2017-2018 Creative Achievement

Julie Larsen
32708

SCALING.UP!

CRAFTING THE FUTURE OF CONCRETE IN THE ANTHROPOCENE

Julie Larsen: Assistant Professor, Syracuse University
6 credit: 'Directed Research' Professional Elective

The Design / Research Studio, "SCALING UP" is the first of its kind at Syracuse University, known as 'Directed Research' that combines research (seminar) and design (studio) to form a new collaboration between students, professors and industry. This studio was sponsored by CEMEX Global R&D to support the study of innovative architectural design that combines concrete, infrastructure and the environment.

Objectives: The course explores the future opportunities for full scale architectural elements that arise from the combination of high performance concrete, contemporary design and fabrication with climatic issues we face today. The world of concrete is moving at a rapid pace, from complex geometries to concrete that floats on water to 3D printing and robotics. The concrete industry is at a pivotal point with the latest material and digital technology available and they are interested to see how students can redefine the concrete industry through new and innovative design strategies that will **Craft the Future of Concrete in the Anthropocene.** And in turn, those design strategies have the potential to begin Crafting the Future of Our Cities. But how do we begin to 'SCALE-UP' beyond small-scale objects and pavilions to achieve high quality and efficient infrastructural strategies that respond to the environment?

New concrete technology being studied was no longer seen as 'fixed' and permanent but rather as an emergent material that adapts to its environment. The focus was on opportunities that create more dynamic interaction between materiality and the environment to preserve and protect nature and bring more biodiversity to the city. In turn, this offered better living conditions for humans and non-humans alike. Questions asked of the studio: What infrastructural forms can serve as a provocation for productive change? Is there a new type of urban public space that derives from merging infrastructure, ecology, and materiality to create more sustainable cities?

Constraints: To give students a guideline, the design investigation dealt with issues of materiality and environment. The students designed stacked forms within a given bounding box to become infrastructural interventions that sustain biodiversity in the city. Questions asked of the studio: How does the 'responsive structure' connect to local ecologies? What systems exist for controlling environmental conditions, such as ventilation, filtration, or flooding etc.? How does materiality play a role in infrastructure and public space?

Design Research: We were asked to participate in the the Malaysia Biennial 100YC, and the goal set forth was to 'identify disruptive patterns of global change and impacts on architecture, urbanism and life for the city of Medini.' The aim of the research was to discover infrastructural opportunities within the city through the lens of a material. The students studied the environment and climatic changes of the site in Medini, Malaysia, some of which addressed issues of wetland depletion in the region, loss of ecosystems and local species, flooding due to heavy rainfall, and polluted storm water runoff leading to rivers and reservoirs. They also studied and attempted to hybridize various types of high performance concrete, such as high strength, porous, and extremely lightweight mixes to invent new uses for the material.

Design Response: In response to the above research, each group designed a 'Responsive Urban Concrete Structure' that could become new green infrastructure for Medini. The aim was to use concrete, the most commonly used infrastructural material in the world, and transform it into new, green infrastructural opportunities within the city. All of the projects take on water, concrete, and conservation as a framework for the design strategy. Concrete becomes stronger when exposed to water and has the opportunity to be rethought for more intelligent purposes when using more sustainable, high performance concrete technology. Each project takes on a common urban problem, whether that be reducing the urban heat island effect, controlling storm water runoff, addressing pollution and water filtration, introducing local ecologies for more biodiversity, or reducing energy consumption. In turn, the students used their architectural interventions to play a pivotal role in redefining the City of Medini through infrastructure, ecology, and materiality.

Submission: The following pages outline the class structure, assignments, research, early design strategies, concrete casts, and final student projects. Each of the projects outlines the student's conceptual goals for the urban intervention and how the project addresses an environmental need with an infrastructural strategy using new concrete technology and fabrication techniques. The final project had additional time during a summer internship at CEMEX Global R&D to develop their ideas and casting methods further.

image: aptum architecture + cemex global r&d / rhizolith island, cartagena, colombia

SUPER PE - SYRACUSE UNIVERSITY

S C A L I N G   U P !

CRAFTING THE DIGITAL FUTURE OF CONCRETE

Assistant Professor: Julie Larsen
6 credit Professional Elective
Super PE: Directed Research

image: aptum architecture + cemex / isla rhizolith, cartagena, colombia

SYLLABUS

Course: ARC 500.1
Prerequisite: NONE
Credits: 6

M+W @ 2:15-5:05
Space: 404 SLOCUM

Instructor: Julie Larsen
email: jmlarsen@syr.edu
Office: 306C

DESCRIPTION - The course explores the future opportunities for full scale architectural elements that arise from the combination of high performance concrete and contemporary digital design and fabrication technologies.

'SCALING-UP,' a Super PE, is the first 'Directed Research' class at Syracuse that combines research (seminar) and design (studio) to form a new collaboration between students, Prof. Julie Larsen (Aptum) and the CEMEX Research Group (CRG) that is sponsoring the class. CRG is the research arm of CEMEX, the second largest cement company in the world.

The world of concrete is moving at a rapid pace, from complex geometries only achieved through the most innovative material science to concrete that floats on water to 3D printing to robotics and high tech logistics. At the same time, digital technology is becoming more readily available to companies, architects, contractors and individuals. The concrete industry is at a pivotal point with the latest material and digital technology available and CEMEX is anxious to see how Syracuse University students can help their company redefine the concrete industry and Craft the Digital Future of Concrete, while in turn, Crafting the Future of Our Cities. But how do we begin to 'SCALE-UP' beyond small-scale objects and pavilions with the use of new technology? Many claim they achieved the first 3D printed house but the quality of the material, costs of construction and realistic time frames are being called into question. Architects should have the ambition to dream big but how can design ideas SCALE-UP while still achieving high quality, efficient, and cost effective architecture? What is the Digital Future of Concrete?

SCHEDULE - As a 6 credit Super PE (2 days a week for 3 hours each), the extended schedule allows for more in-depth research. The class will merge an advanced design studio setting with research on building technologies (old and new). The first day of the week (monday) will be 'material as research', the second day of the week (wednesday) will be 'design as research'.

INTERNSHIP (Opportunities @ CRG in Switzerland) - will potentially be available for students to participate in constructing their designs at full/half scale.

OFFICE HOURS - You may make an appointment via email. Any such meeting will be conducted with the strictest degree of confidentiality.

SCHEDULE (see attached) subject to change

1

SUPER PE - SYRACUSE UNIVERSITY

S C A L I N G   U P !

CRAFTING THE DIGITAL FUTURE OF CONCRETE

Assistant Professor: Julie Larsen
6 credit Professional Elective
Super PE: Directed Research

APTUM, rhizolith island, concrete prototype @ CEMEX lab

SYLLABUS

REQUIREMENTS - Digital proficiency in Rhino. Some Rhino Paneling / Grasshopper / Maya knowledge is recommended but not required.

OBJECTIVES - Students will learn how to design, construct and work hands-on with the most advanced concrete available today. In doing so, they will collaborate with some of the most proliferate researchers in the concrete industry.

COURSE EXPECTATIONS - The course will be divided into two components: SPECULATION AND IMPLEMENTATION. The first 8 weeks of the class will be on SPECULATION of form, concrete elements, and construction techniques for a specific environment. The focus will be on research and design strategies and early mock-ups of concrete elements. The last 6 weeks will be on IMPLEMENTATION of design research into larger scale mock-ups. The studio will revisit the early design research for the final review and exhibition.

This course encourages conceptual and critical approaches to analyzing, making, and learning about materials, digital fabrication and the environment through the following 'Assumptions':

1. Produce work at the highest standards
2. Connect critical ideas to techniques
3. Investigate new methods through curiosity
4. Understand the depth to new techniques (there is never one way to produce an idea)

TECHNIQUES:
Students will be asked to work through 3D in both analog physical making as well as through digital techniques with 3D programs of their choice (Rhino, Maya, Grasshopper, etc.). Second, the research project will be a study of concrete elments, structrual approaches, construction systems and fabrication techniques. Individuals or teams will research various techniques they are interested in using to translate design research into material objects. Lastly, students will use the material and design research as a way to speculate on the city (urban implementation).

Successful completion of this course is dependent on the student's mastery of the following:

- Research in structure, material, and fabrication methods
- Digital and Physical Modeling
- Drawings depicting speculative ideas to accurate construction diagrams and details
- Casting refined concrete elements in the workshop

GROUP WORK:
Projects will be done individually and then later in groups of two where student interests align. It is expected that each person in the group does their fair share of the work so the burden does not fall on one person.

2

SUPER PE - SYRACUSE UNIVERSITY

S C A L I N G   U P !

CRAFTING THE DIGITAL FUTURE OF CONCRETE

Assistant Professor: Julie Larsen
6 credit Professional Elective
Super PE: Directed Research

student work, CRAFTING THE DIGITAL, spring 2016

SYLLABUS

PROJECT:
Class time will be divided into components: MONDAY AS: RESEARCH, WEDNESDAY AS: DESIGN. Monday will be focused on lectures by the professor, research pinups and presentations of students and discussions. Wednesday will comprise of design discussions of projects, reading discussions, and pin ups / reviews. Students should meet with the professor each week for discussion and progress.

