IDEASTUDIO REPORT 2015 - 2016

TEXTILE DESIGN AND MATERIAL STRATEGIES

KIHONG KU

Interdisciplinary Design + Experimental Architecture Studio

PHILADELPHIA UNIVERSITY
COLLEGE OF ARCHITECTURE AND THE BUILT ENVIRONMENT

PROGRAM DIRECTOR:
KIHONG KU

PROGRAM CO-DIRECTORS:
CHRISTIAN JORDAN, LYN GODLEY AND MARCIA WEISS

PRACTITIONERS:
PETRA STANEV AND RYAN LOHBAUER

SPRING 2016 STUDENTS:
FERAS ALSAGGAF, DYLAN CATINO, EMMANUEL ESHUN, SUVIR HIRA, CLARISSA KELSEY, ADDISON KLEINBRAHM, WHITNEY LEH, VERONICA MAGNER, MATTHEW MCMAHON, LORIANN NICOLADSE, CHRISTOPHER PIASECKI, SAMUEL SIEGEL, ETHAN STANLEY, JAVIER VILLARROEL, ZACHARY WILMARTH

FALL 2016 STUDENTS:
JACK ROGERS, NICHOLAS WILLIAMSON, CRYSTAL BROWN, IDRIS SALAHELDIN, TEVIN WILLIAMS, JIATAI WU, MELISSA GARCIA, ZILDA HIJAZIN, JENNIFER MCELROY, KRISTINA PULSINELLI, BRITTANY EWING AND RYAN SCHAEFER

TEACHING ASSISTANTS:
JASON JIANG, MEGAN KOHL, MORGAN YOUNG, NATASHA HANOLD, AND SUJAN KHADGI

PUBLICATION EDITORS:
KIHONG KU, JASON JIANG, HARDI SHAH, AND MORGAN YOUNG

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INTERDISCIPLINARY DESIGN AND EXPERIMENTAL ARCHITECTURE STUDIO (IDEAS) ON TEXTILE MATERIAL STRATEGIES:
STUDIO FRAMEWORK

PROJECT DESCRIPTION:
The IDEA Studio is a curricular approach launched in the spring semester of 2016. The goal of this project was to establish a framework for an interdisciplinary design and experimental architecture studio approach that integrates practice concerns and educational objectives, while also investigating the potential for new material strategies involving textiles for architectural applications. The one-year project period allowed for development and pilot testing of the curriculum in order to substantially evaluate the outcomes for future expansion of this approach.

DEVELOPMENT OF ORIGINAL PROPOSAL:
CURRENT PROJECT STATUS AND DEVELOPMENT AND/OR MODIFICATIONS OF ORIGINAL PROPOSAL:
The project team completed its planned IDEAS course development and successfully implemented the two semester sequence. As proposed the project was administered during the spring and fall 2016 semesters, focusing on design research of textile material strategies for architecture (Figure 1).

Most of the proposed components were implemented as planned with a few adjustments regarding the scheduling and coordination of the companion studio/seminar courses. Course syllabi, schedules, and project assignments were newly developed for all courses, some among the architecture, textile, and industrial design faculty, and others were conducted in collaboration between the architecture faculty and non-faculty architect practitioners. The sections below describe the course development activities in more detail.

SPRING 2016 COURSE/CURRICULUM DEVELOPMENT:
In the spring 2016 semester, the team piloted a 6-credit fifth-year architecture studio (ARCH-508 Design 10) course taught by Professor Ku and a parallel 3-credit special topics course (TXD-797-1/DSGN-371) on 3D Textiles taught by Professors Lyn Godley and Marcia Weiss.

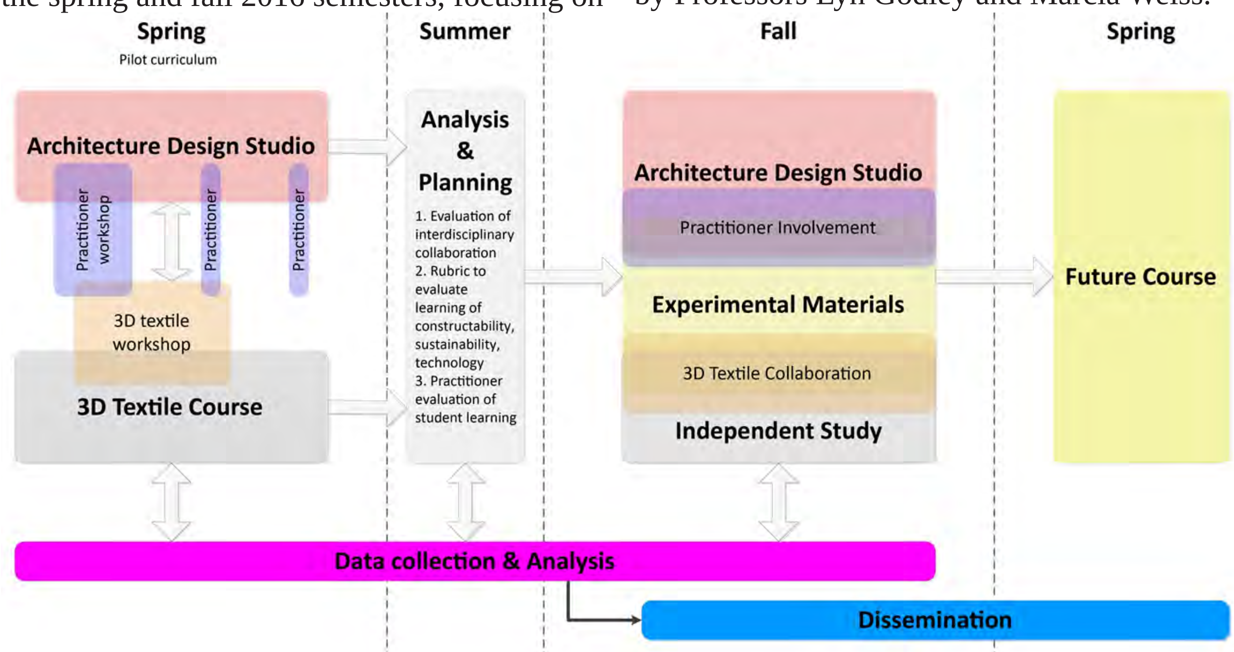

Figure 1: IDEAS curriculum framework

Professor Ku informally co-taught the 3D Textiles course, which focused on exploring various textile techniques without the specific context of architectural practice and projects. Regarding the planned interdisciplinary textile design collaborations and non-faculty practitioner architect participation, the architecture studio incorporated the components of a one-week textile design workshop that was hosted through the 3D Textiles course, a one-week design assignment of an interior sculptural installation led by the non-faculty practitioner architects, and a public art infrastructure/renewable energy plant project (i.e., the 2016 Land Art Generator Initiative (LAGI) design competition). As planned the 3D Textile special topics course was loosely coupled with the design studio around a one week workshop titled "Dilettante Textiles" that hosted a Dutch architect Luc Merx during the week of Feb. 14, 2016 through Feb. 20, 2016. During the workshop architecture students were tasked to collaborate in cross-disciplinary teams of architecture, textile, industrial, and fashion design, to explore various textile techniques such as knitting, crocheting, weaving, and others, to design and manually produce threedimensional textile structures (Figure 2).

After the textile design workshop, the architecture students worked separately from 3D Textile course students except for four

Figure 2: Spring 2016 Textile design workshop presentation with Dutch architect Luc Merx.

architecture students, who were also enrolled in the studio. The 3D Textiles course students continued to further develop 3D textile products that were exhibited at the International Contemporary Furniture Fair (ICFF) during May 14-17, 2016, in the Javitz Center in New York (Figure 3). Because of the relatively limited linkage between 3D Textiles course and the architecture studio, the non-faculty architect practitioners were asked to develop a one-week assignment designed to specifically emphasize constructability (cost estimating) and project management issues (strategies to manage client expectations), and to simulate a schematic design process in practice. The practitioners introduced the assignment based on an actual project from their practice they were working on in Center City Philadelphia. This project challenged the students to design a sculptural interior canopy as an installation responds to a strong historic context and aesthetic, while also satisfying cost and performance requirements (Figure 4). Thus, the three students were grouped to develop one concept for the team from which each of the students were then assigned to develop a low, intermediate, and high budget design scheme (Figure 5).

Figure 3: 3D Textile student work exhibited at the ICFF 2016 (Yi Chun Liu, Textile Design student, and Javier Villarroel, architecture student).

The practitioners participated in a desk critiques and the final review of this assignment. The Dutch architect, Luc Merx, who led the textile workshop also participated in the final review of this assignment.

Figure 4: Studio assignment site photo and elevation introduced by practitioners.

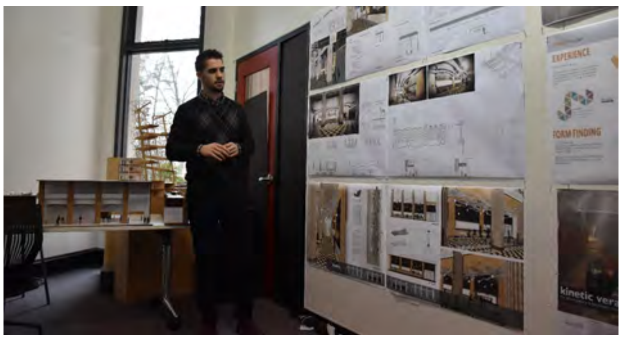

Figure 5: A student who was assigned the intermediate budget presenting his scheme.

In addition to the originally planned mid-term and final review participation, the practitioners gave a presentation on their professional approach to design competitions explaining the type of competitions they would pursue and the reason of investing their efforts in them (Figure 6). This provided an introduction to the final

Figure 6: A slide from the practitioners on design competitions.

project, which adopted the Land Art Generator Initiative 2016 competition (http://www.landartgenerator.org/competition2016.html). The practitioners subsequently participated in the three-quarter and final reviews of this project. This assignment offered the students the opportunity to understand design thinking processes in practice; professional conduct (work ethics), and real world practice management issues. In connection with the LAGI design competition project, the students were introduced to concepts in physical computing, textile techniques, and the design assignments allowed students to apply those technologies to a sustainable design problem that addressed an infrastructure scale public art installation of a renewable energy plant. One of the student projects (Veronica Magner, Ethan Stanley, and Emmanuel Eshun) was selected for the top 25 shortlist (Figure 7) and another team (Suvir Hira, Feras Alsaggaf, and Dylan Catino) was included in the competition booklet of selected projects (Figure 8).

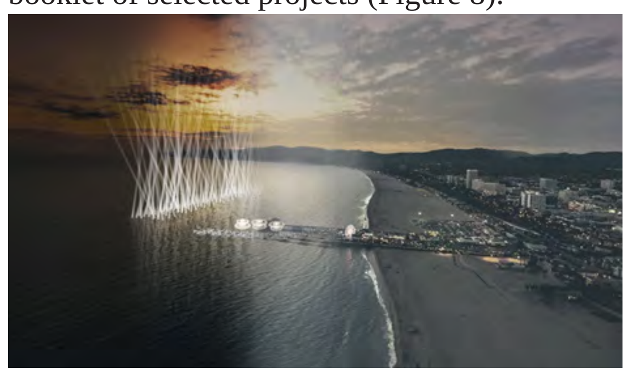

Figure 7: Shortlisted LAGI competition scheme (Magner V., Stanley E., and Eshun, E.)

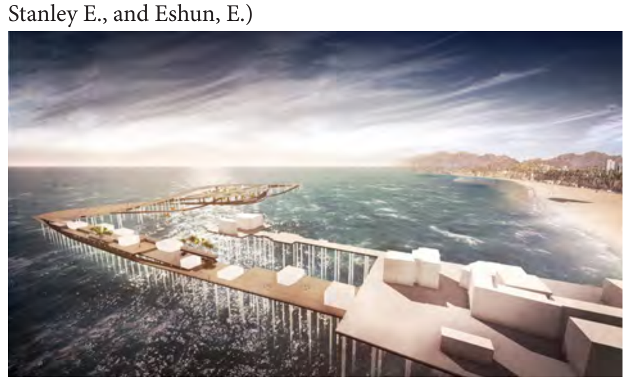

Figure 8: LAGI scheme (Hira, S., Alsaggaf, F., and Catino, D.)

Figure 9: Student textile explorations (Jenny McElroy and Kristina Pulsinelli).

