

6. Thesis and Image: Panel 2, A1 with your thesis text 200 words and a title. The thesis explains your approach to the site, the features that you wish to highlight. This panel also contains with 50x50 cm frame and line drawn illustration. This illustration can be based on sketches, 3D wireframe models in rhino, photoshop illustrations, etc. and should show your imagination of the site and its features. You can use it to illustration spaces, buildings, vegetation, animals and water.

7. Diagrams and Plans: Panel 3, A1 with diagrams and illustrations of the grasshopper ‘hydraulic machines’ and concept sketches.

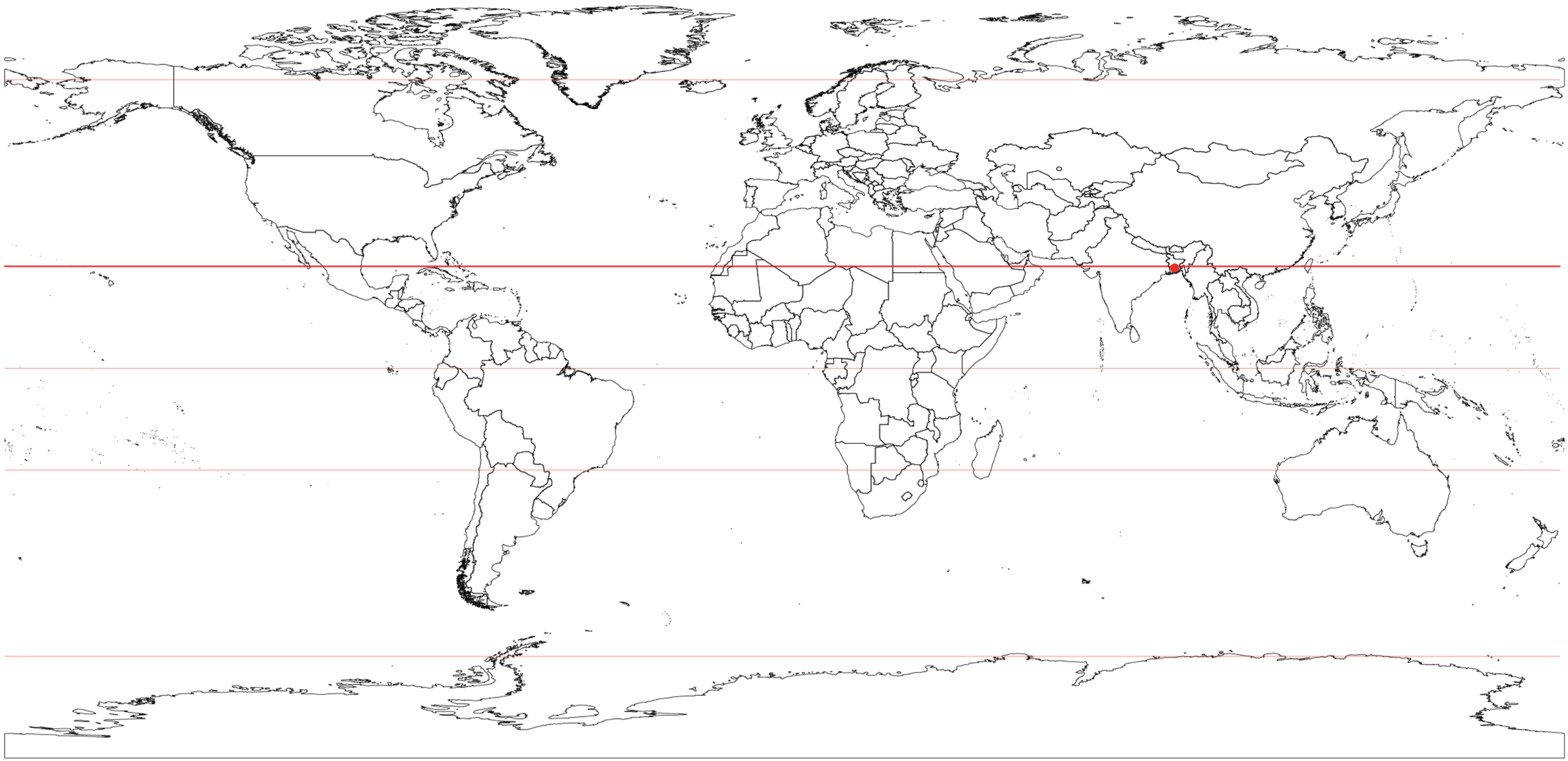
8. Axonometric: Panel 4, A1 with an exploded axonometric of the project. Showcase the structure, circulation and tectonic of the project. Please highlight the water related functions and the hydraulic systems, e.g. the storm water retention, plumbing of your architecture, the connection to the ground water levels, sewerage treatment, ventilation system, temperature regulation, etc.

9. Site model, on the collective base, with your insert and roads and pathways cut out of white cardboard. Vegetation represented by sponge material.

10. Architecture model (full or section) to represent structure, circulation and tectonic in conjunction with water features.

Exam Week 1 Fr. 3. May. 2019
Studio End: Final Report printed and bound and soft copy due, all studio material documented.

Khulna, Bangladesh located on
23° North - The Tropic of Cancer



Excursion to Bangladesh

Overview
The studio on architecture within a water-food nexus in Khulna, Bangladesh, explores the territorial, spatial, socio-economic and material interrelation of water, food production and urbanisation that are seen as the core of multi-level challenges faced especially by the disadvantaged communities of Khulna. To this end the studio will go on an optional seminar trip to Khulna and Dhaka in Bangladesh during recess week. During this exploratory trip, participants will meet activist, visit sites, monuments and natural parks to better understand the challenges of the studio.

Important notes:
1. You need a valid passport with at least 6 months validity. Please read the travel advisory (see below) and familiarise yourself with the circumstances.
2. Please check the visa regulations to see if you qualify for 'Visa on Arrival' (see below).
3. You need to book your airfare individually. Seats are limited and prices might go up. Please try to book the flights proposed (see below). Alternative travel, including earlier return is possible at your own but please let me know.
4. I have reserved the hotels, transfers and guides and need to confirm by Thu 31st Jan latest.
5. Book the Visit of Parliament for Monday, 25th Feb early online from Singapore (see below).

Day 1: Sunday, 24th Feb.
Flight to Dhaka, Bangladesh. Biman BG-85
3:50 PM Departs Singapore (SIN)
6:00 PM Lands in Dhaka (DAC)
Transfer and Check-in to the hotel
8 pm dinner with Dr. Elisa T Bertuzzo, anthropologist and urban geographer, FCL Singapore

Day 2: Monday, 25th Feb.
8:30 am leave the hotel and check-out
9-11 am visit of Dhaka downtown
11 am – 1pm visit of parliament (Louis Kahn architect), visit of old town of Dhaka
1-3 pm lunch
3 pm pick-up luggage at hotel and transfer to airport
6:10 – 6:50 pm flight to Khulna
8 pm check in Khulna hotel

Day 3: Tuesday, 26th Feb.
9 am – 1 pm leave hotel and start field work in Khulna
12:30 pm light lunch in Khulna
1 pm meeting with Anne Loes Nillesen, project lead on Water as Leverage for Khulna, director defacto architecture, the Netherlands
1;30 pm pick up by minibus to Mongla, 1 hours' drive.
3 pm in Mongla embark on live-aboard boat for mangrove tour

Day 4: Wednesday, 27th Feb.
Full day cruise with several excursions in the mangrove, breakfast, lunch and dinner aboard. Charette on board.
Bring: sketchbook, tracing paper, camera, basic model making kit, cardboard, scissors, glue, sticks…
Bring: Your model of the hydraulic machine
Cruise back at night to Khulna.

Day 5: Thursday, 28th Feb.

9 am disembark in Khulna
9:30 -12:30 field work in Khulna
1pm – 2 pm meeting with Dr. Dilip Kurmar Datta, Water expert at Khulna University
2:30 pm Transfer to airport by shuttle b us
5:55 PM - 6:35 PM Flight to Dhaka JSR – DAC Thu, 28 Feb
Transfer and Check-in to the hotel
8 pm dinner and meeting with Dr. Kazi Ashraf of Bengal Institute
10 pm debrief

Day 5: Friday, 1st Mar.
5:30 am leave the hotel
Return flights to Singapore Biman
8:25 AM Departs Dhaka (DAC)
2:40 PM Lands in Singapore (SIN)

















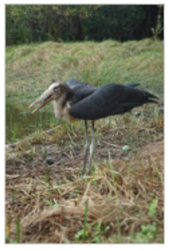














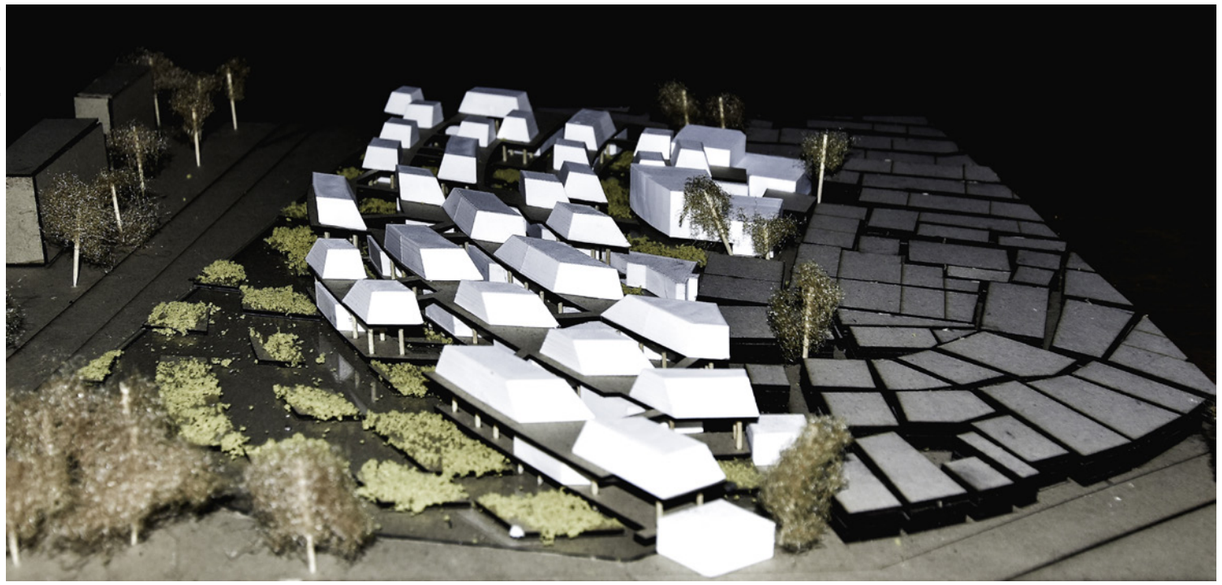


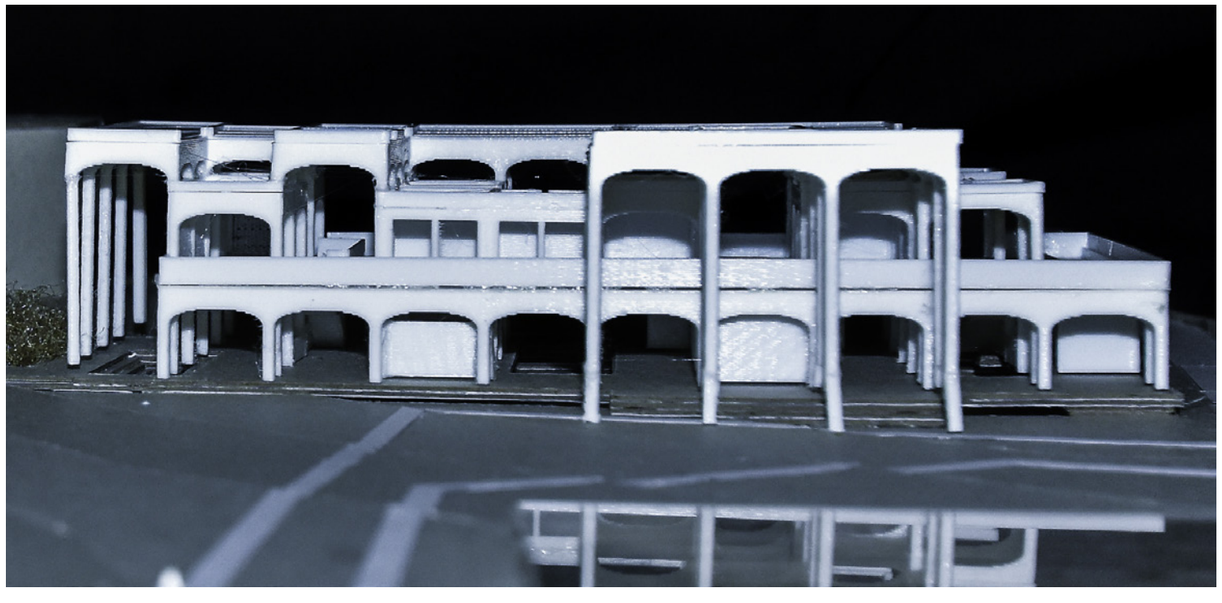


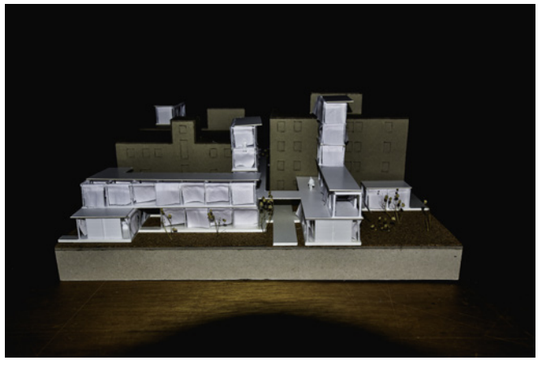


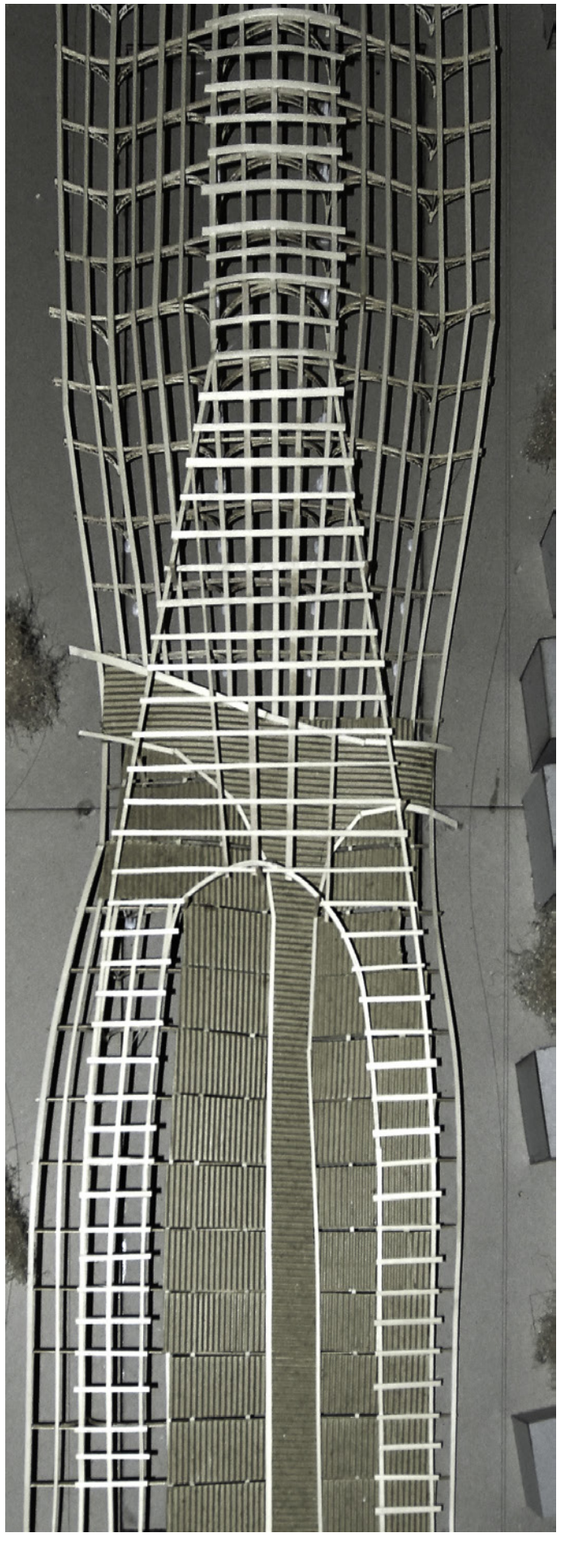



Models









Student Projects

PENG HUITING

THESIS:

The site is characterized by an informal settlement surrounded by newer urban development. The informal settlement is self-organized by the community and it's relatively neat and clean. It provides shelters for underprivileged people to survive in Khulna City. This settlement is self-sufficient and has secured a common pool of human, spatial and material resources. However, there are several problems threatening the community. On one hand, clean water is rarely accessible to them, though they reside nearby a water pond. The pond is polluted, and water cannot be used by people anymore. On the other hand, the limited land cannot fulfill the increasing demand for housing due to the growth of population in the community. The land is fully occupied by one-storey houses and there is no more space for expansion or communal activities. The informal economy of this settlement relies very much on the observed duality of domestic inside spaces and shared outside spaces. Many activities that support the community such as cooking, child-care, education, manual labor, sale of house-hold items and repair are conducted in these intimate outside spaces. The aim of this project is to elevate these spaces to a newer level.

Therefore, the architectural intervention aims to tackle these issues. First, by re-division and re-connection of the alleys, three important communal nodes are identified. On the three nodes, multi-storey interventions provide the opportunity for vertical expansion to fulfil the increasing need for space. The existing spatial quality of one-storey settlements will be translated to multi-storey buildings. Second, the community nodes will be activated by public space which includes market, stalls, playground and bathhouse. The transformation is carefully phased to make sure that no resident is displaced during the process. The phasing also assures that the project can be done with the limited means of the community, mostly mobilising human and material resources instead of money, over time.
Moreover, a water purification system will be placed on the top of the interventions. The polluted water will be pumped from the water pond and purified by the hydraulic system. Clean water will be more accessible to local people, which will improve people's wellbeing. This will assure the viability if the community settlement in the future.


Lack Of Clean Water

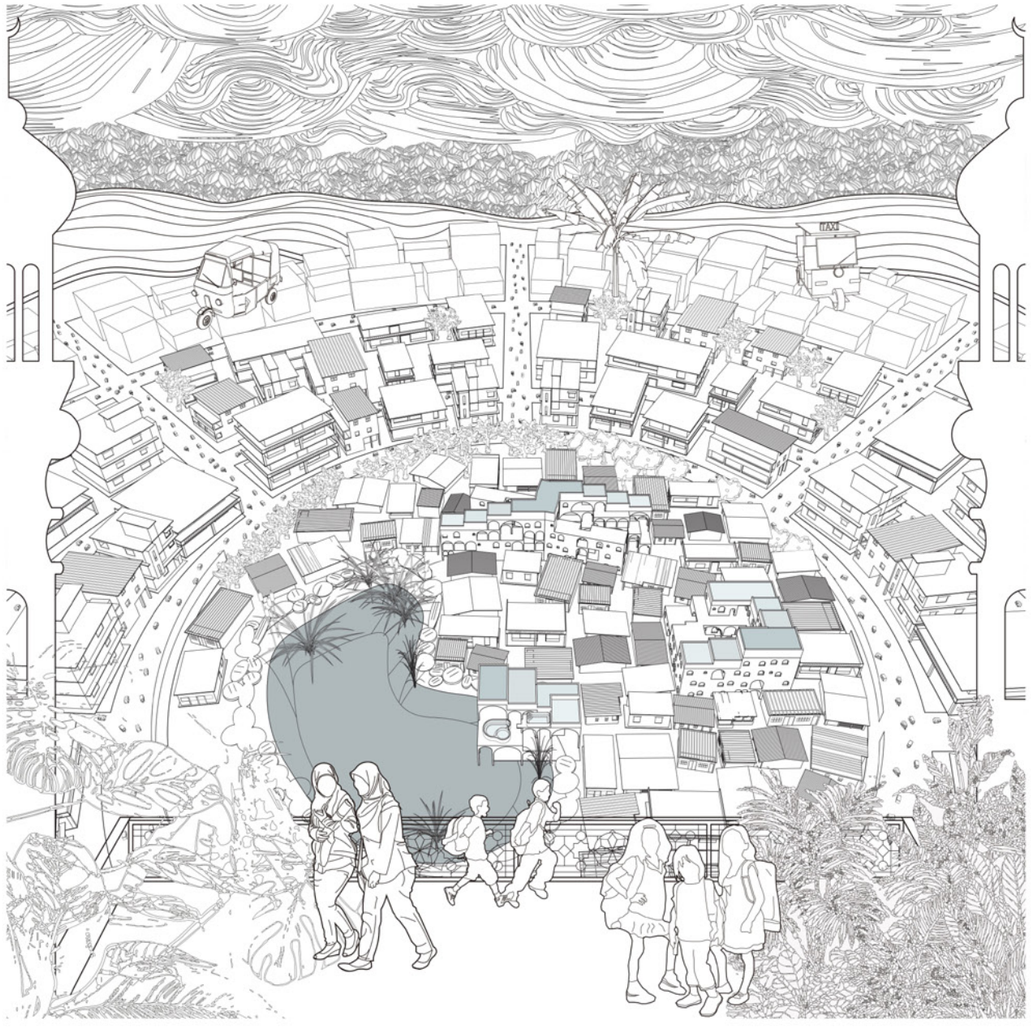

Clean Water Collection Point


Isolated Settlement


Narrow Alley


No Space For Animals


Sharing Public Toilet



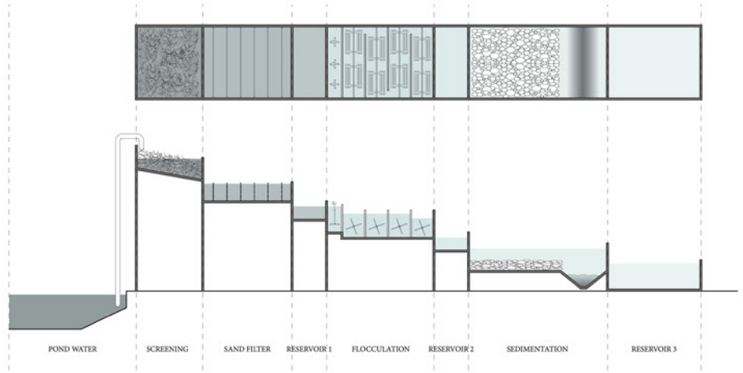
Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

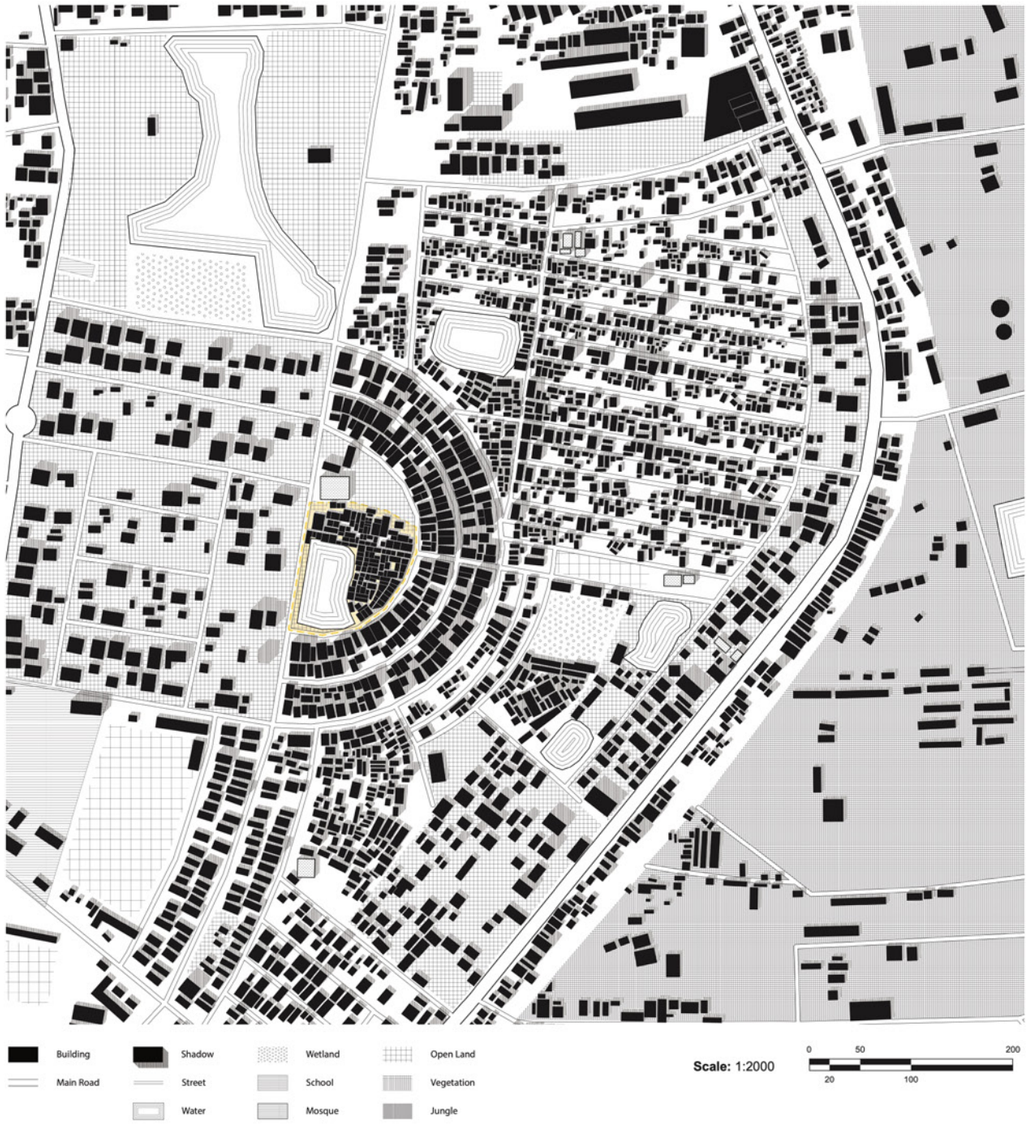
Student Name: Peng Huiting Leona
Site: Ward-12, Khulna, Bangladesh
Coordinates: 22°51'15.8"N 89°32'36.1"E

National University of Singapore
School of Design and Environment
Department of Architecture

Design Module AR5802/ AR5804
AY 2018/19 Semester 02

HYDRAULIC MACHINE - PURIFICATION

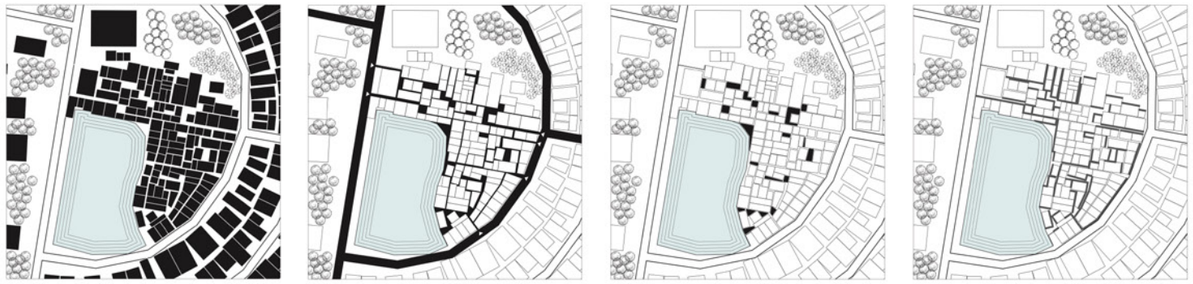




Student Projects

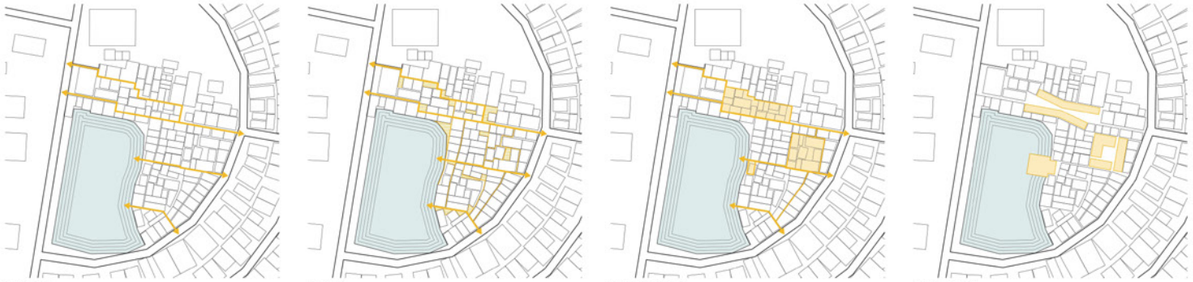
PENG HUITING

ANALYSIS OF INFORMAL SETTLEMENT



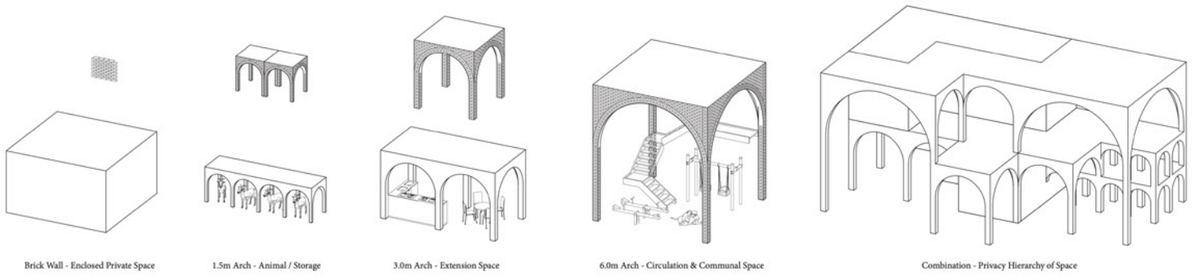
Private Space - Building | Circulation - Alleys | Communal Space - Urban Pocket | Expansion Space

SITE STRATEGY



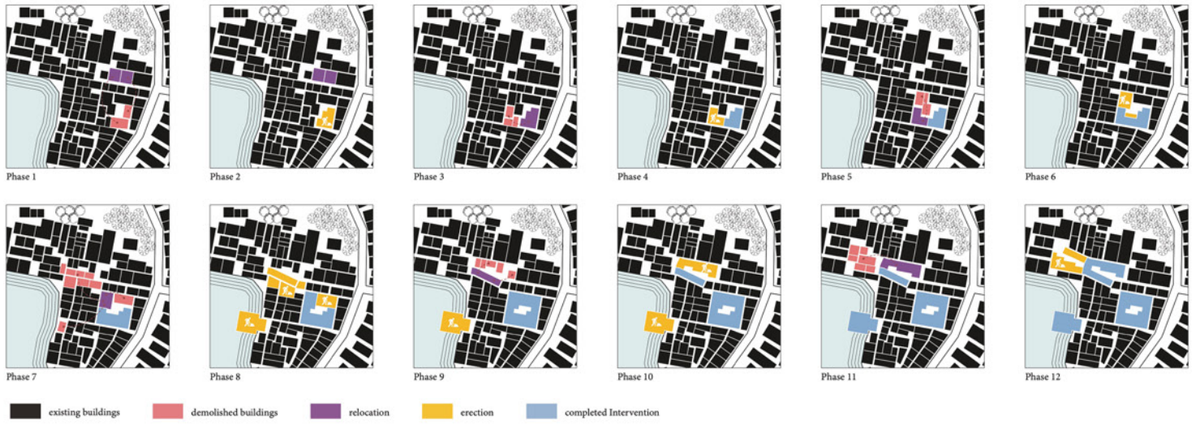
Re-Connect | Re-Divide | Community Nodes | Massing on Plan

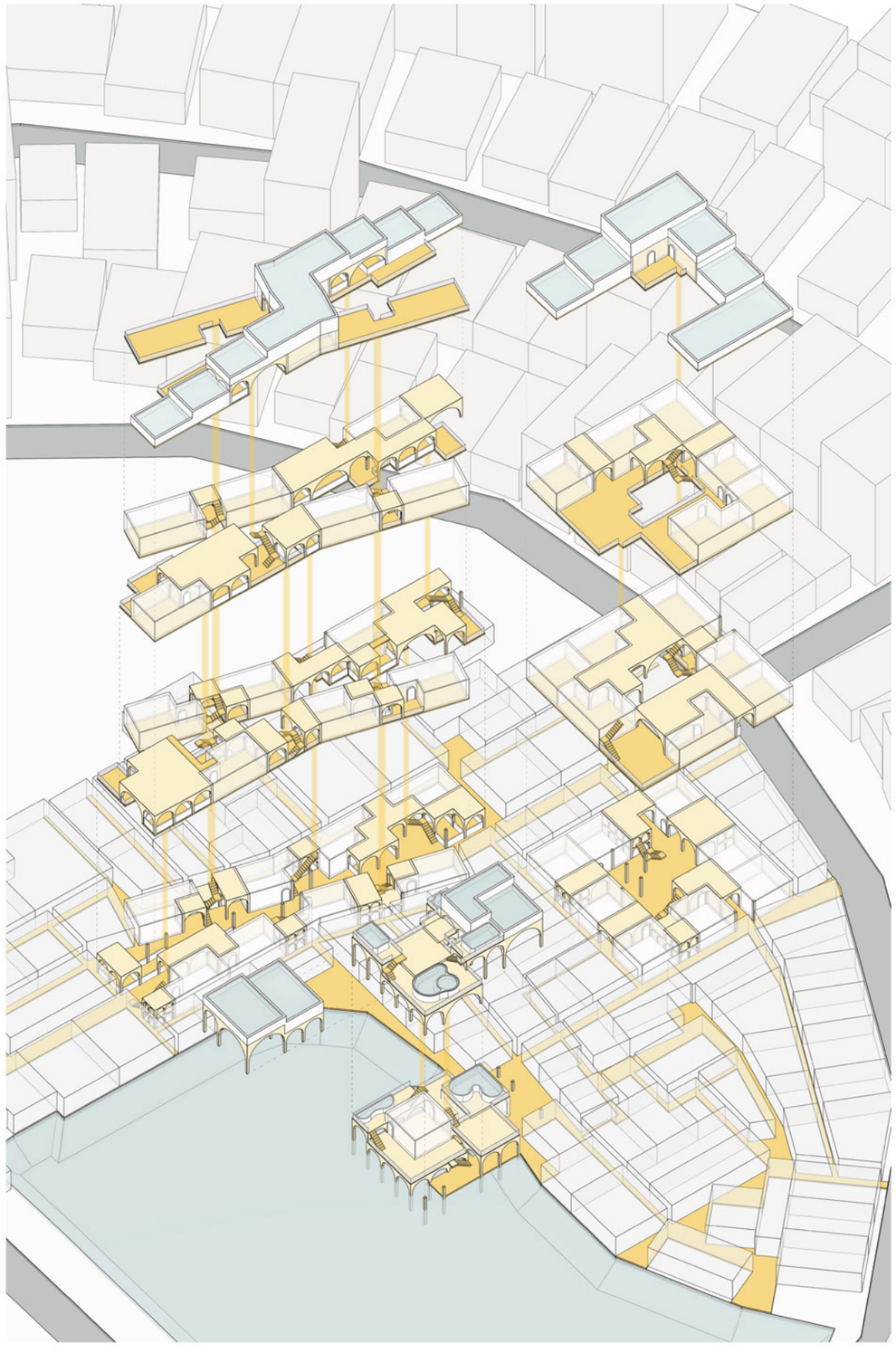
ARCH & SPACE



Brick Wall - Enclosed Private Space | 1.5m Arch - Animal / Storage | 3.0m Arch - Extension Space | 6.0m Arch - Circulation & Communal Space | Combination - Privacy Hierarchy of Space