ATTENDANCE:
Attendance is mandatory at the scheduled class time. Three consecutive absences or four non-consecutive absences will adversely affect your grade. The only excused absences are those for reasons of health or crises, and must be justified with written documentation (i.e. a note from a physician or the Dean). Unexcused absences will reduce your course grade, as will late arrivals or early departures. Missing a group review (unexcused) will lower your grade by one-half grade level. You may not leave class early and you should always plan to use the time you spend in class productively. Students are expected to check .syr emails regularly, however, faculty may not get back to students within the given time frame they are expecting and should continue with project without delay.

SUPPLIES / MATERIALS:
It is highly recommended you obtain the necessary computer programs,(rhino/grasshopper/maya/photoshop/indesign/illustrator) to complete digital tasks. In addition, there will be physical output - 3D printing, etc. as well as some costs for the final 3D casts. All concrete materials and equipment will be provided by CEMEX. There will be some costs for final printing projects at scheduled reviews.

GRADING:
Grading is based on conceptual ideas, development, and technical execution. Creative risks are encouraged and will be rewarded. Attendance, participation, and improvement throughout the semester will be factors affecting your grade. Projects must be completed on time.

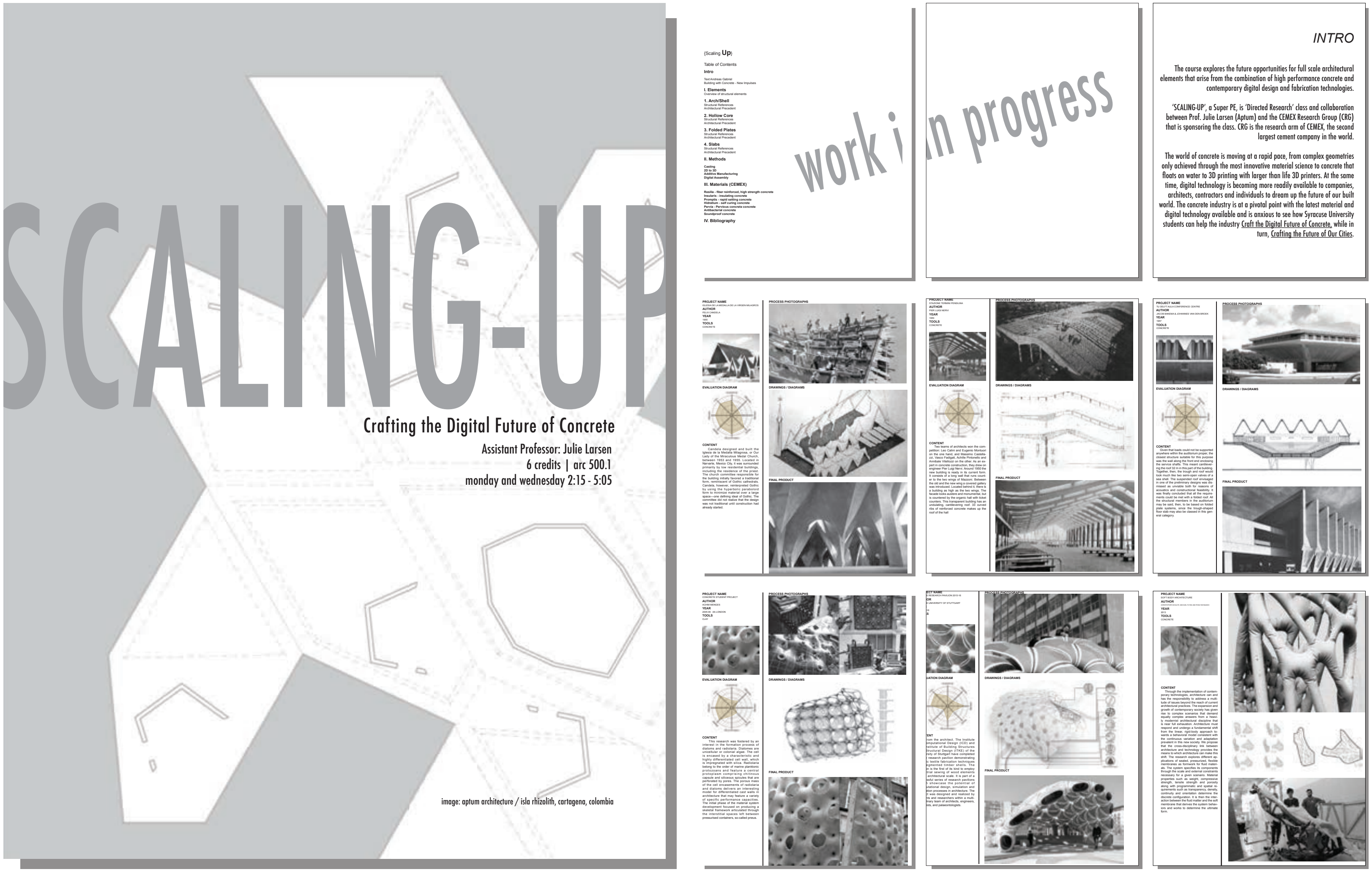
Evaluation will be based on individual abilities with the expectation that one should always test and challenge his/her own strengths and weaknesses.

Design as Speculation (research):	40%.
Design as Implementation (making):	40%
Attendance and Participation:	20%

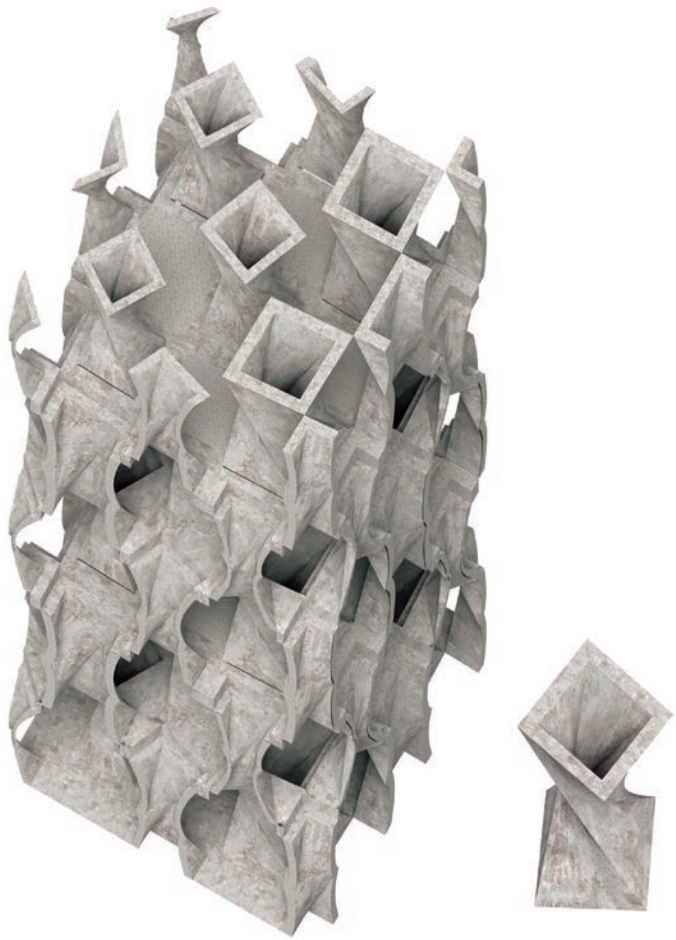
ACADEMIC INTEGRITY:
The Syracuse University Academic Integrity Policy holds students accountable for the integrity of the work they submit. Students should be familiar with the Policy and know that it is their responsibility to learn about instructor and general academic expectations with regard to proper citation of sources in written work. The policy also governs the integrity of work submitted in exams and assignments as well as the veracity of signatures on attendance sheets and other verifications of participation in class activities. Serious sanctions can result from academic dishonesty of any sort. For more information and the complete policy, see http://academicintegrity.syr.edu

3

Pic - Sample Syllabus. The syllabus directly ties the work my office, APTUM, is collaborating on with CEMEX Global R&D. Since we are interested in expanding the scope of the research, the Super PE Directed Research class is the ideal support system to merge design research with pedagogy.



Pic - Sample Pages of Course Booklet. Before the class began, we worked with research assistants to develop the 'scaling up' booklet that would be given to the students on Day 1. We used the semester before to develop a working document that could continuously be updated. The course booklet is a collection of information ranging from precedents in concrete, to structural diagrams, to fabrication techniques and readings. Part of the class assignment was to expand upon and supplement the research in the booklet with additional diagrams, text, and drawings.