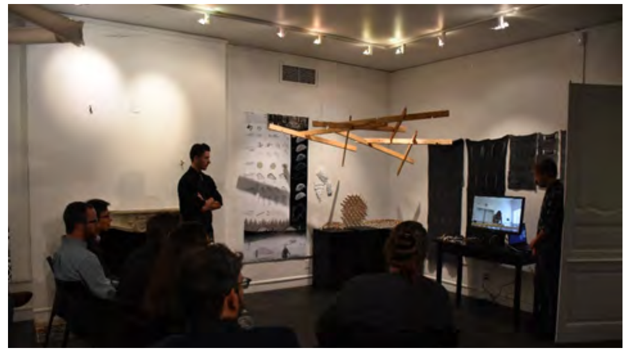

Figure 10: Student presentation during Design Philadelphia Exhibit.

In the spring semester, the projects did not focus on textile applications for building envelopes but students were encouraged to find novel ways to apply design research and textile applications on the scales of an interior sculptural installation assignment and an infrastructure scale public art and renewable energy plant. The faculty tasked the students to incorporate professional management issues, such as cost estimating, with guidance from the non-faculty architect practitioners and challenged them to think creatively within the additional constraints of constructability. The fifth-year architecture students from this semester graduated in May 2016.

FALL 2016 COURSE/CURRICULUM DEVELOPMENT:

Building on the spring semester experience over the summer of 2016, the faculty and non-faculty practitioners collaborated to develop new course content and assignments for the architecture studio (ARCH 507 Design 9) taught by Professor Kihong Ku and an architecture seminar course (ARCH 413 Experimental Structures) taught by Professor Christian Jordan. Professor Marcia Weiss, who taught a graduate level textile design course, coordinated with the team to facilitate the interdisciplinary collaboration between architecture and textile design. The non-faculty practitioners agreed to participate every week in at least one desk critique or review session.

The studio was organized into two primary parts, (1) a temporary shelter project titled Shelter + Textiles, which was exhibited in the Design Philadelphia event, and (2) a façade retrofit project of existing buildings. As the studio students were new fifth-year architecture students, different from spring 2016 semester, the first project started with a research project into various textile techniques and relevant research, including historic context of architectural textiles, textile materials and fabrication technologies, building envelopes and tectonics, computational design methods, and experimental textile strategies in architecture (Figure 9).

The temporary shelter project built upon the student research and investigated architectural solutions for temporary shelter applications in student identified sites. The shelter project tasked the students to explore innovative textile material strategies, while satisfying constructability issues and applying emerging technologies. The results were exhibited during the Design Philadelphia Event in the Paley Design Center from October 10 through October 14, 2016 (Figure 10).

In addition to the assignments, four field trips were scheduled including three locations in New York and one jobsite in Philadelphia. The New York field trip occurred on September 9, 2016, including the Material Connexion library, which exhibits various material samples, Terreform ONE (Figure 11), a thinktank laboratory that conduct futuristic material studies, and Snohetta (Figure 12), a renowned international design firm which completed the San Francisco Museum of Modern Art extension with a fiber composites cladding panel system for the envelope.

Figure 11: Field trip to Terreform ONE (Mitch Joachim presenting).

In Philadelphia, on November 1, 2016, the class visited a row house project, the Arbor House, developed by Postgreen to examine a CNC milled weaving pattern that was designed on a cladding system by the artist, Jenny Sabin. (Figure 13).

Figure 12: Visit to Snohetta, NYC (Elaine Molinar and Samuel Brissette presenting).

For these first two projects, Professors Weiss and Ku organized two faculty presentations, regular weekly workshops, collaborative work sessions for the textile design and architecture students so that both groups were able to share cross-disciplinary design research and concepts (Figure 14).

The collaborative research informed the architectural investigations which were further discussed with the non-faculty architect practitioners who provided weekly feedback to students on the architectural implications of textile investigations, professional communication skills, and design thinking skills to frame clear and precise questions helping to reach well-reasoned conclusions, and testing alternative outcomes (Figure 15). In parallel, Professor Christian Jordan taught the Experimental Structures course to support and reinforce computational explorations of the textile constructs the students were working on in the design studio (Figure 16).

Figure 13: Field trip to observe Arbor House façade weaving pattern (Guide by Ethan Peck and Brian Ledder).

Figure 14: Collaborative session of textile design and architecture students.

The second part of the semester transitioned into a façade scale application of textiles in order to let the students investigate and develop innovative solutions within the practical constraints of building envelopes. The practitioners suggested an intermediate project that adapted the outcomes of the individual textile shelter explorations into a collective twelve-unit vertical surface to consider the aesthetic, structural, and environmental aspects of textile materials (Figure 17).

Figure 15: Review session with practitioner and textile faculty and students.

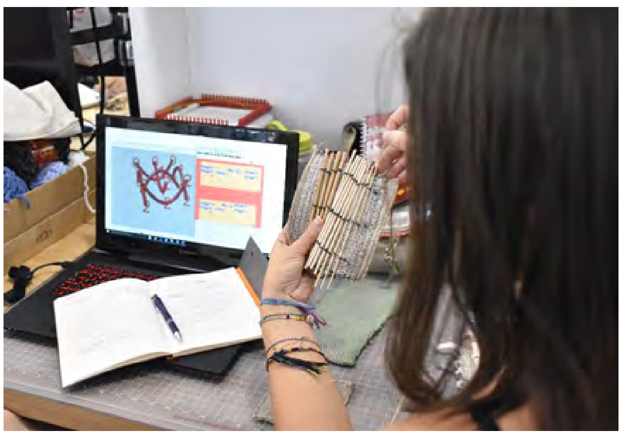

Figure 16: Experimental structures course session within studio with Professor Jordan.

This project allowed students to further refine aspects they found interesting in their first project and some of the students were able to find some elements to further develop for the final façade retrofit project. The students were teamed into six two-member teams and asked to identify three potential sites/buildings in various neighborhoods of Philadelphia. The teams presented the merits of their three choices, and the instructors selected three final sites/buildings out of the total eighteen sites, proposed by the students (Figure 18). Each team was then tasked to design a façade concept that would be adapted to these three different buildings. Part of the exercise included the predesign of the existing buildings in order to propose a program that would define spatial requirements for the facade.

Figure 17: Transitional project between textile shelter and façade project.

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Figure 18: Site analysis and predesign presentation.

Figure 19: Students making fiber composites samples in the shop.

In the companion Experimental Structures course, students experimented with various computational design techniques based on the Rhino 3D and Grasshopper tools (Figure 16) and material research of textile composites, such as carbon fiber composites, glass fiber composites and Kevlar composites (Figure 19). This workshop was led by Brian George, a textile engineering professor. Textile material concepts during this phase dealt with more specific issues of constructability, sustainability, and technology relating to the building envelope system.

INITIAL AND SUBSEQUENT OBJECTIVES, EXTENT TO WHICH THEY HAVE BEEN ACHIEVED, AND OVERALL SUCCESS IN INTEGRATING PRACTICE AND EDUCATION IN THE ACADEMY:

Interdisciplinary design research studio and companion seminar curriculum – Exploring textile material strategies:

The initial objectives of the IDEAS curriculum were quite ambitious considering the complexity of integrating interdisciplinary collaboration and practitioner interactions into this experimental curriculum. The studio-seminar course coupling strategy was implemented as planned with slight changes in terms of concurrent enrollment of architecture students in both the 3D textiles course and the studio. Only four of the fifteen architecture students in the studio enrolled in the companion course. To compensate, the team organized a one-week special workshop to create an interface between the fifteen architecture and twenty-four industrial, textile, and fashion design students to collaborate and work with each other on a topic of manually creating 3D interlaced textile structures. The spring semester companion 3D textiles special topics course offered opportunities to extensively explore various textile techniques such as designing and producing 3D objects utilizing various interlacing techniques, manually and machine-made using a Jacquard loom. In order to facilitate interactions of the students with the practitioners under this loose companion course arrangement, the practitioners were brought in earlier and asked to develop a design assignment that specifically addressed the issues of constructability and budget considerations in design. Thus, in the spring semester the interdisciplinary collaboration between architecture students and other design major students was limited in terms of the duration of activities. Although encouraged by the faculty the textile material applications were somewhat limited and did not involve the development of textile applications for building envelopes.

The lessons learned from the course were used as the basis for the fall semester curriculum development by the faculty. In the fall semester, all architecture studio students were required to co-enroll in a companion architecture seminar course titled Experimental Structures to support

material and computational experimentation. The cross-disciplinary collaboration with textile design graduate students was facilitated through short modular assignments coordinated with the textile design project director Professor Marcia Weiss who taught a separate graduate course for textile students. This arrangement allowed flexibility in terms of enrollment by the students while promoting collaboration between the two disciplines. The architecture students were first exposed to textile design and research strategies with the help of the textile design professor and six textile design students who teamed up with the architecture students who worked together on developing textile samples and designs for a temporary shelter, and final mock-ups. For building envelope applications the non-faculty practitioners and architecture faculty agreed to limit the application to retrofitting an existing façade to limit the project scope to predesign without a complete building design. This allowed emphasis on constructability, sustainability, and technology of textile material strategies for building envelope applications.

STUDENT-PRACTITIONER-FACULTY INTERACTION:

The non-faculty architect practitioners successfully engaged with the students in the spring semester bringing in real-world context through various arrangements including an interior scale one-week design assignment, a presentation on their design practice, desk critiques and project reviews.

In the fall semester this interaction was further expanded by engaging the practitioners in the assignment development process and weekly desk critiques and project reviews where the non-faculty practitioners provided feedback on both design and practical constraints including building code, constructability and technology issues, and also research themes that emerged from the interdisciplinary collaborations. These interactions were supplemented by field trips to involve additional practitioners such as the Postgreen homebuilders, Terreform ONE design thinktank consultancy, and Snohetta architects.

ASSESSMENT OF INTERACTION:

In the spring semester a survey was created and used to gather feedback on student learning experiences on the interdisciplinary one-week 3D textiles workshop. Assessment of student learning was conducted primarily through qualitative assessment by the faculty and non-faculty practitioners through desk critiques and project reviews. A subsequent survey was deployed in the fall semester at the beginning of the semester to ask the students about their familiarity with constructability, sustainability, and technology issues. Throughout the semester, the faculty and non-faculty architects evaluated student learning primarily through qualitative assessment of student work. A change from the proposal regarding assessment of interaction and learning was a shift from the proposed survey based assessment method to a more qualitative method. The reasons behind this modification were: (1) the cohort of students were different students, the spring semester students being a graduating class and the fall semester being rising fifth-year architecture students; (2) the studio-seminar companion arrangement differences of loose coupling versus tight coupling created different interdisciplinary settings; and (3) the different focuses of land art scale infrastructure versus building envelope scale projects, led to adopting a flexible assessment system that could offer students feedback and measure their learning. As such the spring semester learning experiences were not directly comparable with the fall semester in terms of cross-disciplinary learning focuses and student-practitioner interactions. Overall, the contrast of the spring and fall semesters generated insights into how the IDEAS curriculum can be adapted to different interdisciplinary modes of collaboration and how arrangements can be adaptable while impacting the student learning of practice issues.

DISSEMINATION OF FINDINGS:

The architecture students exhibited their work in the 2016 Philadelphia Science Festival, and the students enrolled in the spring 3D Textile course students displayed their work in the 2016 International Contemporary Furniture Fair in New York. The fall studio successfully displayed student work in the 2016 Design Philadelphia Exhibit in October around the concept of ‘shelter’ which incorporated concepts of the building envelope and textile material strategies.

For disseminating the project results, the Project Directors and non-faculty architect practitioners are pursuing multiple peer-reviewed academic conference venues to publish the experiences and lessons. Currently, team’s poster has been accepted to the 2017 Architectural Research Centers Consortium (ARCC) conference. Additional venues including the ACSA and ACADIA are pursued by the team. Concurrently, the team is currently working on publishing the IDEA studio experiences including student work and reflections as a studio publication to be disseminated in hardcopy format and through a website. Final results of this project are planned to be submitted to including the ACSA and ARCC by the end of spring semester 2017.

DESCRIPTION OF WAYS IN WHICH THE PROPOSAL RAISES STUDENT AWARENESS OF AND ADDRESSES:

1. The architect’s responsibility for public health, safety, and welfare
2. Issues central to practice
3. Knowledge/Skills identified in NCARB’s Contribution to the NAAB 2013 Accreditation Review Conference and the 2012 Practice Analysis of Architecture.