PHASE DEVELOPMENT - NOBODY WILL BE DISPLACED





EXPLODED AXONOMETRIC DRAWING

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

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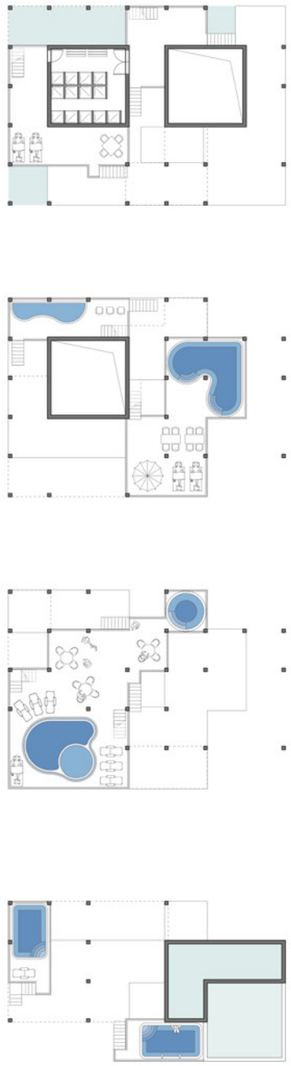
AY 2018/19 Semester 02

AXIS CLUSTER PLAN 1:150

URBAN PLAN 1:150

LIVING CLUSTER PLAN 1:150



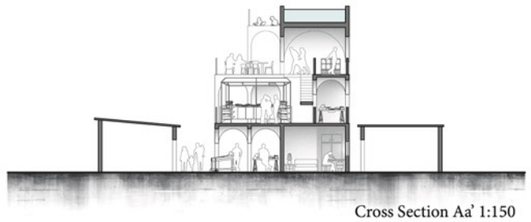
BATHHOUSE FLOOR PLAN 1:150

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

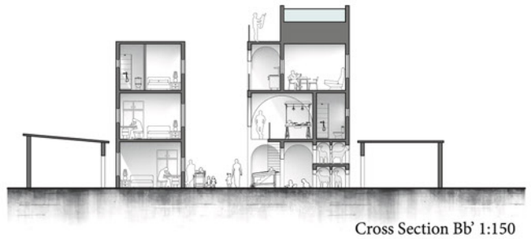
Student Name: Peng Huiting Leona
Site: Ward-12, Khulna, Bangladesh
Coordinates: 22°51'15.8"N 89°32'36.1"E

National University of Singapore
School of Design and Environment
Department of Architecture

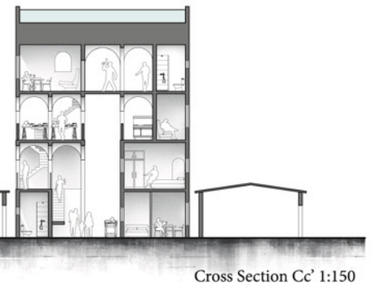
Design Module AR5802/ AR5804
AY 2018/19 Semester 02



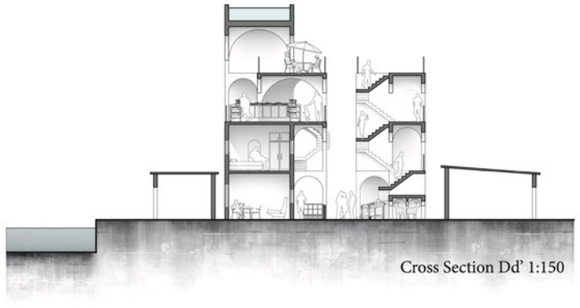
Cross Section Aa' 1:150



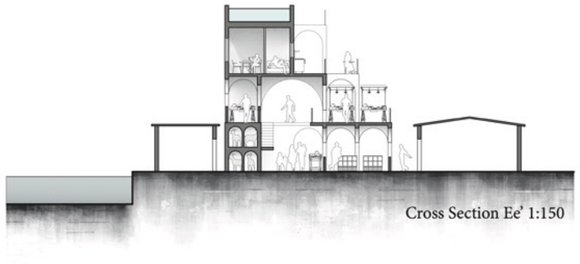
Cross Section Bb' 1:150



Cross Section Cc' 1:150

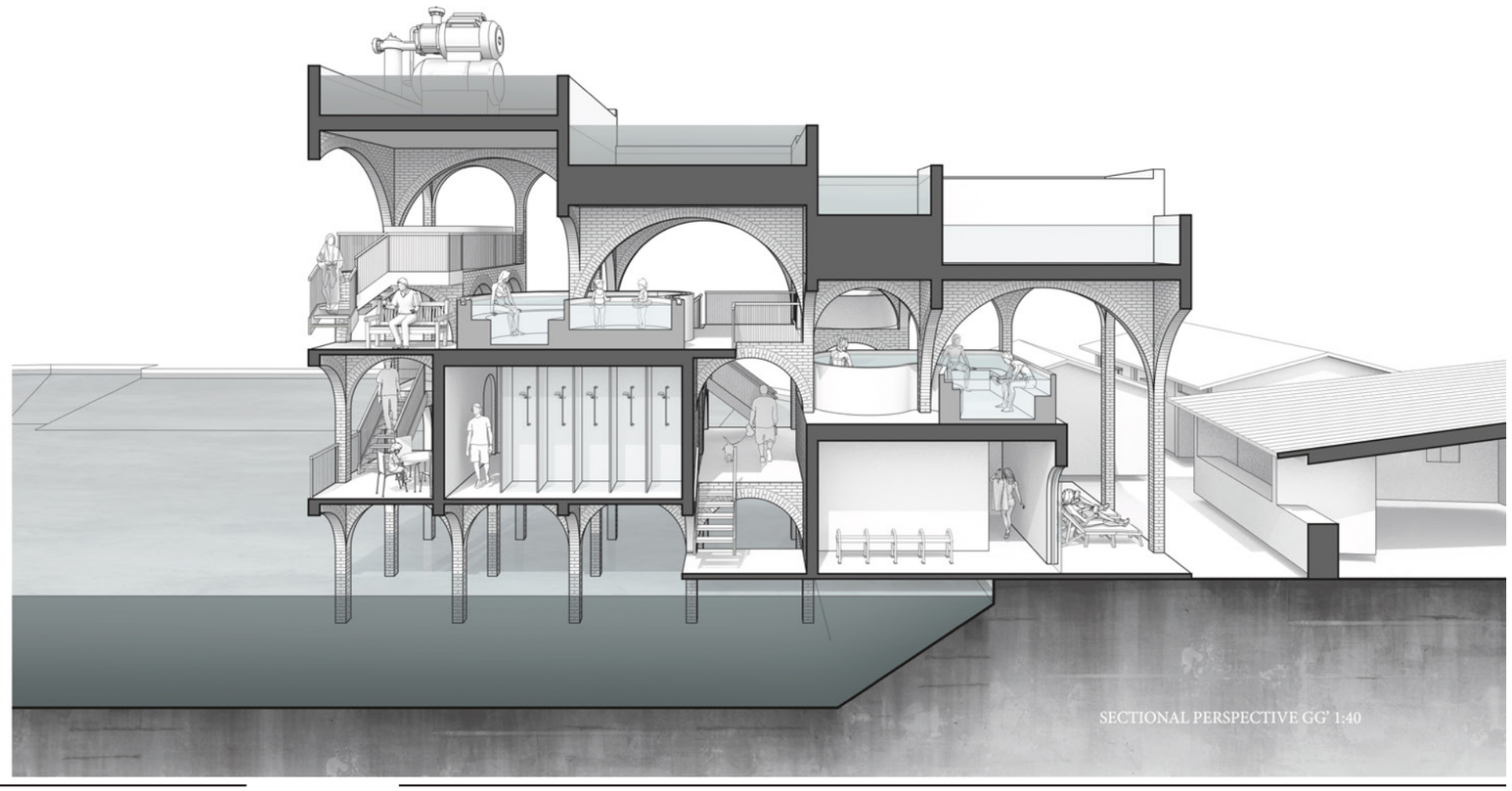


Cross Section Dd' 1:150



Cross Section Ee' 1:150

SECTIONAL PERSPECTIVE FF' 1:40



SECTIONAL PERSPECTIVE GG' 1:40

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: Wang Changren
Site: Khulna, Bangladesh
Coordinates: 22.51158N, 89.32361E

National University of Singapore
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Department of Architecture

Design Module AR4102/ AR4104
AY 2018/19 Semester 02

Thesis : My project addresses the needs of a small community settlement that was gradually surrounded by newer suburbs of Khulna. The community has been deprived of their agricultural land, has no space to expand their settlement and rely on only one resource: an atrophying pond. The community lacks of clean water that needs to be drawn from the pond that unfortunately is subject to waste discarded along the waterside by the suburban neighbors.

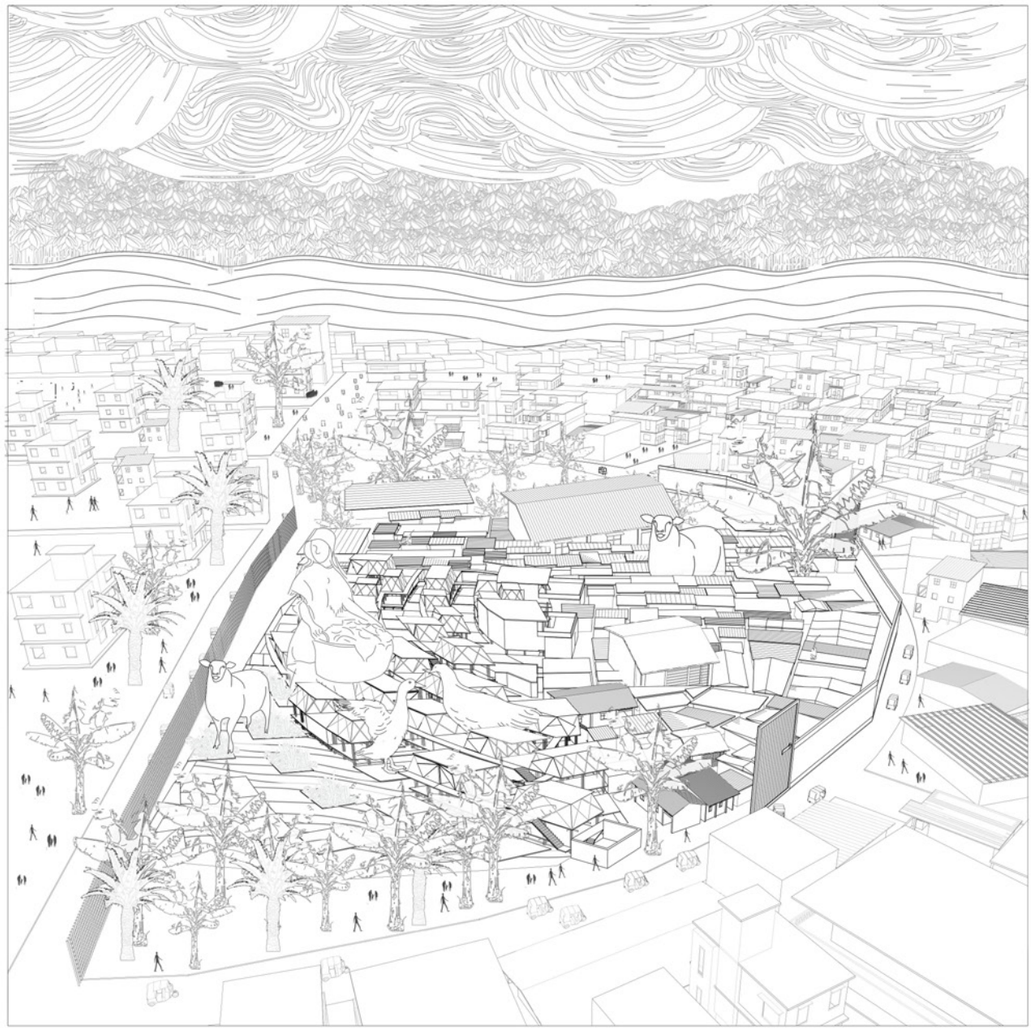
Nonetheless, we observed a highly self-organized semi-agricultural community during our site vitis. Narrow but neat alleys link all houses and outdoor spaces together, livestock are well-kept inside bungalows, the community was largely relying on an informal exchange economy outside of a monetary system. This project wants to strengthen this community by providing opportunities for growth within the tight spaces left.

The project thus plans to activate the lake that lies beside this community. But the eutrophicated water stops them from making good use of the lake. The design aims to solve two problems: Lack of living space & Lack of sanitary water.

Hence the design is a wetland-based, floating farm. Wetlands are sometimes called nature's own water purifiers: as dirty water moves through a sprawling marsh, the bacteria that cling to wetland plants, consume and process some common water pollutants. By creating floating treatment wetlands out of small. Human-engineered rafts of vegetation, I hope to provide these same ecological services to this small. Polluted body of water. Also fodder could be provided by making these wetland consisted of plants with high nutritional value, like water hyacinth.

Consisted of pens, wetland and living sections, the design aims to not only rebuild but extend the farming community onto the lake. I tried to analyse and implement the arrangement of the slum to my design. By shifting the massing up and down, public spaces shared by multiple families are created.

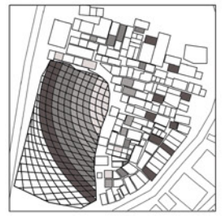
The design will also remold the original slum simultaneously. According to the analysis, part of bungalows will be made into public lounges with residents moving to the new floating community, by doing this, old and new are actually growing synchronously and finally a new entity will emerge.



Transformation of the original slum. Selected units are converted into public lounges,pens and kitchens.

These units are evenly distributed to make sure that each of it will be shared by 5 to 7 families

As a completion of the enclosed pattern,the new community will only cover 70% of the lake.



Construction is carried out by stages. The profit earned by putting one part of the building into use will fund the construction of another part. construction of another part.

Map of location with visible (black and white) and invisible (colored) features

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

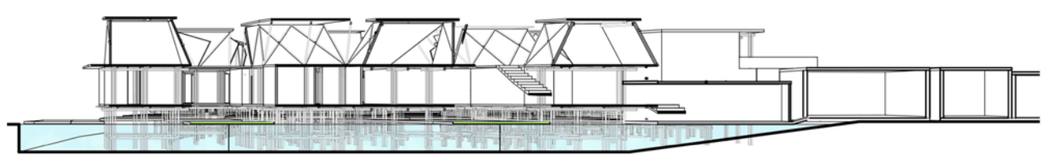
Student Name: Wang Changren
Site: Khulna, Bangladesh
Coordinates: 22.51158N, 89.32361E

National University of Singapore
School of Design and Environment
Department of Architecture

Design Module AR4102/ AR4104
AY 2018/19 Semester 02

Ground floor plans

Scale Bar: 0 1m 3m 7m 15m 25m **Scale:** 1:300



Section 1

Scale Bar: 0 1m 3m 7m 15m **Scale:** 1:150

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: Wang Changren
Site: Khulna, Bangladesh
Coordinates: 22.51158N, 89.32361E

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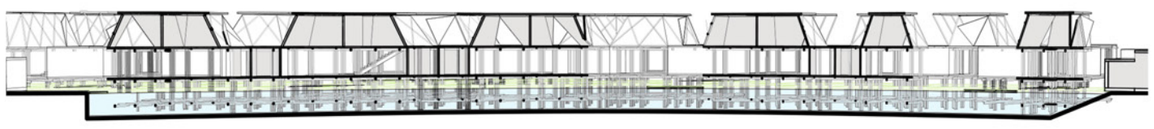
AY 2018/19 Semester 02

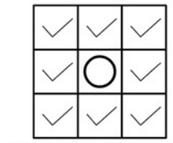
Second floor plans

Scale Bar: 0 1m 3m 7m 15m 25m **Scale:** 1:250

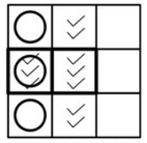


Section 2

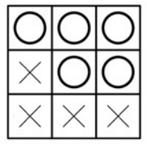
Scale Bar: 0 1m 3m 7m 15m **Scale:** 1:150



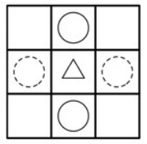
Wetland is able to purify the surrounding water.



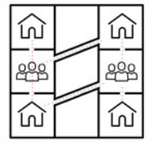
Assume that if one water plot 's surrounding area has more that 30% of wetland, then it is considered as purified water.



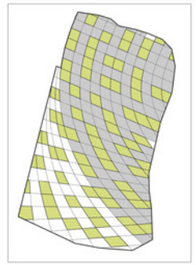
Toa avoid the lake to be totally blocked,every certain area need to have at least 45% openings



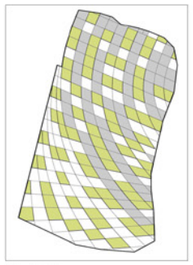
If one plot is connected to at least two wetlands, then it can be used for shrimp farming.



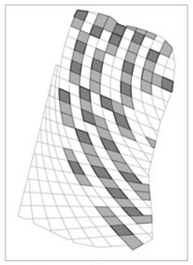
Make sure every family can take use of at least two public spaces.



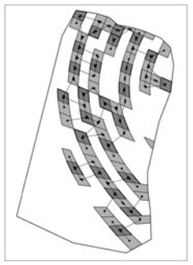
Buildable Area

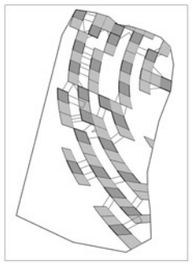


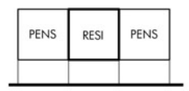
Buildable Area(Some are deleted to ensure enough sunlight for wetland)

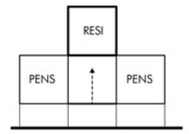


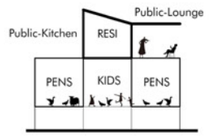
Residence PENS(Public spaces)

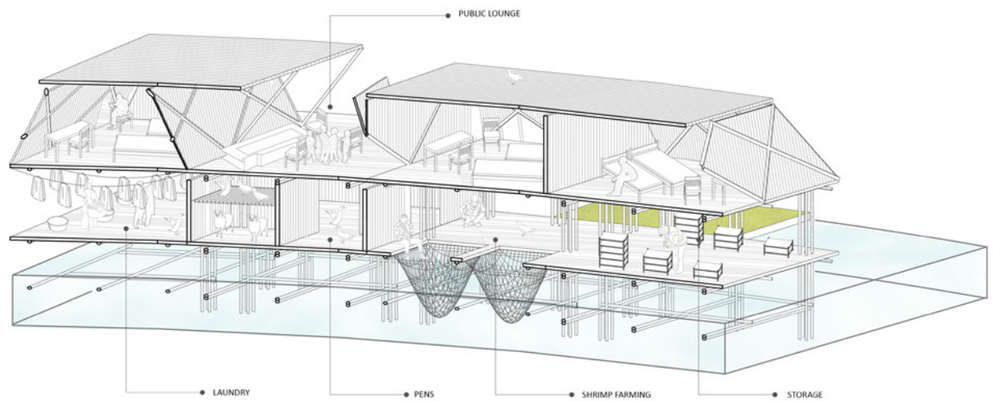






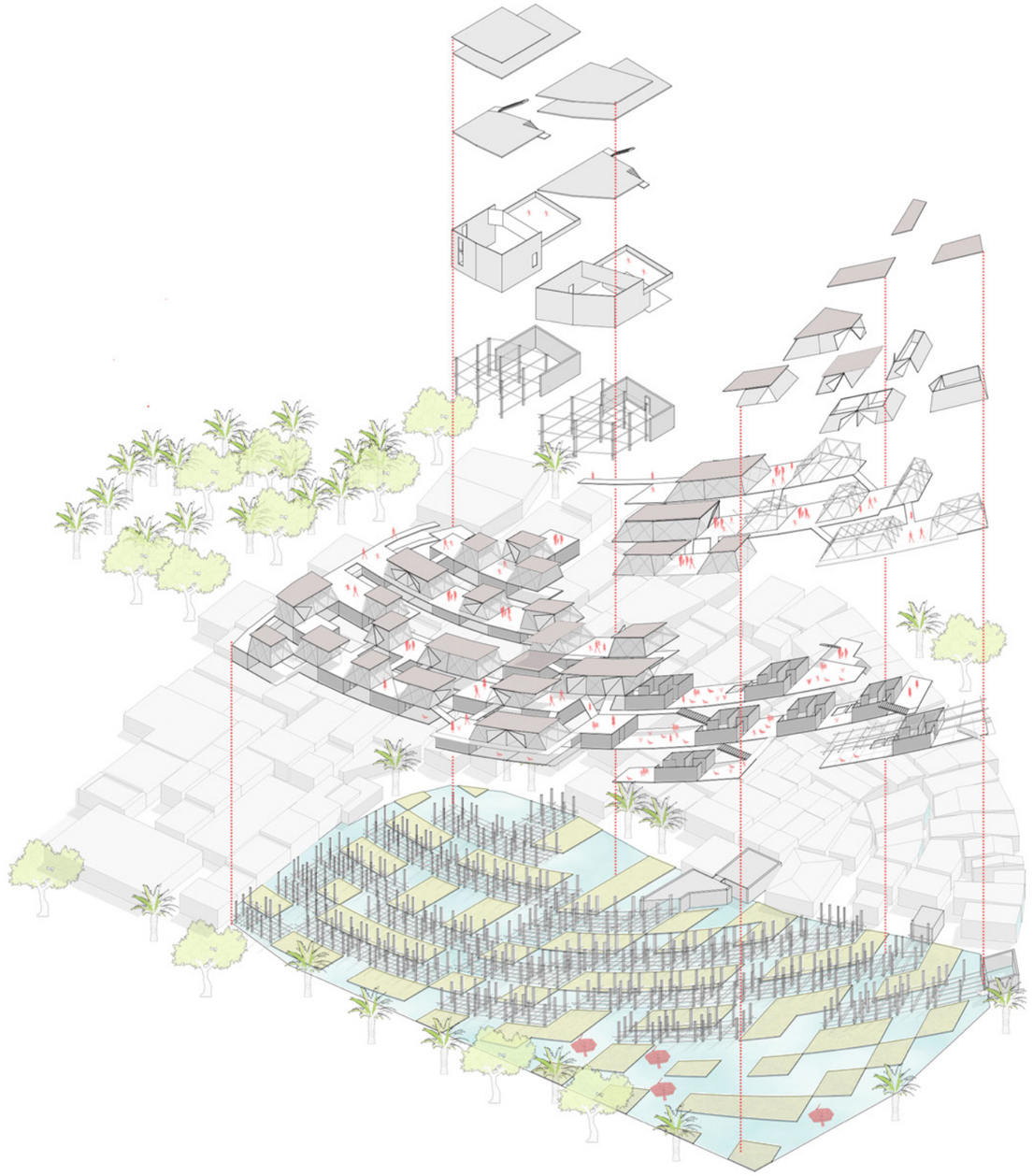






Typical Unit Sections

Scale Bar: 0 0.5m 1.5m 3.5m **Scale:** 1:50



Isometric exploded diagram

Scale: 1:300

Scale Bar: 0 1m 3m 7m 15m 25m

Legend: [ ] [ ] [ ] [ ] [ ]

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

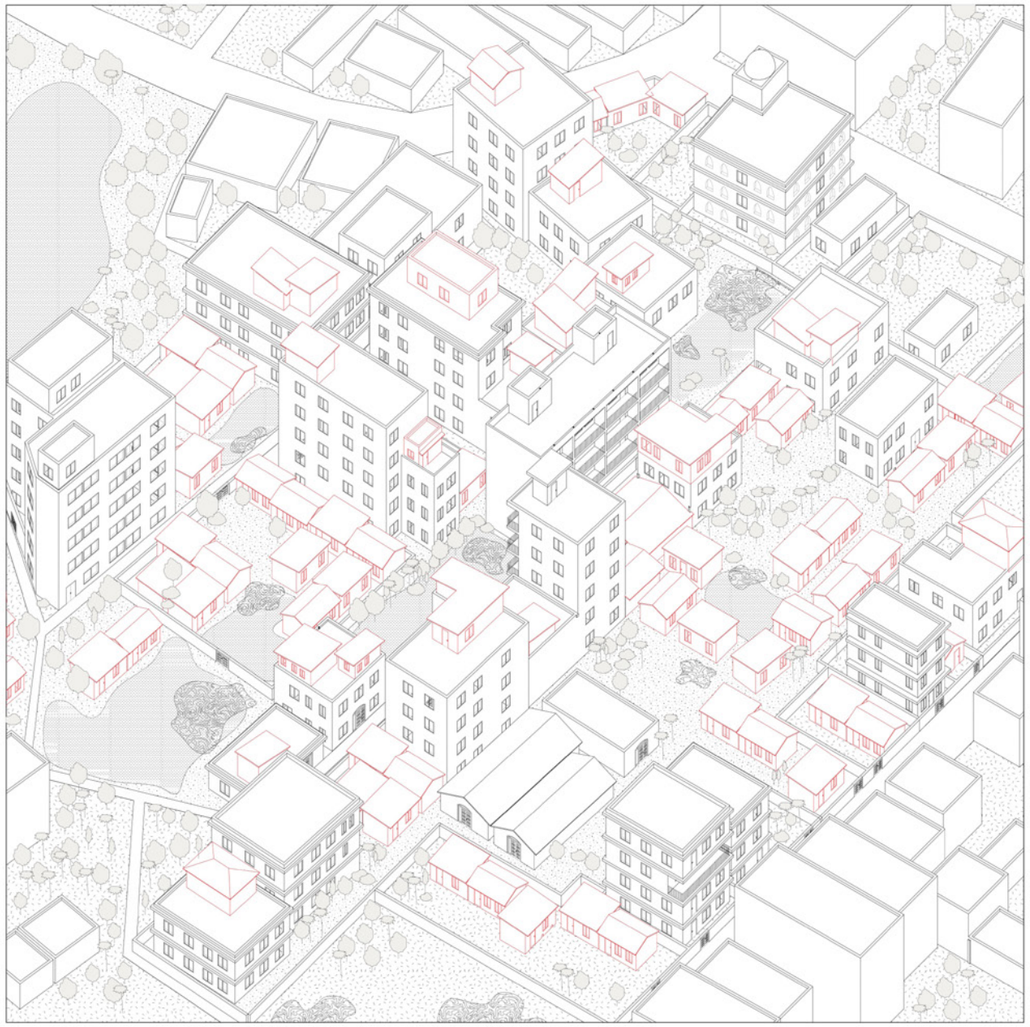
Student Name: Desiree Ng Zi Qi
Site: Khulna, Bangladesh
Coordinates: 22.55092N, 88.31926E

National University of Singapore
School of Design and Environment
Department of Architecture

Design Module AR4102/ AR4104
AY 2018/19 Semester 02

Thesis: This site is a mainly residential area with small pockets of small scale agriculture and fish farming that the locals produce for their own consumption or side venues of income. Its urban fabric is characterised by low rise residential apartments and slums that slowly overtake the unused portions of land. Because of the haphazard construction of formal and informal structures, residents developed ingenious strategies of spatial appropriation. During our site visit we often saw them squeezing through tight spaces or climbing over urban obstacles like fences and low walls to get from one point to another. Bricks are stacked to create elevated platforms that allow one to climb over heights, zinc sheets are put up to create fences around abandoned lots to create private spaces, and informal structures are built upon the rooftops of apartments for the expansion of space or rooftop farms. During floods, water levels can rise to as high as one's chest level - the locals create informal interventions using materials common to the area to mitigate the problem, but their methods are often unsuccessful. The project carefully studies these strategies of spatial appropriation and develops and architectural response to it. I propose a series of interventions in the form of inhabitable structures, spatial plug-ins, additions and extensions to elevate the informal spatial strategies to complement and upgrade the existing urban fabric.

The main cause of flooding in the area is not only the poor sewerage system currently in place; the issue of flooding is exacerbated by indiscriminate littering by the locals mainly due to a lack of education and appropriate infrastructure. Agriculture can be seen growing in water contaminated by plastic bottles and the poor do their laundry and bathe in ponds filled with litter. In the slum areas, living with litter seems to have become just a normal way of life.



Interpretation of the current situation at site.

Scale: n/a
Scale Bar: n/a
Legend: [ ] [ ] [ ] [ ] [ ]

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: BBB
Site: Khulna, Bangladesh
Coordinates: 22.55092N, 88.31926E

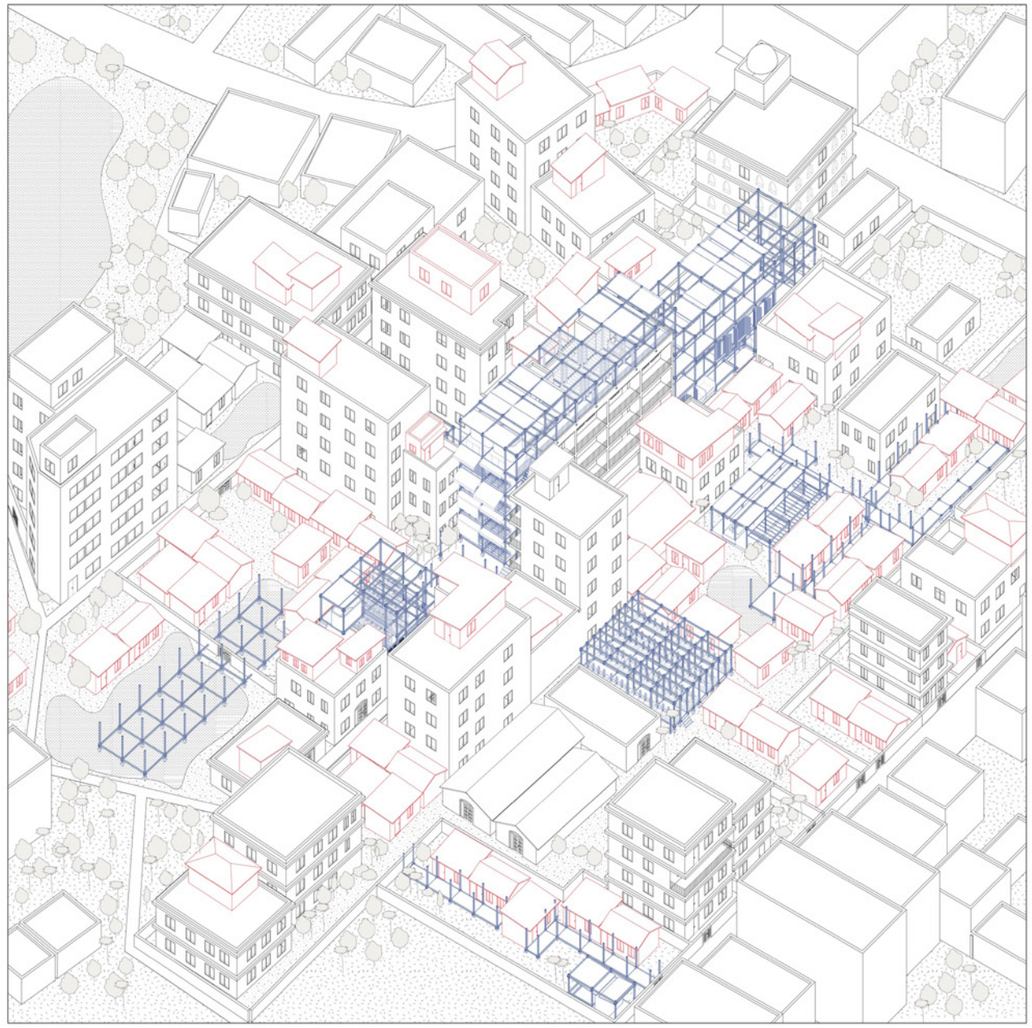
National University of Singapore
School of Design and Environment
Department of Architecture

Design Module AR4102/ AR4104
AY 2018/19 Semester 02

This project seeks to address these issues through the implementation of a programme that repurposes plastic so that it can be incorporated into modular architecture. Through the upcycling of plastic into the creation of bamboo joinery, the residents can therefore continue to construct informal structures that allow them to adapt to their surroundings, but with order. Rainwater collection and flood pools provide residents with the adequate resources to supplement their day to day activities of farming, cleaning, and rearing animals.

A plastic recycling workshop collects plastic waste from residents, which is then softened and extruded into plastic joints. These joints can then be used to create bamboo scafolding that acts as the skeleton to structures that can be utilised in whatever ways the residents desire.