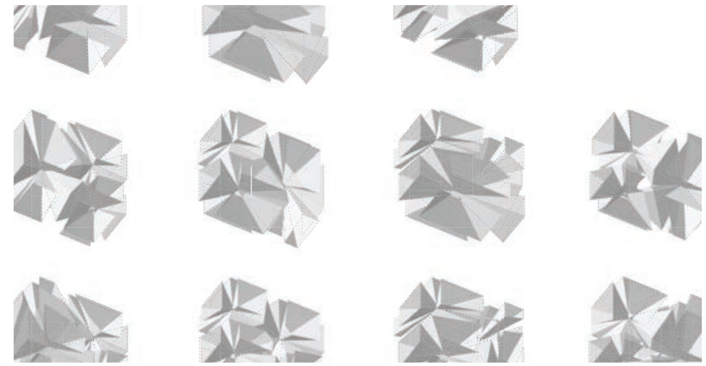
Pic - final stacked form with singular module.
(Image: Gabe Maese)

SUPER PE - SYRACUSE UNIVERSITY

S T A C K I N G   C O N C R E T E

C R A F T I N G   T H E   D I G I T A L   F U T U R E   O F   C O N C R E T E

Assistant Professor: Julie Larsen
Super PE: Directed Research



student example

DESIGN ASSIGNMENT 1

OUTPUT :

groups of 2
refer to 3D models and templates
on google drive
(required 3D boundaries and sheet examples)

24X24 Presentation Boards
+ 8.5x11 Formatted Booklet Pages

DUE DATES:
Critical Questions / Responses (2/5)
Reading Discussion (2/6)

Design Pin Up (1/30)

Design Review (2/13)

READINGS:
Hensel Menges: Morpho Ecologies
Kennedy, Material Presence

REFERENCE:
Scheurer - Size Matters_Digital Manufacturing
in Architecture

TASK:
Using one of the formal/structural principles from one of the precedents researched thus far, repeat the element into a stacked tower. The structural logic of the element should already be inherent in the form but might need tp be adapted to account for the vertical expansion. Feel free to deform / skew / bloat / twist / etc. the original struuctural grid or element and scale up or down. Spans may vary, so you can omit bays to create longer spans.

The 3D gradient of the elements can vary from small to large as desired as long as the structural logic of the element stays in tact. Load must continue down, no hovering forms. If there is a point load on an element, that element must get deeper to accomodate additinal load distribution to nearest vertical elements. Use whatever digital 3D means necessary to achieve desired goals.
Complexity in ideas and formal output should be tested!

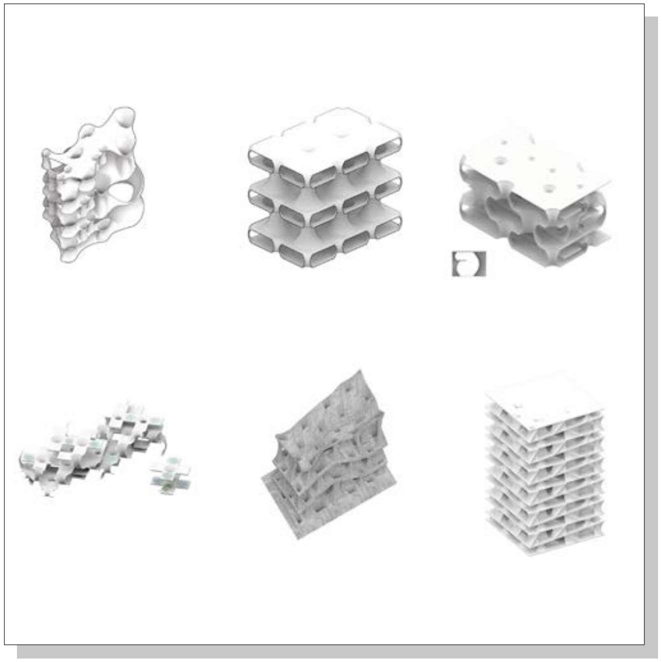
The footprint of the tower is 50 feet x 100 feet. Each 'story' is approximately 12-15 feet. The tower can be anywhere between 6 to 10 stories.

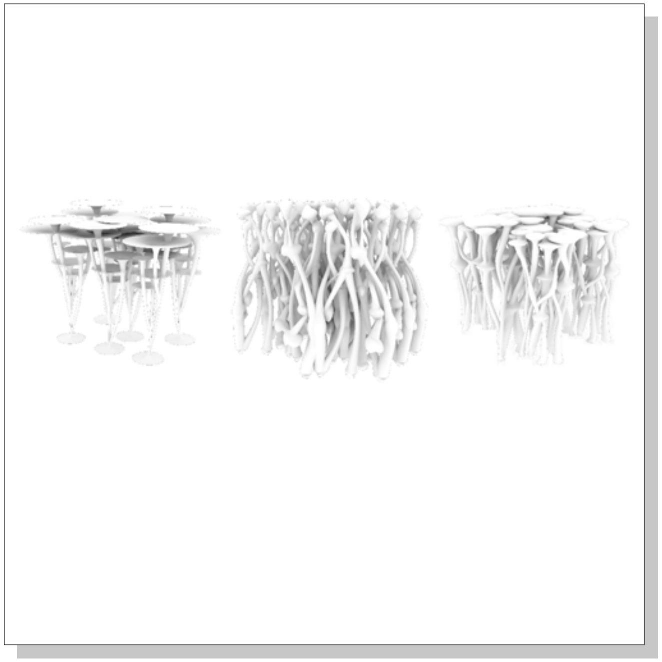
Week 1 - One ALTERED element from original precedent list stacked into tower:
1. Arch/Shell
2. Hollow Core
3. Folded Plates
4. Slabs
5. Other

WEEK 2 - Based on new technologies researched, choose (1) type of casting method + (1-2) Cemex materials of choice to deform / alter original element. How does formwork method influence formal output? How can a particular material alter the formal expression?

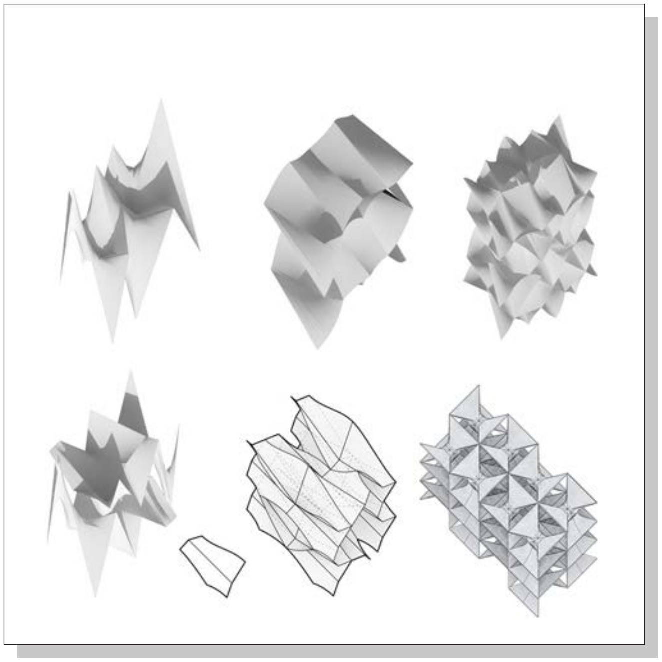
Cemex Material Selections +
Technology
1. Casting Methods
2. 2D to 3D
3. Additive Manufacturing
4. Digital Assembly
5. Other

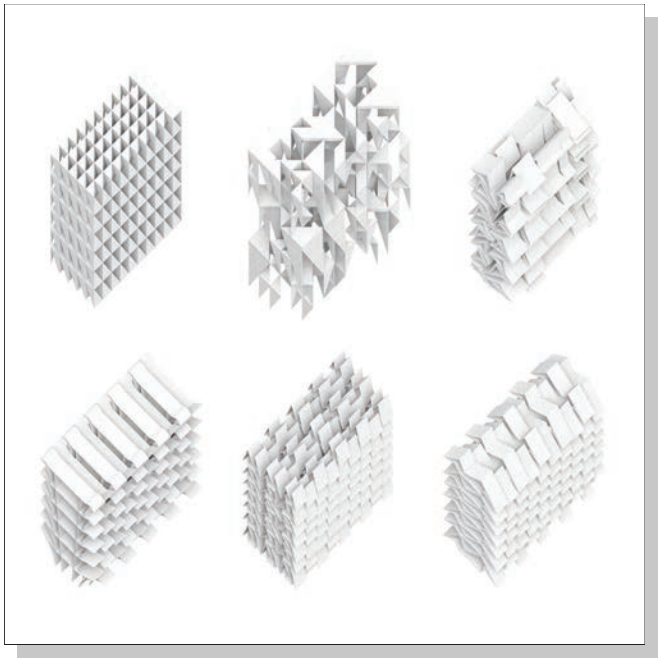
REQUIREMENTS:
Design Exercise Week 1- Form
Design Exercise Week 1- Technology + Material
See Template on google drive for specific drawing requirements