The rationale behind exploring textile material strategies for building envelopes was to understand the implications of technological and material innovations encompassing the disciplines of architecture, structural engineering, building science, material science and engineering, and relevant design disciplines. The studio and seminar companion course structure allowed students to gain new knowledge of material systems while considering issues central to practice. Students were tasked to investigate material innovations and the construction of architectural form at the macro level in the design studio while studying in-depth technologies and skillsets in the companion seminar course. For both the spring semester and fall semester, the issues of constructability, sustainability, and technology were emphasized through engagement with the non-faculty architect practitioners. In the spring semester the constraints of different budget levels as constraints challenged students to design with cost implications in consideration. At the same time, it was emphasized that a strong architectural concept would integrate those constraints successfully. In the fall, through a sequence of design assignments students started to investigate possibilities of textile material strategies for envelopes from a temporary shelter scale to a permanent building scale. While developing novel tectonic and formal opportunities, the assignments tasked the students to address constructability issues of cost, fabrication, and building code compliance, and to identify sustainability issues including embedded and operational energy, and energy code compliance. In collaboration with the non-faculty architect practitioners the project directors focused on real-world constraints and issues through reviews, field trips, presentations, and meetings with additional relevant specialists.

PARTICIPATION OF NON-FACULTY ARCHITECT PRACTITIONERS, STUDENT, AND FACULTY:

As explained above the non-faculty architects collaborated with the project directors on course planning, identifying and clarifying the range and scope of critical practice issues to be covered, defining the studio research topic of architectural textiles, and trying to match or arrange live projects to provide a real-world context. Ryan Lohbauer, one of the non-faculty architect practitioners noted excitement about their role of practitioner-advisors. He particularly saw benefit for their own practice in exploring advanced technologies with open-ended possibilities, and explained, “Petra and I shared our perspectives about how these techniques might be applied in practice, and how the careful understanding and defining of real world constraints can suggest elegant architectural applications.”

In the spring semester, they engaged in developing a project assignment, delivering presentations, mentoring, and providing feedback. Reflecting on their spring semester participation of one-on-one desk critiques with the students, and short talks, Petra Stanev and Ryan discussed how competitions can be useful thinking and communication exercises for the practicing architect, in preparation for the students' development of submissions for the Land Art Generator competition. He added, “More important than winning or losing, the development of a strong conceptual framework can guide the direction of an exciting career.”

In the fall semester, the non-faculty architects interacted with students every week for a desk-critique session, a mid-term, three-quarter semester, and final reviews. This increased frequency provided adequate opportunities to develop a student-practitioner relationship that fosters both content and personal interactions.

In the spring semester, from the architecture student perspectives, the non-faculty practitioners were perceived as external reviewers, and experts. The majority of students appreciated the real-world context.

In regard to the interdisciplinary-disciplinary experience in the one-week 3D Textiles workshop between architecture, textile, industrial, and fashion design disciplines, students offered a wide range of responses. For architecture students not formally enrolled in the companion special topics course, the experiences varied depending on how much the students were able to incorporate their work later into their subsequent projects. One of the fifth-year architecture students mentioned, “Collaboration was a great idea as the cross disciplinary knowledge assisted us in acquiring the know-how to make future projects more efficient and cohesive.” In contrast, another architecture student found the textile workshop experience challenging as it did not easily translate back into his/her following project. Students from other disciplines shared similar thoughts, such as an industrial senior student who said, “I really enjoyed working in these teams as I have never worked on an interdisciplinary design project with other design majors.” Another graduate student in textile design mentioned how the cross-disciplinary experience helped her learn about establishing a common vocabulary with other design disciplines and concluded that, “the collaboration made it much easier to ask for advice and help with materials and designs and generally to network with the peers around us.”

The project directors incorporated lessons learned from the spring semester and improved assessment methods and advanced the studio/companion seminar course integration and cross-disciplinary collaboration of architecture, textile and industrial design. Accordingly in the fall semester, Professor Christian Jordan taught the Experimental Structures course in parallel with the design studio. He note that the amount of growth each student demonstrated as a result of this experience was, in his ten years of teaching experience, unprecedented. He attributes these to the structure of the semester, the ability to work, test, theorize and produce in both studio and his lab allowing the students and faculty to develop stronger solutions for complex design problems. Additionally, he mentioned, "Throughout the semester, I could clearly see moments when the students would realize that they could actively apply lessons from seemingly disparate lessons/experiences. The connection between analog textile studies and the visual programming of Grasshopper for Rhino was especially strong; the two endeavors would not have been as successful if they had been decoupled and taught over two independent courses."

One of the architecture student mentioned that finding connections through textiles was extremely challenging but explained how it helped to discover new ideas and thoughts and how the weekly interactions with the practitioners helped to move them forward. One of the collaborating textile graduate students shared her perspective on how her architecture counterparts were able to hand-knit and crochet but not knowing structurally what was happening within the resultant textile. On the other hand, she appreciated her learning about the process and structure of architectural assignments and highly appreciated the opportunity to see how architecture students were utilizing the Grasshopper Rhino3D modeling software to create forms.
Overall, the IDEAS curriculum had a highly positive reception from all participants including architecture students and the collaborating textile, fashion, and industrial design disciplines, in addition to the faculty, and non-faculty architect practitioners.

NUMBER OF STUDENTS IN THE CLASS/SEMINAR/STUDIO PER YEAR, DEGREE PROGRAM, AND YEAR IN THE PROGRAM AND HOW OFTEN AND HOW MANY SECTIONS ARE PLANNED TO BE OFFERED/ WERE OFFERED PER YEAR:

The existing architecture curriculum offers fifth-year students a selection of studio options by research topics, such as digital methods, urban design, global and humanitarian design, design-build, etc. Taking advantage of this current structure, in the spring 2016 semester, the project enrolled fifteen fifth-year architecture students from one section studio and four architecture students in the companion seminar course (four of those students were co-enrolled in the architecture studio). In the special topics companion course, twenty-four junior and senior level and graduate level textile design and industrial design students enrolled, and participated in cross-disciplinary design interactions between the architecture, textile design, and industrial design students. In the fall 2016 semester twelve fifth-year architecture students co-enrolled in the studio and companion seminar course. And five textile design students enrolled in a separate textile design graduate course to collaborate on a number of joint projects with the architecture students. The total number of students from various disciplines participating in this project ranged from twenty-five to thirty students per semester, among which twelve to fifteen students were fifth-year BARCH students each semester. Thus, approximately twenty-five to thirty fifth-year architecture students will be accommodated per year. The number of students could increase with other fifth-year architecture studio sections potentially adopting this curricular approach.

BENEFITS:

EXTENT TO WHICH THE PROJECT HAS IMPACTED THE ARCHITECTURE PROGRAM AND CURRICULA:

The project has provided the architecture program with external recognition and financial support allowing exploration of a

Year	Semester	Course	Student number	Degree	Year
2016	Spring	Studio	**15**	**BARCH**	**5th**
		Seminar	4	BARCH	5th
			24	MSTD	Graduate 1st
				MSID	Graduate 1st
				BSID	Junior/Senior
				BSFD	
	Fall	Studio	**12**	**BARCH**	**5th**
		Seminar	12	BARCH	5th
		Independent Study	5	MSTD	Graduate 1st/2nd
	Total architecture per year		**27**	**BARCH**	**5th**

new cross-disciplinary curriculum and driving design innovations in advanced technological systems. The new curriculum enables tight integration of a fifth-year architecture studio with a companion seminar course which was previously decoupled. Most importantly it increase student learning and output and innovative thinking.

BENEFITS TO THE STUDENTS, FACULTY, NON-FACULTY ARCHITECT PRACTITIONERS, THE ARCHITECTURE SCHOOL, AND THE INSTITUTION:

It afforded the team the opportunity to perform hyper-iterative experiments, interact with design professionals and architects within the studio environment and outside via site visits. The students were able to build their portfolios in ways that their peers were unable to, and lastly, it reinforced the importance of cross disciplinary collaboration. Architects have traditionally occupied a unique place in the process of creating the built environment. While specialization is a byproduct of technologies increased prevalence throughout our professional and personal lives, it has become even more important for architects and architecture students to be able to communicate with many different experts and user groups. The NCARB experience gave Philadelphia University students, and the professional architects along for the ride, the chance to develop those skills, while also revealing areas in which additional knowledge and experience will only serve to strengthen the profession and enhance architecture.

Overall, the project contributed to a better understanding of the positive impacts of student-practitioner partnerships relating to constructability, sustainability, and technology concepts. The students learned about practice issues in the collaborative design studio and through associated seminar courses while enhancing their design research skills. Part of the NCARB Award funding supported materials and equipment supplies for students, and engagement with additional professionals and experts regarding material and fabrication technologies. Teaching assistant support and course releases allowed the faculty to focus on the project and interfaces with practitioners, resulting in more satisfying faculty-student interactions supported by student-practitioner learning, and gained access to practice data to support their design research. Non-faculty architect practitioners gained access to faculty at Philadelphia University, broadening their network for future collaborations. They also appreciated the opportunity to learn about graduating students' thought process regarding job preparation and influence their thoughts for such preparation.

The architecture program has extended its partnership with Stanev Potts architects through the NCARB and enhanced the program's national visibility.

OTHER VALUE THAT THE NCARB AWARD AND THE PROJECT HAS HAD SUCH AS REGIONAL AND/OR NAAB ACCREDITATION, ENGAGEMENT SERVICE, TENURE:

Philadelphia University's Bachelor of Architecture program's NAAB accreditation visit is scheduled for the spring semester of 2018 and the NCARB Award and project will be included in the evaluation of student learning outcomes. Because the project involved both involvement of non-faculty architect practitioners who helped develop the curriculum and a student learning assessment component, the curriculum, coursework, and student projects are well aligned with the NAAB requirements. Thus, the NCARB Award and project were considered by the Project Directors as an important component for the NAAB accreditation process and will provide important data and information to the NAAB team. The NCARB Award was also an important factor for Professor Ku that helped him to get nominated and to receive the 2016 Philadelphia University President's Award for Excellence which is awarded to one exemplary faculty member each year who demonstrates mastery of teaching, significant scholarship and human values dedicated to education.

OTHER ORGANIZATIONS AND/OR BODIES TO WHICH THE PROJECT DIRECTORS(S) AND/OR SCHOOL ADMINISTRATOR HAS REPORTED THE PROJECT:

Project information has been disseminated in the ACSA March 24, 2016 newsletter. Student work produced in the 3D textiles special topics course have been exhibited in the ICFF 2016 and the architecture studio students have displayed responsive architecture prototypes in the 2016 Philadelphia Science Festival. The fall student work was exhibited in one of the 2016 Design Philadelphia events. On November 11, 2016, the project director Professor Ku and four of the architecture students (Jack Ryan, Crystal Brown, Ryan Schaeffer, and Jennifer McElroy) presented the project to the College Advancement Council which is a board of architectural firms that support the mission of the College. And the project team has a poster accepted on the IDEAS curriculum to be presented at the 2017 ARCC conference.

FUTURE GROWTH AND DEVELOPMENT:

PROJECTION FOR FUTURE GROWTH AND VIABILITY INCLUDING FUTURE GOALS:

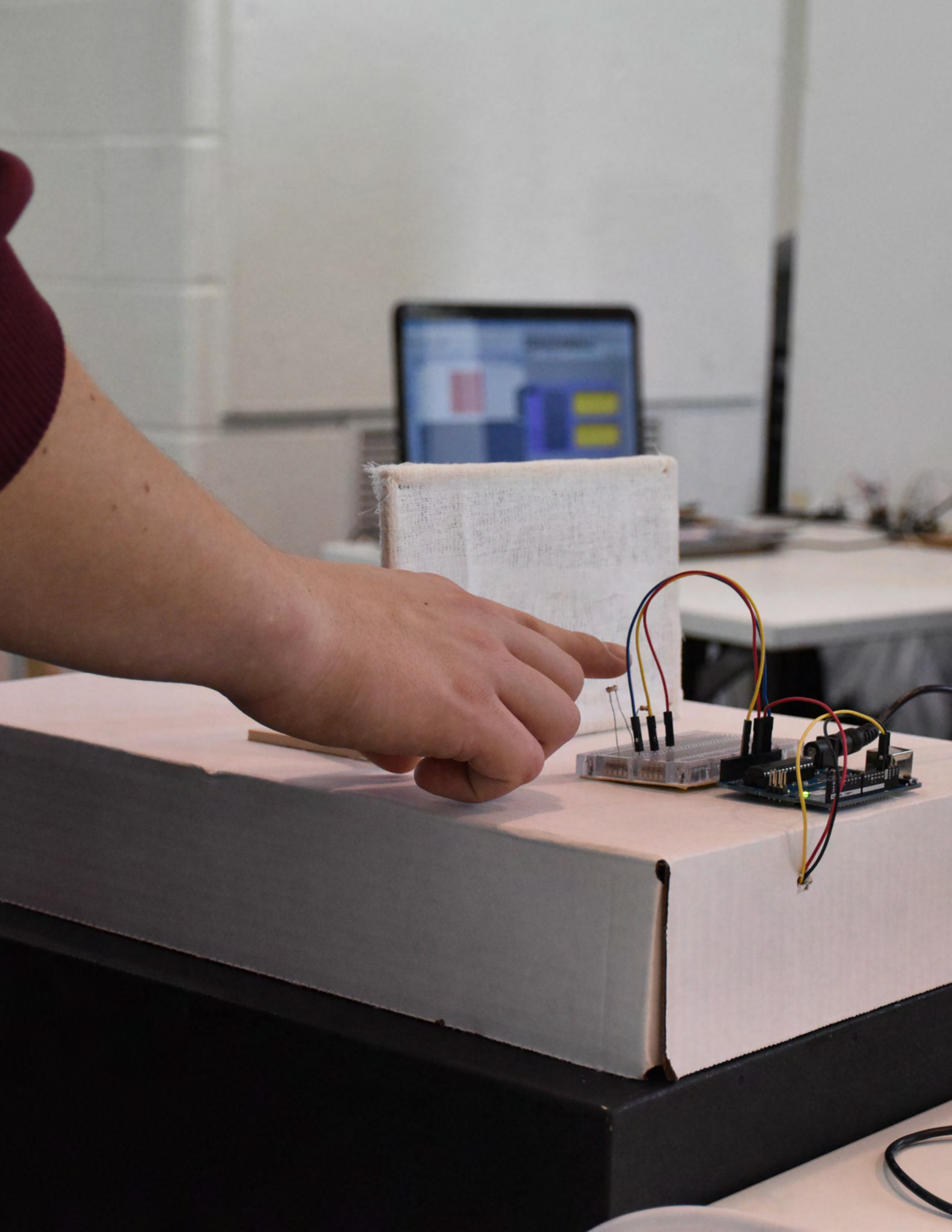
The proposed interdisciplinary and companion studio/seminar curriculum can potentially be formalized to engage at a minimum thirty fifth year architecture students per year. The project directors are working on this model to be accepted at the architecture program level, so that additional studio sections could adopt a similar cross-disciplinary companion course structure with other topic focuses, broadening the impact of the project. The design research and student work supports the program directors' research agenda in emerging technologies, materials and environmental issues, through prototyping and computation, and expanding disciplinary methods and practices. The findings of architectural textiles and composites for building envelopes fulfill the professions need for advancing the professions knowledge of material innovations and achieving high performance building systems.

As a variation of this model Professor Ku has taken the IDEA studio for the spring 2016 semester and applied the framework for an interdisciplinary collaboration with medical students at Thomas Jefferson engaging practicing architects from ENNEAD architects, NYC.

IMPACT ON RECEIVING ADDITIONAL FUNDING FROM OTHER SOURCES:

The remaining balance on the NCARB Award will be helpful to disseminate the IDEAS curriculum and to repeat parts of the curriculum in the future. The faculty is working on a number of grant proposal ideas building on the textile material and composites explorations in the studio to apply for relevant funding opportunities such as the Advanced Functional Fabric of America (AFFOA) partnership which aims to develop innovations in advanced fabrics.

STUDIO PROJECTS
PROTOTYPING SMART ART | SPRING 2016



PROTOTYPING SMART PUBLIC ART - PART 1 OF 2:

Project 1 is an assignment through which you will to develop the basic skills required to design and prototype your proposed responsive architectural systems. You will diagram, map dataflow, explore parameter driven design and represent theses subject matters through a variety of graphic media including but not limited to: vector drawing; raster images; animation; montage; collage etc. The IPO diagram is one tool to sketch possible responsive behaviors and a conceptual pathway to the design of algorithms using Input-Process-Output (IPO) diagrams. The IPO diagram was developed by IBM in the 1970's as a communication device to describe the main steps of an algorithm (the formation of inputs, a process to manipulate these inputs and the outputs of that process).

INTRODUCTION TO SCULPTURAL INSTALLATION AND PRAGMATIC CONSTRAINTS:

A consistent element of all applied design work is the presence of a context. Whether a project is as small as a piece of jewelry or as large as an urban plan, it is always constrained and informed by its site. Regardless of the type of design, the discussion of the success of a project revolves around a consistent set of topics: aesthetic value, functionality, inventiveness of the idea, and quality of the execution.
For this project you are asked to design a sculptural installation building on the skills you developed in Project 1.b. You are encouraged to employ parametric design tools and responsive or interactive elements.

PROGRAM:

A client has acquired a historic building in Center City, Philadelphia and is interested in commissioning a sculptural canopy installation in a section of the building's cavernous double-height residential lobby to highlight and define a newly re-opened bar area. In addition to a strong aesthetic, the piece is to serve the functional purpose of defining the bar zone, lowering the perceived ceiling, creating an interesting lighting condition, and mitigating potential acoustic issues.

SITE:

The building is located on the SE corner of 9th and Chestnut Streets. Designed by Horace Trumbauer, it first opened as a luxurious hotel, the Benjamin Franklin Hotel, in the late 1920's. At the time the building boasted of its technologically advanced features, including the air conditioning system, which cooled the lobby through cleverly designed ceiling registers. The interior of the lobby is highly ornamented in a classical manner. Part of the challenge of this assignment is to formulate an approach to the strong historical context, then develop an installation that stays true to the approach while satisfying cost and performance requirements.

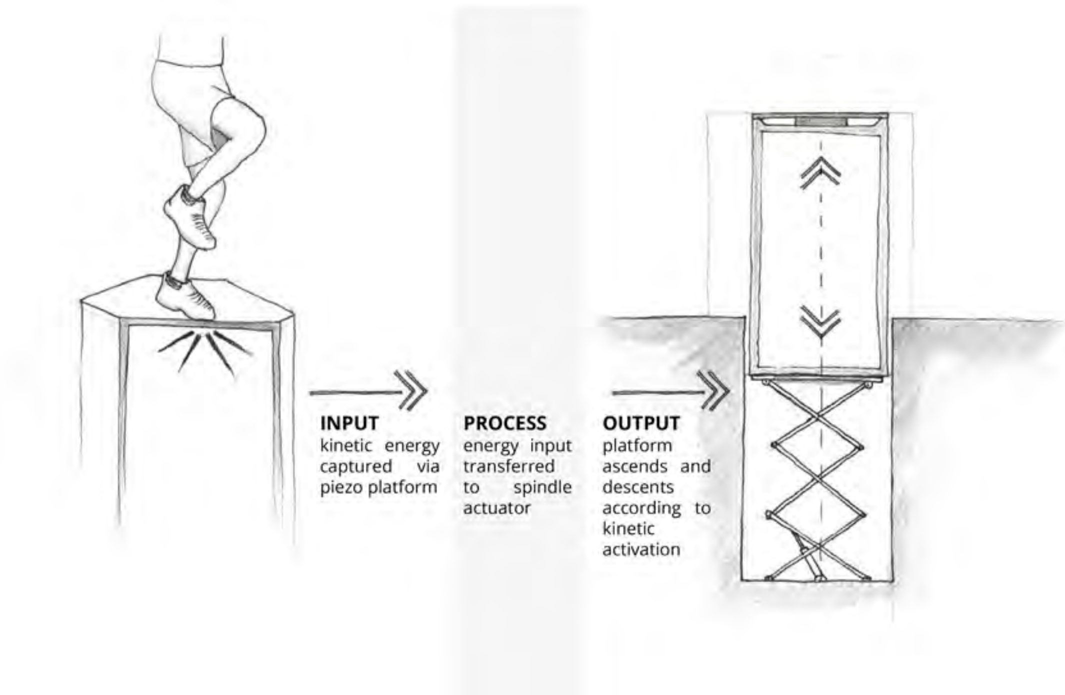
CONSTRAINTS:

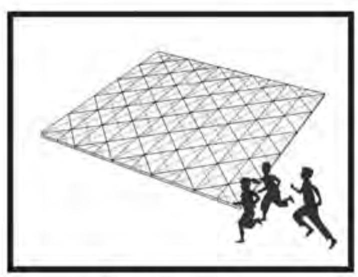
The installation is to be placed in the general area indicated. Consideration must be given to the realities of construction: a structural strategy, attachment to existing conditions, electrical supply, relationship to existing HVAC registers, sprinkler heads, etc.

SCULPTURAL INSTALLATION
PHILADELPHIA UNIVERSITY
FEBRUARY 15, 2017

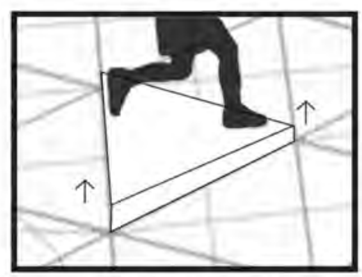
KINETIC PLAYSCAPE

CLARISSA KELSEY
VERONICA MAGNER
JAVIER VILLARROEL





Playscape at rest.



Platform is engaged.

Realization of activity- Platform rises.

Platforms rise and fall with energy input.

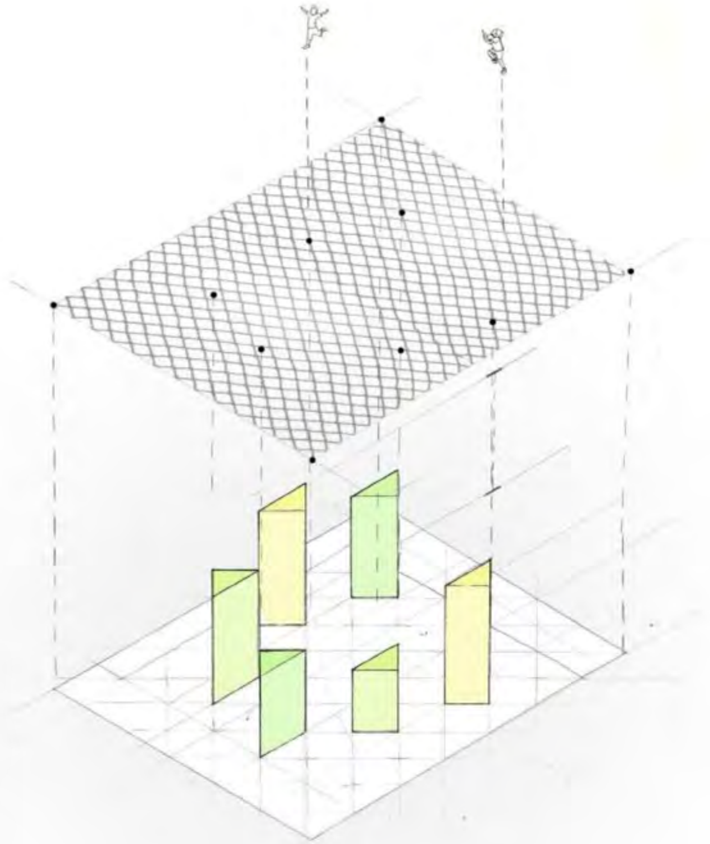
Additional engagement and play!

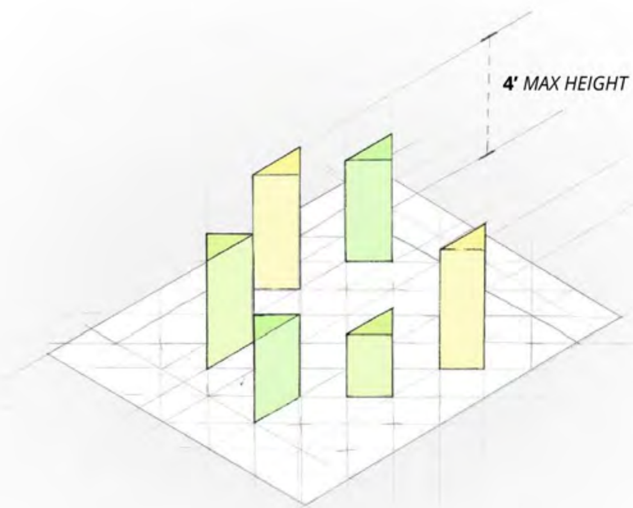
APPLICATION:

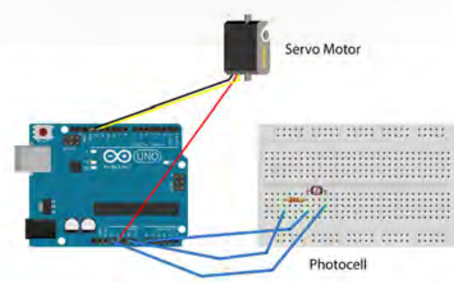
Urban schoolyard setting where outdoor recreation space is limited.