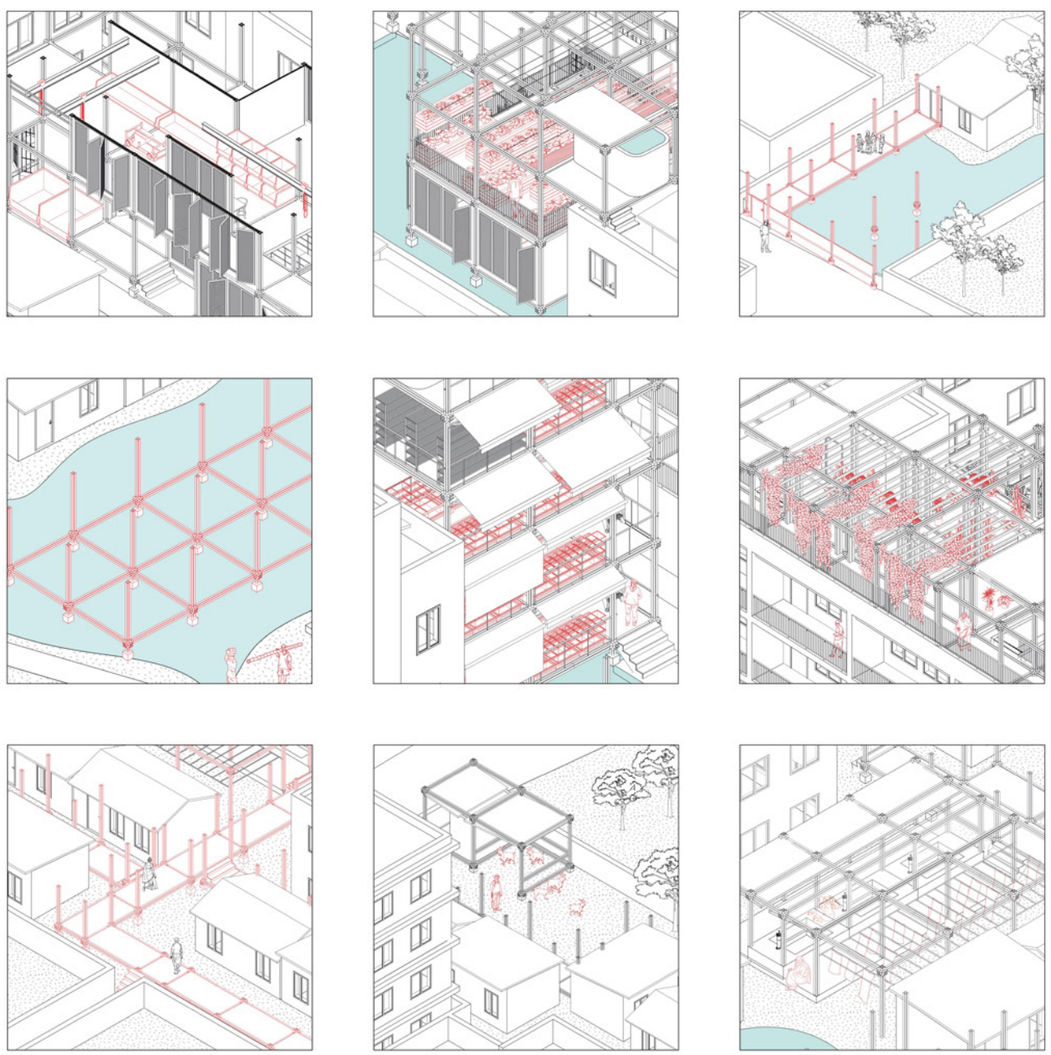
Elevated pathways can be created for traversing over flooded areas, or even as a gazebo over ponds. Communal laundry areas that harvest rain water can be created for residents in the slums that currently do their laundry in sewage water littered with rubbish. Structures that wrap around the building can be used to enhance the current roof top farming situation, and fish farms can be expanded along the facade of the apartment buildings as well. Marshy areas currently unused by the residents can have agriculture growth with elevated farms, giving purpose to currently unusable space. Free roaming farm animals can now also be contained within small sheltered huts instead of being exposed to the elements during rainstorms or floods. All of these interventions can be coupled with a rainwater harvesting module to solve the issue of shortage of clean water.



Interpretation of the changes to site.

Student Projects

DESIREE NG ZI QI



Snapshots of the interventions
on site

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: BBB
Site: Khulna, Bangladesh
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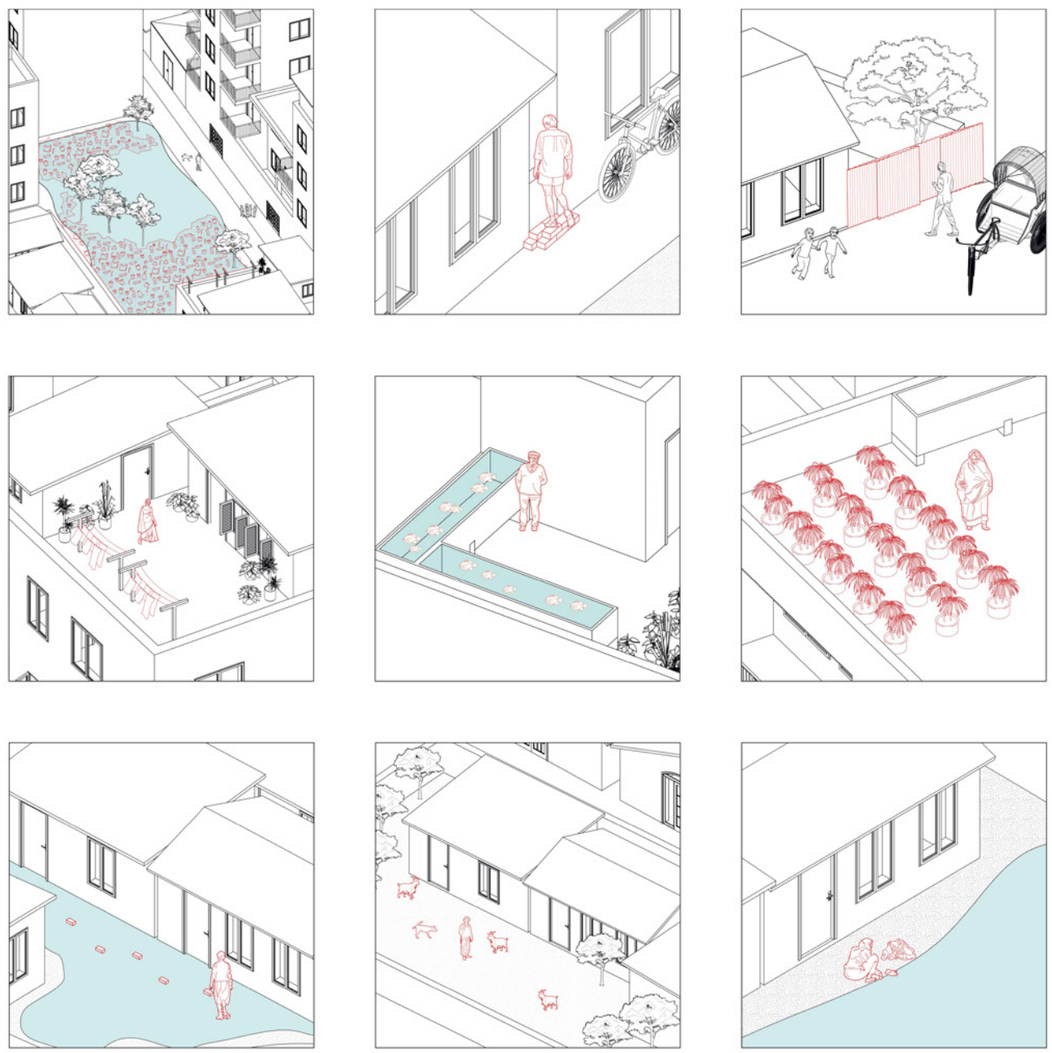
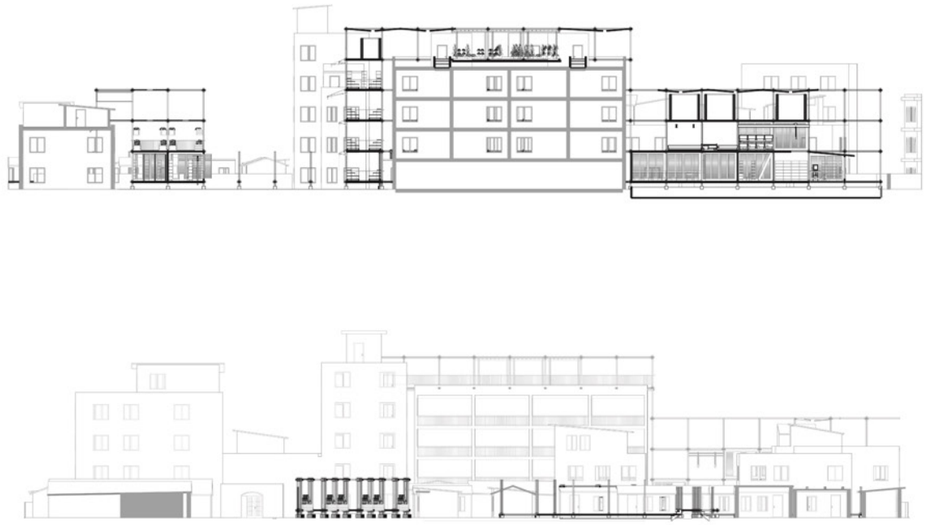
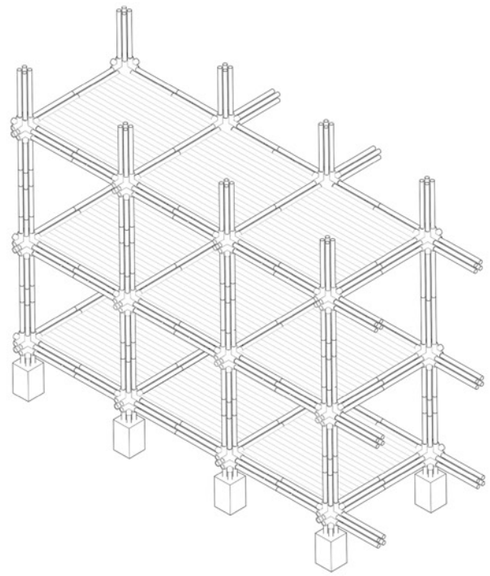


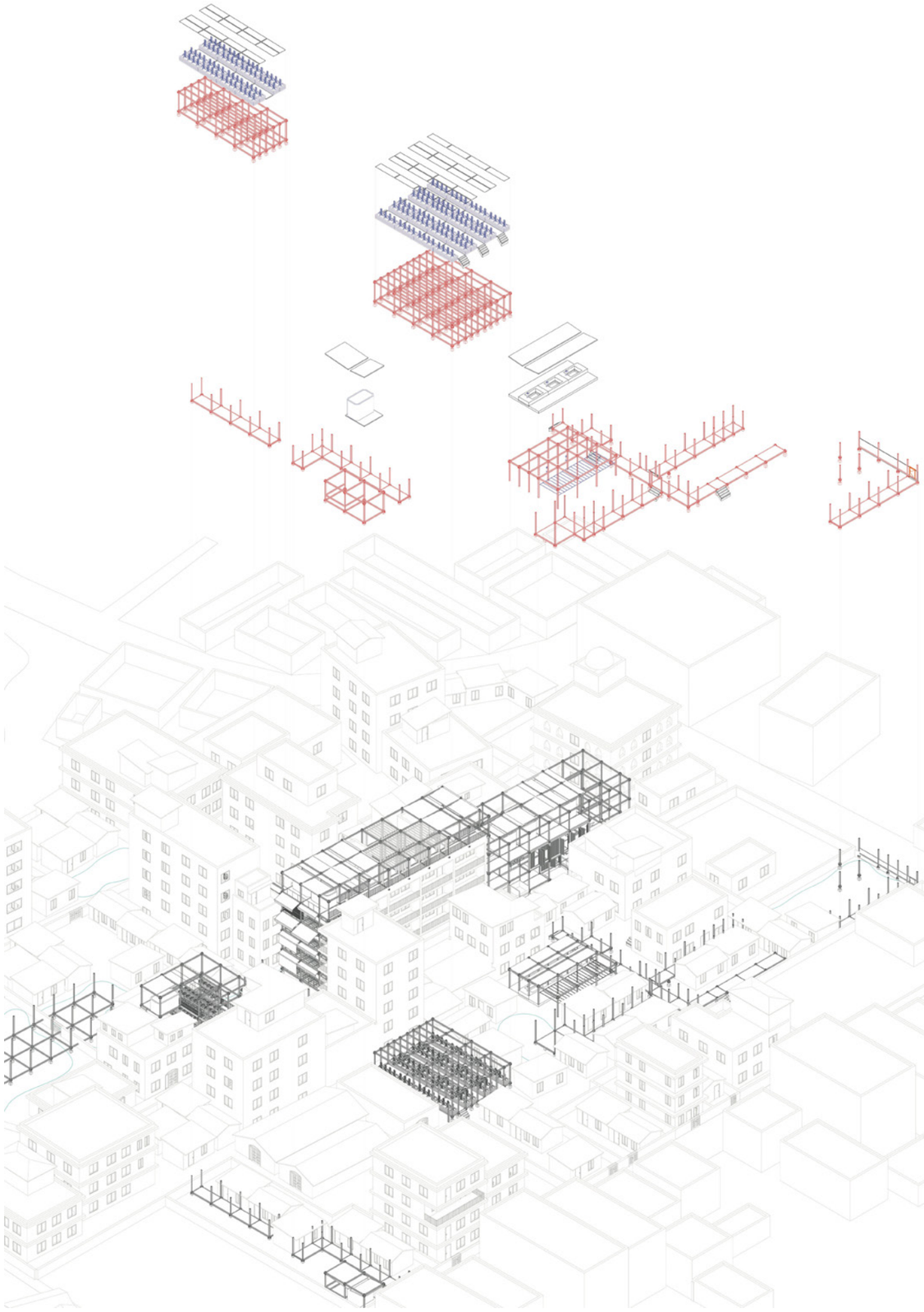
Snapshots of the current site



Scale: 1:200



Top: Section through residential apartments
Middle: Section through slums
Bottom: Joinery

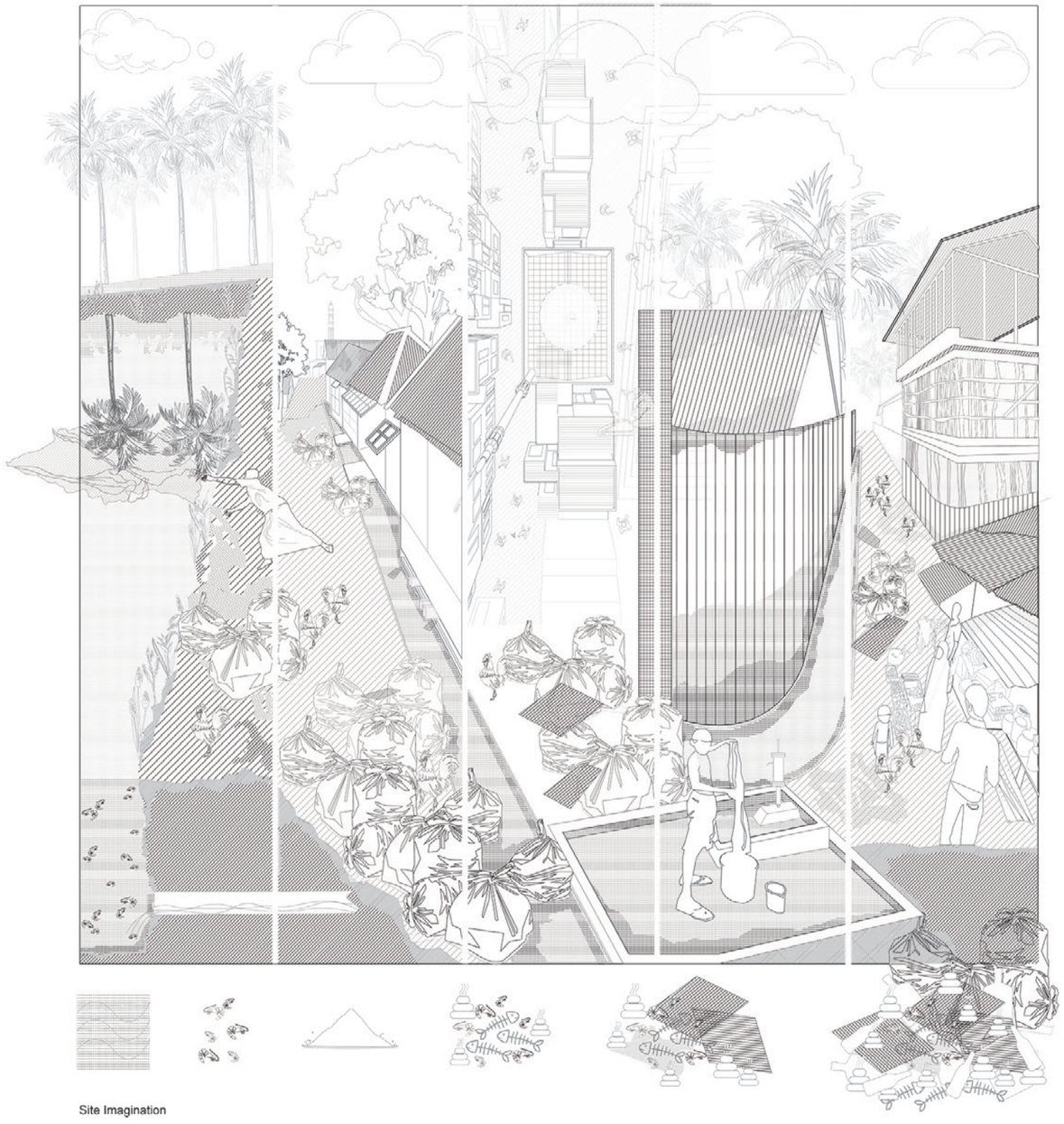


The Basthohara Neighborhood, formerly a refugee community, lies between the region of agriculture and urban housing. This informal settlement faces a major issue of dumping that has not been dealt with/poorly with by the local authorities. The cumulation of trash leads to detrimental impacts on ecological and social environments and issues such as water pollution and floods are faced by the community on a regular basis.

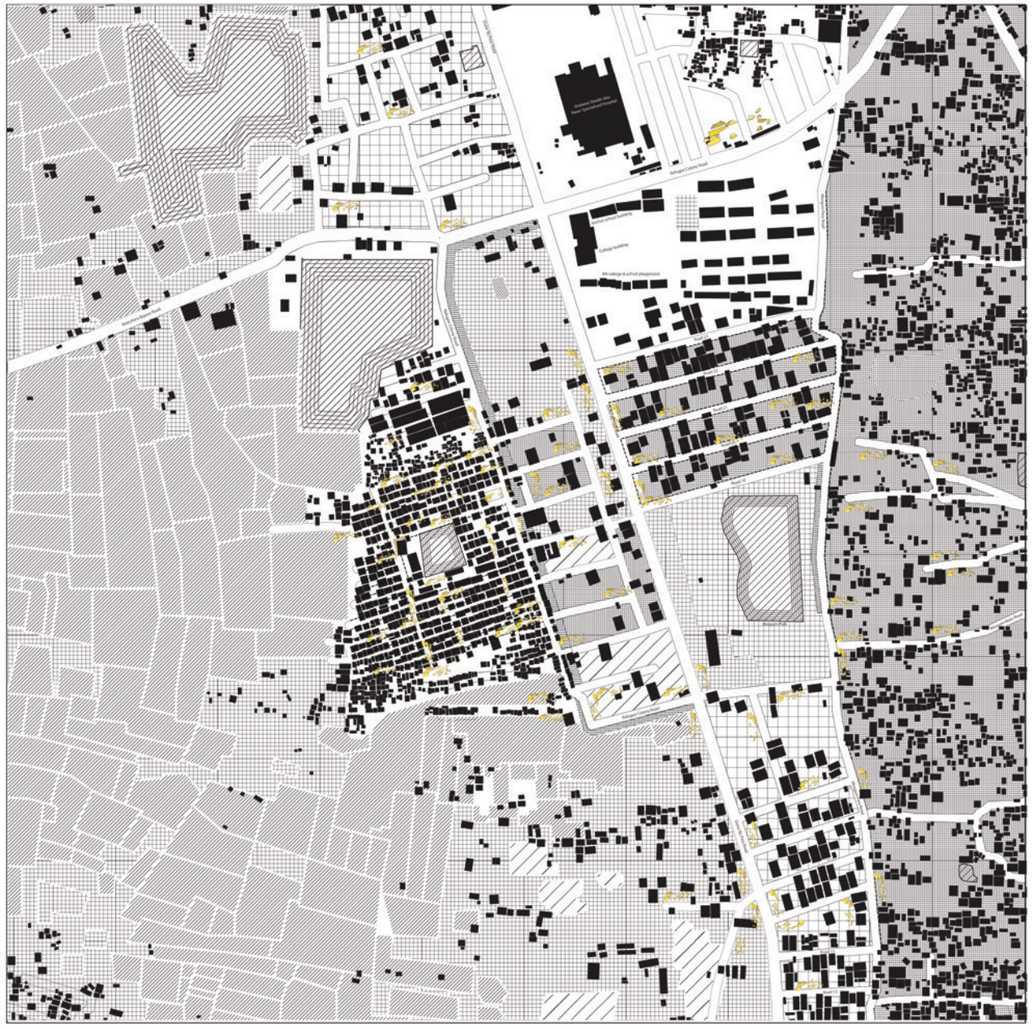
This issue of water pollution is rampant throughout Bangladesh and could be dealt with using water purification/rainwater harvesting strategies. However, just by inserting any hydrological intervention would not get to the root of the issue because awareness and education among the communities should always be the first step in dealing with social or environmental issues.

"One man's trash is another man's treasure" My architectural proposal seeks to educate the local community on the importance of waste management by teaching & cultivating habits in the locals that waste could be beautiful if it is managed and sorted properly. The project proposes to create an ornamental waste recycling facility as addition and extension to the existing Basthohara Mosque. This is not an act of religious infamy, but an expression of purifying and dignifying aspiration of a Mosque. The otherwise relatively uninspiring mosque becomes the indicator of social and ecological transformation, where waste is sorted, stored and re-used. This communal function allows the creation of a micro-economic benefit for the Basthohara community.

By locating the architectural intervention around the Basthohara Mosque, it could also serve as a symbolic reminder to the local community that dumping is not the end of the lifecycle for any material, if it is treated correctly. Through education and implementation of this architectural proposal, the Basthohara Neighborhood could be the first step that can be done to alleviate dumping all around Bangladesh.



Site Imagination



Map of location with visible (black and white) and invisible (colored) features

Scale: 1:2000

Scale Bar:

Legend: n/a

Legend
- Building
- Road
- Cultivation
- Park
- Vegetation
- Paddifields
- Lakes
- Waterlogged land
- Sewer drainage
- Surface drainage
- Public water source

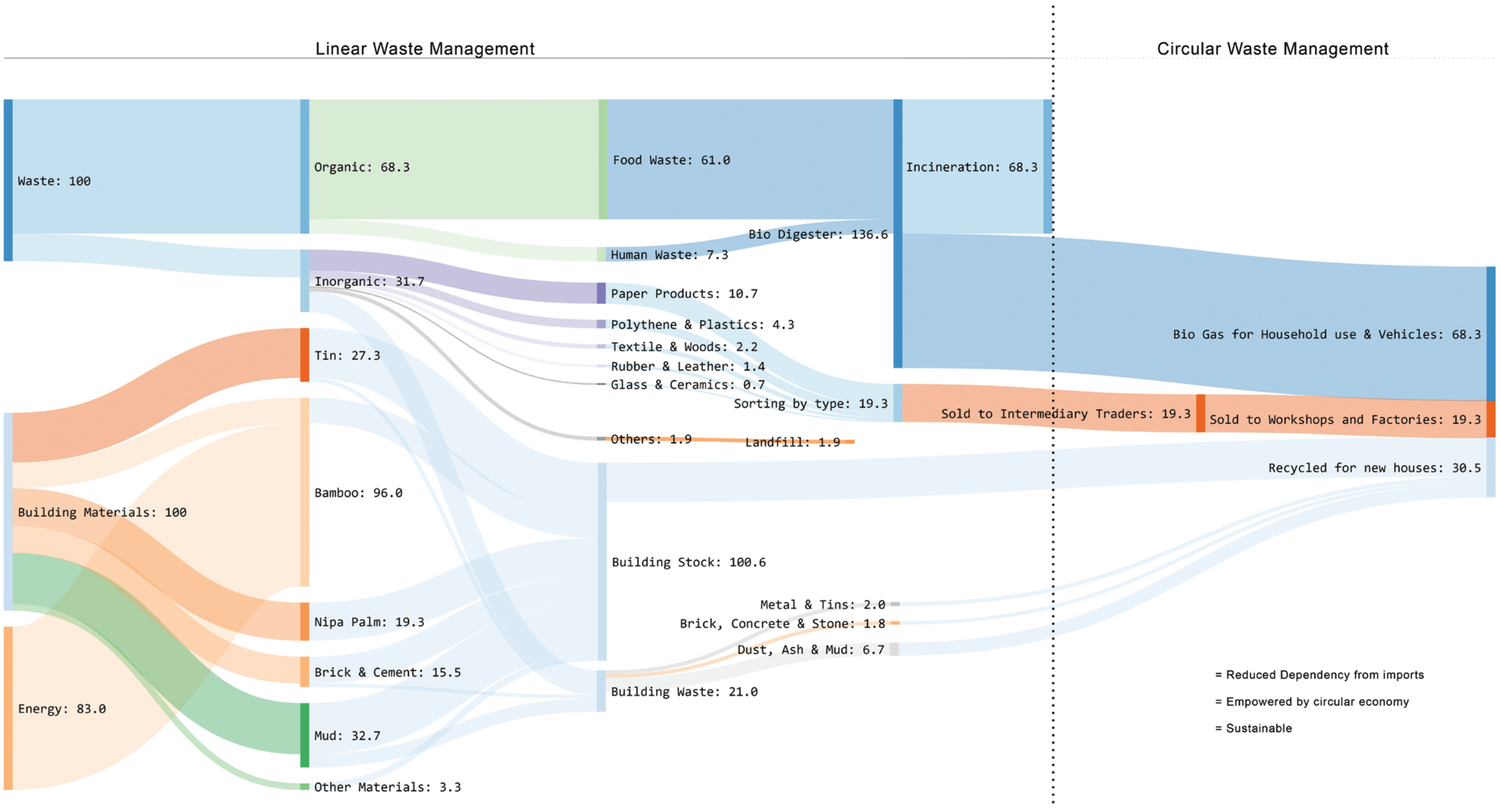
Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: Chan Jia Hao Martyn
Site: Khulna, Bangladesh
Coordinates: 22.8472046N, 89.525891E

National University of Singapore
School of Design and Environment
Department of Architecture

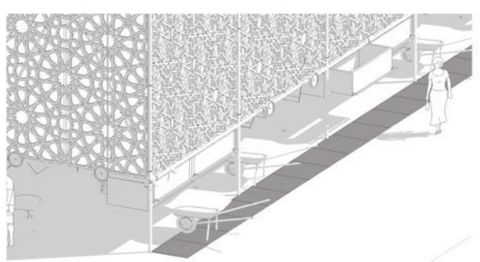
Design Module AR4102/ AR4104
AY 2018/19 Semester 02

Waste Management Process

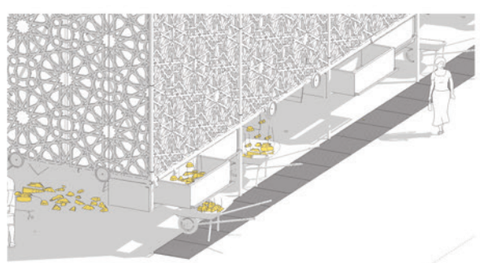


Before

After



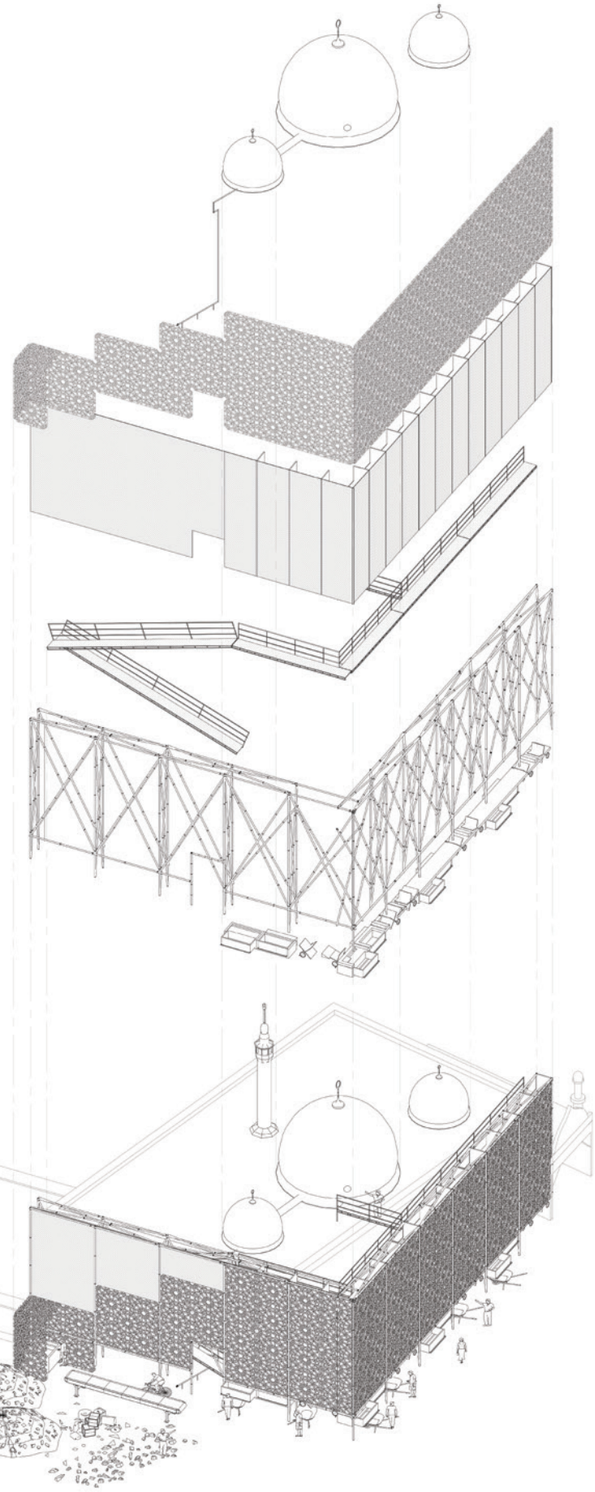
Close



Open

Section

Scale: 1:50



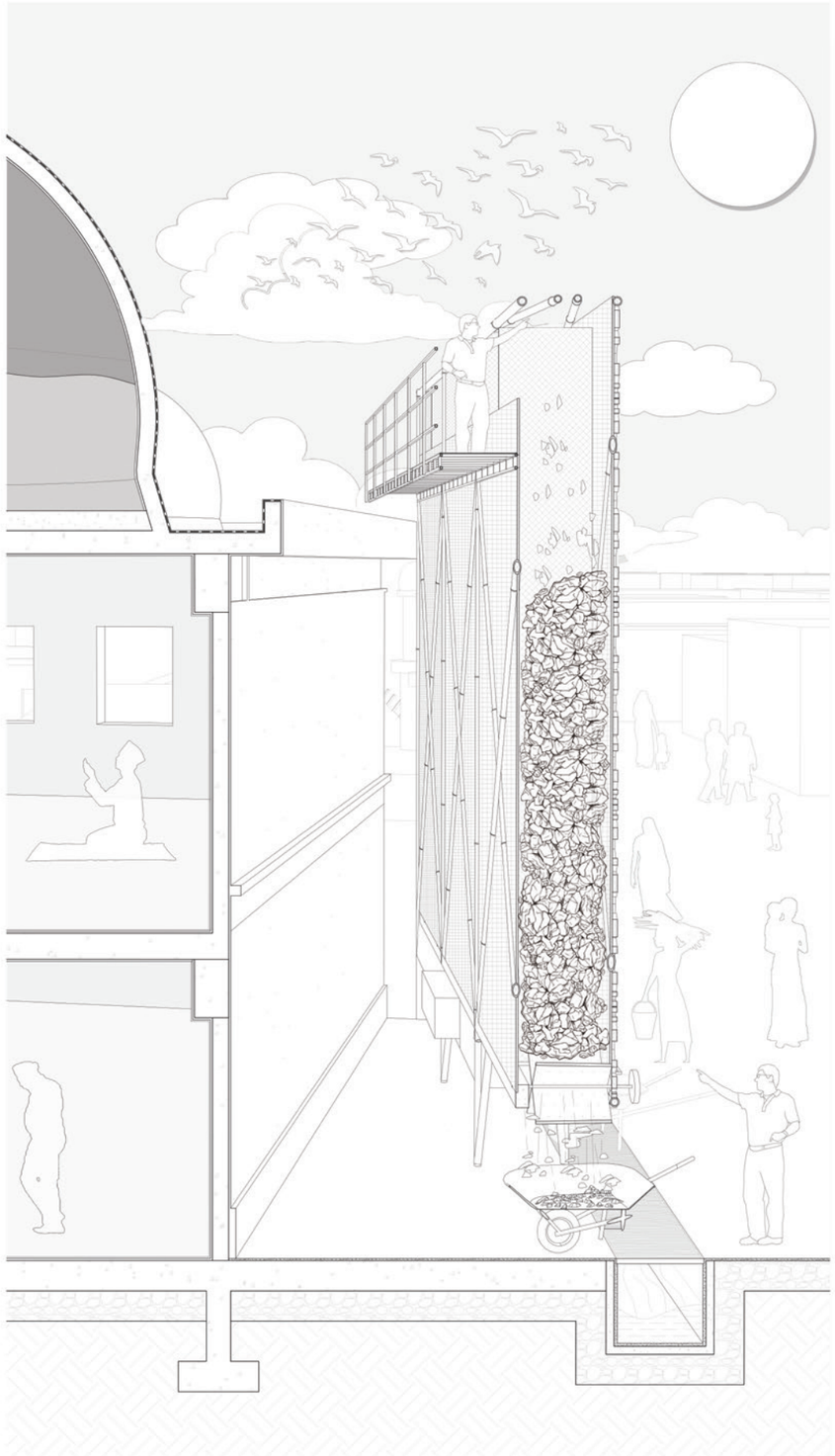
Exploded Axonometric

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: Chan Jia Hao Martyn
Site: Khulna, Bangladesh
Coordinates: 22.8472046N, 89.525891E

National University of Singapore
School of Design and Environment
Department of Architecture

Design Module AR4102/ AR4104
AY 2018/19 Semester 02



Section **Scale:** 1:50

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: Yeo Ze Wei Sean
Site: Khulna, Bangladesh
Coordinates: 22.849389N , 89.531070E