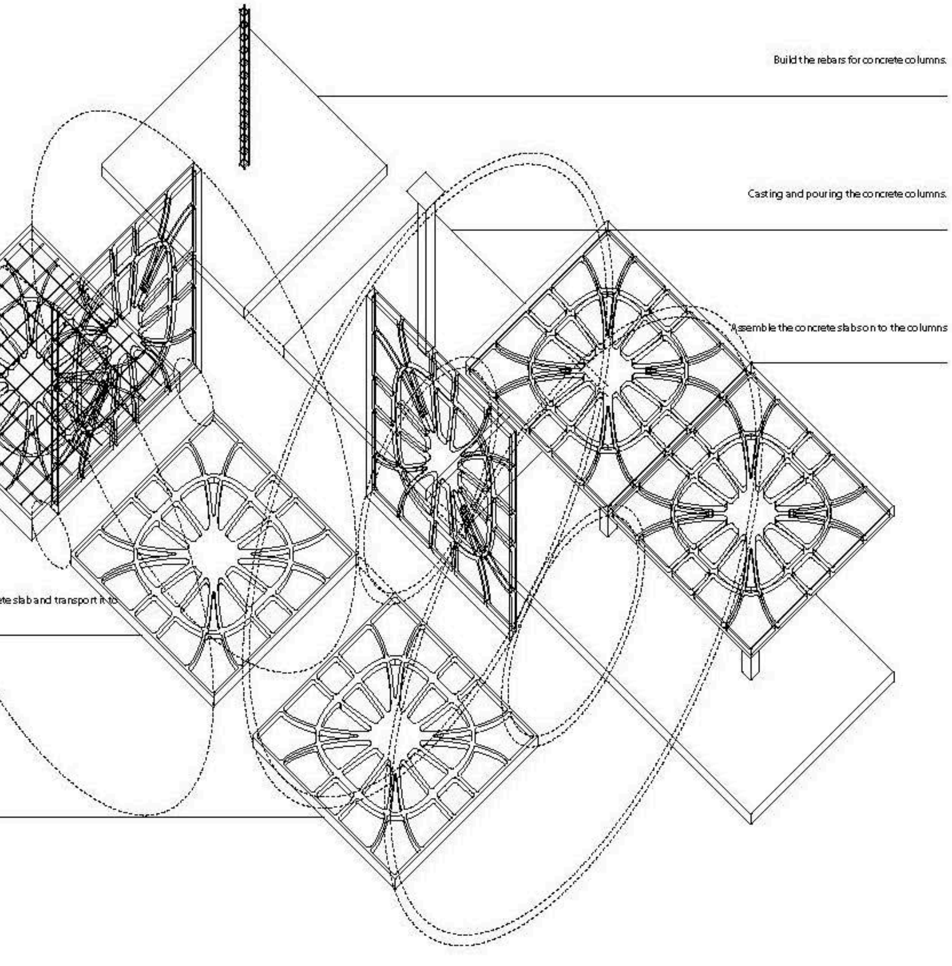




Pic. - Early studies of stacked forms in sequence from each design group. The initial exercise of the semester was to stack elements digitally to form a vertical structure. Each of the groups refined their ideas as they began to test and cast their techniques in concrete.







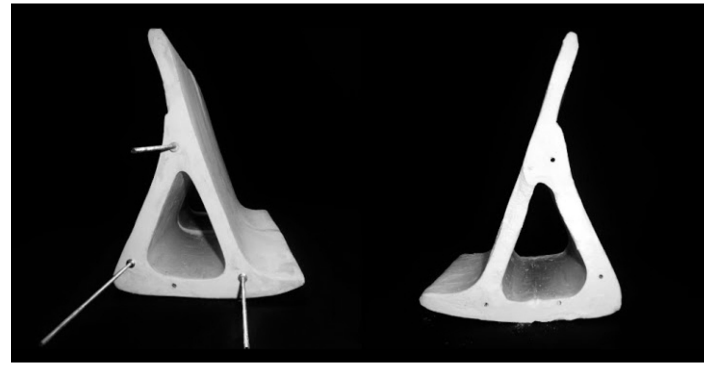
Pic - final diagram of Pier Nervi roof structure
(Image: Minglu Wei)

SUPER PE - SYRACUSE UNIVERSITY

P R E C E D E N T   I N   C O N C R E T E

C R A F T I N G   T H E   D I G I T A L   F U T U R E   O F   C O N C R E T E

Assistant Professor: Julie Larsen
Super PE: Directed Research



elements, centro de estudios hidrográficos y laboratorio de hidráulica, miguel fisac serna

RESEARCH ASSIGNMENT 1+2

OUTPUT :

groups of 2
1 SHEET per precedent - for booklet template on google drive

DUE DATES:

Critical Questions / Responses (1/22)
Reading Discussion (1/23)

Research Precedent
(digital presentation: 1/25)

Technology Precedent
(digital presentation: 2/1)

READINGS:

- Moussavi, Farshid: The Function of Form

- Gabriel, Andreas:
Building with Concrete - New Impulses

- Kwinter, Stanford: Concrete - Dead or Alive?

"What becomes deeply interesting out of this method [of repetition] is pattern. When tied to information, pattern becomes the fundamental quantity of the diagram. A system of differential repetition becomes a means of handling a variety of material within the same organization."
- Jesse Reiser, Variety vs. Variation, Atlas of Novel Tectonics

TASK:

Using the 'Scaling UP' Booklet as a starting point, select a precedent from each of the 4 categories and do more in-depth analysis. In addition, research 1-2 additional contemporary or historical precedents and the concrete elements associated with them. These may be of interest for you to further develop in future design exercises.

WEEK 1 - Precedent / Type (# of projects)
1. Arch/Shell (13)
2. Hollow Core (9)
3. Folded Plates (8)
4. Slabs (2)

WEEK 2 - Technology (# of projects)
1. Casting Methods (17)
2. 2D to 3D (16)
3. Additive Manufacturing (6)
4. Digital Assembly (6)

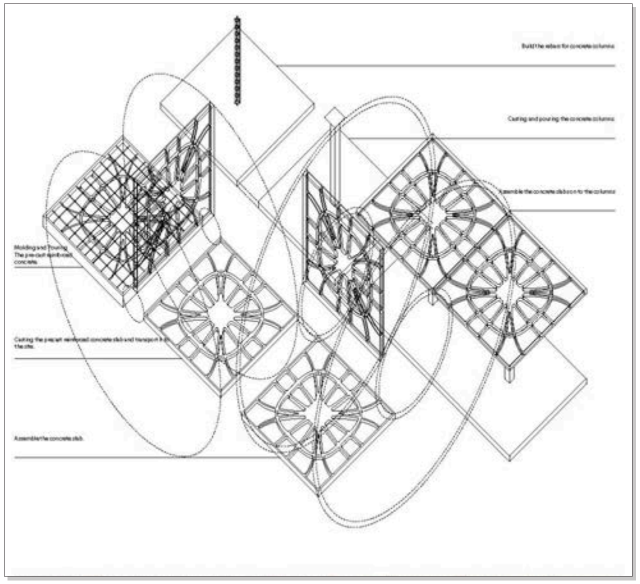
REQUIREMENTS:

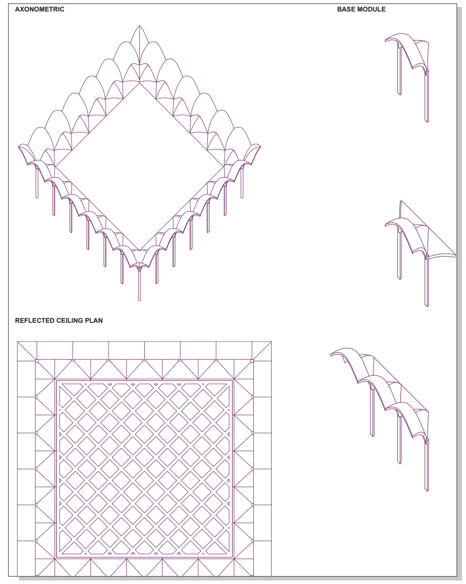
- Add additional drawings + pages to existing booklet (1 page per project):

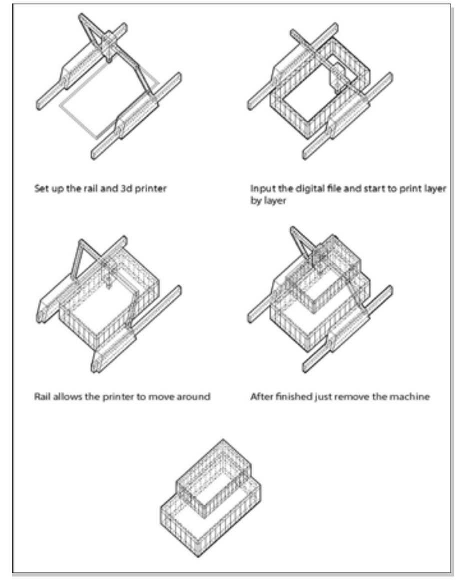
Week 1- Precedents
- Project from each of 4 categories, PLUS 1 additional contemporary concrete precedent
  - drawing: singular structural unit (1 module, 1 bay, etc.)
  - drawing: repetitive axonometric (overall form)

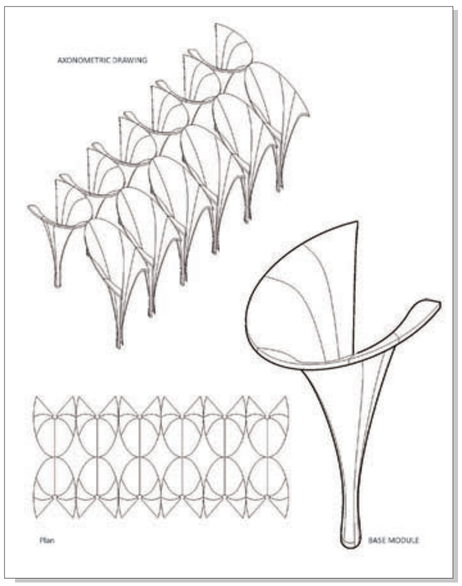
Week 2 - Technology
- Project from each of 4 categories, PLUS 1 new technology precedent not currently in booklet to further develop
  - diagrams/drawings outlining process of construction, methods, 'step by step,' etc.
- Study of 1-2 CEMEX materials (Resilia, Promptis, Hidratium, Pervia, Antibacterial, Soundproof)