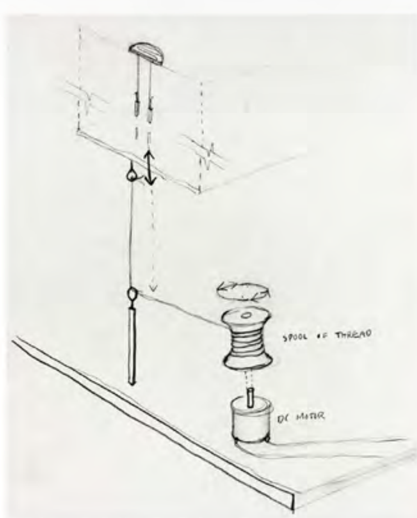
Condition 1: Playground
Netting is affixed to attachment points and actuators are enabled, creates continuously changeable playscape.

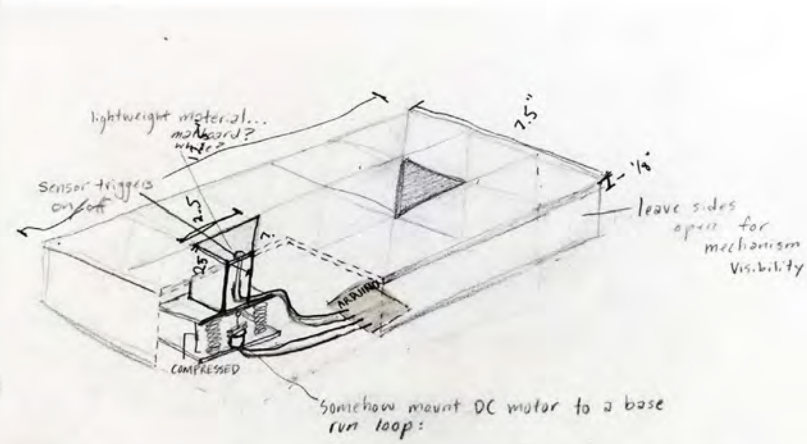
Condition 2: Open Court
All platforms are in lowered position, actuators are disabled, and net is removed to allow for open playing field.





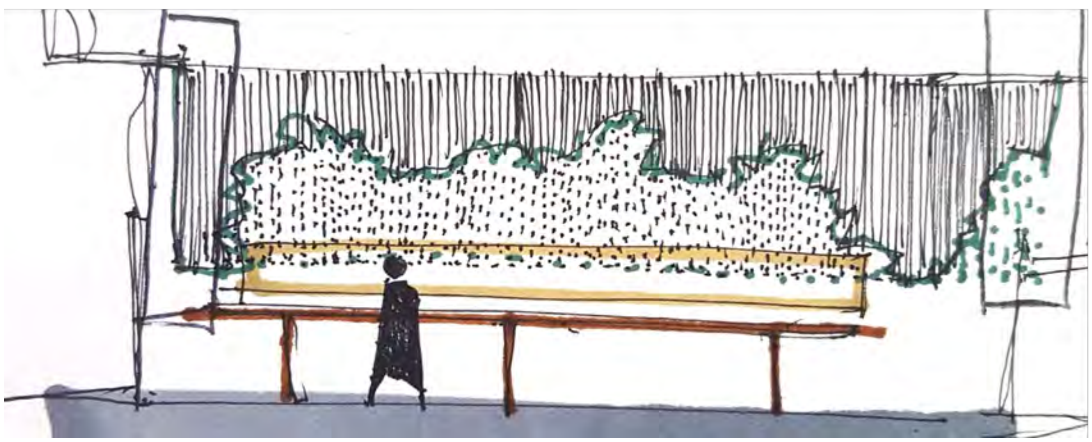


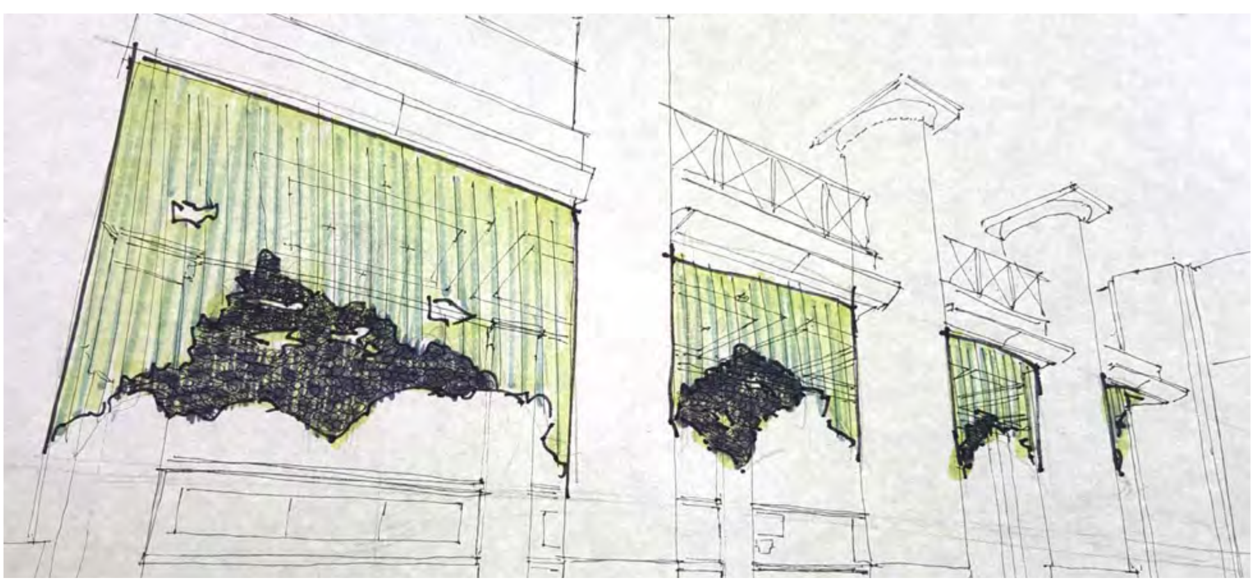


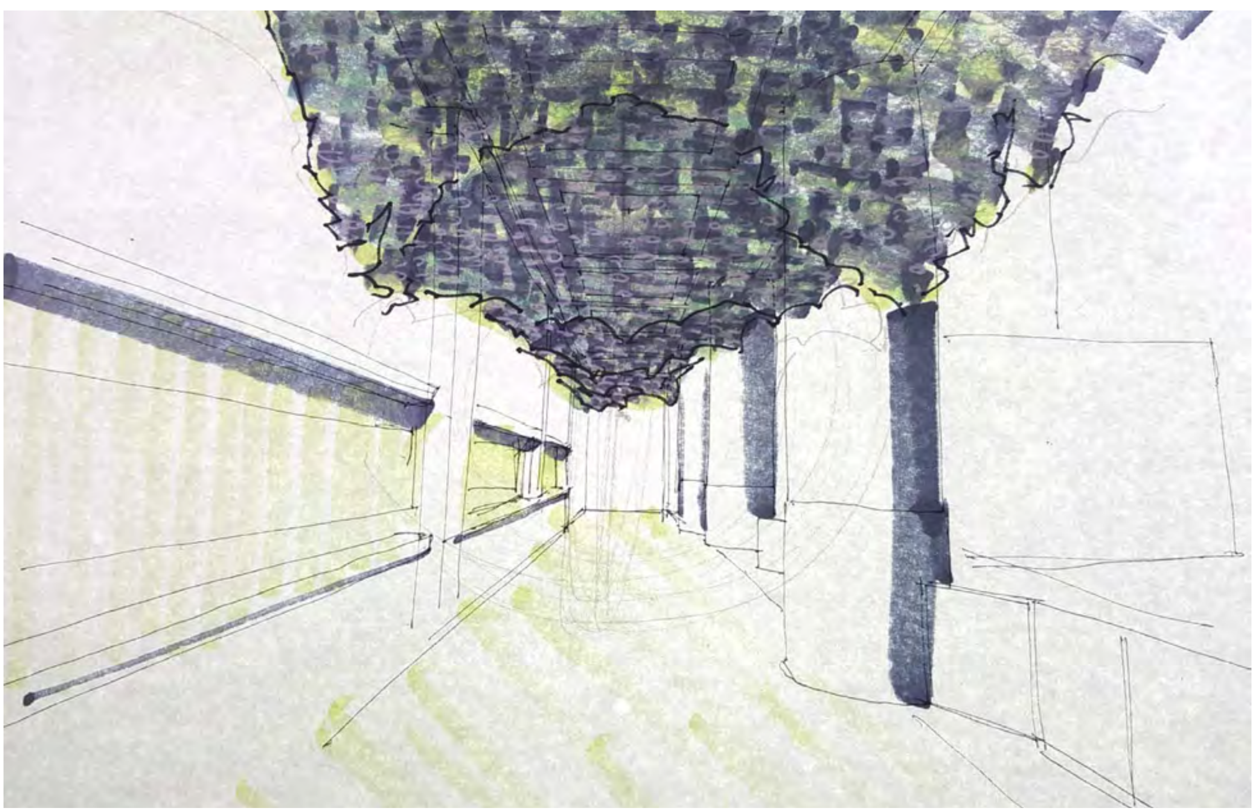


SCULPTURAL INSTALLATION

SAM SIEGAL
MATT
ADDISON







STUDIO PROJECTS

2016 INTERNATIONAL LAGI DESIGN COMPETITION | SPRING 2016

**PROTOTYPING SMART PUBLIC ART - PART 2 OF 2:
2016 LAGI INTERNATIONAL DESIGN:**

We will use the 2016 Land Art Generator Initiative design competition as a vehicle to experiment and study the implications and complexity of integrating clean energy and water infrastructure into urban habitats. The problem requires interdisciplinary approaches involving architecture, engineering and science which enhance the value of our cultural landscapes through combining public art with novel energy and water infrastructure.

TASKS (A):

This project is the first phase of developing a proposal for LAGI 2016. Each group is to analyze the design brief and all project documentation, to generate initial ideas about the site context, emergent technologies, computational strategies, and textile material strategies and Q&A items. Also think about composing teams which can maximize your individual expertise. You will be forming teams of three members (each team should include only one member enrolled in the 3D Textiles course).

TASKS (B):

Building on your initial analysis of design guidelines and research, you will begin to develop and narrow down your investigations. You will create and present a concept design proposal that responds to the site context, renewable energy and clean water potential, emerging technology and material strategies.

You will develop at least three concepts per group based on your analyses and defined research areas of interest through sketching, diagramming, preliminary mass modeling, and literature review and documentation including APA style citation (http://www.philau.edu/library/Help/Citation.html). Each concept should be developed through multiple iterations. You analysis and research should support and justify your selection of renewable energy sources, technology choices and rough system ideas, and your design approaches.

TASKS (C):

Building on the three preliminary alternatives you will develop one strong concept that is addressing the design criteria. You will present a concept design proposal that responds to the site context, renewable energy and/or clean water potential, emerging technology and material strategies.

1. You will evaluate, select and refine one concept. Concisely describe the concept in a sentence explaining how it relates to ecological, environmental, social and historical context, spatial, or technological research. Based on the concept develop a schematic design. Your project should demonstrate coherence in terms of aesthetics, functionality, novelty of the idea, and craft of the implementation.

2. Investigate and identify preliminary physical prototyping ideas and technologies that are applicable to your schematic design in subsequent stages.

TASK (D):

Building on your previous explorations, revisit your concept and schematic design to make sure your proposal is built on a clear and well defined design concept and direction. Revisit the design brief to evaluate how your design succeeds or fails. If necessary you may modify your schematic design.

1. Further develop your land art scheme for energy generation and user experiences; estimate and validate your energy generation and/or water production capacity

2. Identify the minimum requirements for a

working prototype that will illustrate the user experience, energy-water technology and aesthetic characteristics of the system. You will use the prototype to test your design concept and its inherent processes, and use it to learn from and derive criteria for refining your concept. Prototyping helps you to specify your real, working system.

3. Determine the scale and scope of your prototype.

4. Develop the energy input/output/ control scheme and associated interaction scenario. Sketch out the system information and interaction flow between these parts. The conceptual algorithm of the system's performance that includes all the technology, the physical and virtual forms and models, the user of the system, and/or the participant in the scenario enacted by the system also need to be specified in detail. Develop a cost breakdown and an implementation schedule.

5. For programming, break down the algorithmic performance of the prototype into smaller pockets (descriptions of possible functions that need to be scripted). For physical modeling develop the design of the parts and pieces of the physical form to be fabricated, and its material specifications. For circuits develop Fritzing (http://fritzing.org/home/) diagrams and the pieces needed.

6. Define the technologies that you will incorporate in the working prototype.

TASK (E):
Working towards the LAGI 2016 competition, Philadelphia Science Festival, and Senior Design Show, you are expected to develop complete designs and mock-ups that provide understanding of the proposed architecture of the system including clean

energy/water generation, sufficient aspects of the user experience, and the underlying logic of operations. Video recording of working physical prototypes will allow for demonstrating the ideas to possible interested stakeholders for fundraising, and soliciting their engagement in further developing the ideas into full scale implementations. You are expected to develop enough information that can be used to develop working prototypes which include technical specifications. Based on your mock-up/prototype, working prototypes can be implemented using refined clean energy technology, robotic, electronic, and kinetic components and systems.