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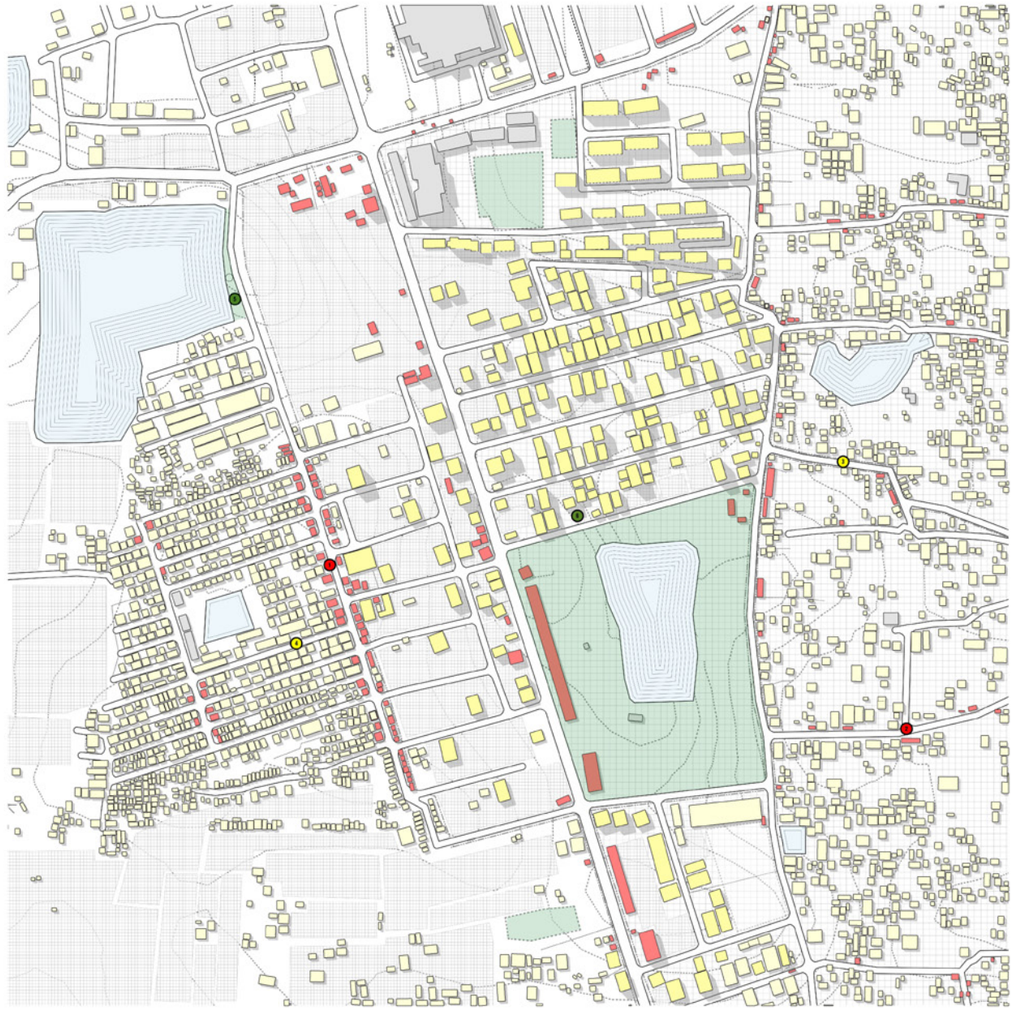
Work

Live

Leisure



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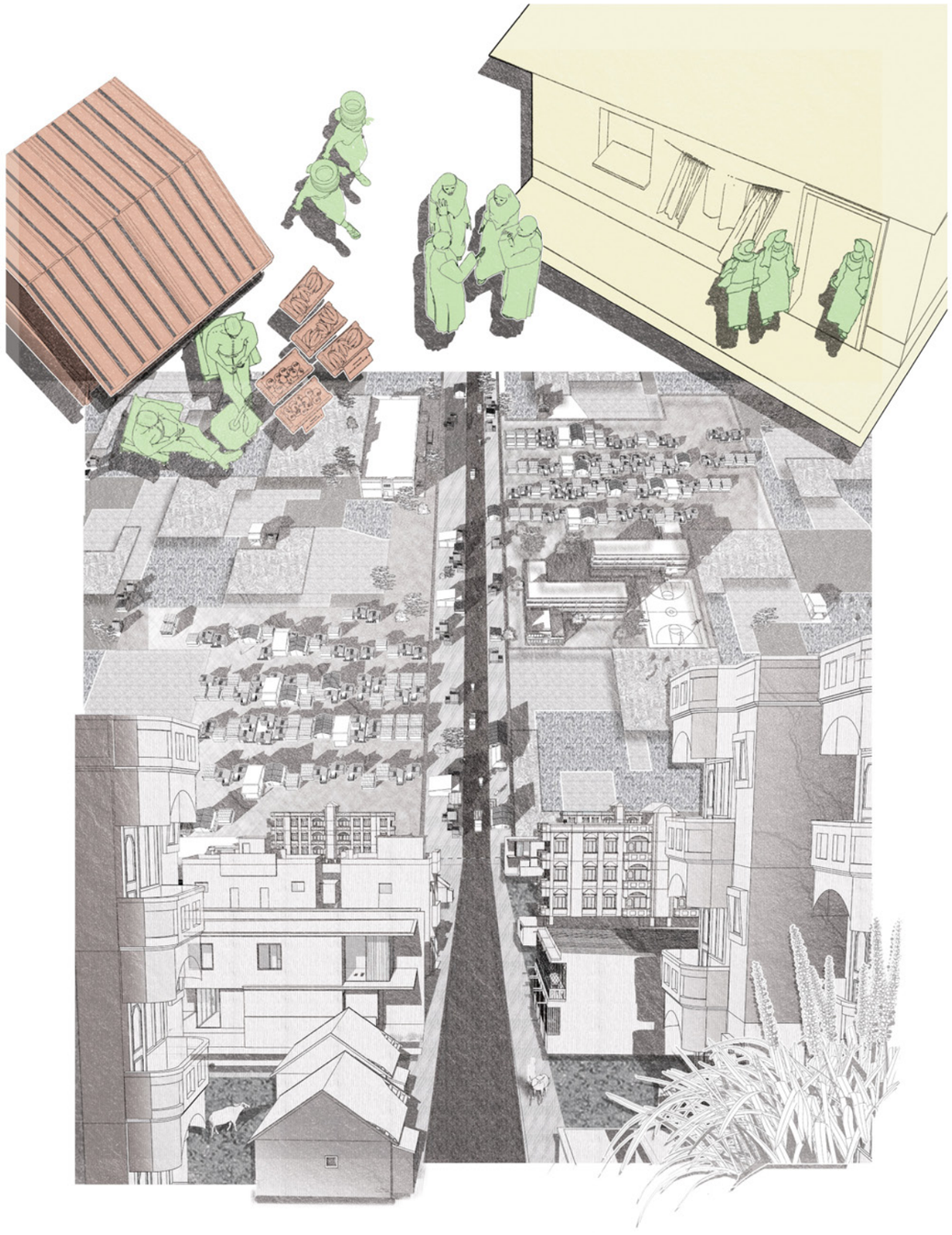
Introduction
There exists a stark disparity between the lower class and middle class in this area of Khulna. This disparity is manifested in the clearly demarcated formal (middle-class) and informal (lower-class) zones, evident from its infrastructure and human activities. The formal zone is situated within the centre of the site and is surrounded by informal zones, separated by main roads. The infrastructure in the formal zone consists of mostly apartment blocks and landed private housing, with empty plots and streets that are waterlogged. On the other hand, the infrastructure in the informal zones consist of compact urban slums, street-side stalls, common toilets and waterpoints and narrow pathways. As one passes through the formal to the informal zone, the level of human activities dramatically changes. In the formal zone, aside from a few passers-by and curious onlookers from the apartment windows, the place is virtually lifeless. Instead, the informal zones are often messy and noisy, yet full of life. The compact and narrow spaces result in private and public spaces overlapping seamlessly and locals appropriating the common spaces unreservedly. In the informal spaces Live, Work and Leisure takes place in the same areas. The current situation offers a state of mutual respect, despite the aggravating social divide.

Site
The formal zone is chosen as the project site for its undeveloped area, central location and lack of vibrancy. The aim of the project seeks to tap on the site's potential to bring in the vibrancy of the informal zone by creating Live, Work and Leisure spaces for the lower class while overcoming some of the short-comings of informality. At the same time, there is a need to respect the site and its existing inhabitants, as well as to provide thermal comfort. Following a trend of the formal zone being more and more built up over the years, there is a worry that the urban heat island effect will get worse, resulting in an increase in temperature.

Design
Four different types of modules are proposed – Shops, Houses, Toilets and Rest Areas. Taking the pattern of the surrounding site typology, shops are located along the periphery of the site along the streets, close to the public zone. Houses and toilets are located along the inner circumference, creating a space in the middle that connects the entire site. This private inner zone serves as the common area of the neighbourhood where essential activities like cooking and laundry are done. Rest Areas are located sparsely around the site and mainly on the second level where people can have full view of the surrounding while relaxing. The second level also serves as a circulation route across the site. To supplement the existing buildings, modules are retrofitted to and onto the them, serving as balconies and pavilions.

Structure
The innovative use of modular bamboo structures presents a less-invasive architecture intervention that builds on the in-between spaces and harmonises with the existing buildings. Bamboo is a natural resource that grows rapidly and is readily available. As a building material, it has high tensile strength, fire resistance, elasticity, and is light and flexible. It also functions well in hot and humid weather as it does not trap heat. Using basic joinery and configuration, it provides an easy and straightforward building solution for the not so well to do people of Bangladesh. Everything from the slabs to the walls and the structural elements are all made using bamboo. Building on waterlogged land, the modules and platforms are constructed on stilts. This prevents water from reaching up the spaces even in the event of rain and does not impinge on the existing green spaces.

Evaporative Cooling
Textiles made from bamboo fibre are used as curtains to create flexible and customable spaces. These textile curtains can be drawn to enable different spatial configurations depending on the number of people or the nature of the activities. Because of its excellent wicking properties, it takes advantage of water from the waterlogged soil (from the first level modules), as well as rain (on the second level modules) to create evaporative cooling. Evaporative cooling happens when evaporation removes the latent heat from the wet textile, resulting in cooler air particles that cools the surrounding area. When wind passes through, the cooling area is extended. The first level textile uses a shower curtain system. Water from the waterlogged soil comes into perpetual contact with the textile, enabling the textile to be constantly wet through capillary action, providing a continual cooling effect. The second level textile uses a roman shade system, where the curtains can be drawn up and down to control privacy and views. The textile on the second level will only be wet in the event of rain.



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Site Experiment 1

Back Facing with Apartment Blocks in Background
Use of Linen Textile

Site Experiment 2

Side Facing with Apartment Block in Background
Use of Linen Textile

Site Experiment 3

Back Facing in-between Apartment Blocks
Use of Linen Textile

Site Experiment 4

Entrance of Empty Plot
Use of Cotton Textile

Site Experiment 5

Immediate Frontage of Building
Use of Linen Textile

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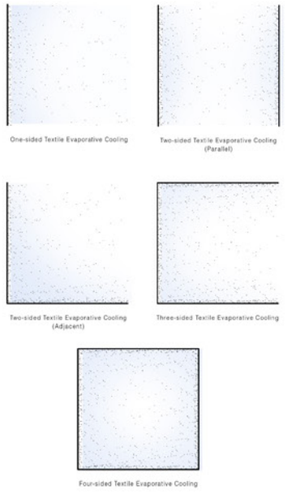
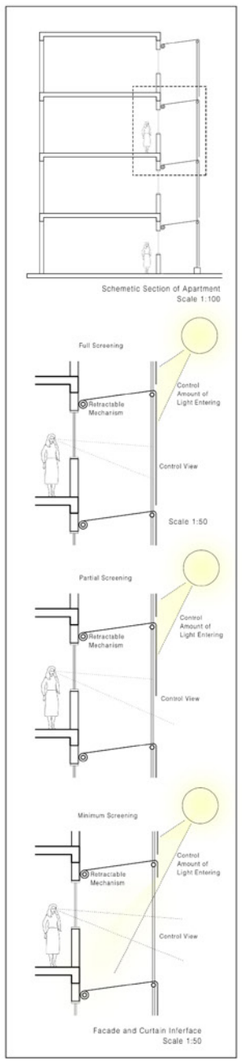
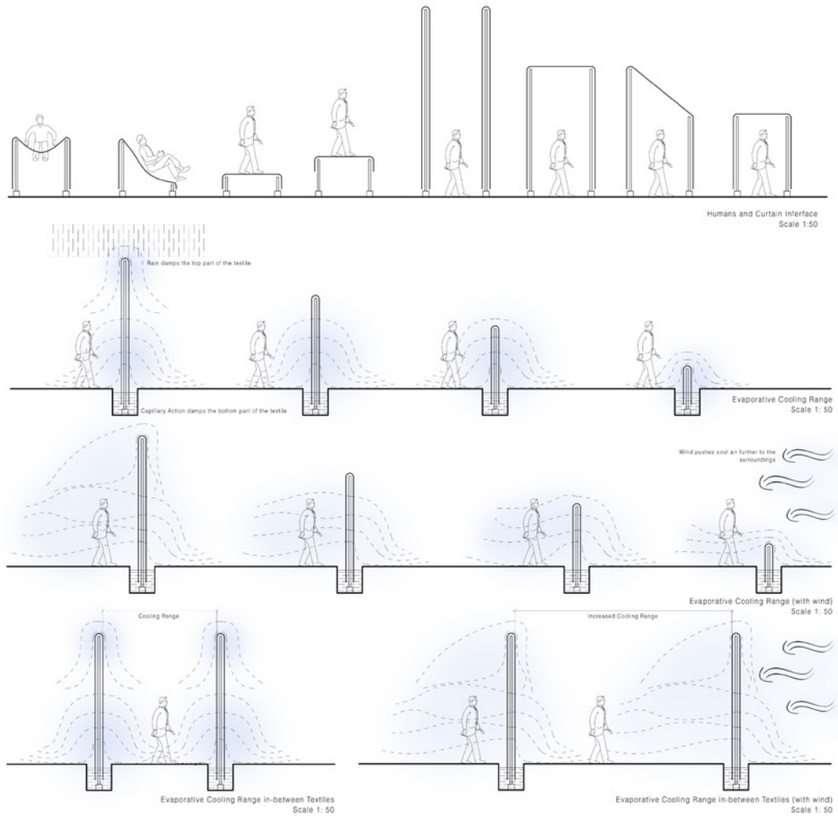
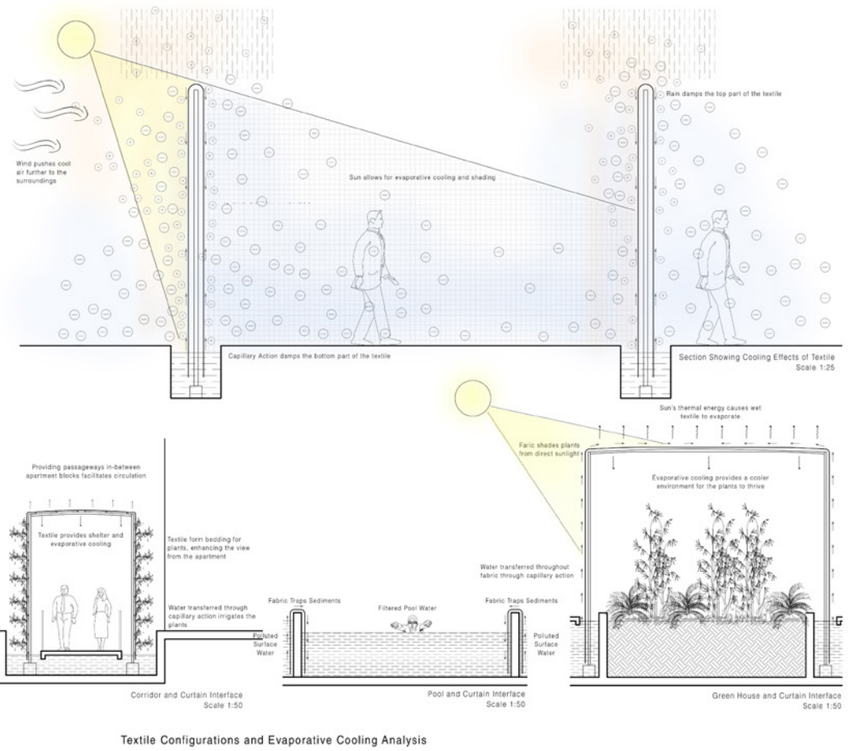


Evaporative Cooling Analysis Plan of a Single Module
Scale 1:50







Textile Configurations and Evaporative Cooling Analysis

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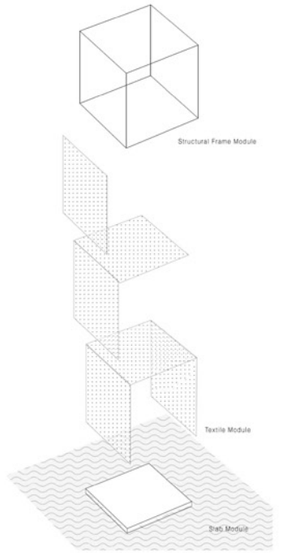
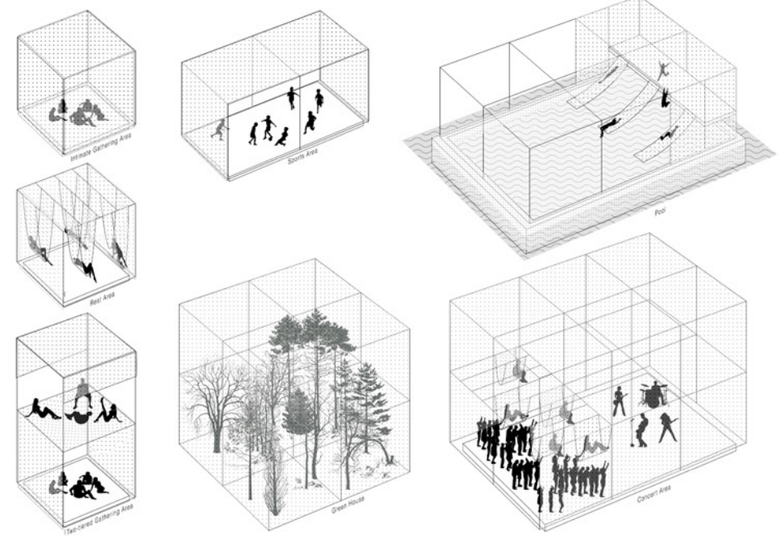
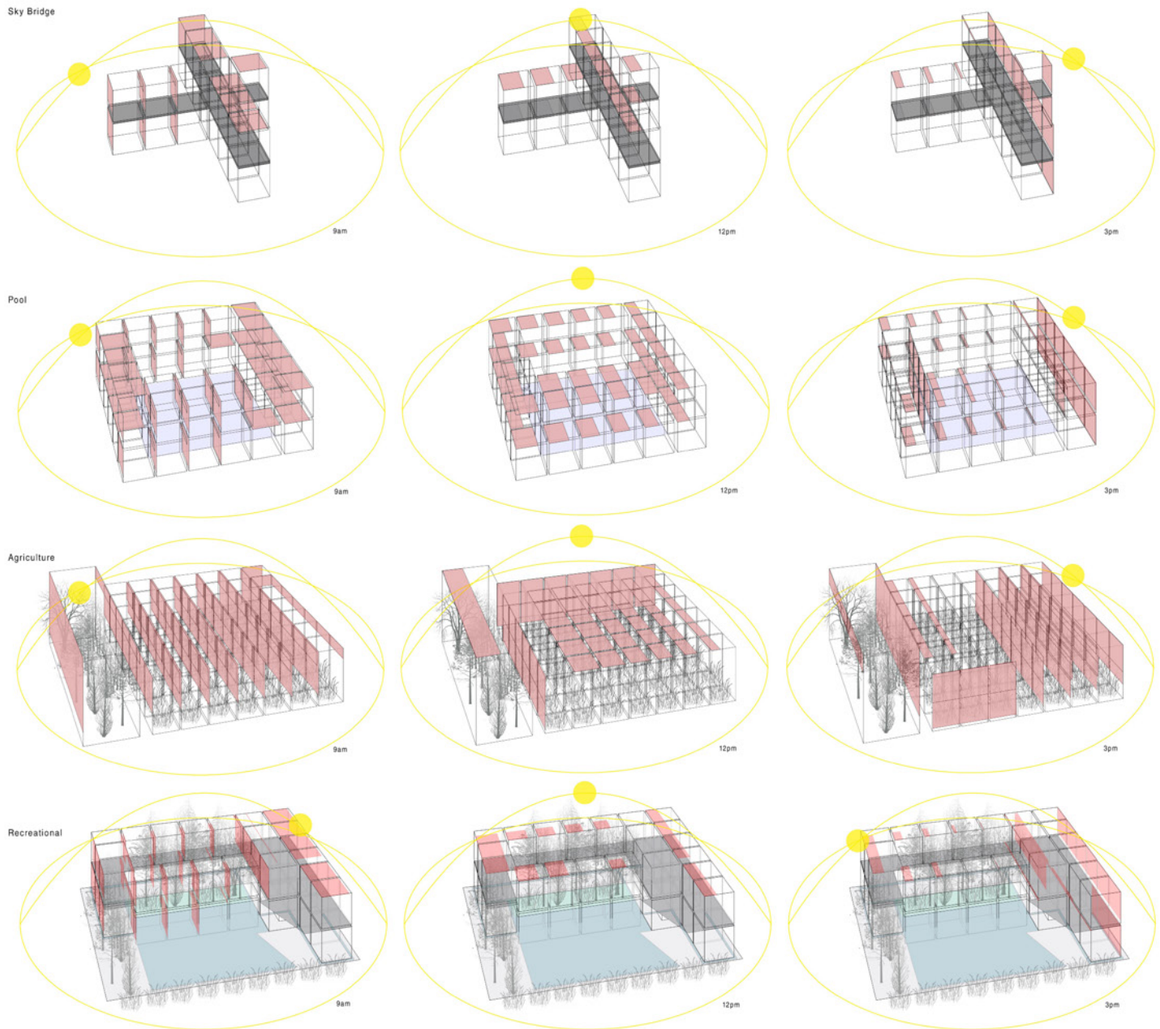


Module Components



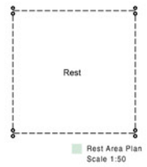
Study on Module Configurations



Micro-climatic Study on Textile's Reaction to Sun Path

Student Projects

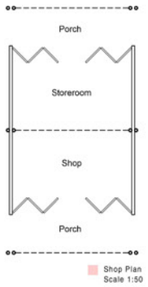
YEO ZE WEI SEAN



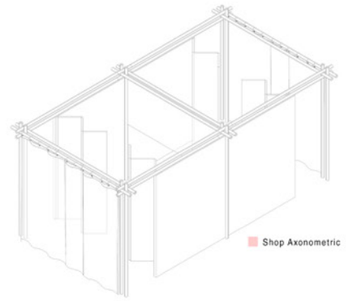
Rest Area Plan
Scale 1:50

Rest Area (Top) Axonometric

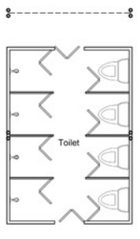
Rest Area (Bottom) Axonometric



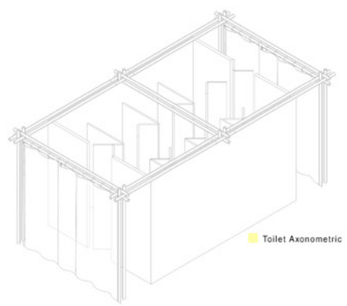
Shop Plan
Scale 1:50



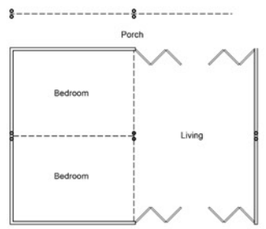
Shop Axonometric



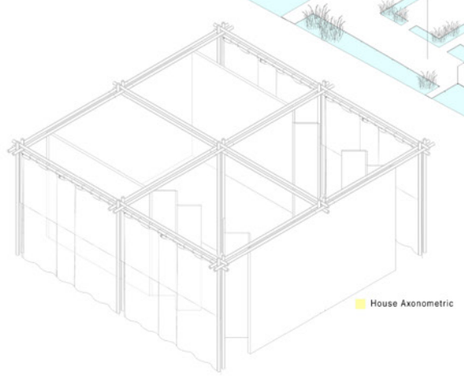
Toilet Plan
Scale 1:50



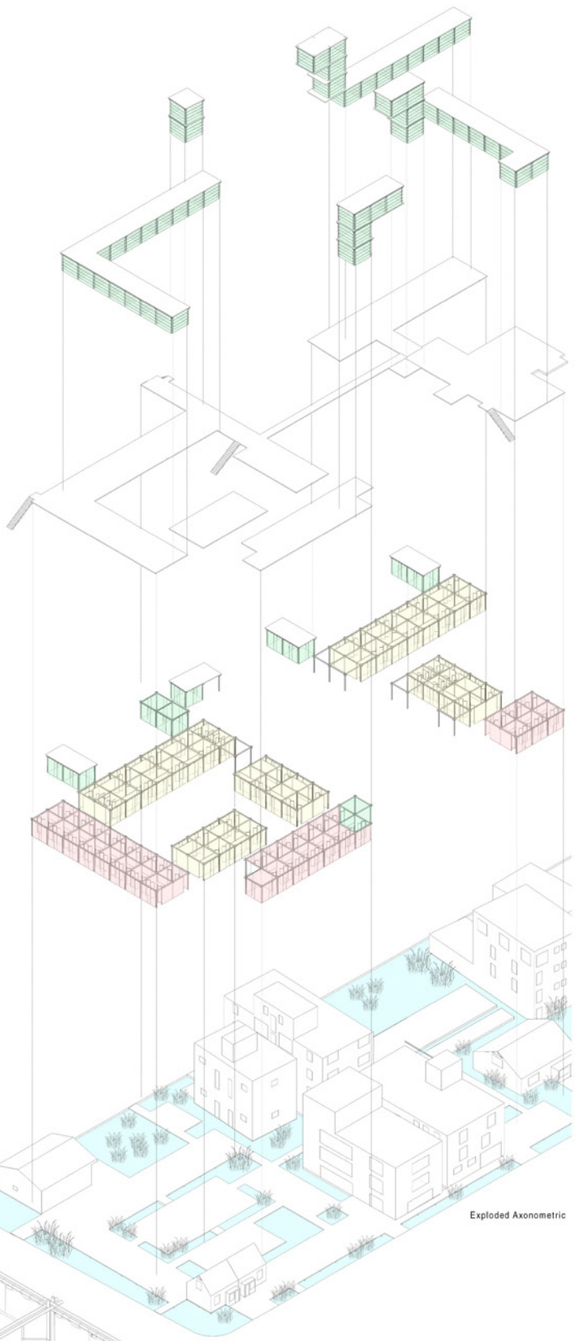
Toilet Axonometric



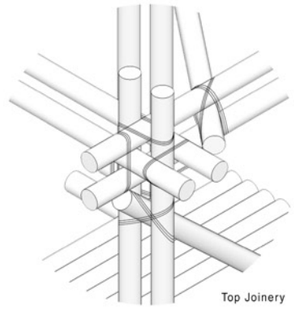
House Plan
Scale 1:50



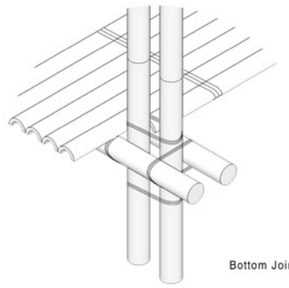
House Axonometric



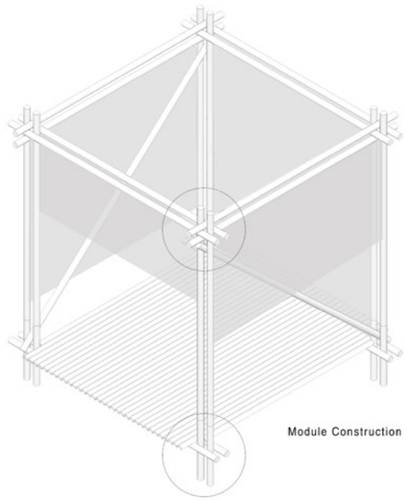
Exploded Axonometric



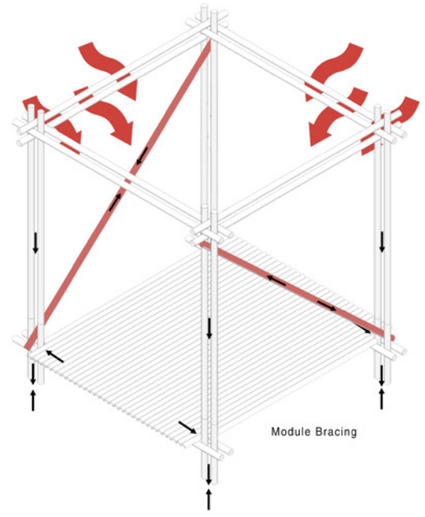
Top Joinery



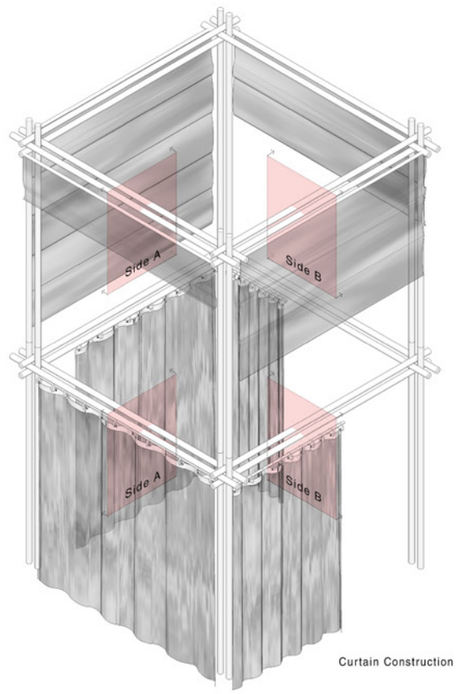
Bottom Joinery



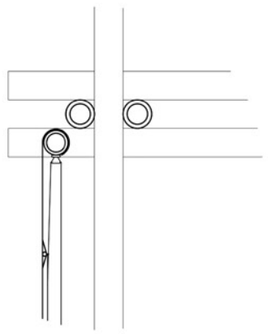
Module Construction



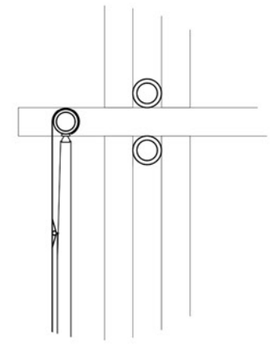
Module Bracing



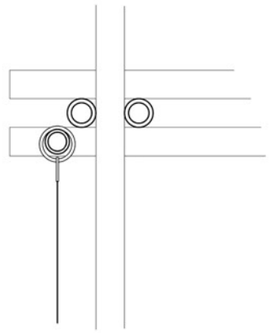
Curtain Construction



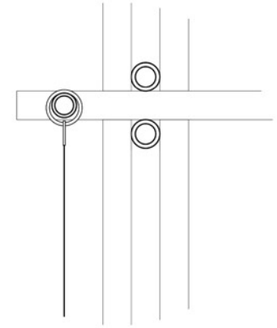
Top Curtain Detail - Roman Shade System
Side A
Scale 1:5