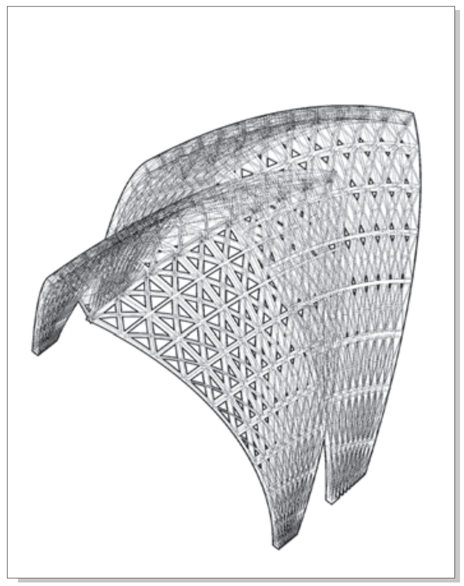
No duplicates (everyone must take different precedents for further study)
Use template provided on google drive

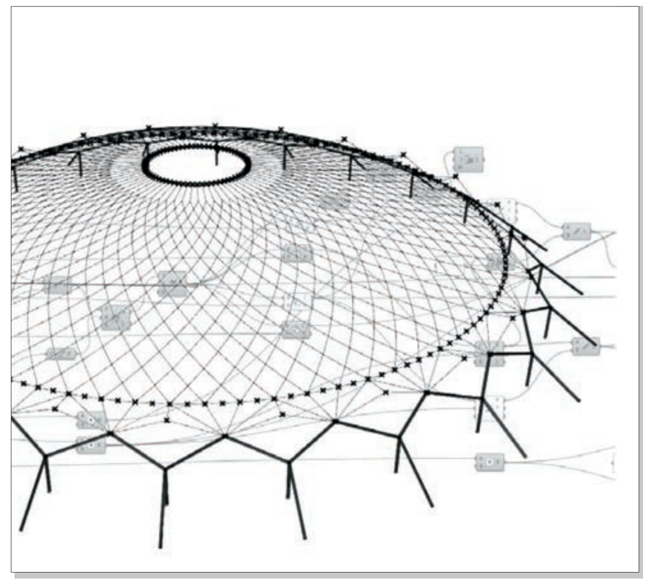












Pic - precedent studies / diagrams + axonometrics of structural forms

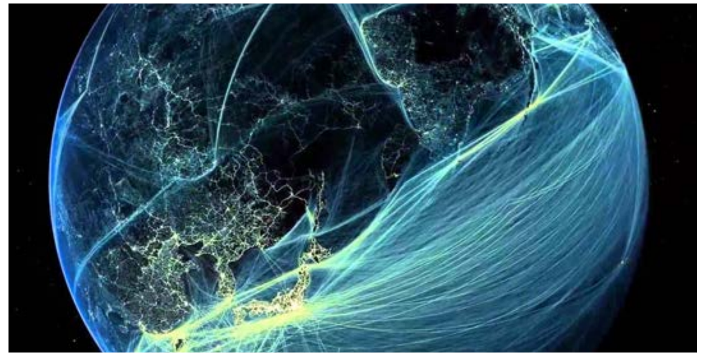
Pic - stacked forms of hybridized concrete forms (mixture of high strength, porous and/or lightweight concrete mixes)

Pic - site plan of new Master Plan for Medini, Malaysia (Image: Shaguni Gupta)

CONSTRUCTING THE ANTHROPOCENE

CRAFTING THE DIGITAL FUTURE OF CONCRETE

Assistant Professor: Julie Larsen
Super PE: Directed Research



welcome to the anthropocene video

DESIGN ASSIGNMENT 3

OUTPUT :
groups of 2
diagrams / renderings / section

24x24 Presentation Boards

DUE DATES:
Critical Questions / Responses (2/19)
Reading Discussion (2/20)

Design Review (3/1)

Midterm Review (week of 3/20)

READINGS:
Hensel Menges: Morpho Ecologies
Gissen, Subnature

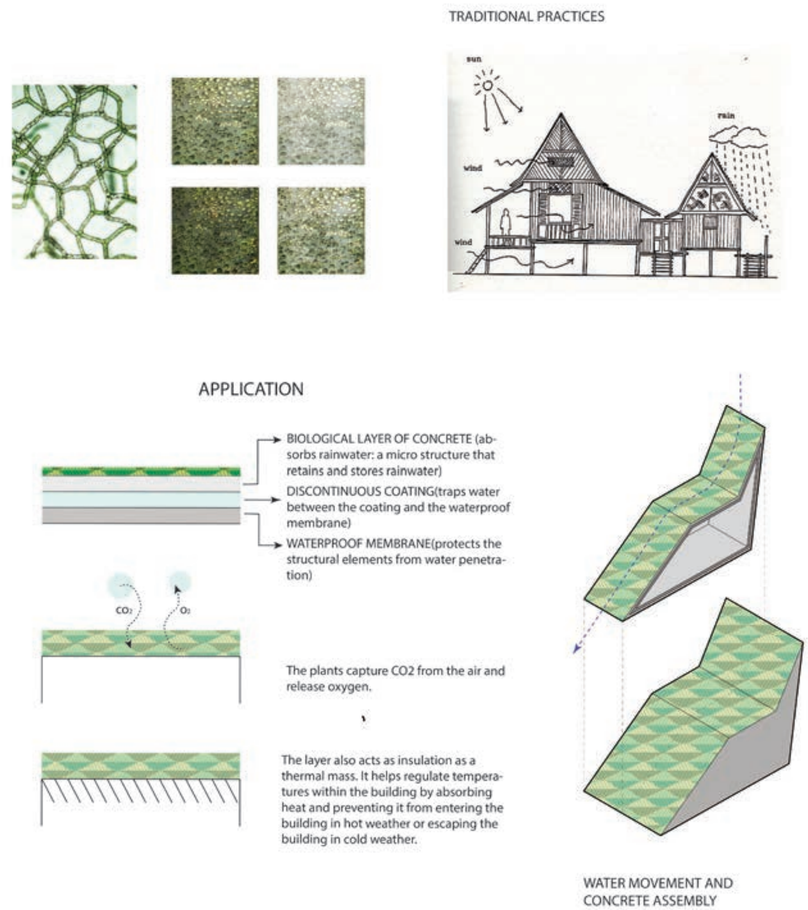
"You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete." – R. Buckminster Fuller , www.wilderutopia.com

According to the Malaysia Biennial 100YC, the goal is to 'identify disruptive patterns of global change and impacts on architecture, urbanism and life for the city of Medini Iskandar, Malaysia, now and in the extreme future'. It was Buckminster Fuller's vision and desire to speculate on new futures and made him one of the first modern thinkers to connect ecology and the environment to architecture and design. If we are now in the 'Anthropocene Era,' defined as the current geological age and viewed as the period during which human activity had the most influence on climate and the environment, how do we speculate on new futures for the urban environment that can provoke productive change?

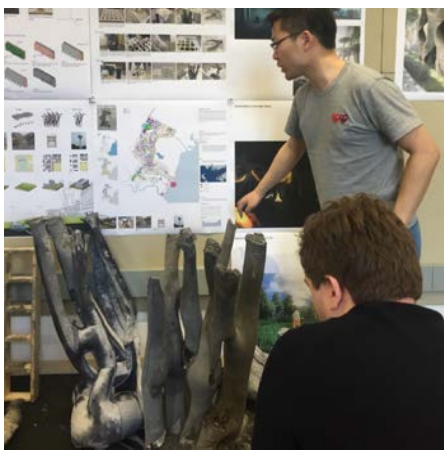
TASK: Each group is to create a 'Responsive Structure for the Anthropocene' with your speculative stacked form that is responsive to the urban environment. The notion of a concrete structure as a 'fixed form' is obsolete and should be seen as an emergent and responsive structure that can continuously adapt to its environment. Urbanization will forever change our environment but also has the most potential to save it. If we focus on the opportunities that cities offer to create more sustainable development that protects nature, rather than exploiting it, we can create more biodiversity within cities to preserve nature beyond them. Your construct will be located in Medini but is 'siteless' in such that each group will have to 'site' their proposal in a particular environment based on the performance and effects your group is aiming to achieve.

What Is A Responsive Structure For The Anthropocene? Your responsive structure should negotiate between spectacle ('events') and ecological constraints (water, earth, energy, resources, etc.) that sustains biodiversity in a particular environment. A speculation is an open-ended response; therefore you are not limited to a particular scale (if justified, your structure can go taller or wider) but the structure should be inhabited by humans and/or non-humans. How does it connect to local ecologies? What systems exist for controlling environmental conditions, such as thermal, ventilation, filtration, etc.? How can you leverage formal /spatial / experiential potential from a systematic approach to ecology?