The mock-ups should inform and address the following deliverables and aspects:

1) Size and scale of mock-up: Decide what scale/size is most effective to demonstrate the kinetic aspects of your design.

2) Kinetic patterning: study the possibilities of patterns that incorporate the 'time' dimension.

3) Simulations: using your platform of choice, Rhino3D grasshopper/firefly, Processing/ Arduino, etc., visualize potential applications, applying parametric control and animations.

4) Support documentation and analyses: depending on the goal and function of your system, provide support analyses. For example, consider illustrating fluid dynamics models, etc.

5) Develop specifications for the final working prototype. Revisit the design brief to evaluate how your design succeeds or fails. If necessary you may modify your schematic design.

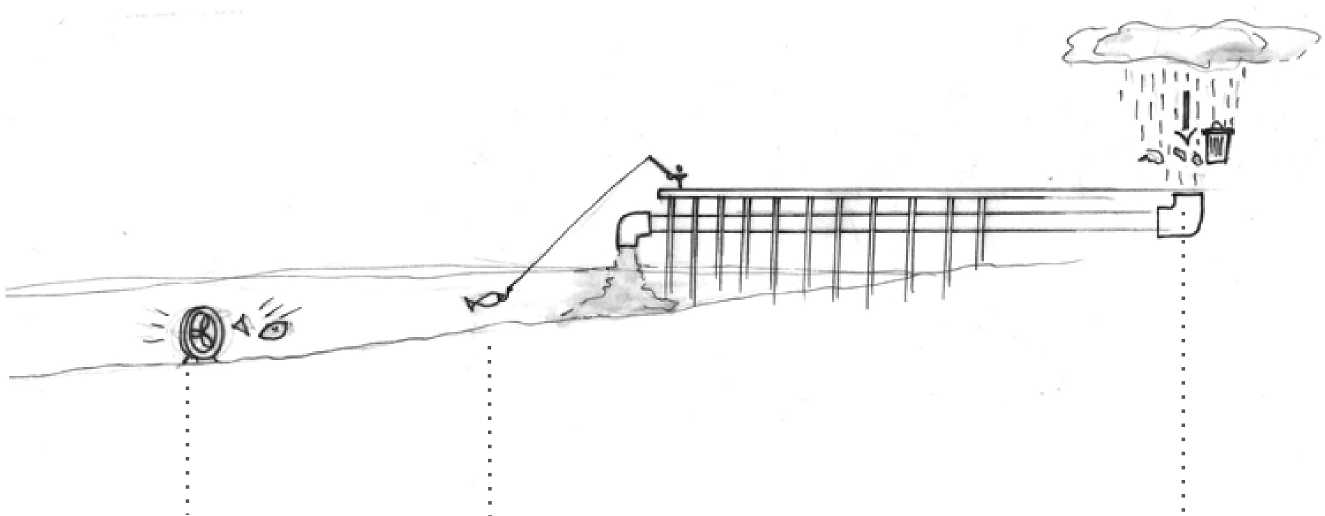
TASK (F):

1. Refine and resolve your generator/water harvesting schemes and incorporate them into scaled drawings and models.

2. Develop working prototype that will illustrate the user experience, energy-water technology and aesthetic characteristics of the system. You will keep testing the prototype to refine your design concept and its inherent processes, and use it to learn from and derive criteria for refining your design development.

WAVE FOREST

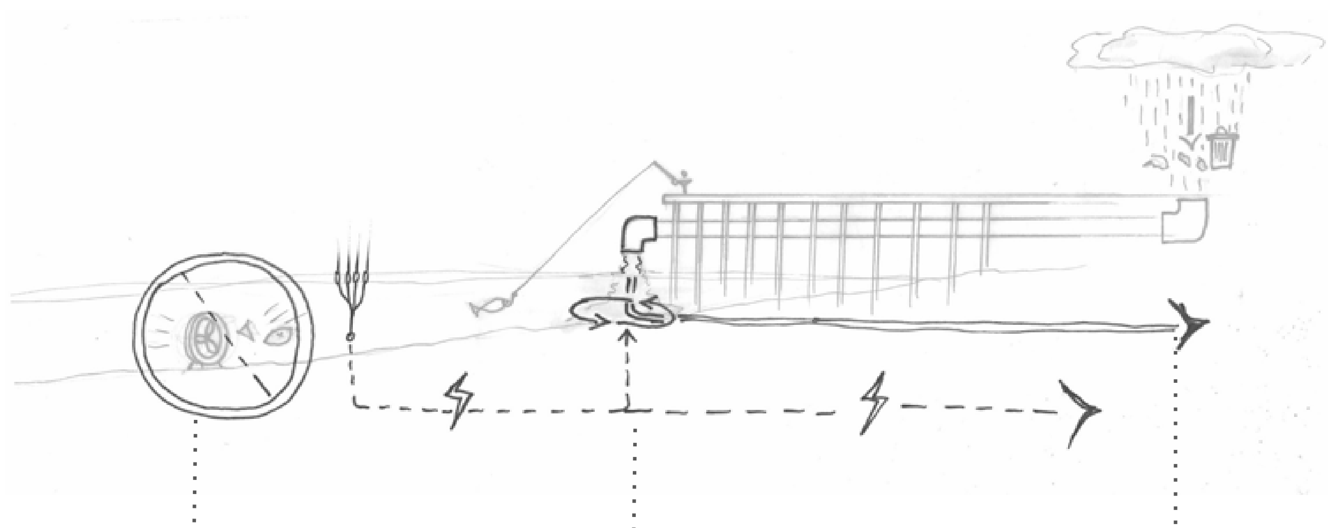
STANLEY
ESHUN
VERONICA MAGNER



TIDAL TURBINE
spinning blades
dangerous to marine life

OVERFISHING
commercial and recreational
upsets ecosystem balance

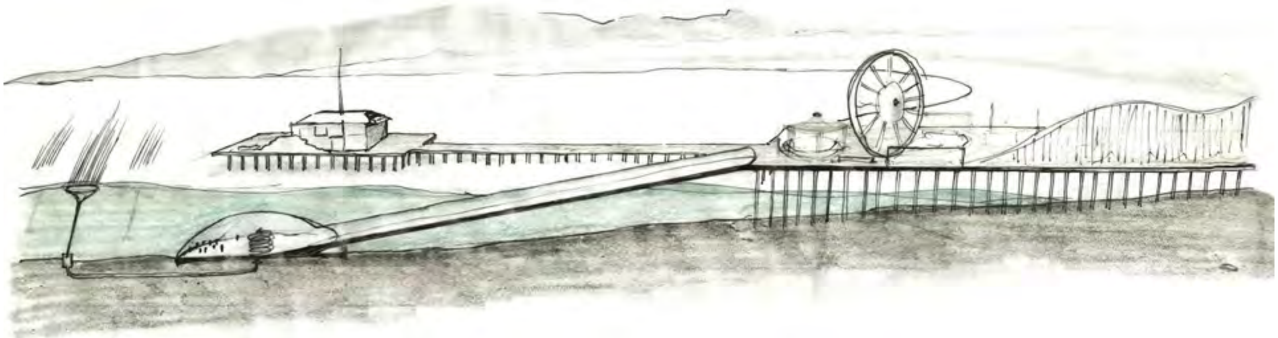
URBAN RUNOFF
dumps toxins and trash into
ocean, dangerous to marine
life and human health

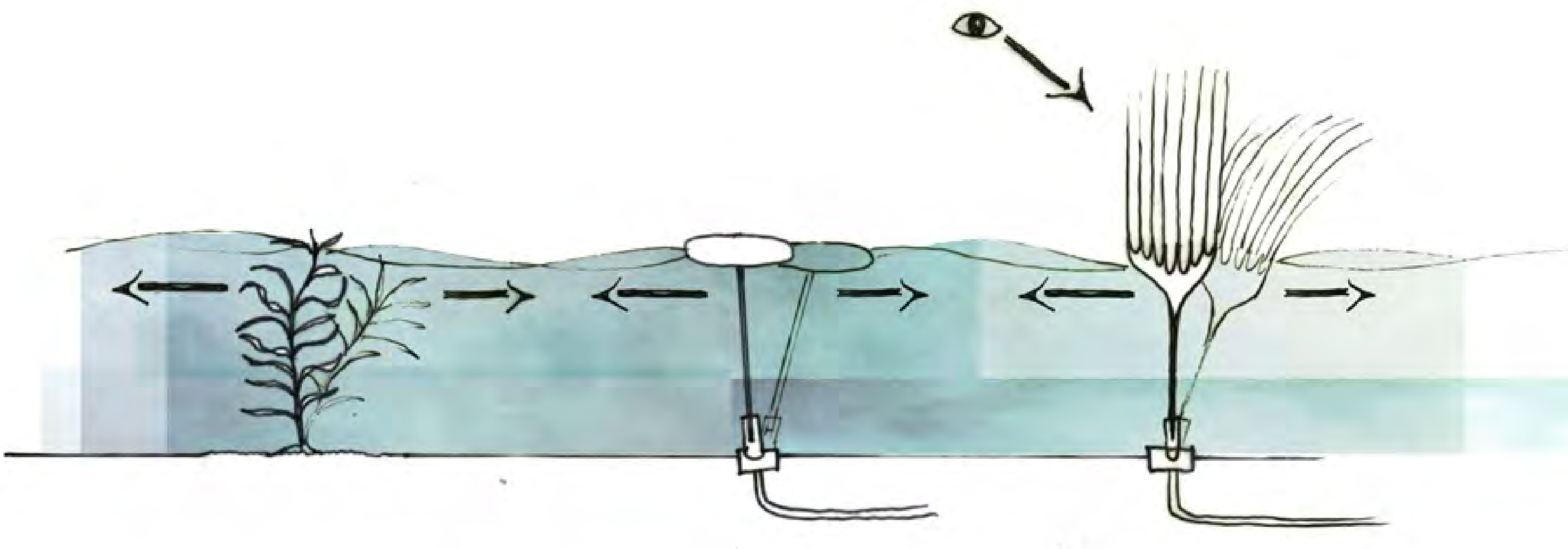


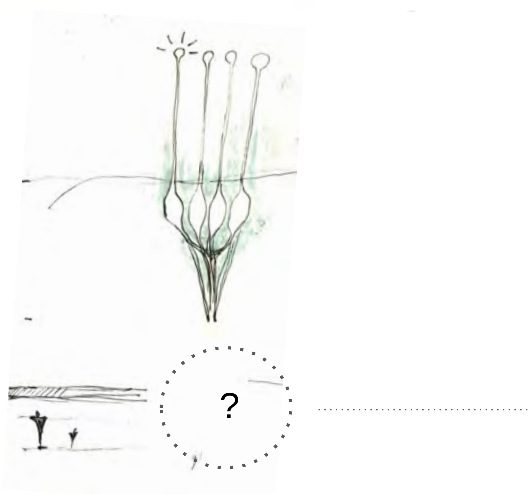
ELIMINATE EXPOSED TURBINE
utilize forms and movements
which naturally exist

COMBINE ENERGY GENERATION &
STORMWATER FILTRATION
bring people below surface of water
to better understand this
relationship

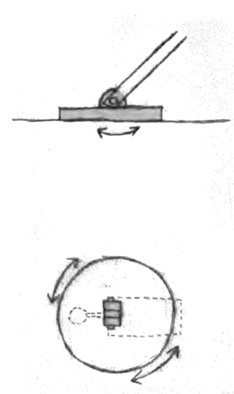
RETURN FILTERED WATER
TO CITY
signifies newfound
responsibility towards
water usage