Top Curtain Detail - Roman Shade System
Side B
Scale 1:5



Bottom Curtain Detail - Shower Curtain System
Side A
Scale 1:5

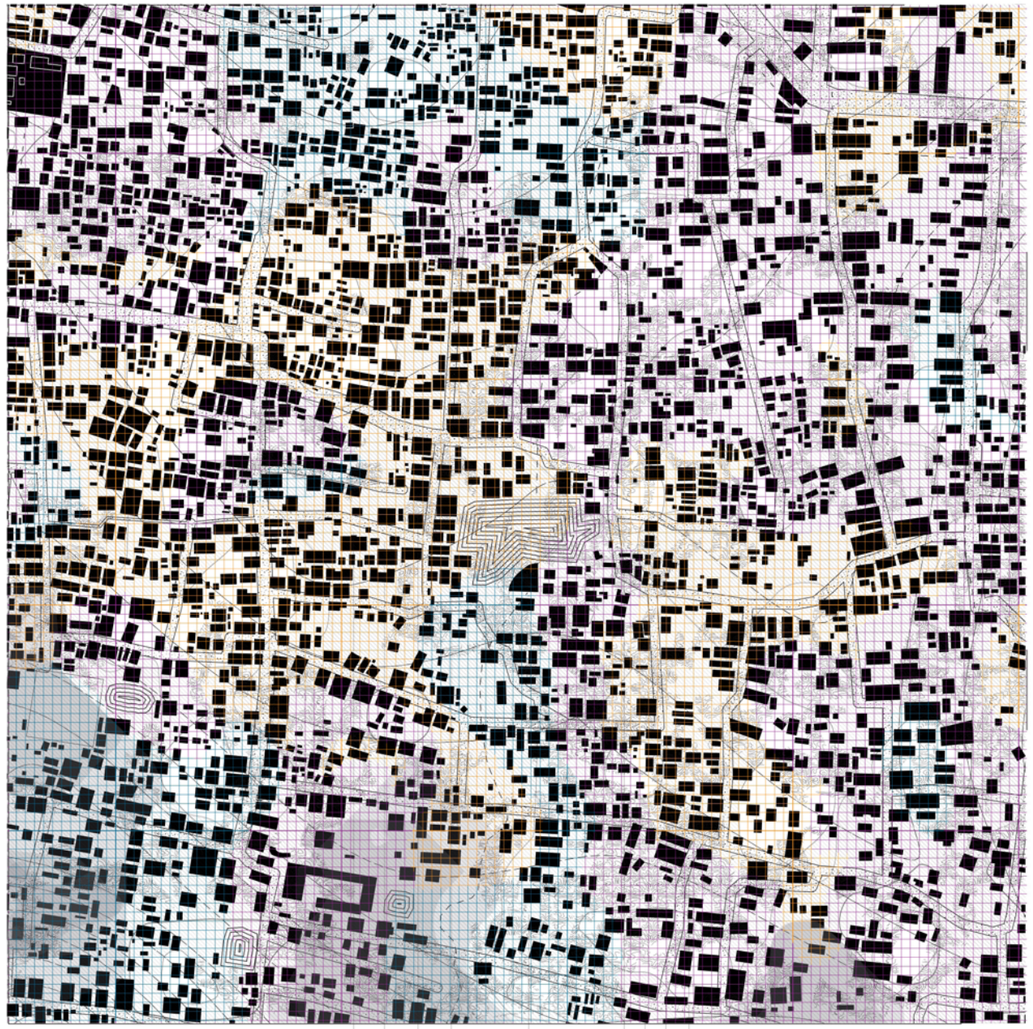


Bottom Curtain Detail - Shower Curtain System
Side B
Scale 1:5

Student Projects

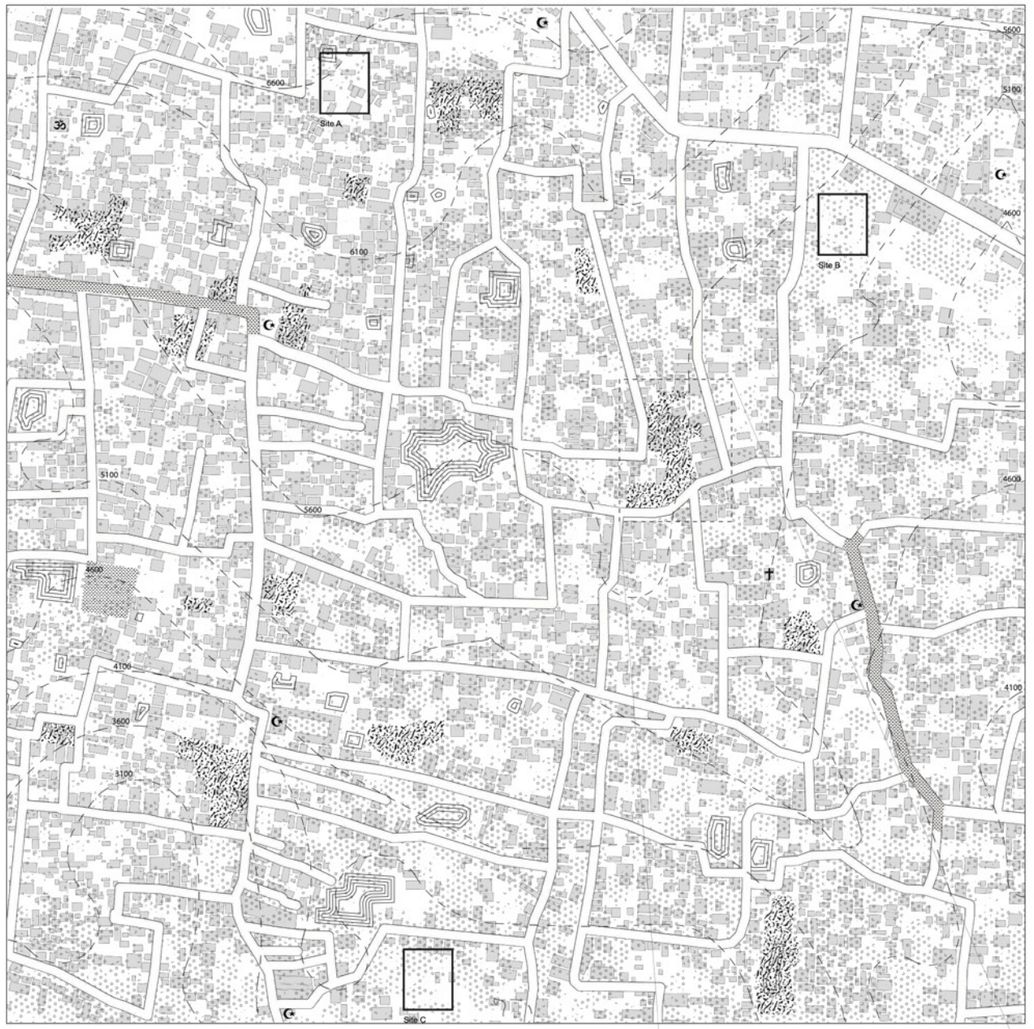
NIJEL HONG TERNG WEI

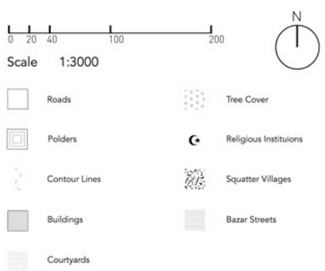
Wind Velocity Mapping



Map of Khulna Old Town
B&W - Site Details
Coloured - Wind Velocity

Low Rise Urban Mapping





Map of location with visible (black and white) and invisible (colored) features

Scale: n/a
Scale Bar: n/a
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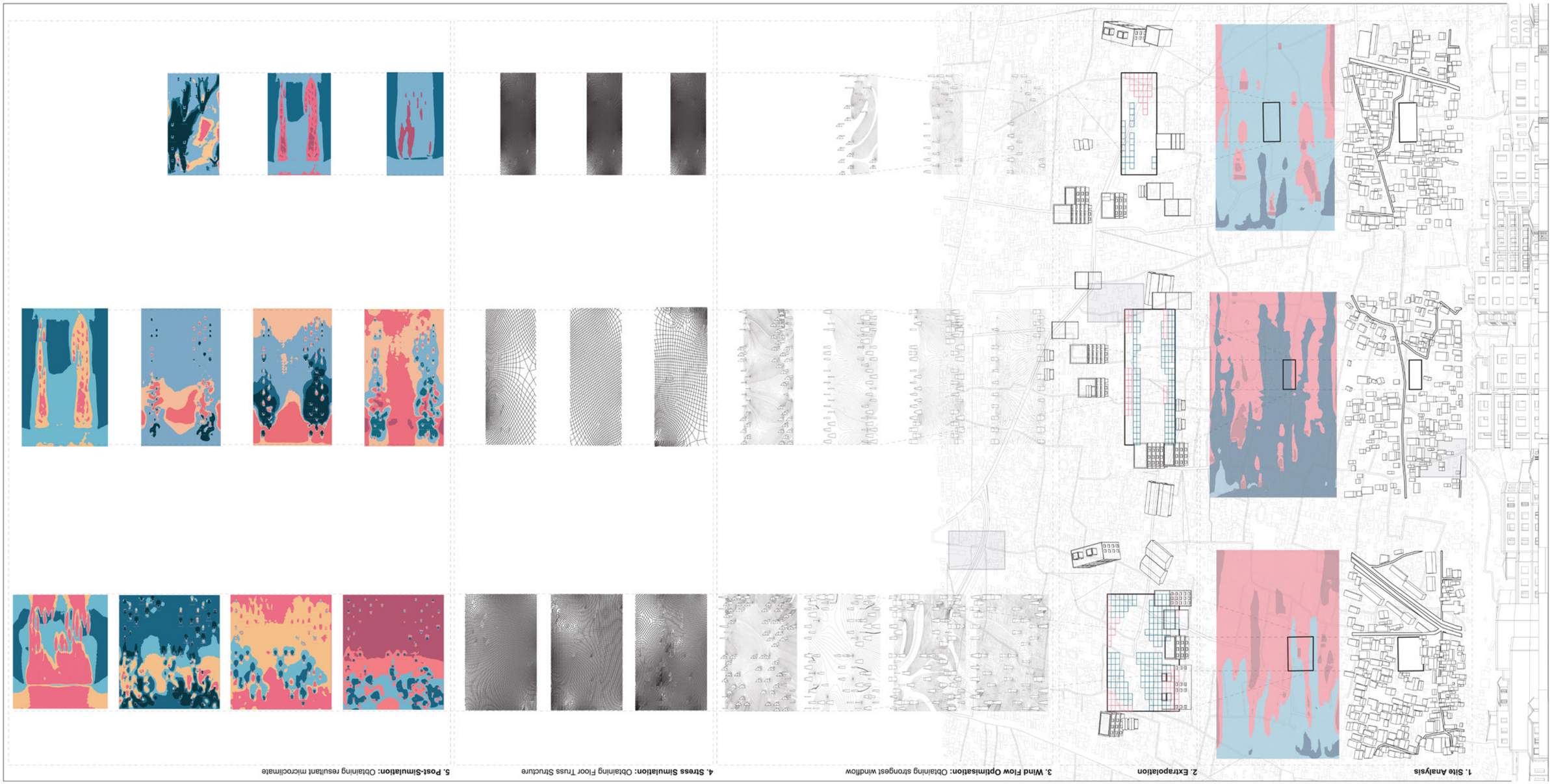
Parametric and Simulative Processes
Studio Aurel von Richthofen WithOut Water
Architecture and the water-food nexus.
Student Name: Nijel Hong Terng Wei
Site: Khulna, Bangladesh
Coordinates: 22.550926N, 88.31926E
National University of Singapore
School of Design and Environment
Department of Architecture
Design Module AR4102/ AR4104
AY 2018/19 Semester 02
1. Site Analysis
2. Extrapolation
3. Wind Flow Optimisation: Obtaining strongest windflow
4. Stress Simulation: Obtaining Floor Truss Structure
5. Post-Simulation: Obtaining resultant microclimate

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: Nijel Hong Terng Wei
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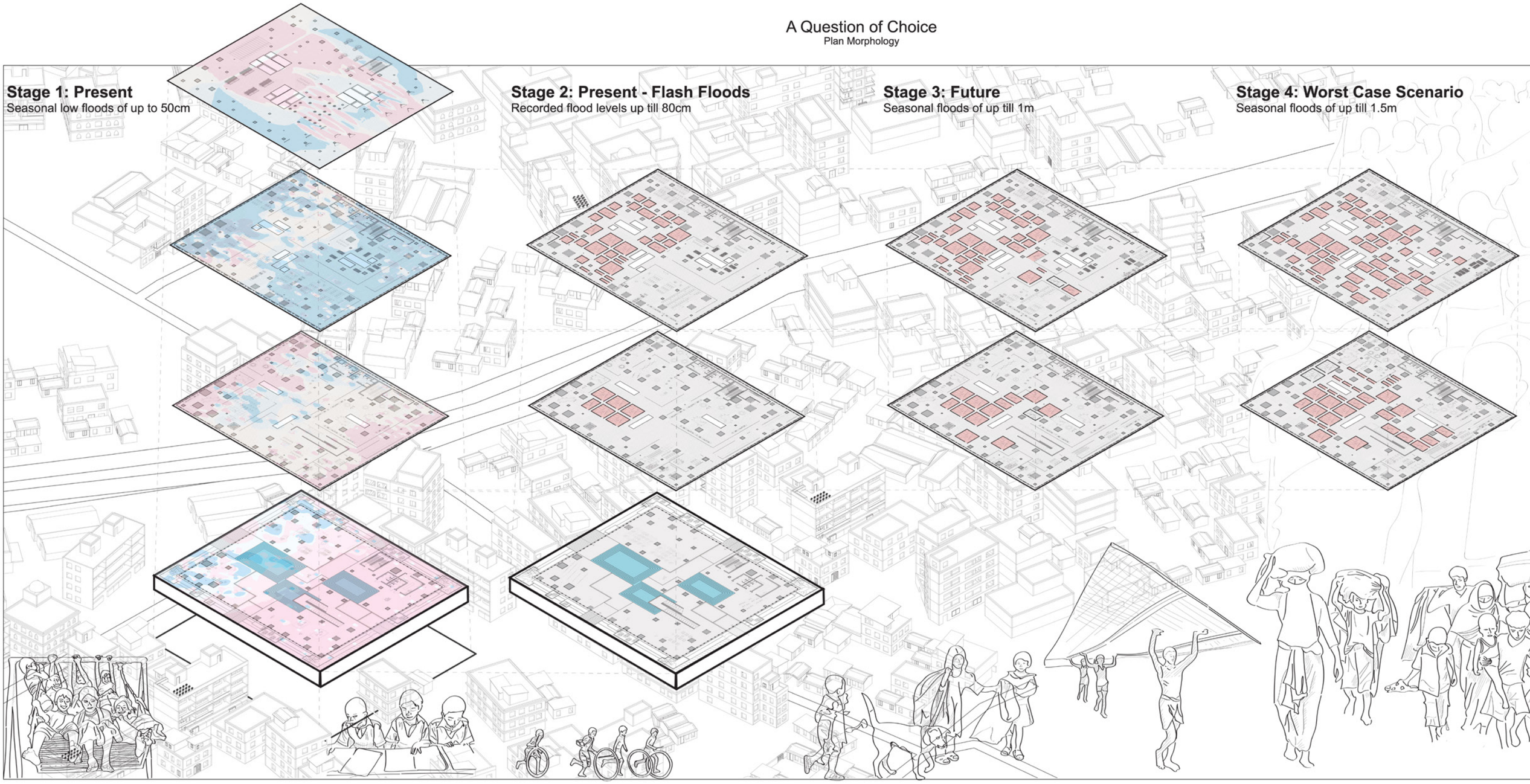
A Question of Choice

Plan Morphology



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NIJEL HONG TERNG WEI

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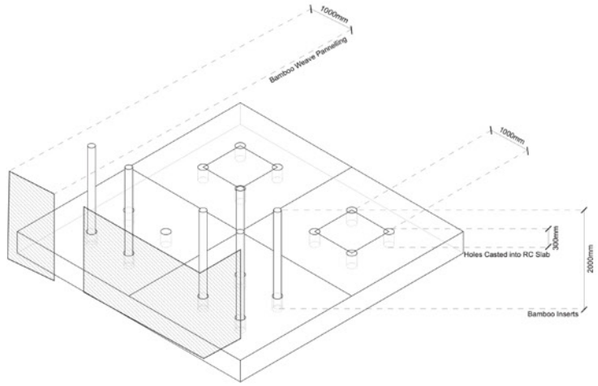
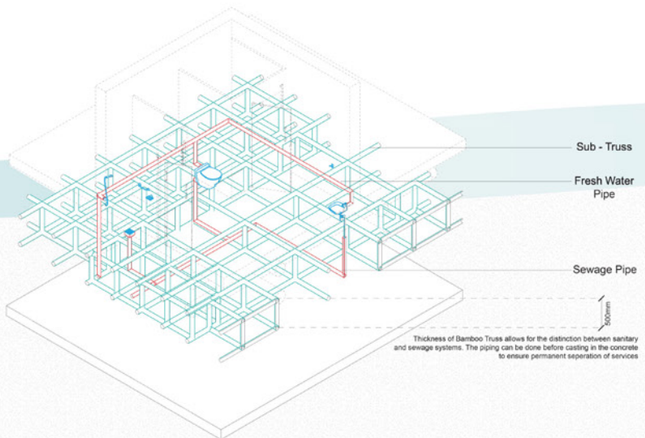
Programatic System Flow

Panneling System



Water Services



Wind Catchers
Brings in Less Humid Air Above the Building into the System, Utilising the Venturi Effect

Moire Facade
Facade that Utilises the Moire Effect to Create a Gradation of Permeability to Ensure Pressure in the System

Concrete + Bamboo Reinforced Slab
Ensures Tensile Integrity of Long Span Structure (Longest C-C between Columns 30m)

Solar Light Well
Axial Moment Structure to Prevent Shear. Brings Light to Lower Floors

Brick + Bamboo Compressional Columns
Ensures Compressional Integrity of Building

Various Crops
Serves as Indicator of Salinity to Detect Salinisation of Subterranian Aquifers (Indicates Possible Inundation)

Concrete Footings
+ 6.5 MSL
Ensures Protection of Bamboo Compressional Columns in the Event of Flooding (in 2070)

Maximum Predicted Flood Height
+ 6.5 MSL
Site Elevation
+5.0 MSL
1500mm

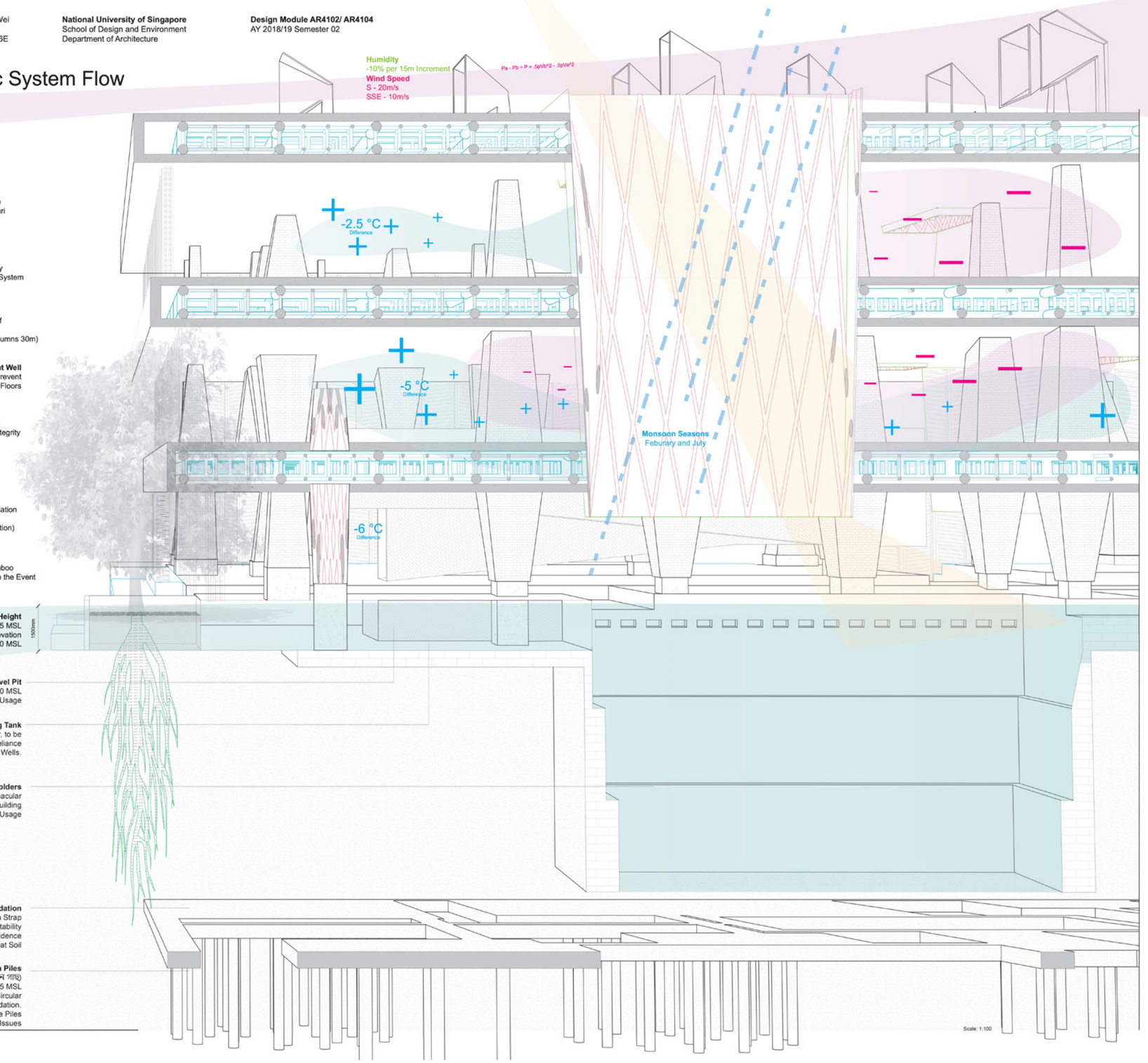
Gravel Pit
+1.0 MSL
Cleanses Water After Communal Usage

Water Holding Tank
Water Tank that Stores Cleaned Water, to be Hand Pumped. Reduces Communal Reliance on Bore Wells.

Polders
An Adaptation of Vernacular Features into the Building to Strengthen Communal Usage

Bamboo + Concrete Strap Foundation
Due to Irregularity of Columns, a Strap Foundation is Used to Ensure Stability of Load Transfer, thus Preventing Subsidence in Peat Soil

Vernacular Garāna Gācha Piles
(গরান গাছ)
+1.5 MSL
Magrove Stumps of 3-5m Long are Piled in a Circular Fashion to Support the Strap Foundation. This Method Reduces Reliance on Bore Piles due to Mobility and Cost Issues



Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: Chia Hui Jie Christopher
Site: Khulna, Bangladesh
Coordinates: 22.803777N, 89.565031E

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Map of location with visible
(black and white) and invisible
(hatched) features

Scale: 1:750

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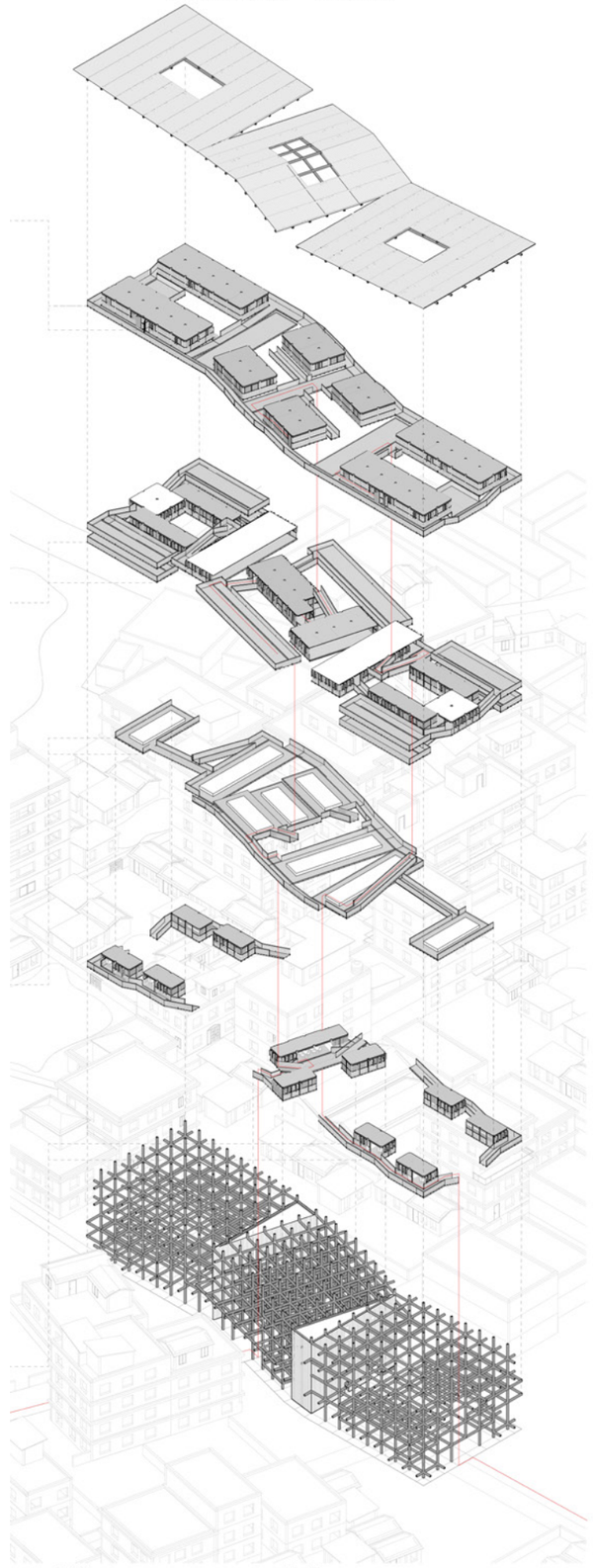

Exploded Axonometric

Scale: 1:150

Scale Bar: _ __ ____

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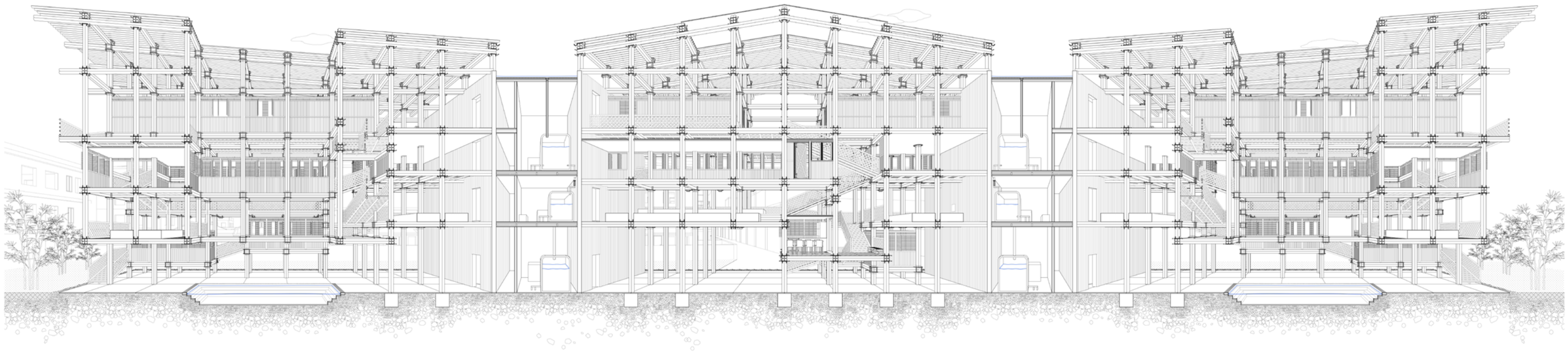
Design Module AR4102/ AR4104
AY 2018/19 Semester 02

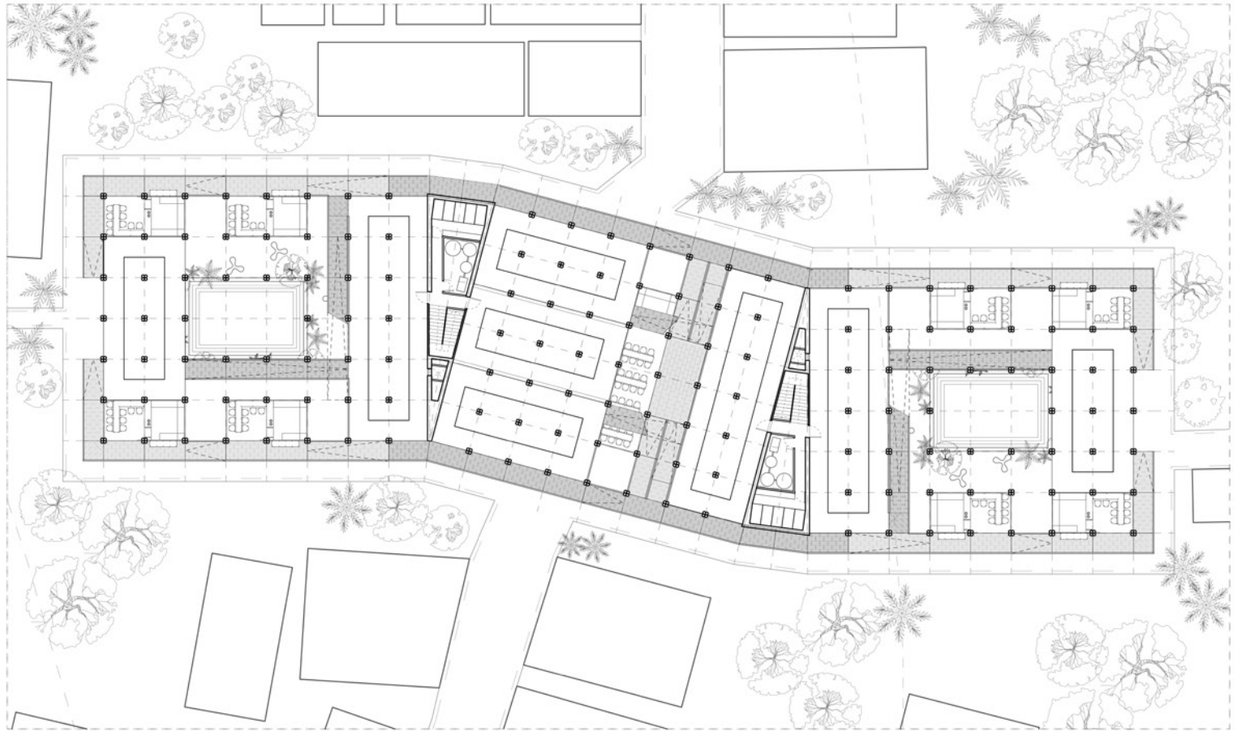


Sectional Perspective
Cutting from North to South

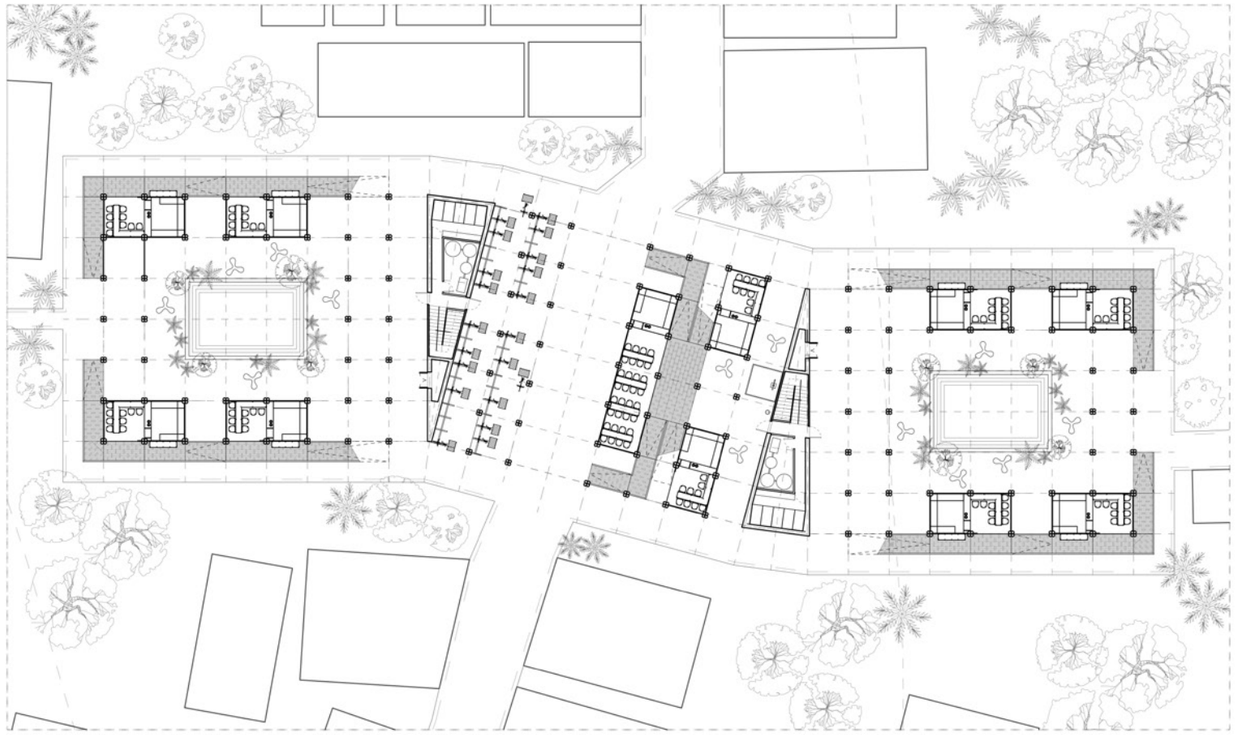
Scale: 1:50

Scale Bar: _ __ ____

Legend: [ ] [ ] [ ] [ ] [ ]



Second Storey



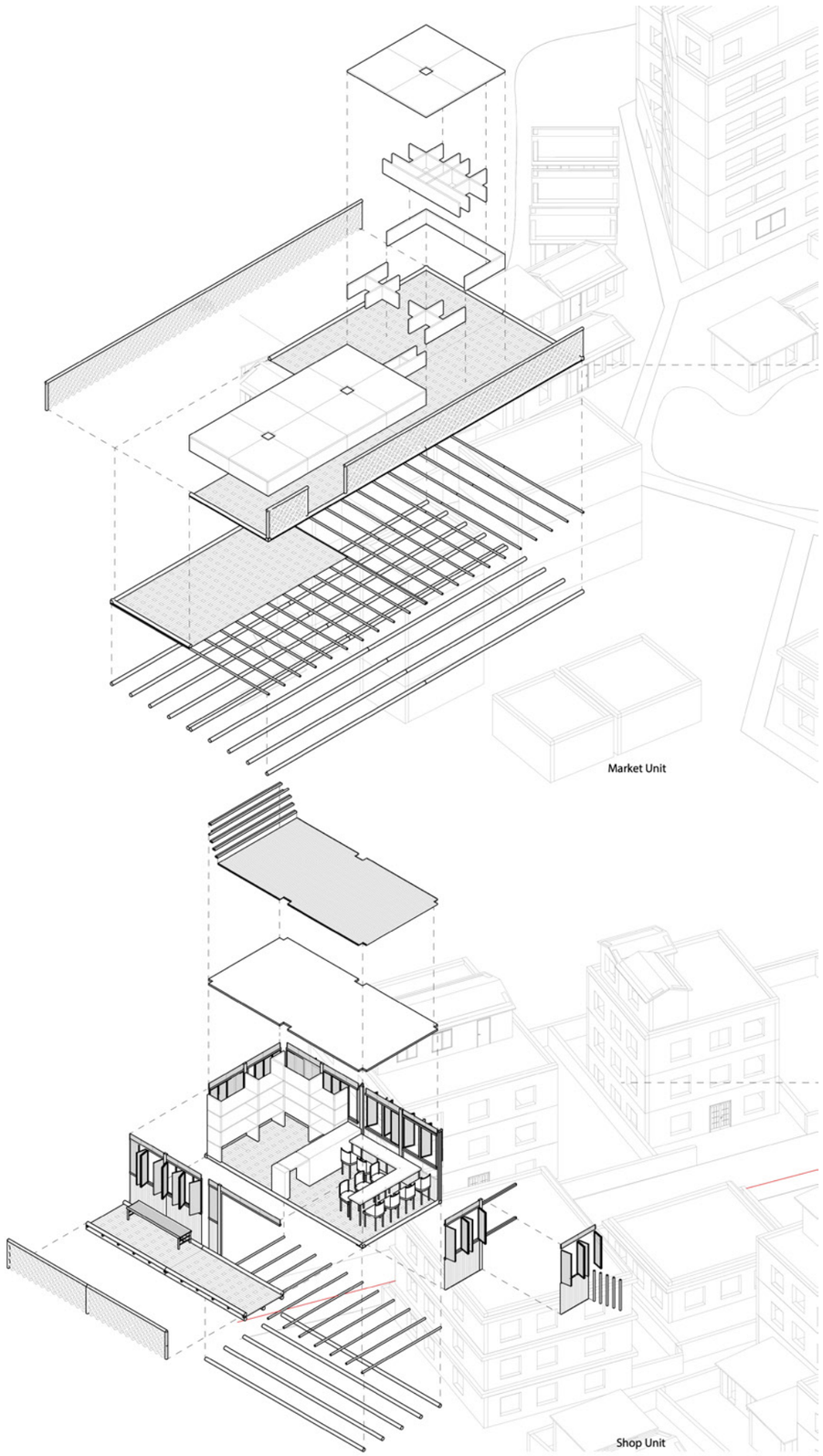
First Storey

Floor Plans

Scale: 1:150

Scale Bar: _ __ ____

Legend: [ ] [ ] [ ] [ ]



Exploded Modules

Scale: 1:50

Scale Bar: _ __ ____

Legend: [ ] [ ] [ ] [ ]

Studio: Aurel von Richthofen
With/Out Water Architecture within a water-food nexus in Khulna, Bangladesh

Student Name: Amanda
Site: Ward 09
Coordinates: 22.849389N, 89.531070E

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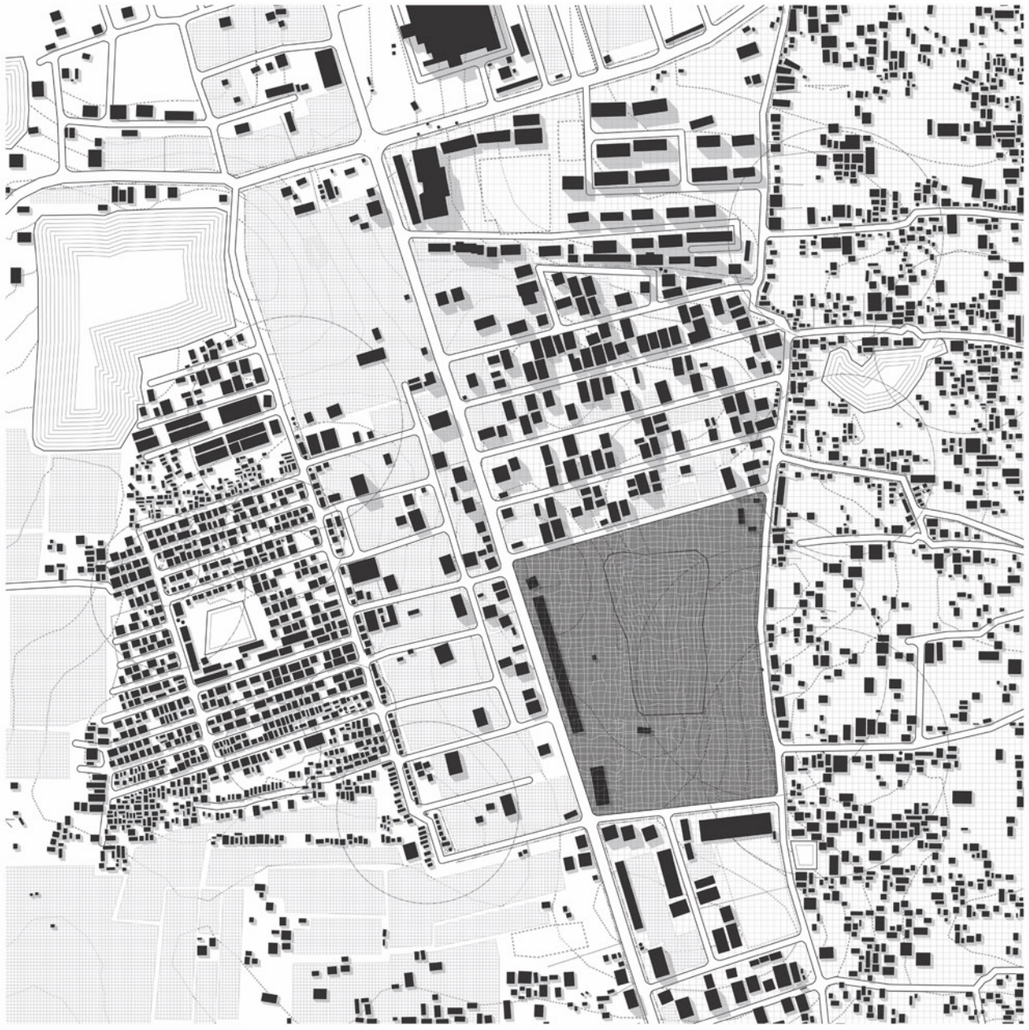
Large-scale extractions of ground water from deep aquifers is Khulna's foremost water source, yet they are not done in conjunction with the replenishing rate of ground water. The rapid depletion of groundwater is further aggravated in the absence of sustainable aqua-infrastructure and the persistent increment of salinity found in both soil and water present in farmlands. This project, also named as 'Mohona', will be a new landscape model to carefully curate a gallery of sustainable landscaping methods that displays the natural course of conserving rainwater as a new water source. Additionally, Mohona involves the integration of an agricultural school to improve the current local farming practices in the region. Education, farming and water-harvesting form a synthetic approach to the water challenges in Khulna.