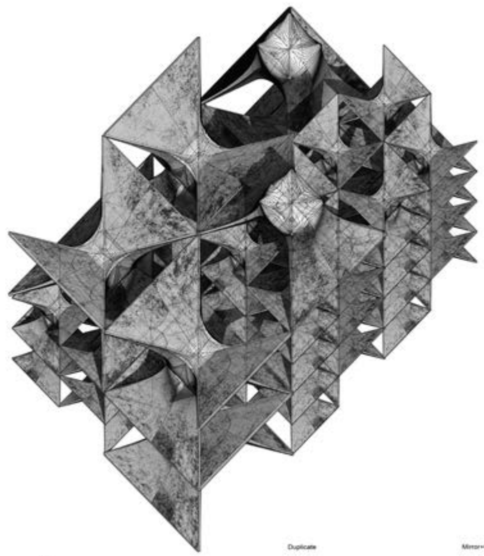
Responsive Structure Examples (but not limited to):
FILTRATION: How do we filter and purify water to reduce pollution, harness for agriculture, etc.?
ACCRETION: How do we instrumentalize and accrete particulate matter (wind, energy, sedimentation, etc.)?
CARVING AND BRANCHING: How does water, waves, thermal change, or wind form productive territories and flows?
FLOW CONTROL AND STORAGE: How do we store and contain a substance like water to regulate distribution over time?
HARNESSING: How can we use hydraulics, waves, or energy harnessing structures to generate electrical currency?

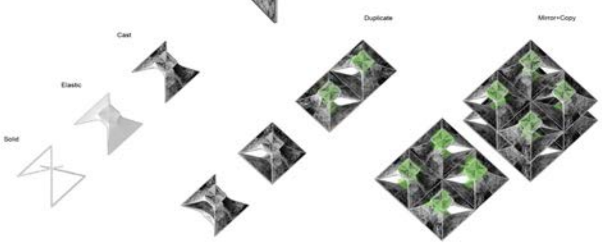


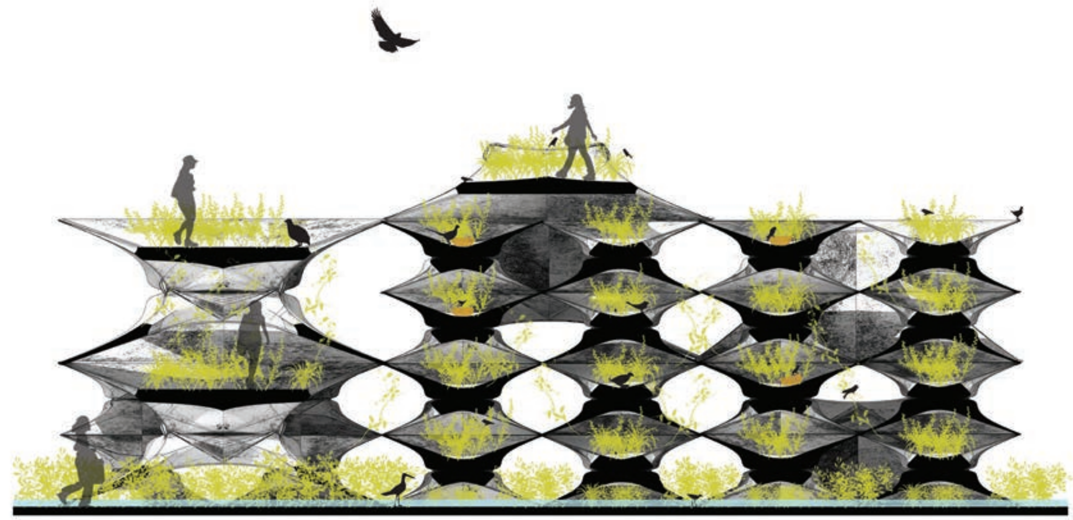
Pic - diagrams of algae system applied to the concrete surface as passive green system to soak up CO2 emissions (Image: Andrea Dominguez)

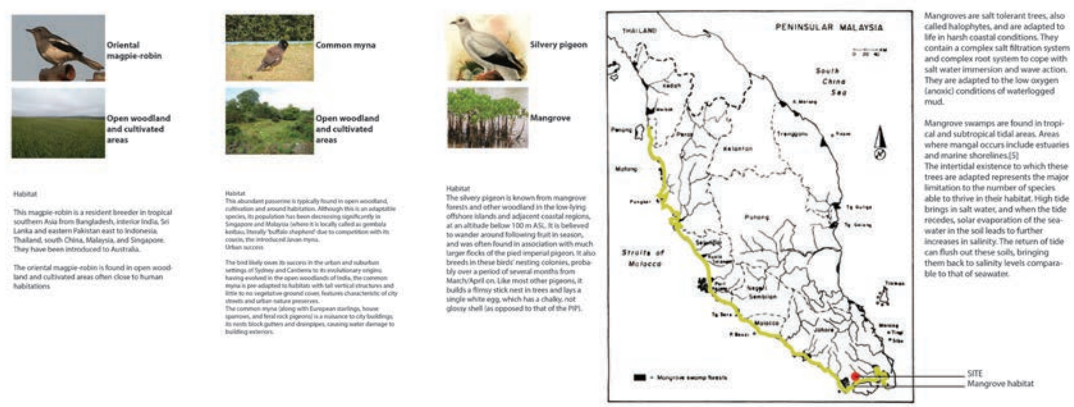


Pic - Final Review with students, professors, outside critics, and CEMEX Global R&D Representatives



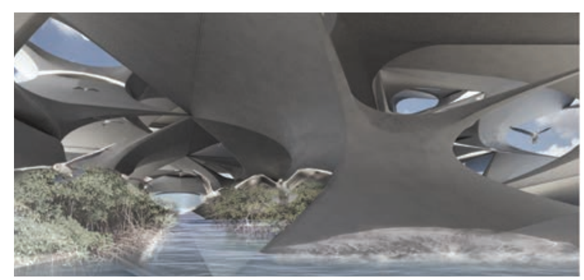






Project 1 - Urban Nesting
This urban infrastructure becomes a new nesting ground for local species and migrating birds in the Medini region. The goal is to scatter 'urban green dots' as urban pocket parks that form a network of nests for various ecologies. There are varying degrees of nesting, water filtration, and water retention for growing plant medium to attract birds and other local species. Four types of sites were used for their potential to be prolific throughout the city, such as bus stops, parking, loading docks, and balconies.

Students: Minglu Wei and Le Yang

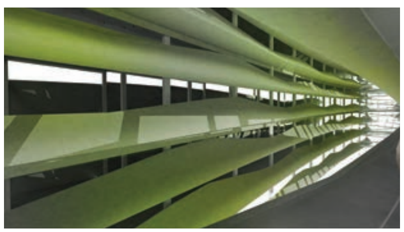


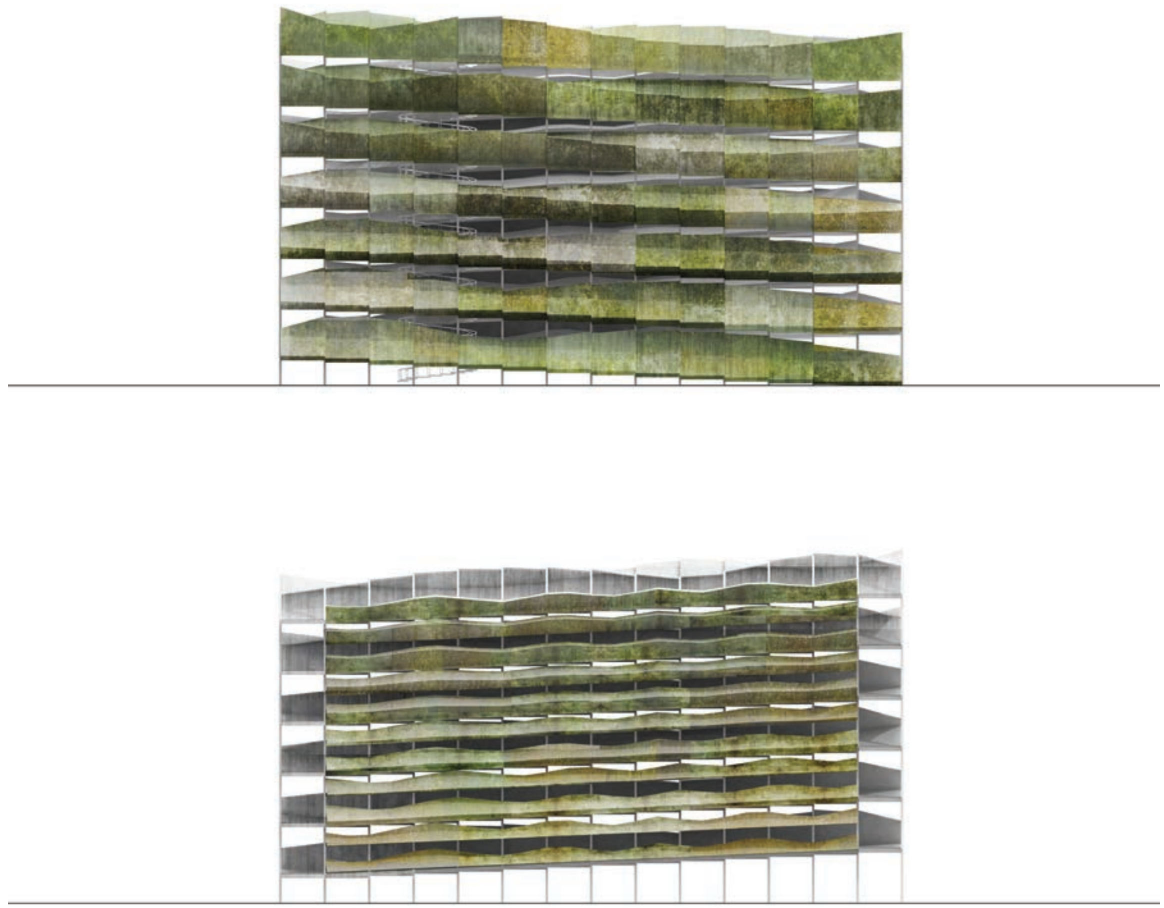
Pic - steps of fabrication process to create two layered system of bent forms.