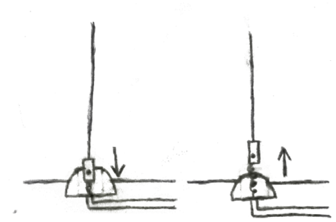






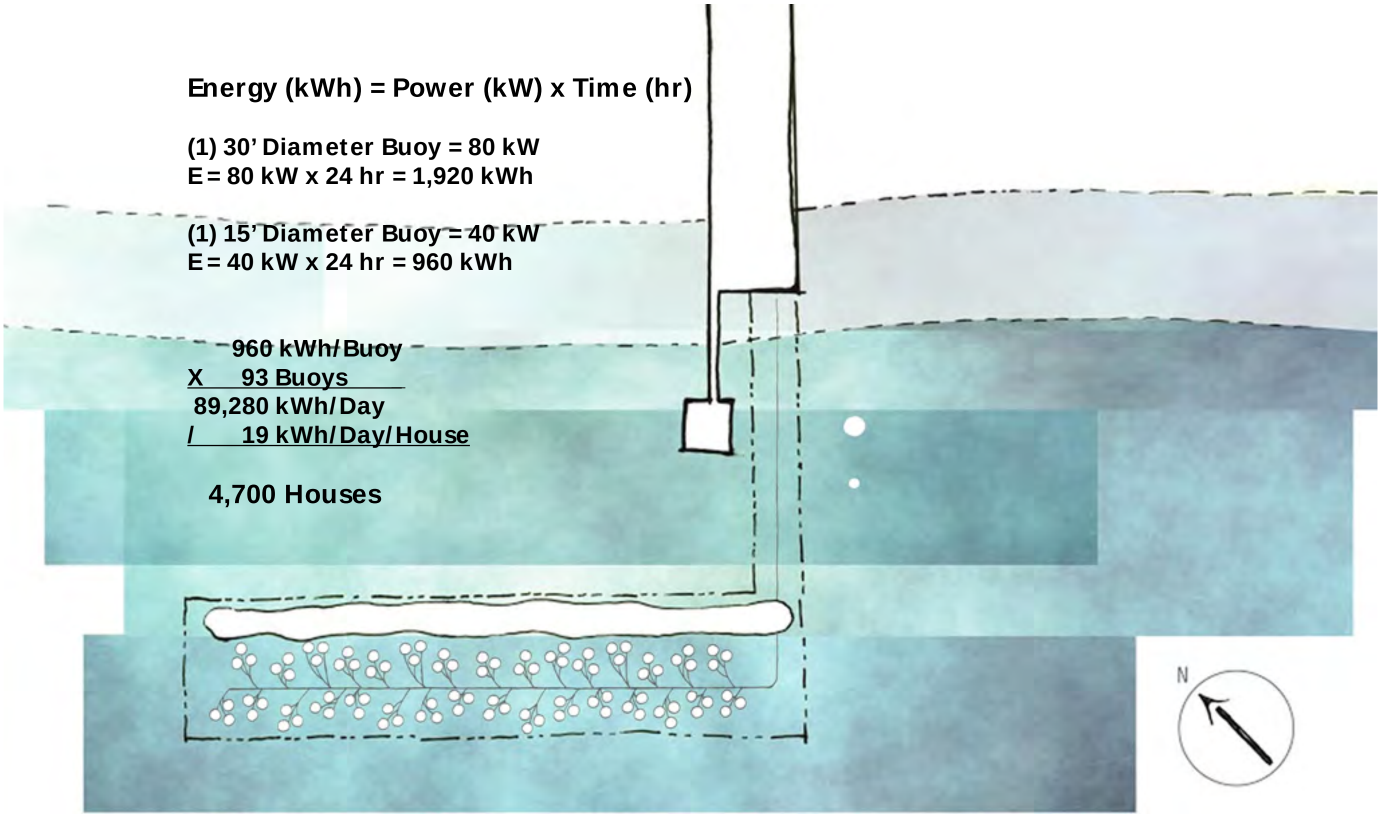
ANCHOR POINT
rotates to match wave orientation captures maximum amount of wave energy

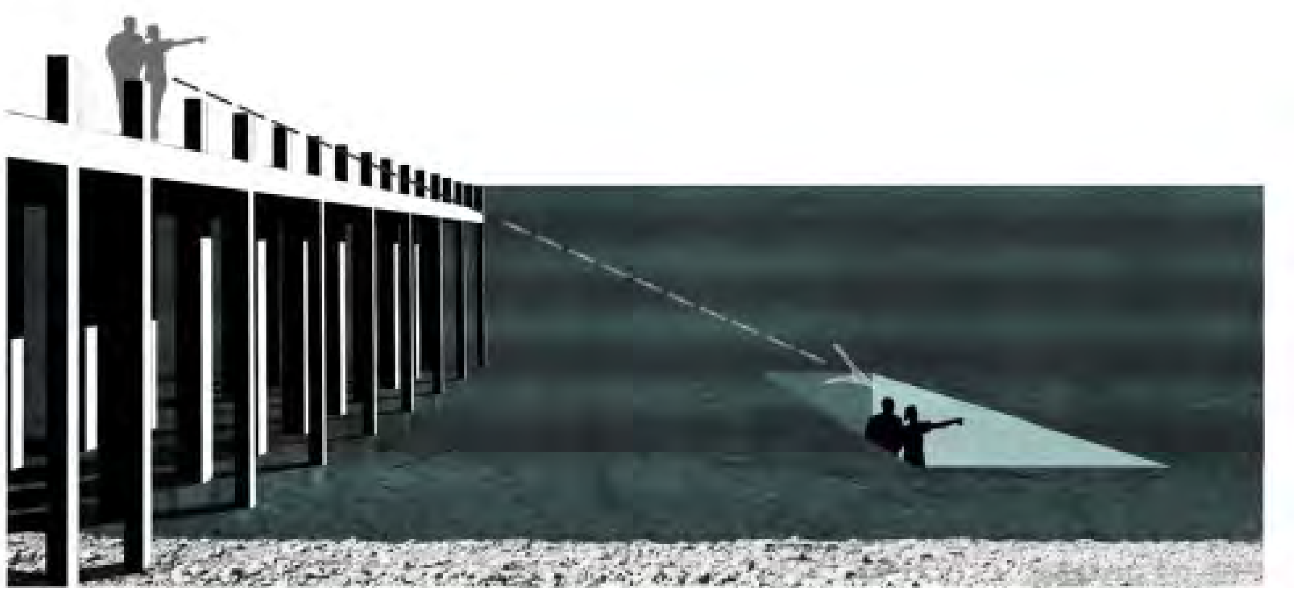


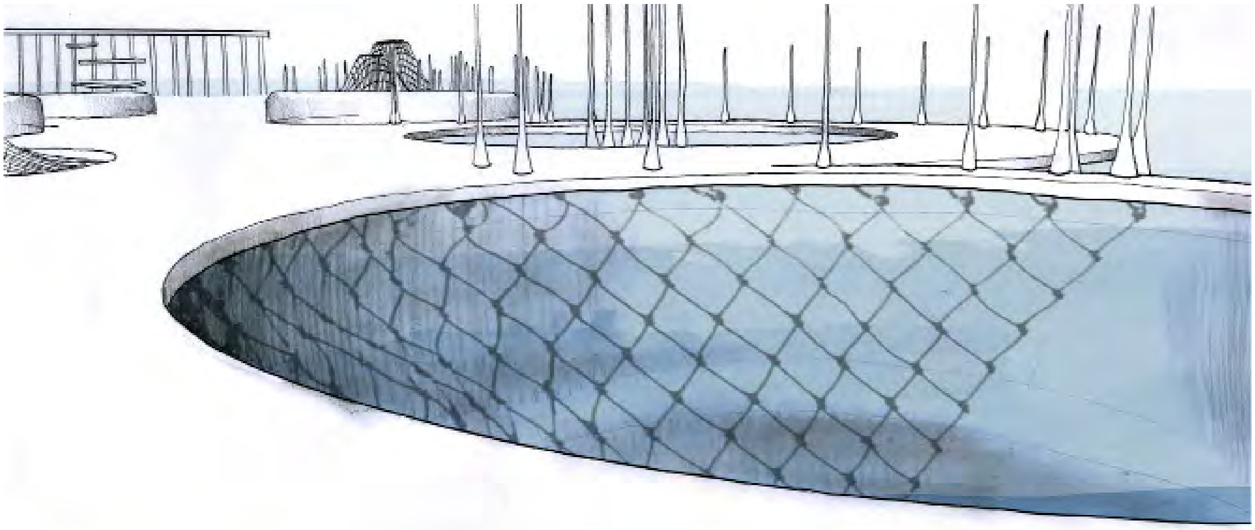


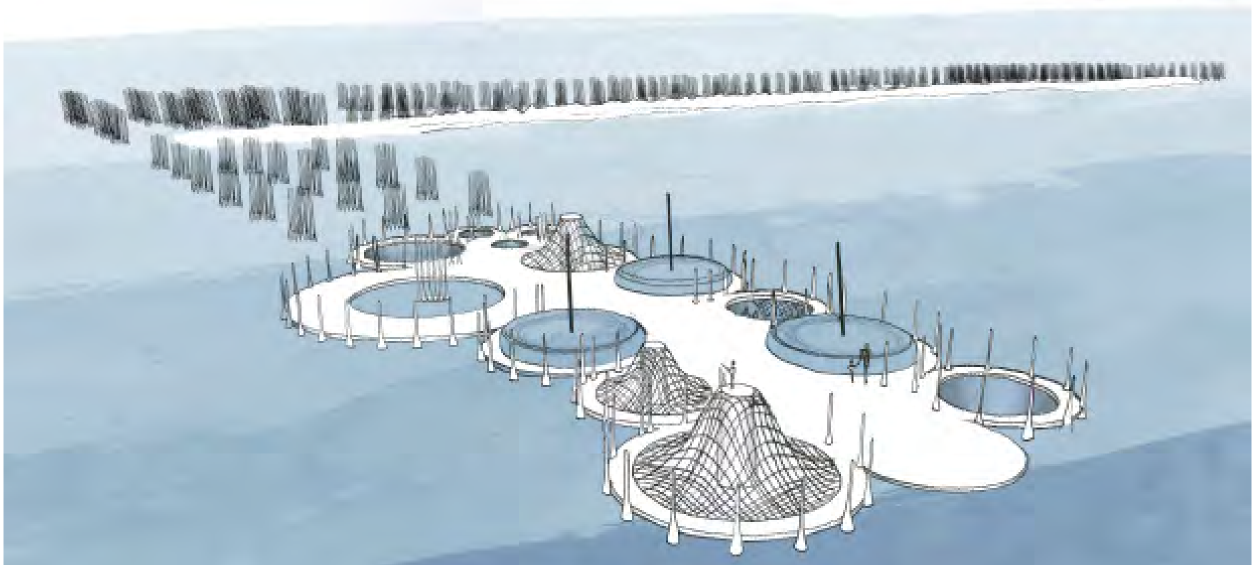
FLEXIBLE, SEPARATE BUOYS
inspired by buoyant pods which keep kelp afloat

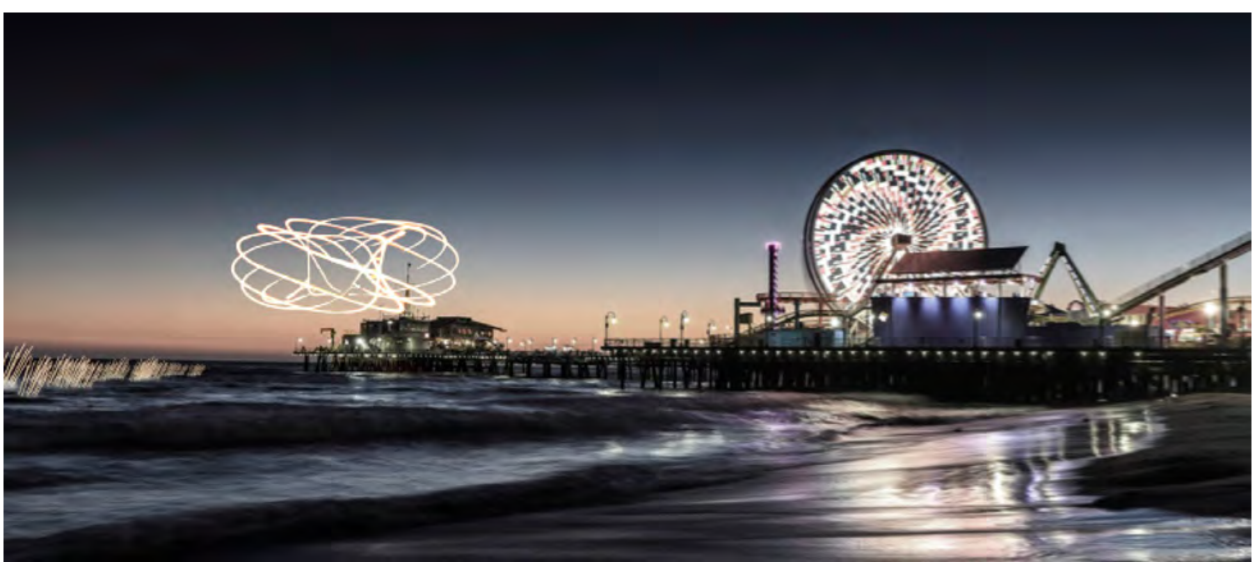
VERTICAL MOVEMENT
of buoy captures water and pumps it to turbine