This project will consist of 5 integral phases; each serves to readjust landform, preserving current vegetation, soil desalination, community integration and promote healthy agro-practises. The project transforms the landscape through the use of cut-and-fill with conscious zoning and phasing out the planting of various vegetation. The former horizontal site becomes an artificial landscape with man programme possibilities. Architecture and landscape architecture 'occupy' each part of this new scheme. Alongside, the agricultural school is designed in coherent with the landscape, providing a smooth transition between the school and the landscape and to assist with the curation of water flow through the new landform. All of these done with the goal of promoting sustainable landscape, new biodiversity hotspots and establishing the next Water-Food nexus within this neighbourhood. Hence, the exploration of various landscape interfaces such as woodland renewals, biostrip filters and bioswale econtones and the agriculture programmes are used to reignite the bridge between nature and man.

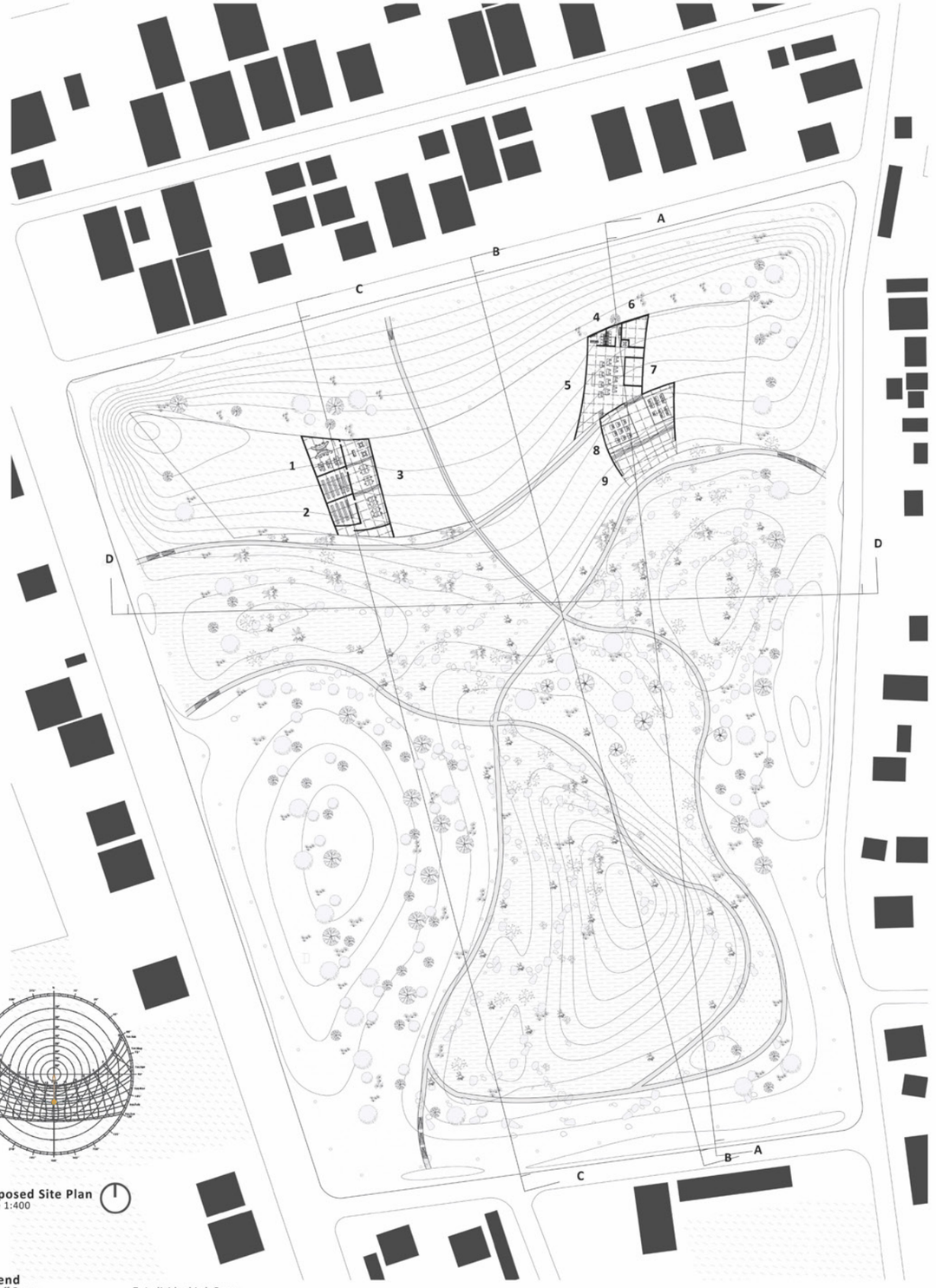


Map of location with visible (black and white) and invisible (colored) features

Scale: 1:2000

Scale Bar: 0 50 100

Legend:
- Building
- Shadow
- Agriculture
- Dense Vegetation
- Open Field
- Open Water Body
- Stand alone Toilet
- Open Water Source
- Open Drainage
- Contour
- Dirt Road
- Road
- Water Provison Radius *(Estimated)*



Proposed Site Plan
Scale 1:400

Legend
1. Staff Room
2. Archive Room
3. Study Area
4. Toilet
5. Classroom
6. Storage
7. Individual Lab Room
8. Classroom
9. Library

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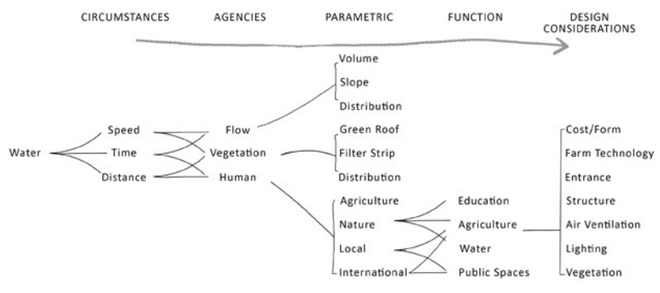
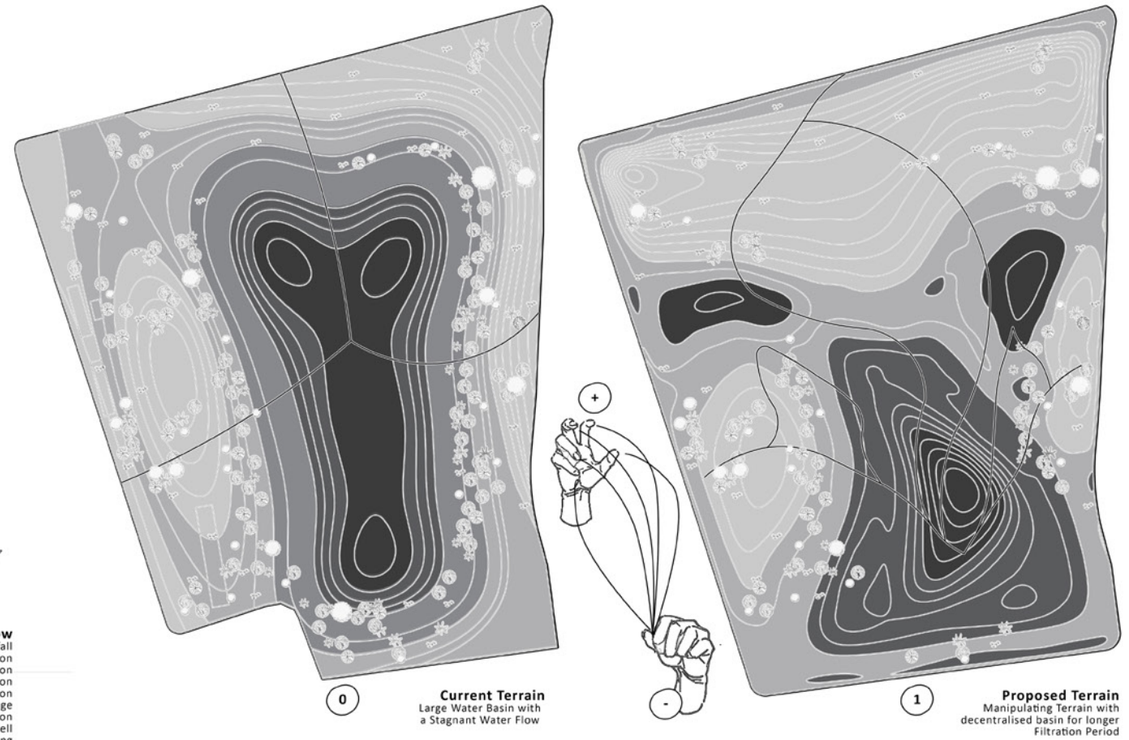


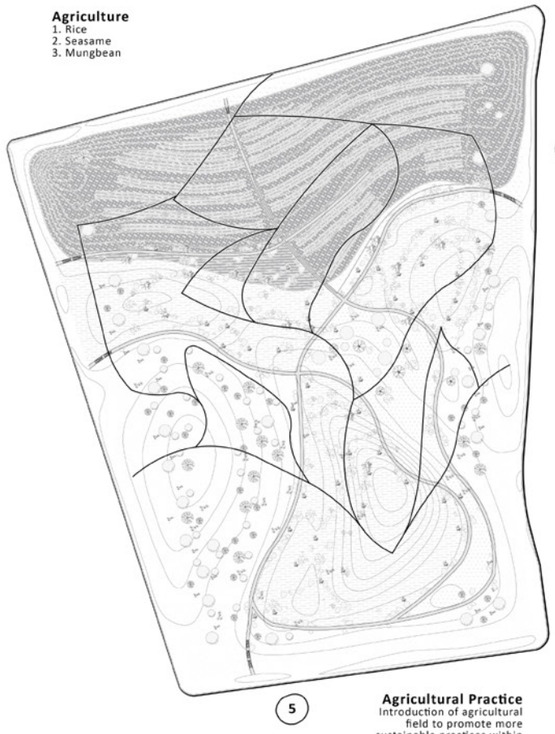
Waterflow
1. Rainfall
2. Transportation + Sedimentation
3. 1st Filtration
4. 2nd Filtration
5. Harvestation
6. Agriculture Usage
7. Infiltration
8. Recharging Groundwater Well
9. Transpiration + Cooling



0 **Current Terrain**
Large Water Basin with a Stagnant Water Flow

1 **Proposed Terrain**
Manipulating Terrain with decentralised basin for longer Filtration Period

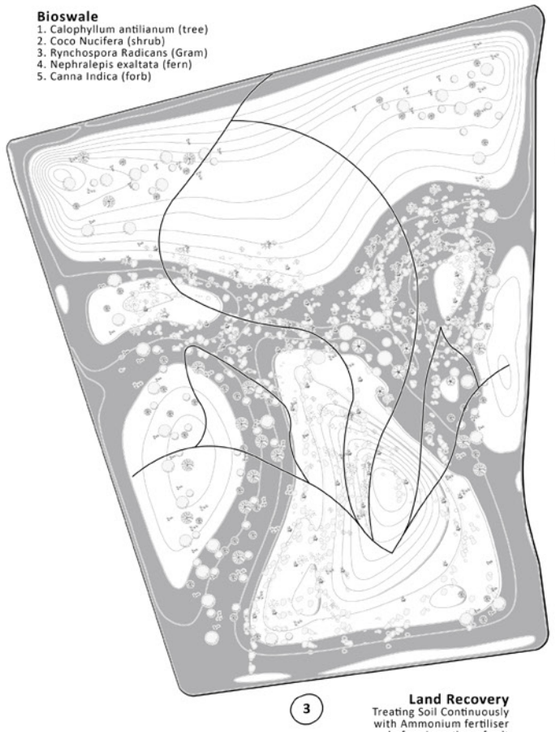
Agriculture
1. Rice
2. Seasame
3. Mungbean



5 **Agricultural Practice**
Introduction of agricultural field to promote more sustainable practices within Ward 09

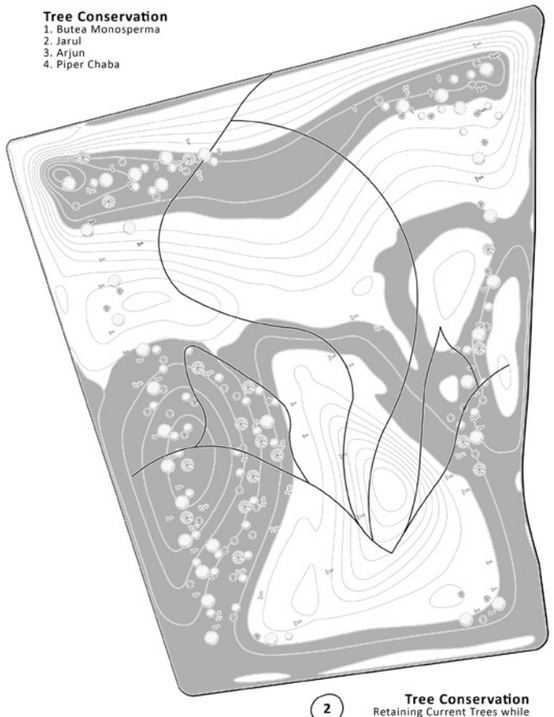
4 **Community School**
Insertion of Communal Agricultural school which acts as both a learning hubg and a communal space with available public library

Bioswale
1. Calophyllum antilianum (tree)
2. Coco Nucifera (shrub)
3. Rynchospora Radicans (Gram)
4. Nephralepis exaltata (fern)
5. Canna Indica (forb)



3 **Land Recovery**
Treating Soil Continuously with Ammonium fertiliser before insertion of salt marshes and bioswales gradually (1 Year period)

Tree Conservation
1. Butea Monosperma
2. Jarul
3. Arjun
4. Piper Chaba



2 **Tree Conservation**
Retaining Current Trees while additiong of a more variety of tree density &tree types fto promote diversified land ecosystem for Mohona

Studio: Aurel von Richthofen
With/Out Water Architecture within a water-food nexus in Khulna, Bangladesh

Student Name: Amanda
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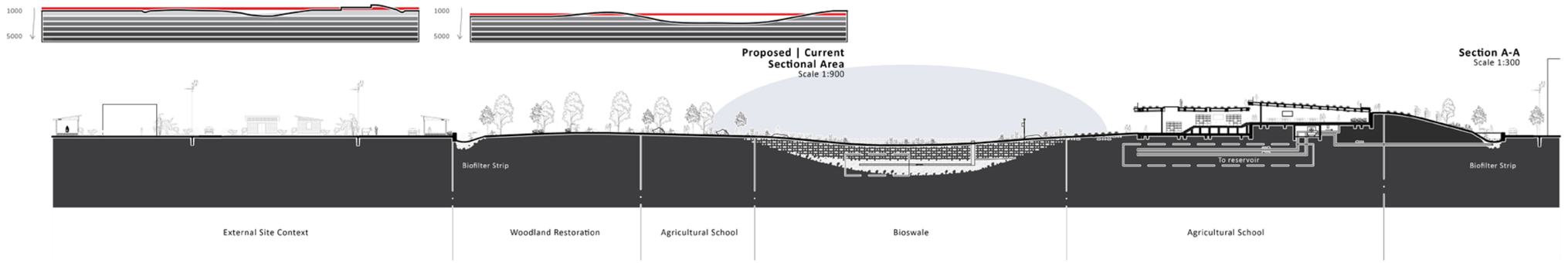

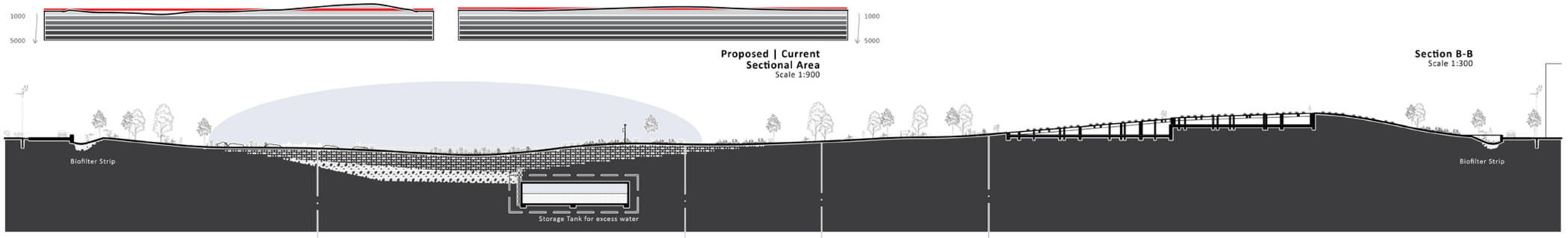

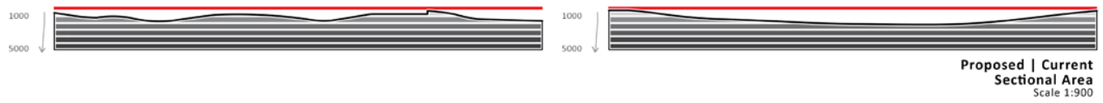

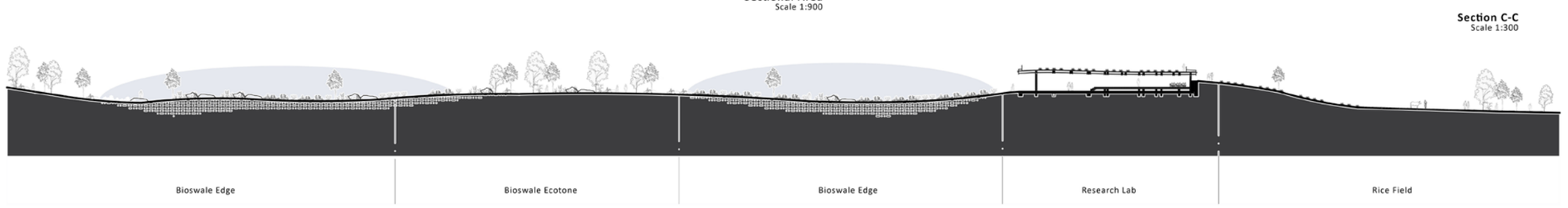

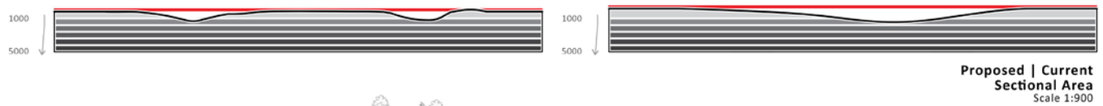

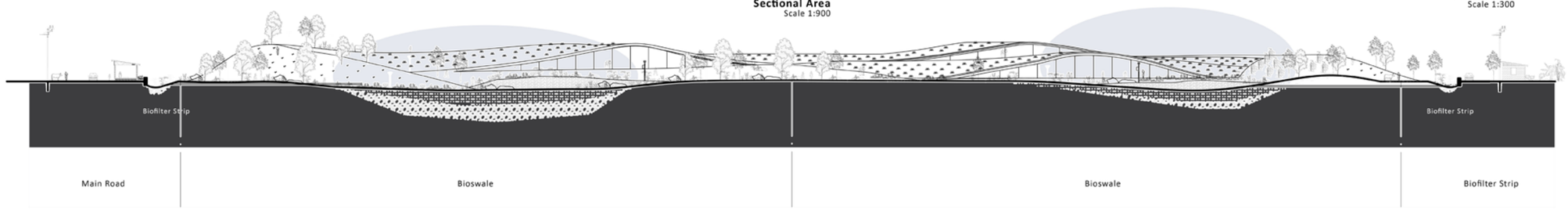

Studio: Aurel von Richthofen
With/Out Water Architecture within a water-food nexus in Khulna, Bangladesh

Student Name: Amanda
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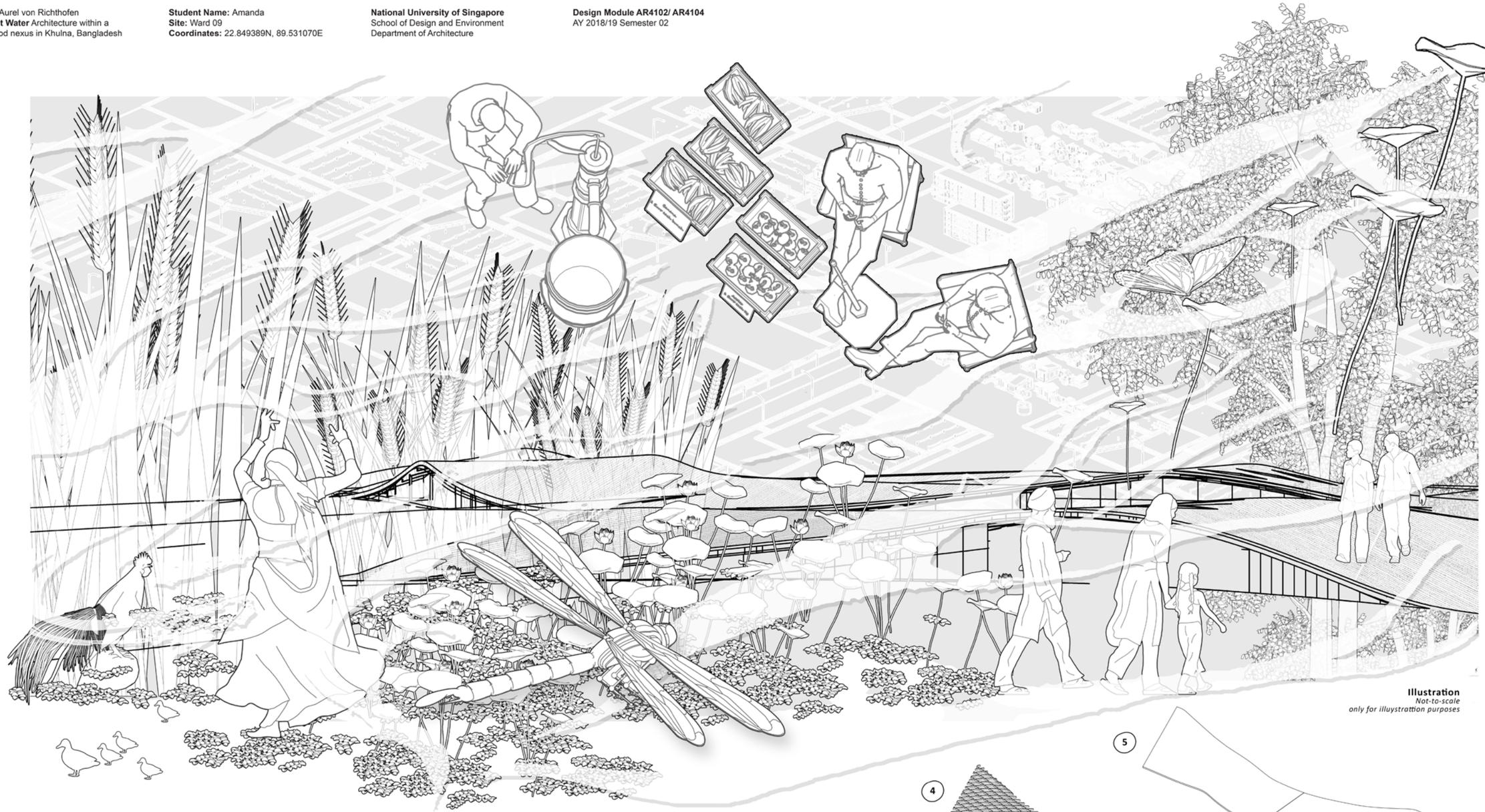
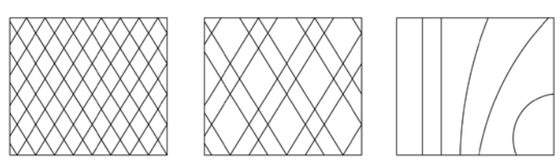
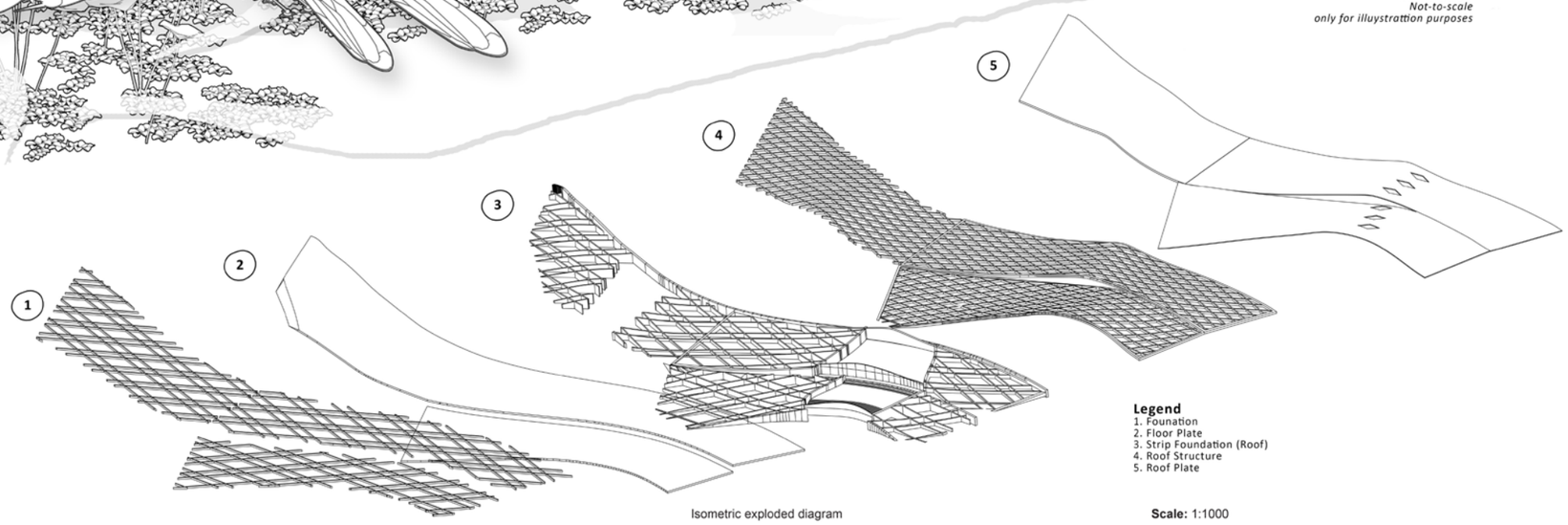


Illustration
Not-to-scale
only for illuystrattion purposes





Isometric exploded diagram

Legend
1. Founation
2. Floor Plate
3. Strip Foundation (Roof)
4. Roof Structure
5. Roof Plate

Scale: 1:1000

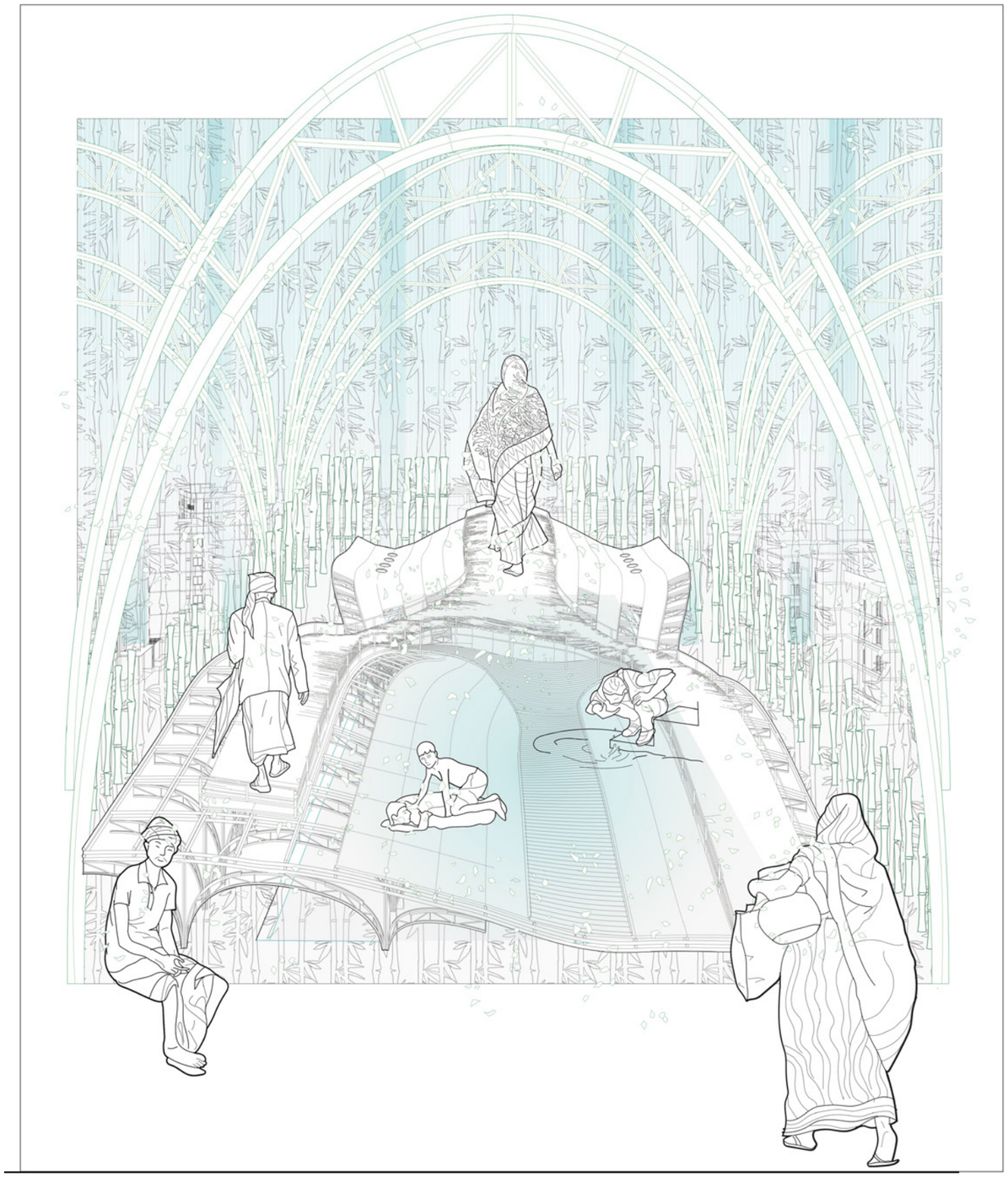
Scale Bar: _ __ ____

Legend: [ ] [ ] [ ] [ ] [ ]

Thesis: The chosen site at Ward 17 is a well-developed residential area with a thriving community of middle-class income households. One of the community's largest water resources is the Solar Pond located within the Solar Park. This historical Solar Pond was speculated to be an energy generator, but its current facility is being abandoned while the pond remains as a site for various recreational uses such as swimming and washing. However, the current Solar Park segregates the community due to its surrounding fence while the Solar Pond restricts movement within the park due to its long profile (190m).

This project seeks to take advantage of the huge surface area of the park to provide a water harvesting roof while enhancing existing public uses that emerged around the pond and the park. The undulating bamboo structure aids rainwater movement for filtering and encourages movement around the park. At the same time, the roof structure divides the homogeneous park and pond into various zones by creating multiple pockets of space and shelters for various uses on top and below this new urban canopy. This artificial landscape reacts to various climatic conditions and meteorological events.

The crests of the roof provide shelter and protection from the hot summer and also lookout points around the site. The roof shape also encourages cross ventilation which aids the evaporative cooling effect of the pond. During the monsoon season, the trough collects the rainwater and form a new pool of rainwater, transforming the landscape and allowing the use of fresh rainwater to be separated from the current pool. Rainwater that is harvested through the columns and can be filtered for park users or stored at the basement water tank for future uses.



Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: Lam Jun Yuan
Site: Khulna, Bangladesh
Coordinates: 22.8248N, 89.5380E

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School of Design and Environment
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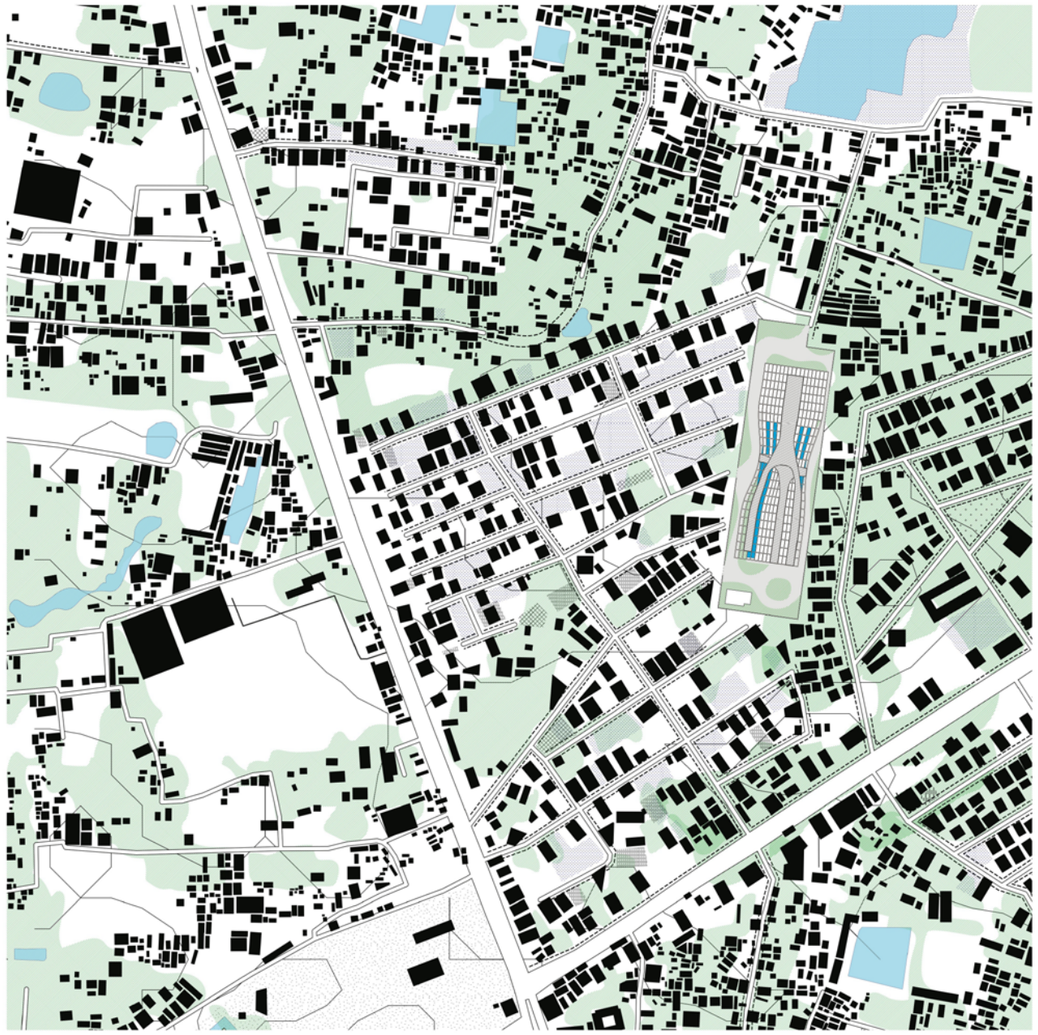
AY 2018/19 Semester 02

Khulna Ward 17



Human Activity
- Road
- Building
- Cleared Land
- Roadside Drainage
- Community Park
- Small-scale cultivation
- Small-scale livestock
- Public Water Source

Geographic Features
- Vegetation
- Water Body
- Waterlogged Land
- Contours, 4m interval

N

Site Plan
Scale: 1:2000

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: Lam Jun Yuan
Site: Khulna, Bangladesh
Coordinates: 22.8248N, 89.5380E

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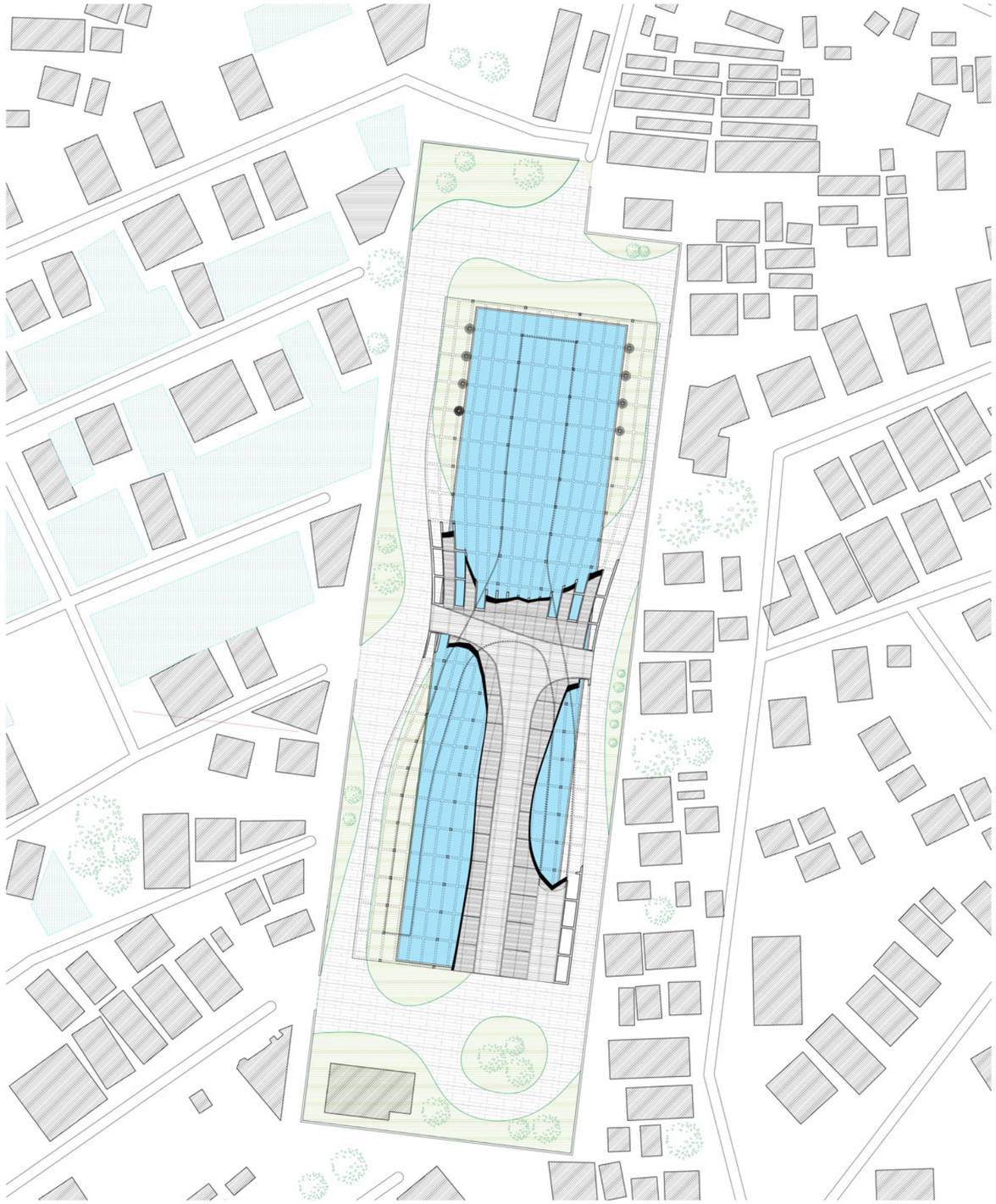

Ground Floor Plan
Scale: 1:500

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: Lam Jun Yuan
Site: Khulna, Bangladesh
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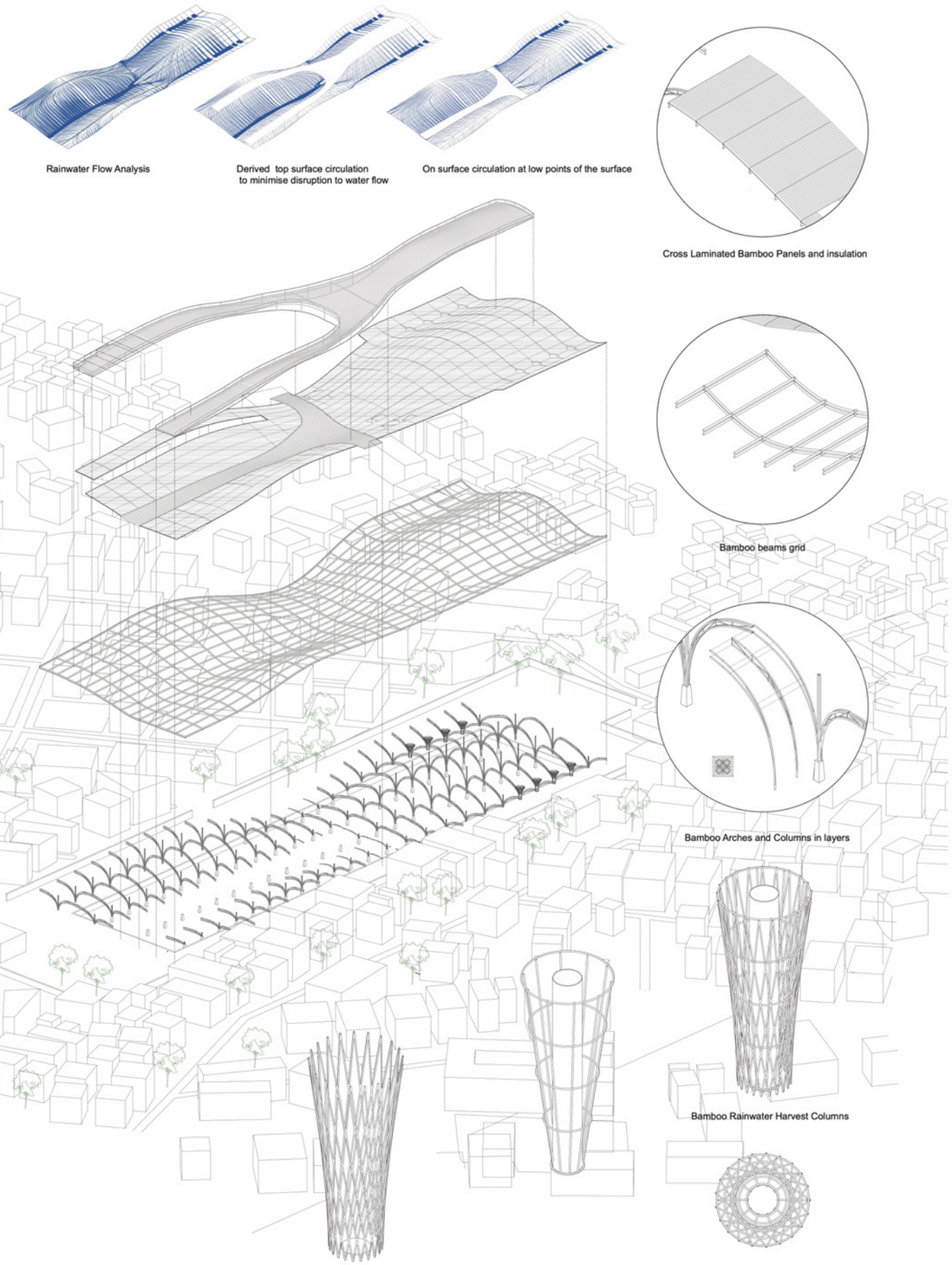

Isometric Exploded

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

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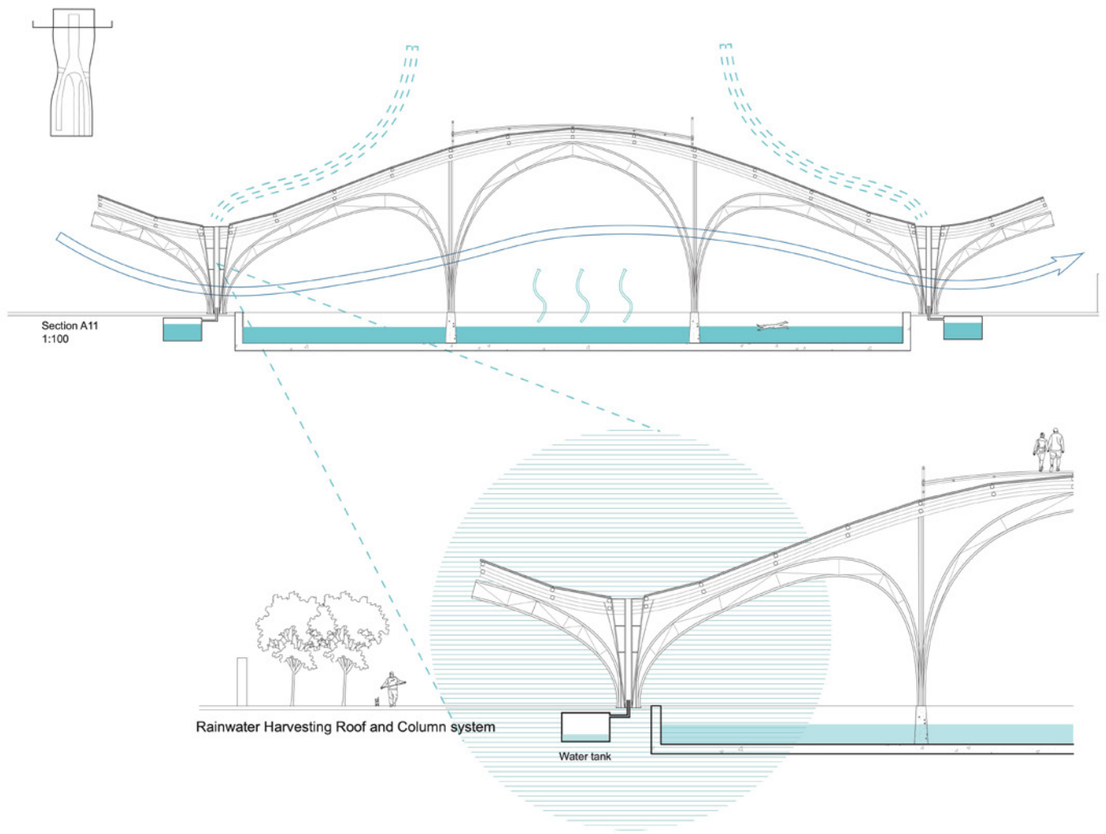
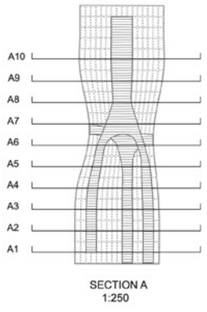
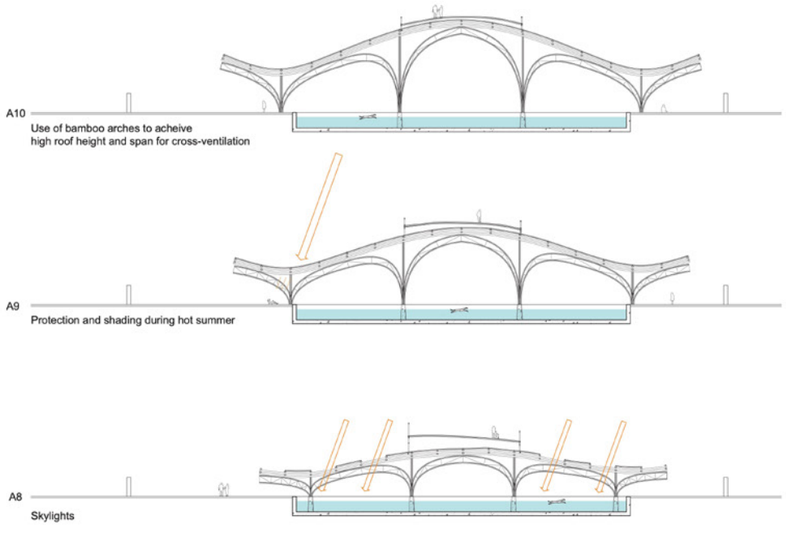
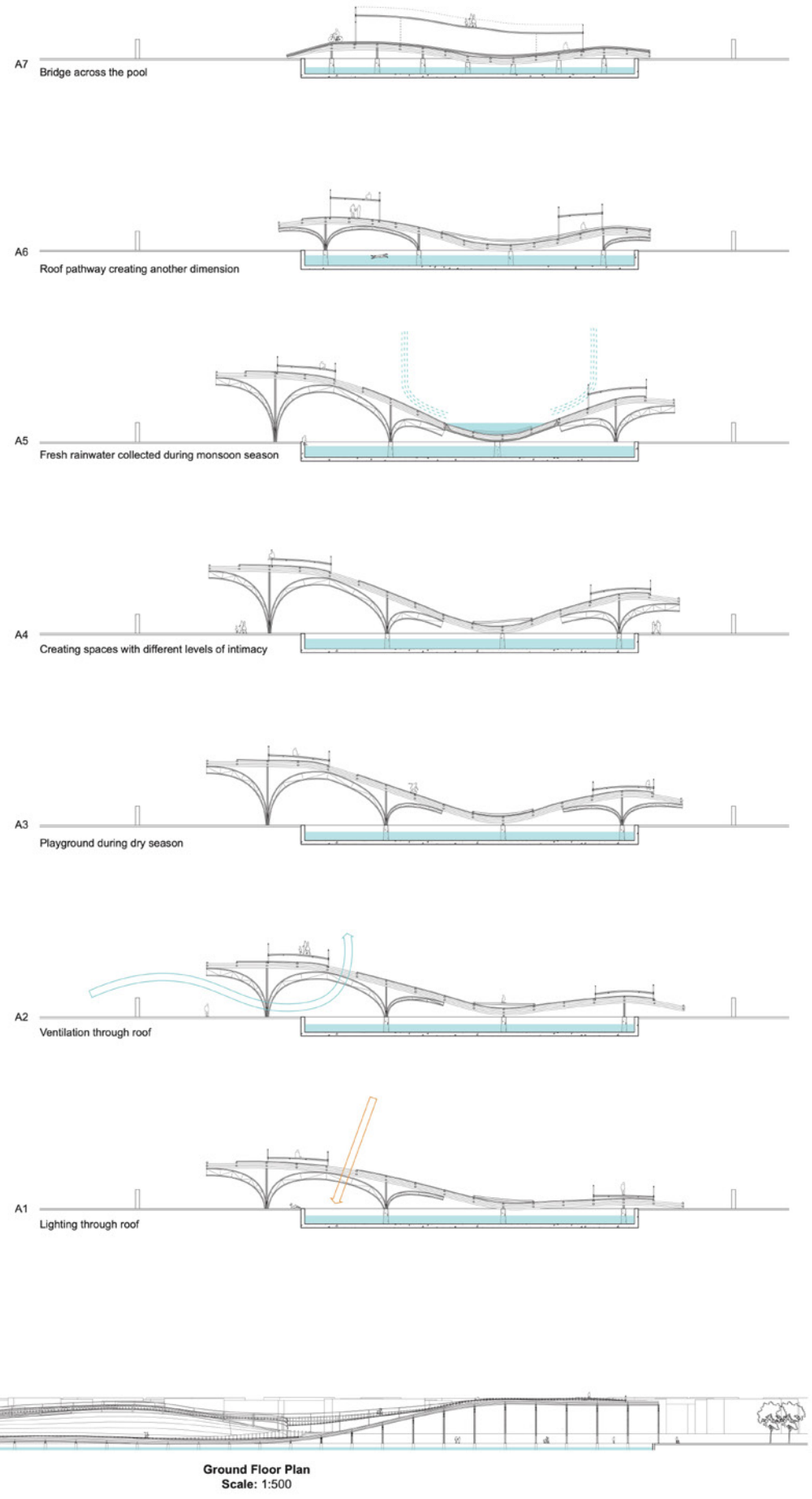
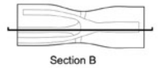




SECTION A
1:250







Section B
1:500

Ground Floor Plan
Scale: 1:500

Thesis: In Rayarmahal, Khulna, 90% of the land is occupied by aquaculture, while an overpopulated Bangladeshi Muslim community of approximately three thousand dwellers crowds within an unsanitized informal settlement. As the commemorative district name suggests, Refugee Colony Road contained temporary settlers who later transformed the makeshift location into a permanent space for inhabitants. The former fields now transformed into tight and dense neighborhoods. From an urban scale analysis, the settlement layout implies a centrifugal pattern diffused from the focal point, marked by a mosque and Islamic lake in the middle ground.
Contrary to the teachings of the Qur'an, which preaches the importance of pure water amongst all living beings, humans; animals; plants, the Refugee Colony residents are deprived of clean water access. The site experiences an extreme saline condition in the earth and water source quality, in addition, to worsen by unhygienic disposal. The unfortunate existing plight of the site, therefore, opposes the Islamic beliefs and only further amplifies the detrimental effects on the well-being of these people.
With these, my thesis is to incorporate the profane and pragmatic solution of pure water access through a natural filtration process and emphasize the significance of water as a quintessential resource in the spiritual dimension of Islamic use to support lives. The vision of Refugee Colony would be imagined as a reconstructed neighbourhood transformed through assimilating the principles from a traditional Char Bagh Islamic garden. The concept grasp on the idea of paradise as a visionary space symmetrically divided by four cardinal points and a central node. Commonly demarcated by walkways leading to a water feature as a pivotal point. On the four quadrants, lush greenery and agriculture would take place as a celebration of life, stability, and goodness. An Islamic garden is a sacred notion of paradise that is bounded on the perimeters, separating the divine from the outer realm of reality.
Overall, the project aims to aesthetically become an architectural landmark that reinforces the notion of an Islamic garden presence on site likewise heightens the community pride. This is achieved by designing 5m x 5m replicable modules supported by low-cost bamboo construction and are strategically invented to be easily managed by the community. The architecture is situated on the perimeter of the informal settlement and metaphorically operates as paradise's boundary wall and gate. Moreover, incorporating the pragmatic solutions to intensify food and water security that benefits the physical and psychological well-being of the people in the long run.

Illustration of Site Context

Scale: n/a
Scale Bar: n/a

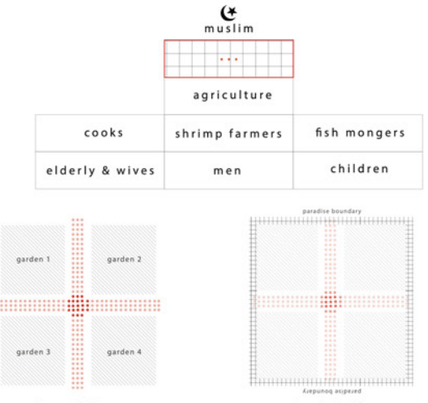
Legend: n/a

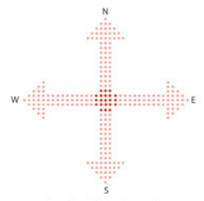
Map of Rayarmahal, Khulna, Bangladesh

Scale: 1:2000

Scale Bar:
0m 50m 100m 200m

Legend: (Stated above)



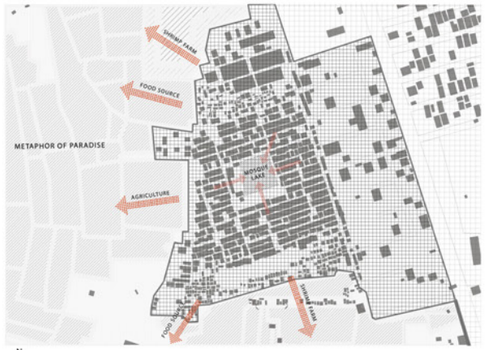


4 cardinal points & centrality

Symmetrical layout

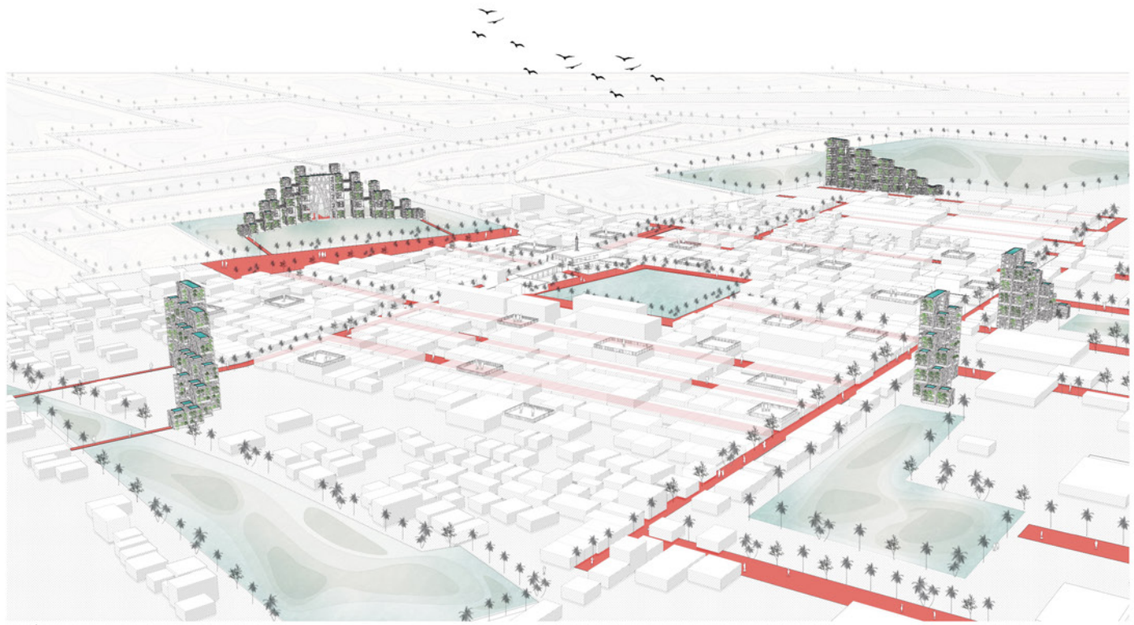
Paradise boundary

Lush greenery and water way



The metaphor of Heaven
Scale 1:3000

Reinterpretations of an Islamic Garden
Scale 1:3000



Aeriel View of reimagined Refugee Colony Road

Charg Bagh Interpretation Diagrams

Aeriel View

Scale: n/a
Scale Bar: n/a

Legend: n/a

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: Rebecca Chong
Site: Khulna, Bangladesh
Coordinates: 22.8472046N, 89.525891E

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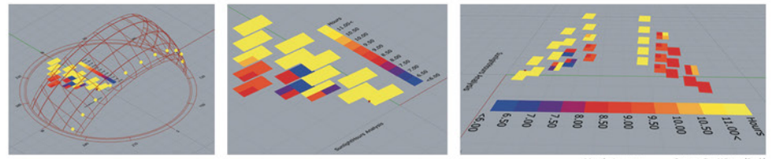
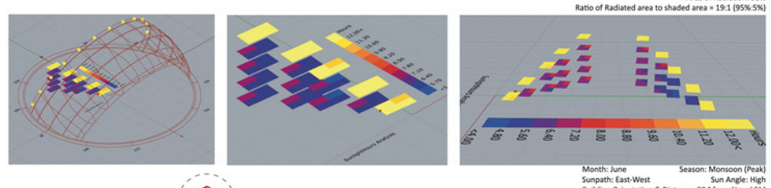
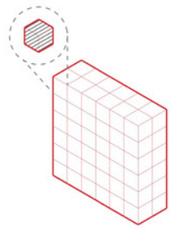


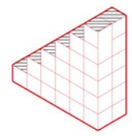
Month: January
Sunpath: South-West
Building Orientation & Distance: 80 ° from N and 5M
Season: Dry Winter (Peak)
Sun Angle: Low
Area of Radiation: 95%
Ratio of Radiated area to shaded area = 19:1 (95%:5%)



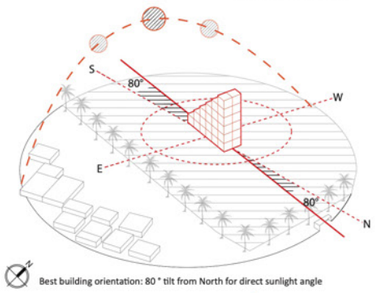
Month: June
Sunpath: East-West
Building Orientation & Distance: 80 ° from N and 5M
Season: Monsoon (Peak)
Sun Angle: High
Area of Radiation: 35%
Ratio of Radiated area to shaded area = 7:13 (35%:65%)



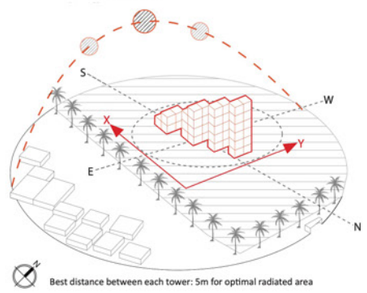
5m x 5m Bamboo modules



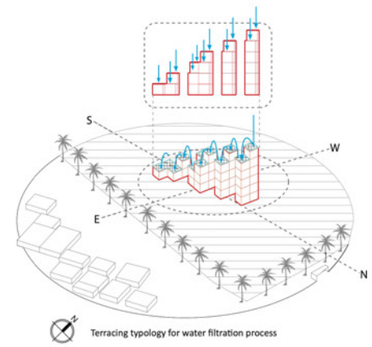
Terrace Typology



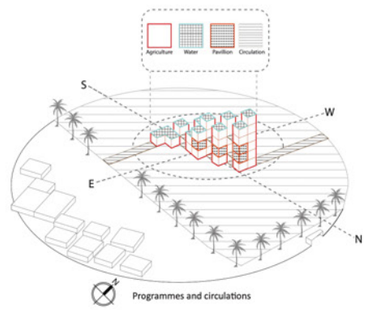
Best building orientation: 80 ° tilt from North for direct sunlight angle



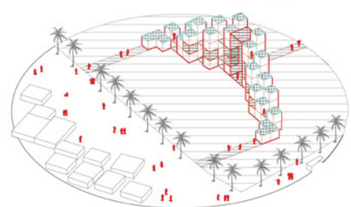
Best distance between each tower: 5m for optimal radiated area



Terracing typology for water filtration process



Programmes and circulations



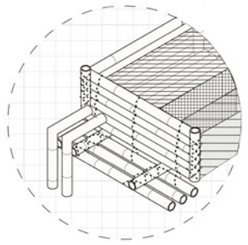
Islamic wall design

Simulation Diagrams

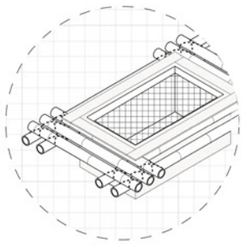
Design Diagrams

Scale: n/a
Scale Bar: n/a

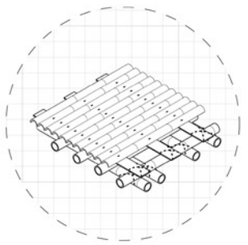
Legend: n/a



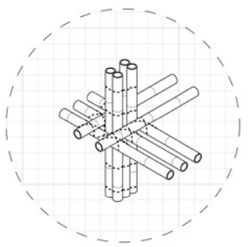
1. Water Filtration Bamboo Container with Polyester lining



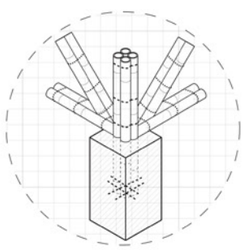
2. Harvesting Rack



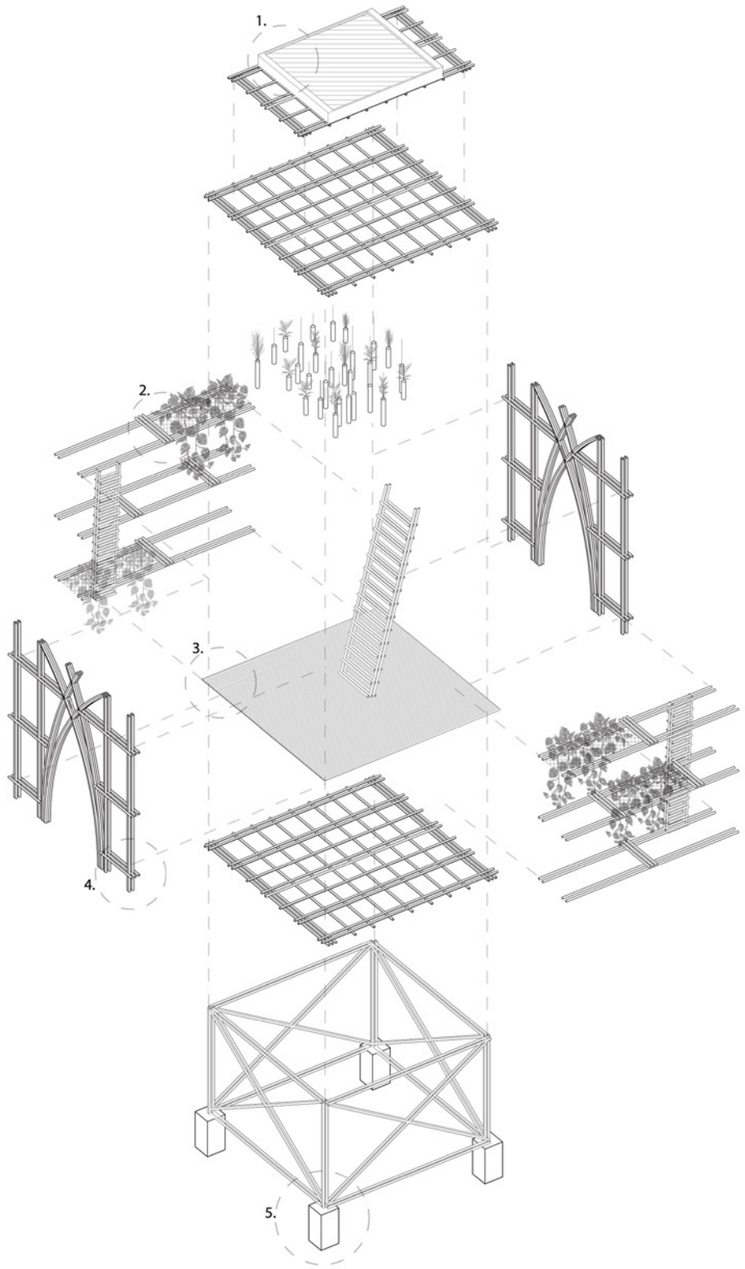
3. Half Culm Bamboo Flooring



4. Column & Beam Intersection



5. Foundation



Isonometric Exploded Diagrams

Isometric exploded diagram

Scale: n/a
Scale Bar: n/a

Legend: n/a

Studio: Aurel von Richthofen **With/Out Water**
Architecture and the water-food nexus.