Project 1 - Urban Nesting

Fabric was used as the formwork to create a warped form in section. Porous concrete was used to allow water to move through the structure as it is passively filtered through the plant roots. In order to have a strong enough structure, high strength was poured as a second layer, covering the porous concrete but leaving a void in the center for the water to pass through both layers.

Students: Minglu Wei and Le Yang

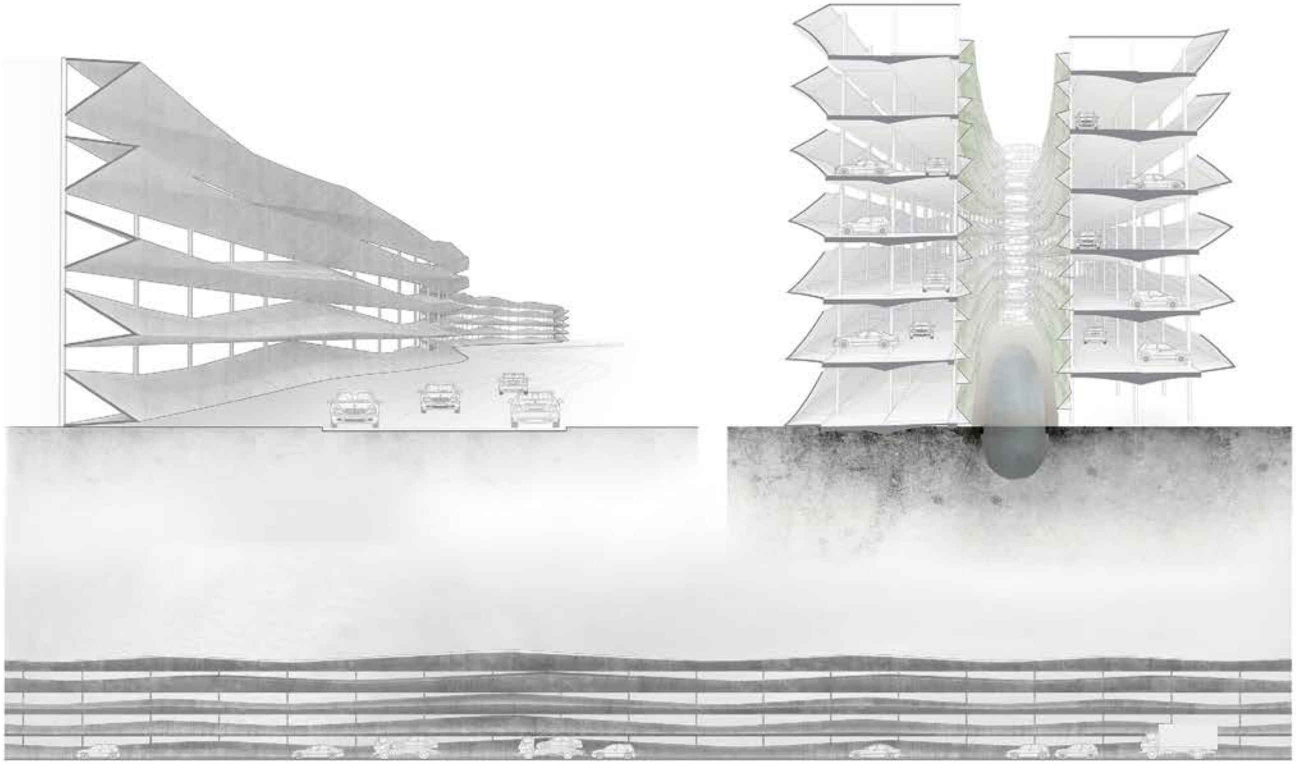




Pic- parking structure with algae twisted walls along perimeter

Project 2 - Biological Concrete
Malaysia has pledged to cut CO_2 intensity by 45% by 2030 and is looking for new techniques to reduce carbon dioxide. Microalgae is amongst the most productive biological systems for capturing carbon and a natural vehicle to clean the air by taking in CO_2 and emitting O_2. The project focuses on sites that have large amounts of CO_2 emissions, such as industrial sites and highways, with infrastructural solutions, such as parking lots and sound walls.

Students: Shaguni Gupta and Andrea Dominguez.

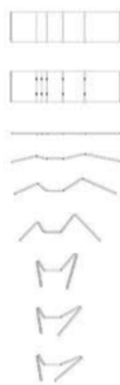


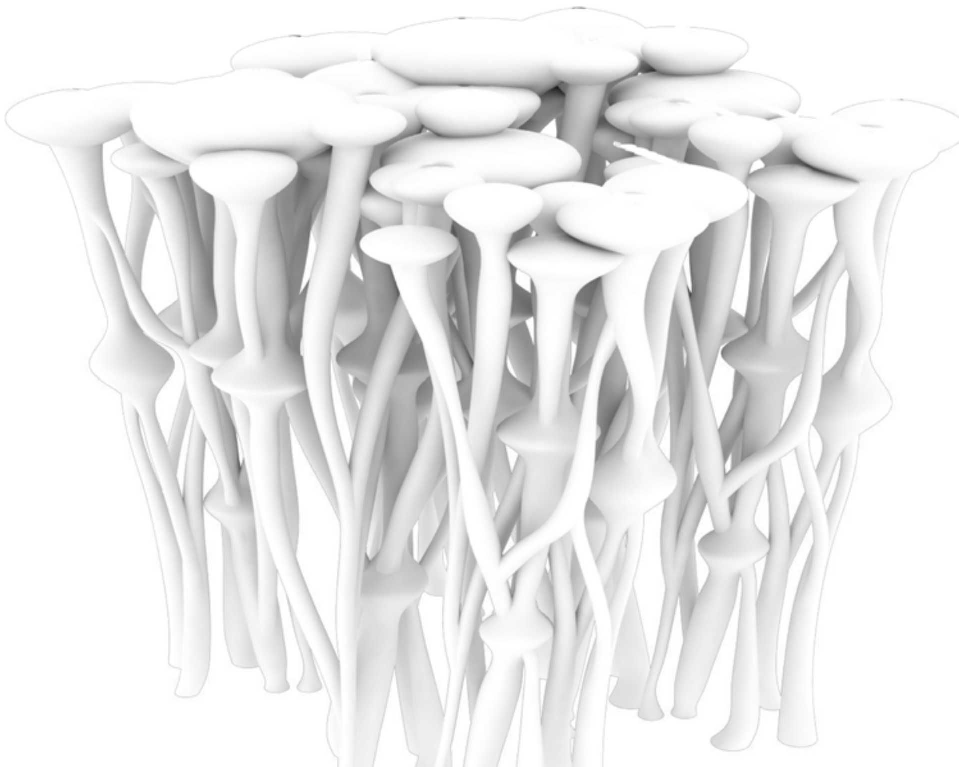
Pic- parking structure and sound wall along highway with algae twisted walls along heavily trafficked areas

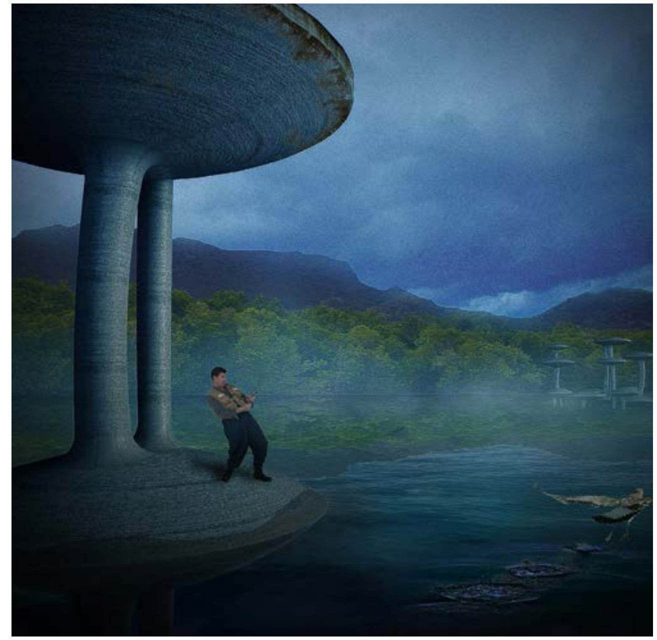
Project 2 - Biological Concrete

The project incorporates 'biological concrete' into a three layered concrete system to capture CO2. The algae surfaces are an undulating 'shingle,' made with folded plates of concrete with algae growing on its surface. Since algae needs different amounts of sun radiation to The formwork is initially flat and then pops up into place to create the folded surfaces. The shingles provide varying types of shading and coloring on the facade where the algae grows. With its productive use of algae, concrete, and vehicles, the project provides a new of infrastructure that reduces CO2 while providing a new urban space to inhabit.

Students: Shaguni Gupta and Andrea Dominguez.