Student Name: Rebecca Chong
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Coordinates: 22.8472046N, 89.525891E

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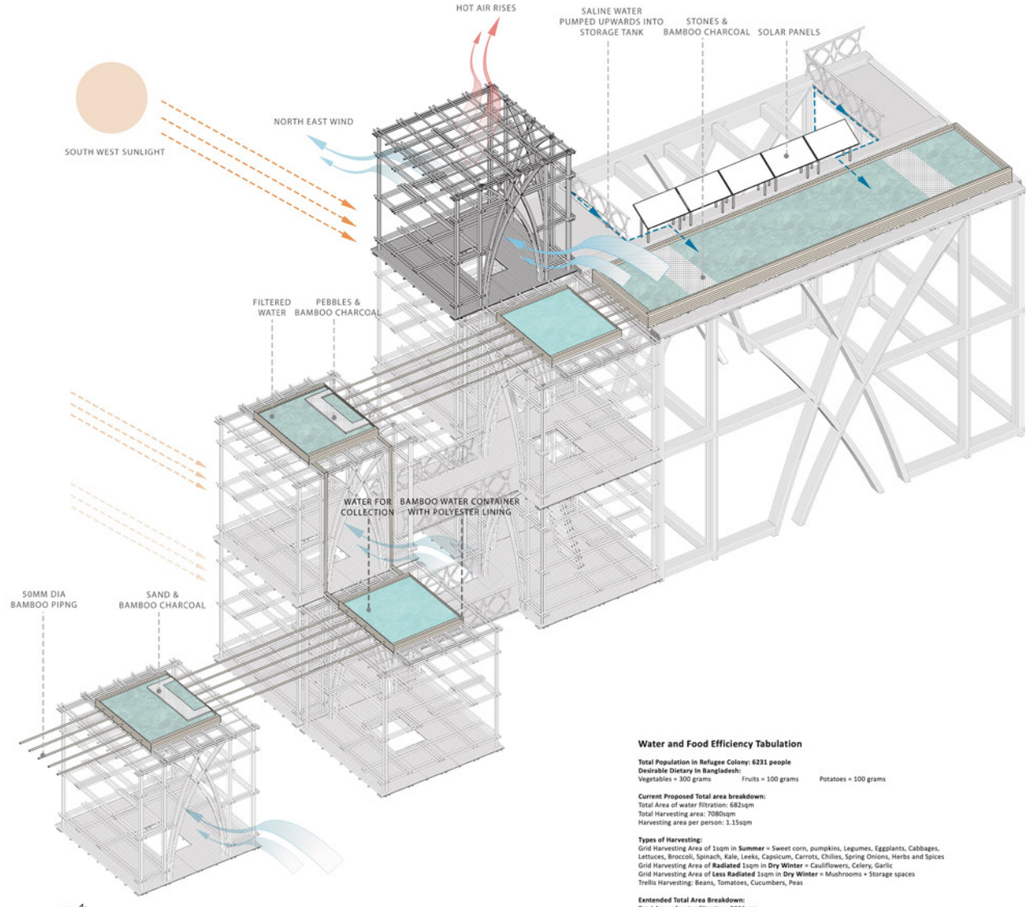


Isonometric View of Water filtration Process

Water and Food Efficiency Tabulation

Total Population in Refugee Colony: 6231 people
Desirable Dietary in Bangladesh:
Vegetables = 300 grams Fruits = 100 grams Potatoes = 100 grams

Current Proposed Total area breakdown:
Total Area of water filtration: 682sqm
Total Harvesting area: 7080sqm
Harvesting area per person: 1.15sqm

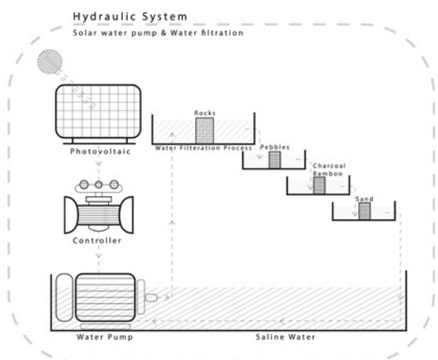
Types of Harvesting:
Grid Harvesting Area of 1sqm in **Summer** = Sweet corn, pumpkins, Legumes, Eggplants, Cabbages, Lettuces, Broccoli, Spinach, Kale, Leeks, Capsicum, Carrots, Chilies, Spring Onions, Herbs and Spices
Grid Harvesting Area of **Radiated** 1sqm in **Dry Winter** = Cauliflowers, Celery, Garlic
Grid Harvesting Area of **Less Radiated** 1sqm in **Dry Winter** = Mushrooms + Storage spaces
Trellis Harvesting: Beans, Tomatoes, Cucumbers, Peas

Exntended Total Area Breakdown:
Total Area of water filtration: 3066sqm
Total Harvesting area: 32753sqm
Harvesting area per person: 5.25sqm (Results if Islamic Garden Boundaries were maximized)

Conclusion:
Therefore, Increases the Agriculture intensity by 4.5 times the original proposed area.
The further extension of Islamic Garden boundary will

1. Secure the food production in long run
2. Produce surplus products to market
3. Transform the community living environment

Extended Urban Diagram

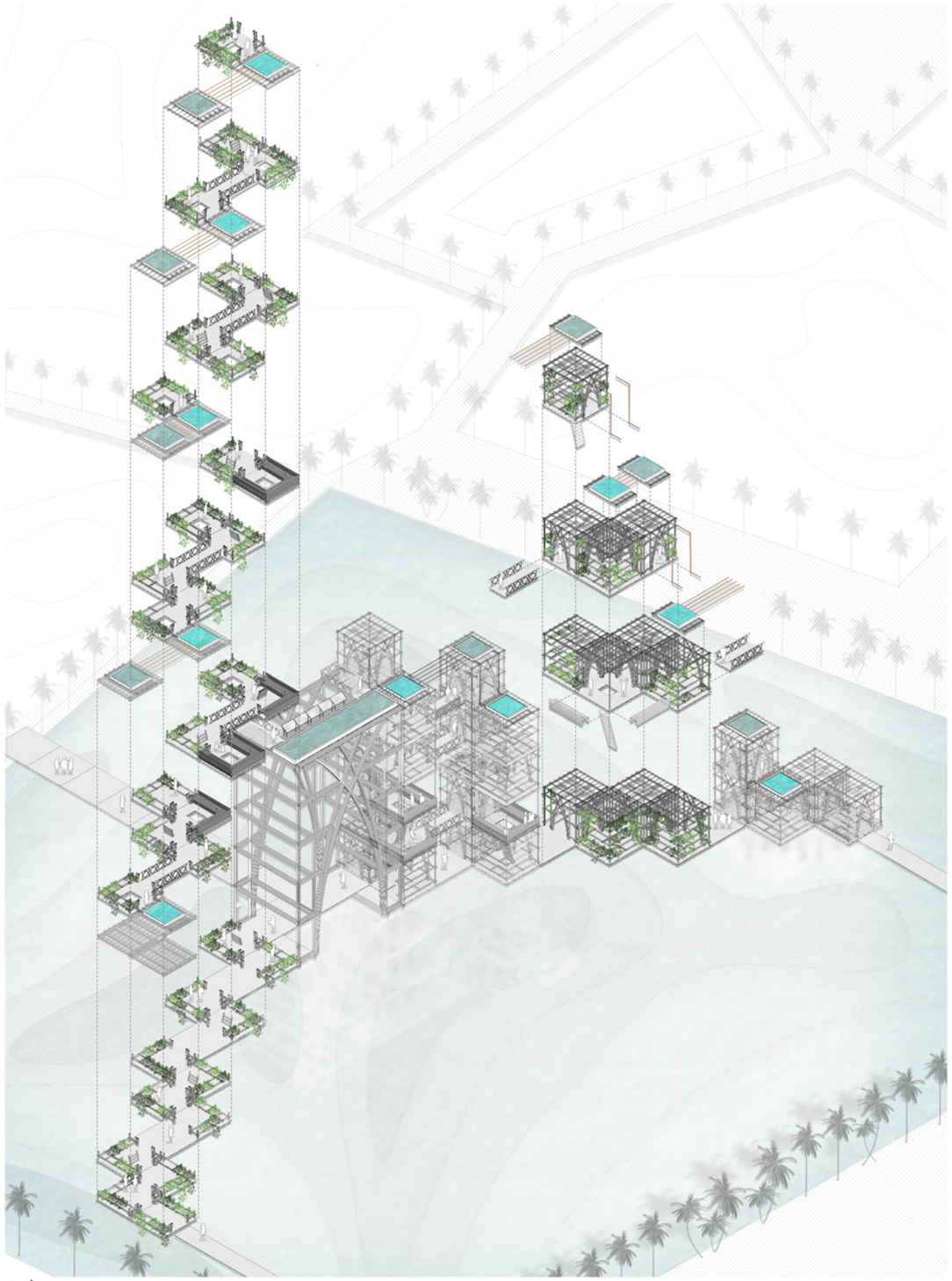


Water Filtration Diagrams

Extended Urban Diagrams

Scale: n/a
Scale Bar: n/a

Legend: n/a



Isometric Exploded Plans and Modules

Scale: 1:200

Scale Bar:

0m 5m 10m 20m

Legend: n/a

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Perspective of Entrance into Refugee Colony Road

Perspective of Elevation from a Balcony

Perspective of Entrance into Refugee Colony Road

Perspective of Elevation from a Balcony

Scale: 1:200

Scale Bar:

0m 5m 10m 20m

Legend: n/a

Studio: Aurel von Richthofen **With/Out Water**
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Student Name: Renee Tay Tzeman
Site: Khulna, Bangladesh
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THESIS: In the Muslim and highly conservative society of Bangladesh, most of women's work is confined to the domestic sphere. Wiith most women having their first child by the age of 18, women cannot be engaged within the formal economy, instead dropping further education to tend to housework and children.

Domestic activities make great demands on clean water, a resource which is often insufficient. Despite the necessity of clean water for activities such as cooking, washing, and sanitation, the provision of water is most often through public tube-wells, which often need to be pumped by hand. The water, stored in aluminum jugs, is then ferried manually to the home. Thus, women's daily life often revolves around rituals of water.

However, facilities are scarcely sufficient to meet demand, and in particular to serve the needs of the female population, who both in menstruation and childbirth have much higher demands for sanitation. Most of everyday washing, for example, takes place in polluted, trash-filled water bodies. In this case, women are seen to frequent the now-derelict saltwater solar collector known as the Solar Park in order to carry out everyday laundry. However, the provisions for washing are neither built for purpose nor comfortable for use, and lead to greater pollution of the Solar Pond itself.

The architecture aims to bring about social development and localized change in Khulna. It strives to elevate the highly important daily activities carried out by women – the lifeblood of the city's households – as valuable economic labour. The chosen site builds upon existing economic activities which already take place there and are driven by women: the recycling economy, livestock raising, and raw material and fuel production. At the same time, the architecture seeks to provide women with safe, protected spaces which would provide them the same free and comfortable access to privacy, clean water, bathing, and sanitation – spaces which in the public sphere are more frequently only available to men.

Illustration of site features

Scale: n/a
Scale Bar: n/a
Legend: n/a

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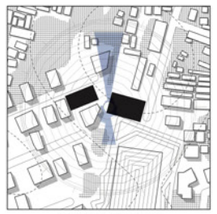
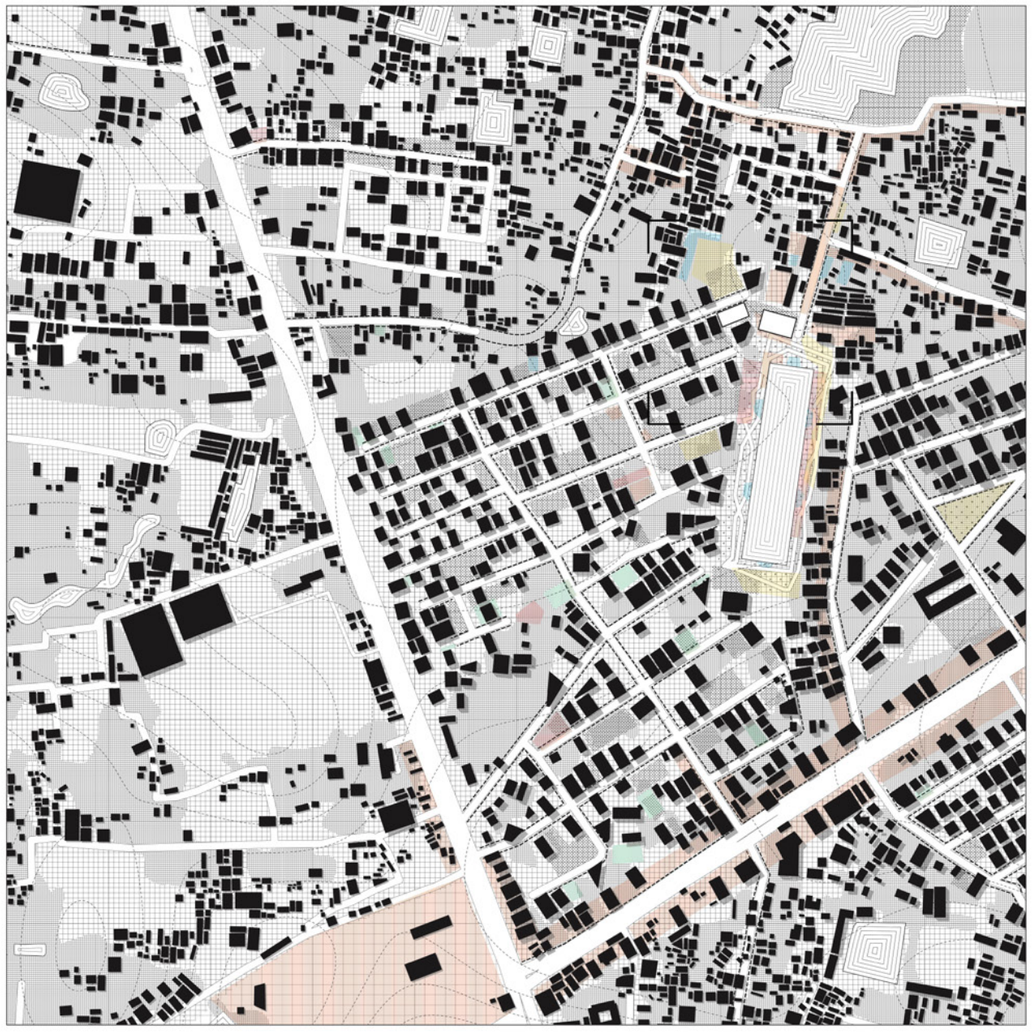
Annual Sunpath



Annual Prevailing Winds

Wind Speed at Site

Circulation Flow



Scale: 1:2000

Scale Bar:

0 30 45 60 80 100 200m

Legend:

- Business
- Playing
- Washing
- Livestock
- Agriculture
- Open Land
- Grass
- Trees
- Waterlogging
- Water
- Park
- Road
- Drainage
- Contour Line
- Building

Map of location with visible (black and white) and invisible (colored) features

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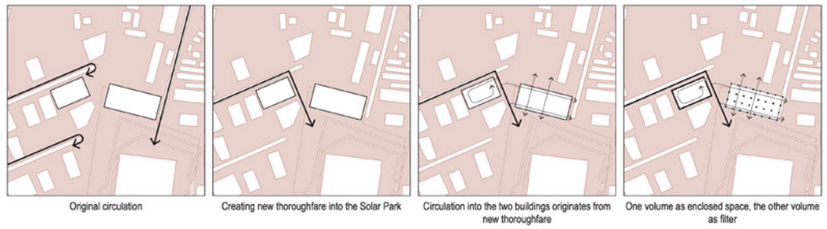

Ground floor plans / sections

Explanatory detail samples

Scale: -

Scale Bar: -

Legend:

Private space | Semi-private space | Public space

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Site plan

Elevations

Scale: 1:200

Scale Bar:

0 2 4 6 8 10 20m

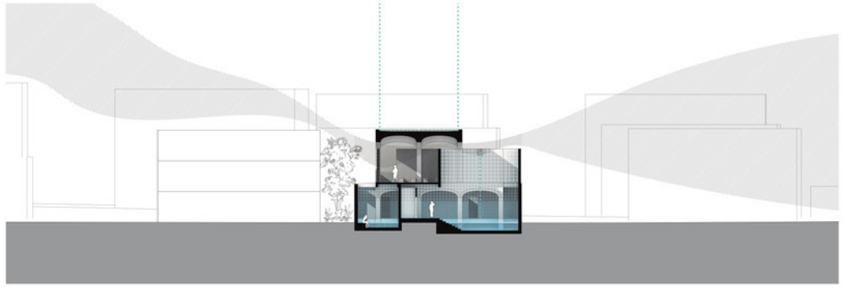
Legend: -

Bath House

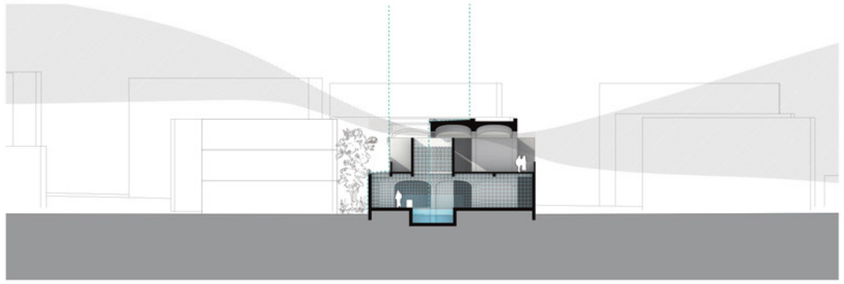
1. Reception
2. Lockers & Changing Rooms
3. Makeup Room
4. Private WC
5. Public-facing WC
6. Showers
7. Heated pool
8. Steam room
9. Deep pool, 1.5m
10. Bathing pool,1.2m
11. Resting Room
12. Multi-purpose space
13. Health Education classroom
14. Clinic waiting area
15. Clinic reception desk
16. Exam Room
17. Counselling Room

Women's Centre

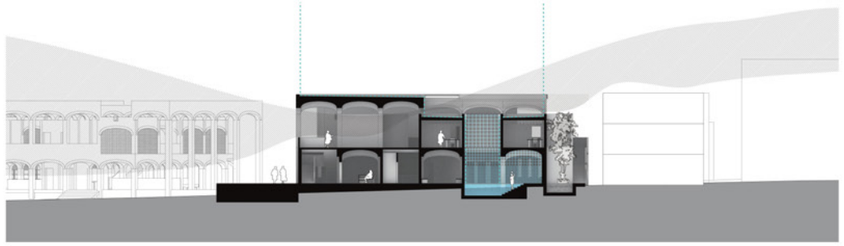
18. Laundry area
19. Recycling workshop
20. WC
21. Storage
22. Market
23. Training Room
24. Library
25. Children's play room
26. Computer room
27. Meeting room
28. Staff office
29. Classrooms



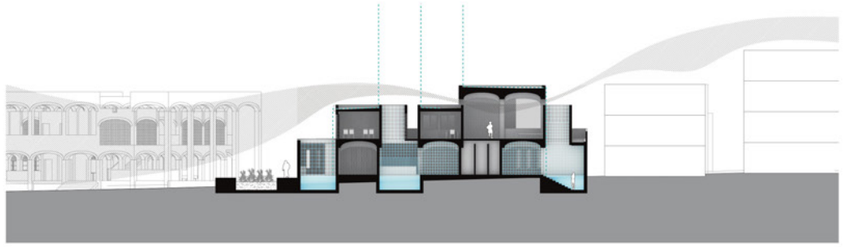
A-A'



B-B'



C-C'



D-D'

Sections

Scale: 1:200

Scale Bar:

Legend: -

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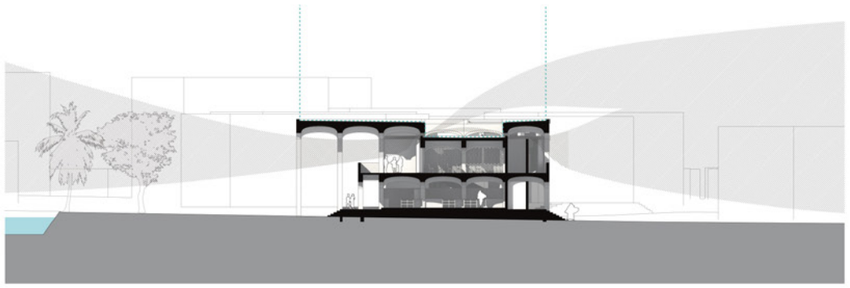
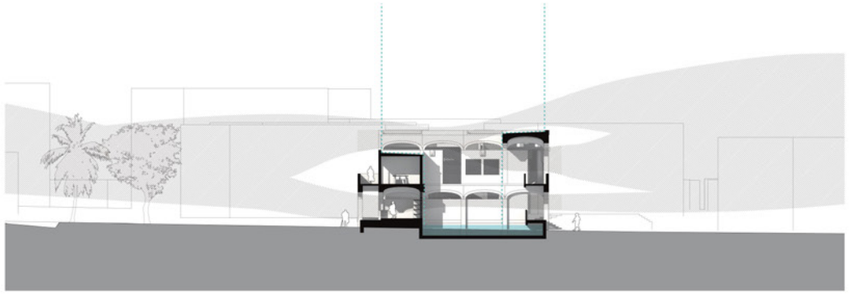
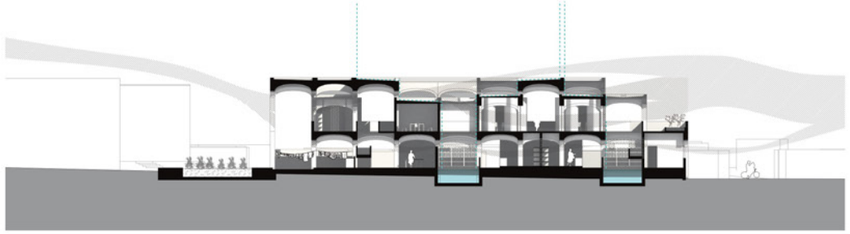


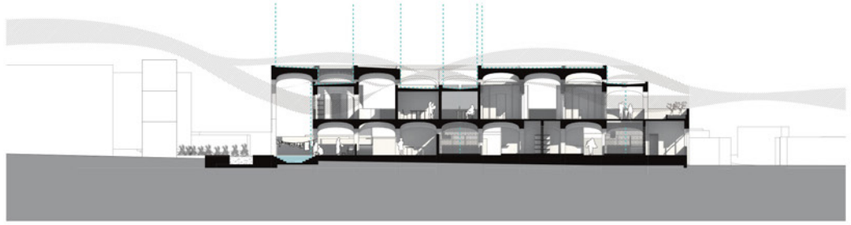
E-E'



F-F'



G-G'



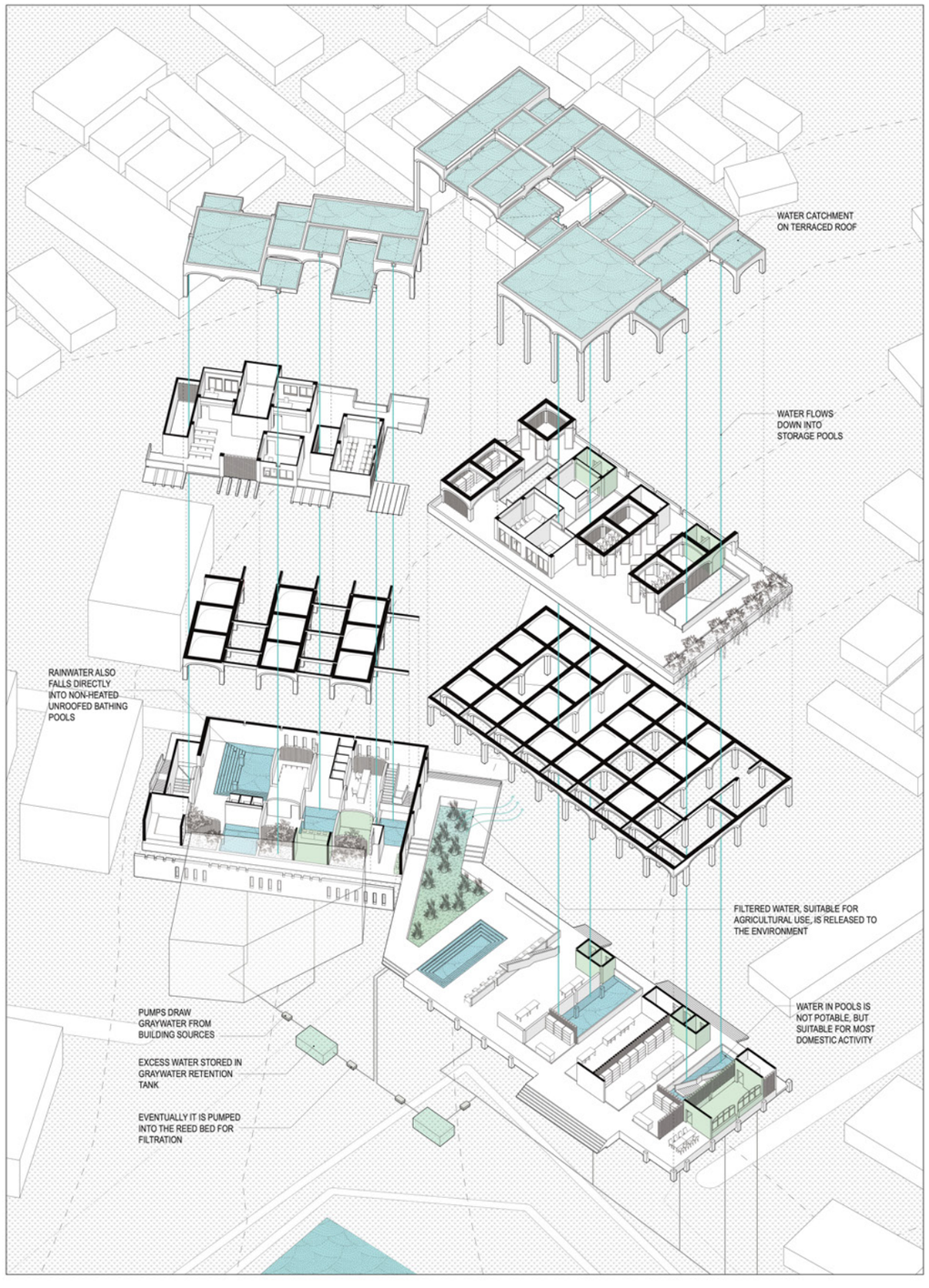
H-H'

Scale: 1:200

Scale Bar: -

Legend:

Sections



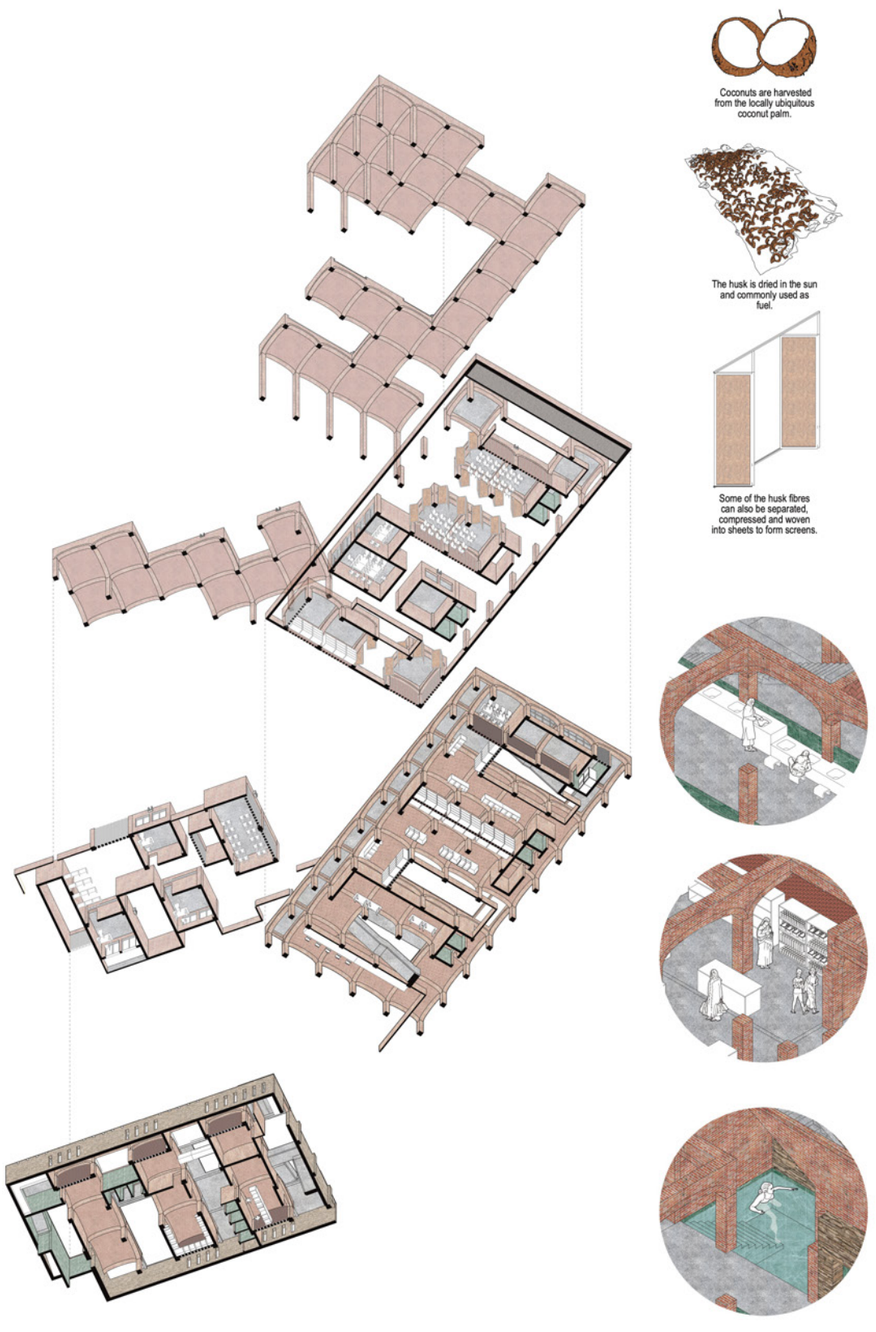
Axonometric Exploded Diagram

Scale: 1:200

Scale Bar:

Legend:

Rainwater Greywater



Worm's Eye Axonometric
Details

Scale: -

Scale Bar:

Legend: -

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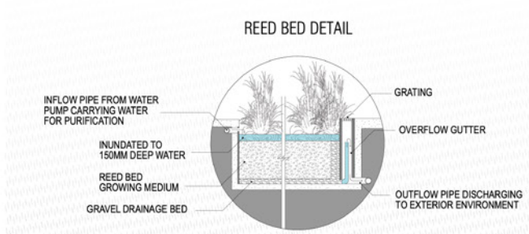

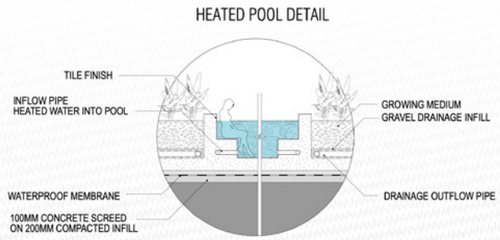

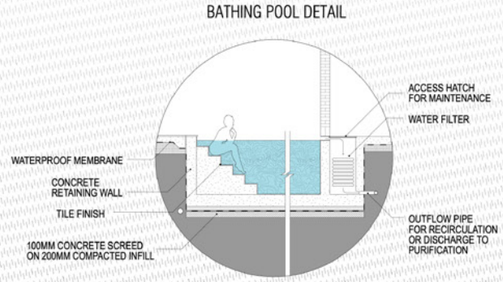

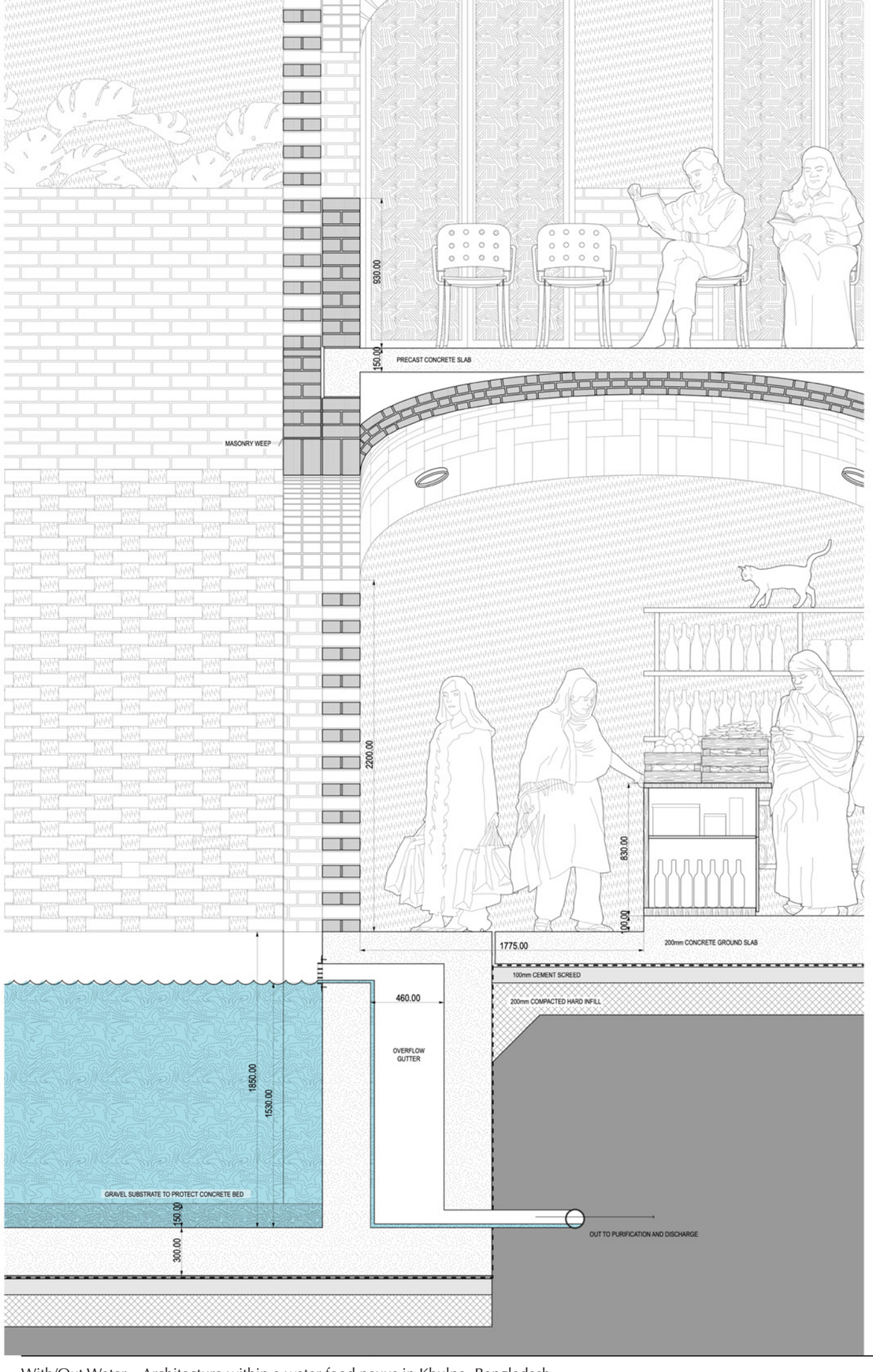

With/Out Water

Rethink the nexus of architecture and water in light of sustainable design

Colophon:

Editor: Dr Aurel von Richthofen

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