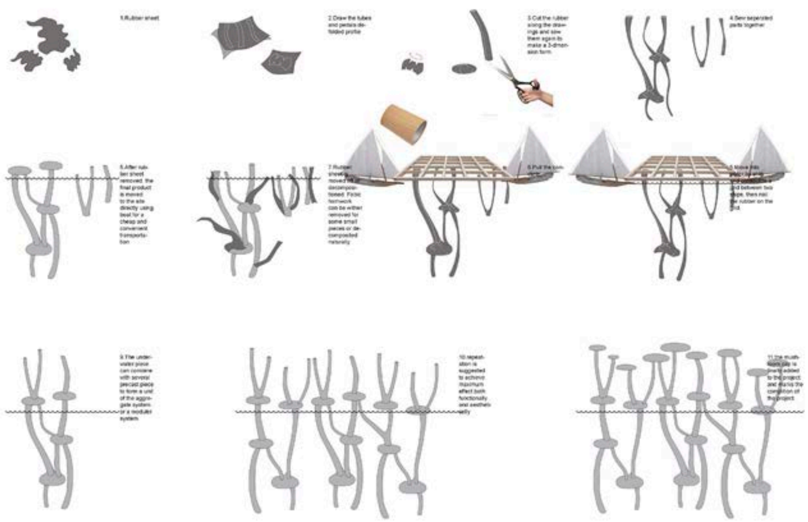




Project 3 - Mushroom Water Towers

A network of vertical 'mushroom shaped' water towers circumvent ground water from parking lots and filter it before reaching the river basin. There are above ground cisterns scattered in urban infills that cool off the urban spaces around it as it collects, filters, and releases rain water. The project reconsiders water conservation in the form in the long tubes of concrete. This new infrastructure is proactive in how to bring productive change to the environment for the city and its users.

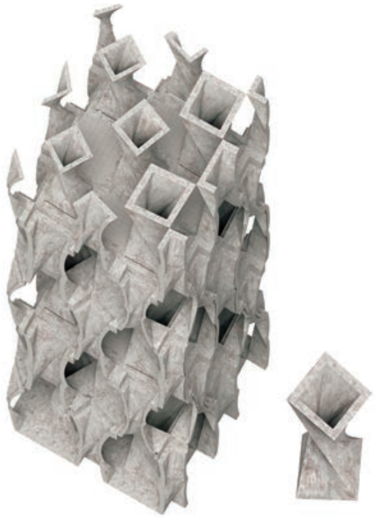
Student: Chenghan Peng

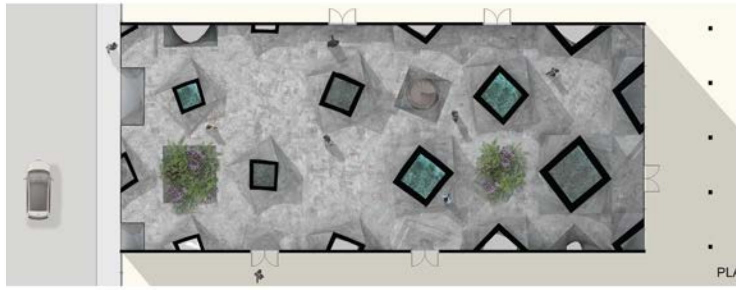


Pic - diagram outlining steps of fabrication process

Project 3 - Mushroom Water Towers
The project uses water as the falsework for casting the concrete. The fabric formwork, for the shape of the mushrooms, is positioned and connected to a simple frame that can be adjusted, lowered or raised. There are potentially infinite formal variations to one single formwork. The fabric formwork is then lowered into the water where the concrete is cast and cured. The water contributes to the curing process.

Student: Chenghan Peng





Project 4 - Urban Wetland: An Above Ground Cistern
Due to its proximity to the Equator, Malaysia is strongly affected by El Nino, which leads to constant floods and draughts. The project proposes a new type of infrastructure: an above ground cistern for the city of Medini. The cistern pops up throughout the city; from fountains in residential neighborhoods, to infill strategies attached to buildings and floating urban parks.

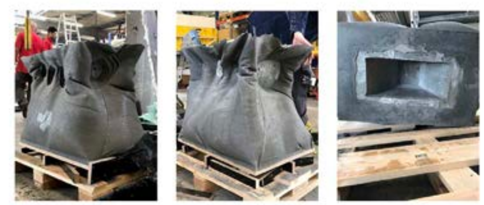
Students: Gabriel Maese and David Knaide

Pic - early conceptual cast

Testing Geotextile

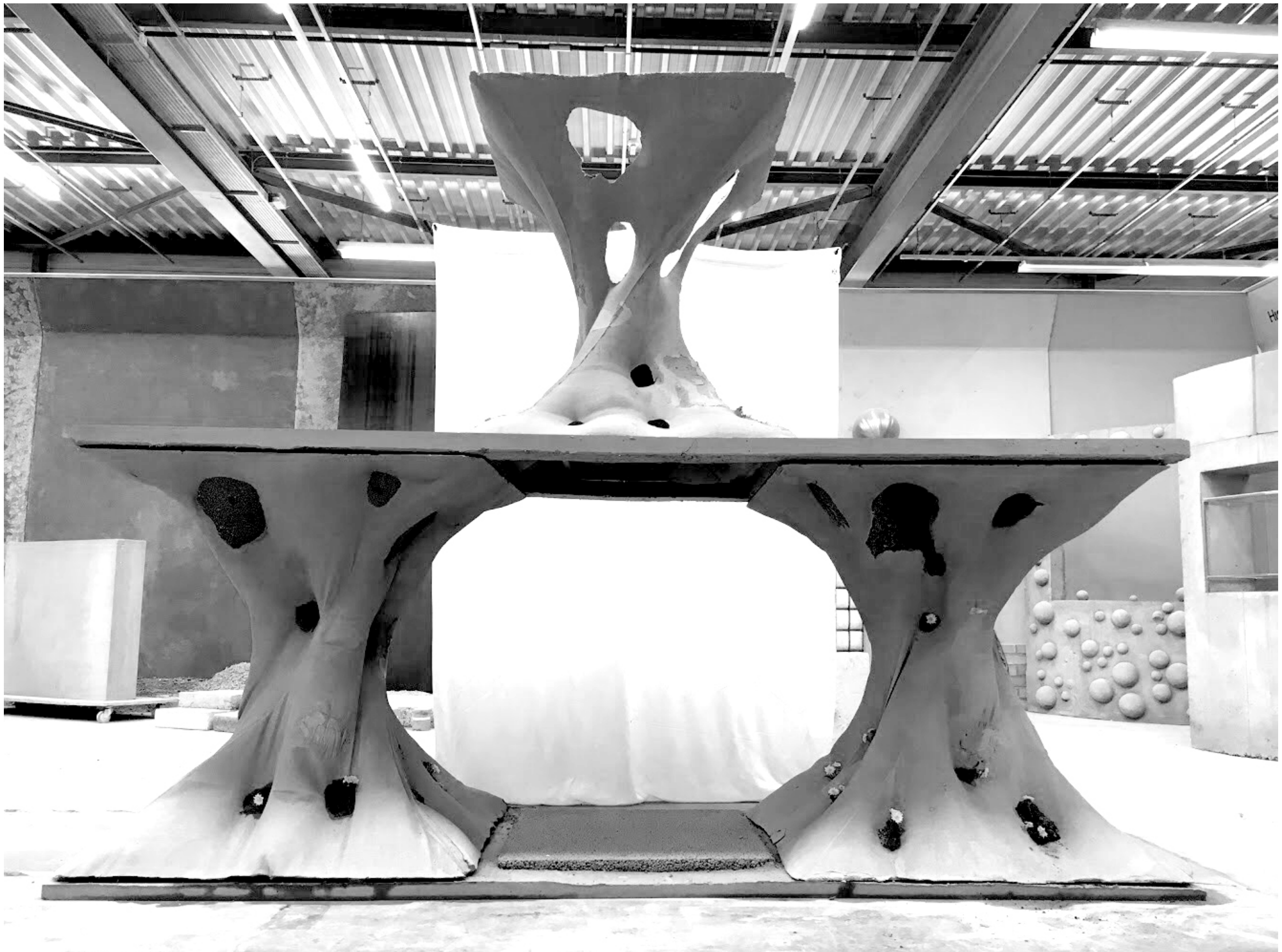
Testing "Twist" and Patterns

Testing "Twist" and Patterns



Project 4 - Urban Wetland: An Above Ground Cistern
Twisted concrete tubes perform as a cistern; holding and pumping water up through the structure to create green spaces, pools and waterfalls. The structure becomes a cooling system to reduce the heat island effect with water continually running through the structure and keeping the spaces cooer than the hot outside temperatures. The forms comprise of porous concrete on the inside and high strength concrete on the outside to retain water at night and slowly release it back by day to keep the space cool as wind moves through the open-air structure.

Students: Gabriel Maese and David Knaide



Pic - time lapse imagery from video of students illustrating water cascading and moving through the porous concrete structure. The aim was to filter the water as it passes through the openings with planted vegetation.

Project 4 - Urban Wetland: An Above Ground Cistern
These two students were selected for a summer internship to develop their ideas and build mock-ups of their design strategy at the research lab of CEMEX Global R&D. This was an amazing opportunity to work alongside some of the best material scientists and engineers in the world. They were able to build their design modules at half scale and test how water can move through the system.

Students: Gabriel Maese and David Knaide