Energy (kWh) = Power (kW) x Time (hr)
(1) 30' Diameter Buoy = 80 kW
E = 80 kW x 24 hr = 1,920 kWh
(1) 15' Diameter Buoy = 40 kW
E = 40 kW x 24 hr = 960 kWh
960 kWh/Buoy
X 93 Buoys
89,280 kWh/Day
/ 19 kWh/Day/House
4,700 Houses
N



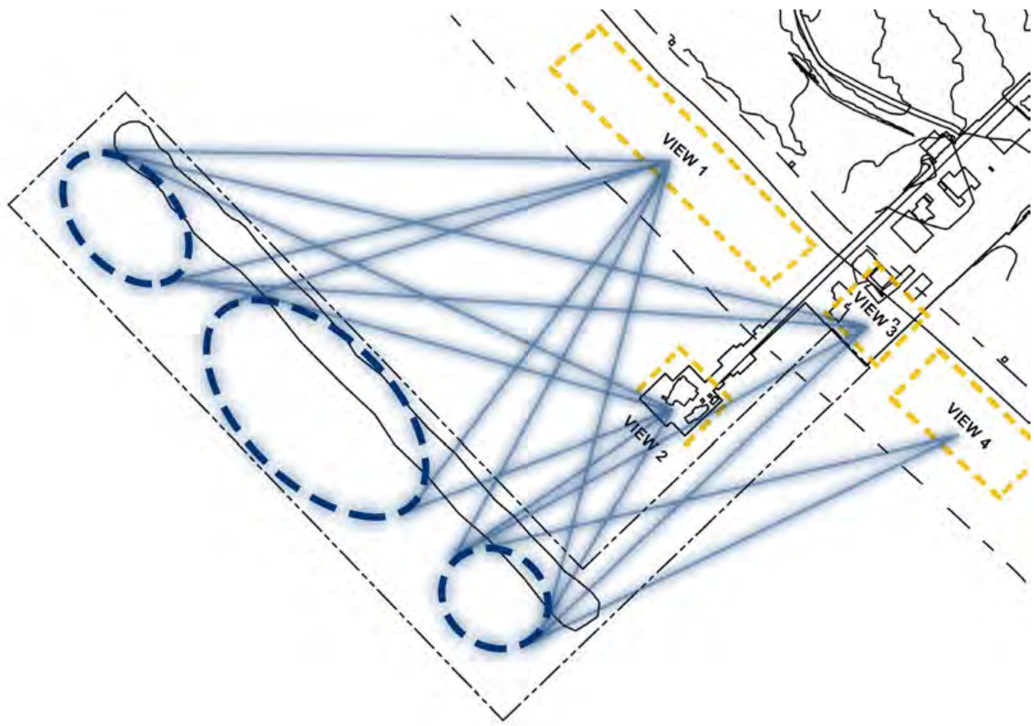


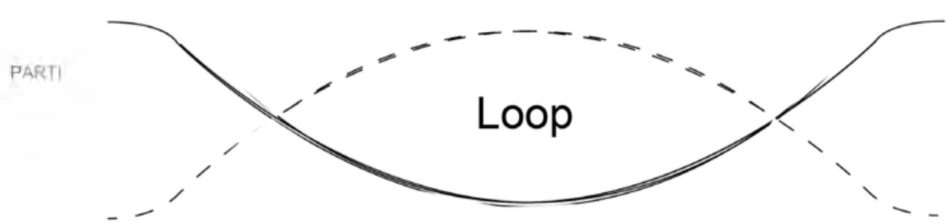


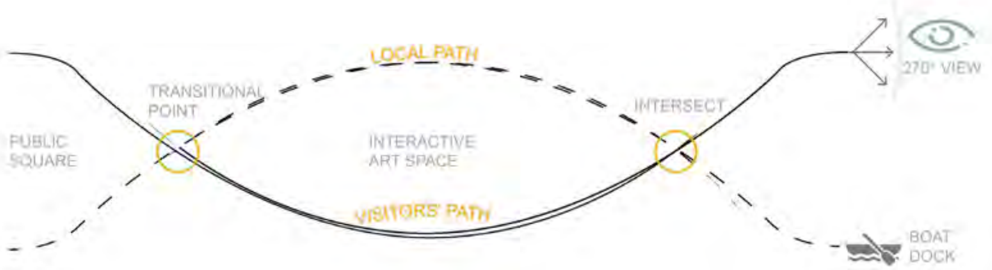


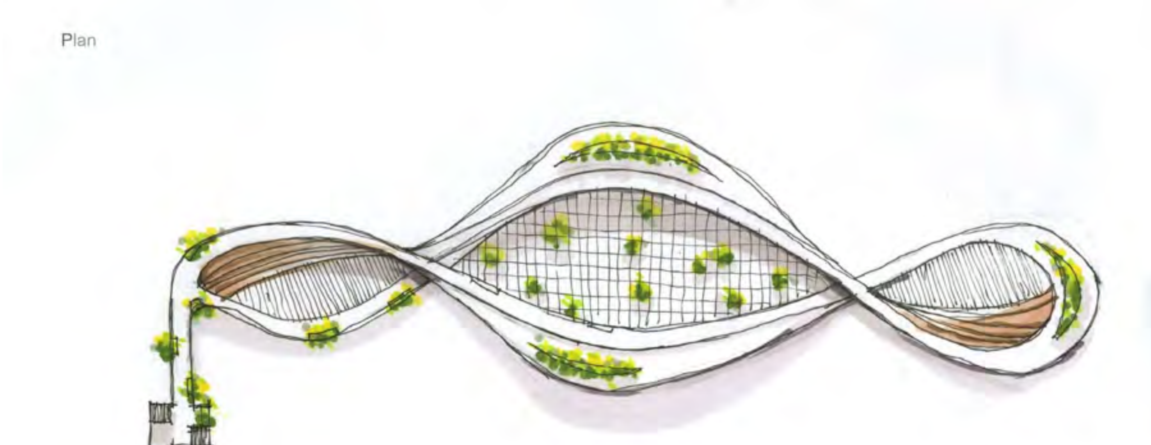
THE LOOP

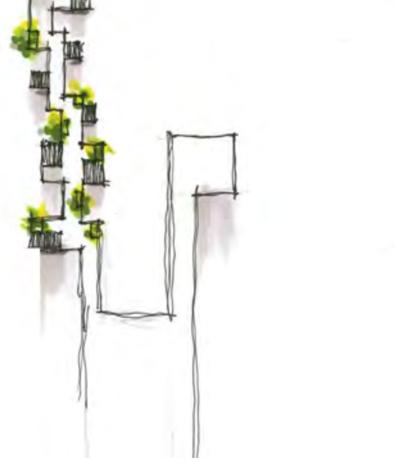
DYLAN CATINO
SUVIR HIRA
FERAS ALSAGGAF









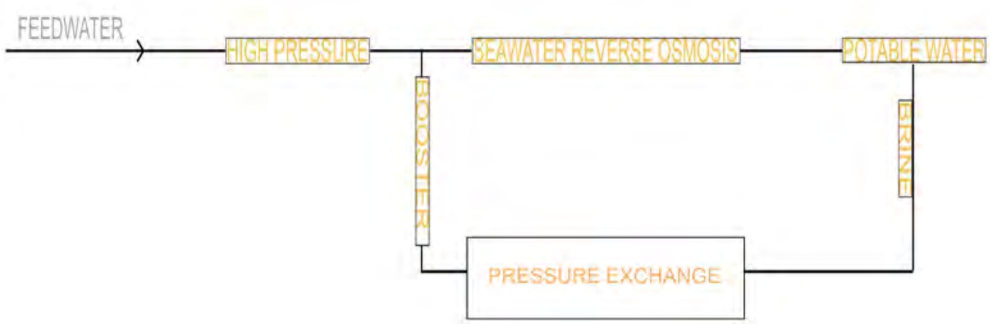


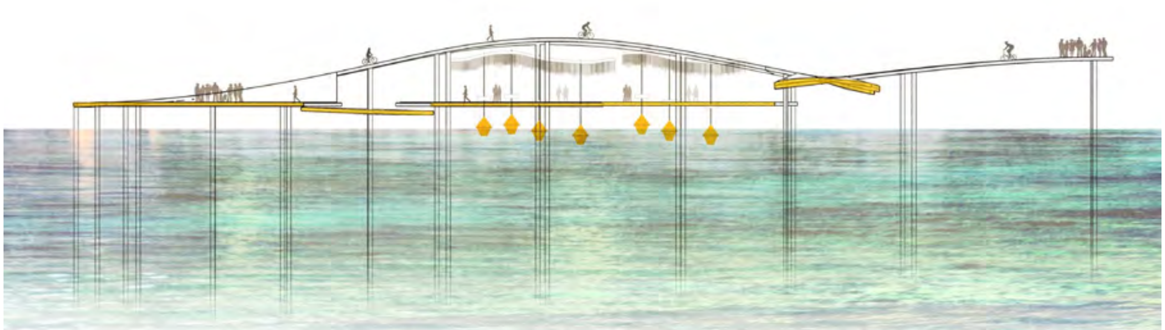
OBJECTIVE:

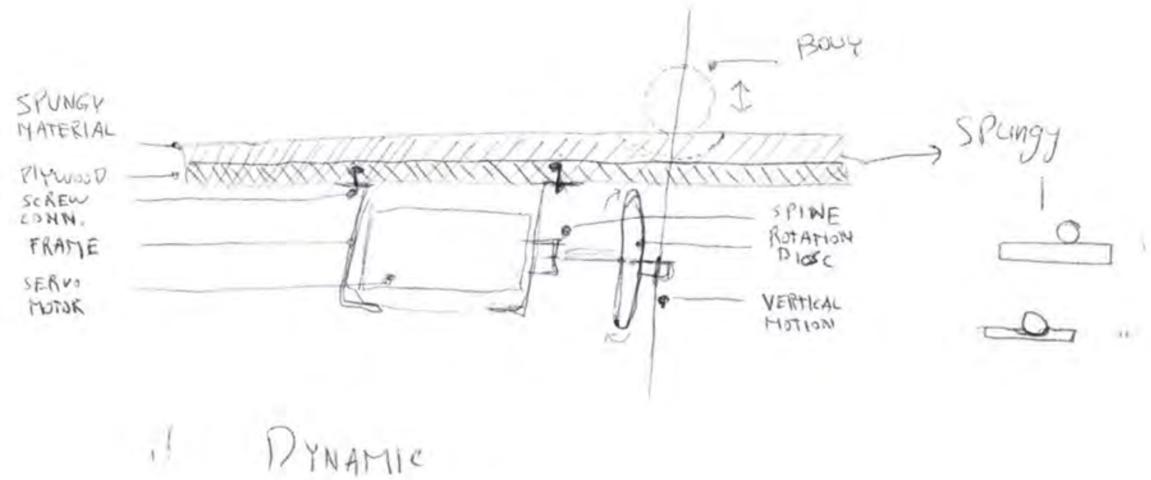
1.Raising public awareness of California's drought and pollution challenges.

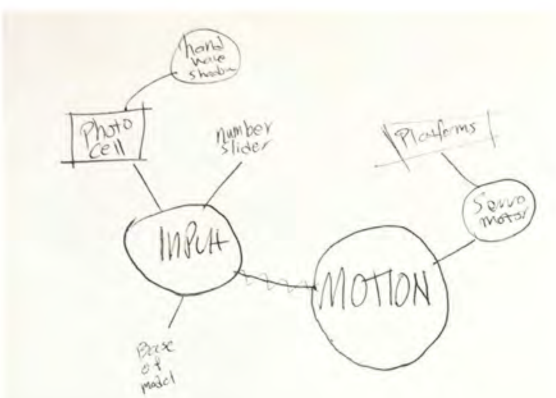
2.Harvesting energy and increasing potable water generation in the city.

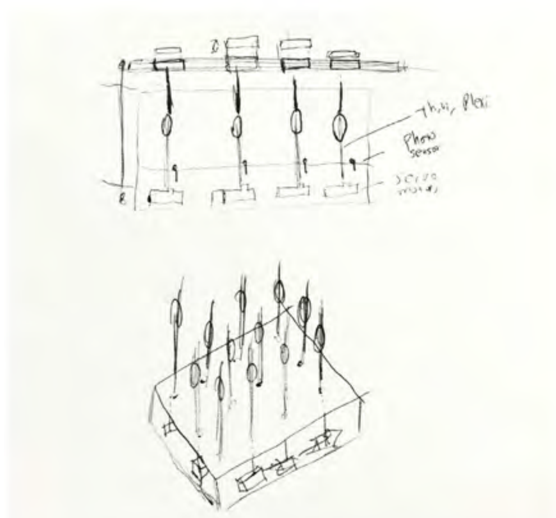
3.Accommodating lifestyle essentials for both locals and visitors. Provide the city with a public venue to accommodate city-wide events and festivals.



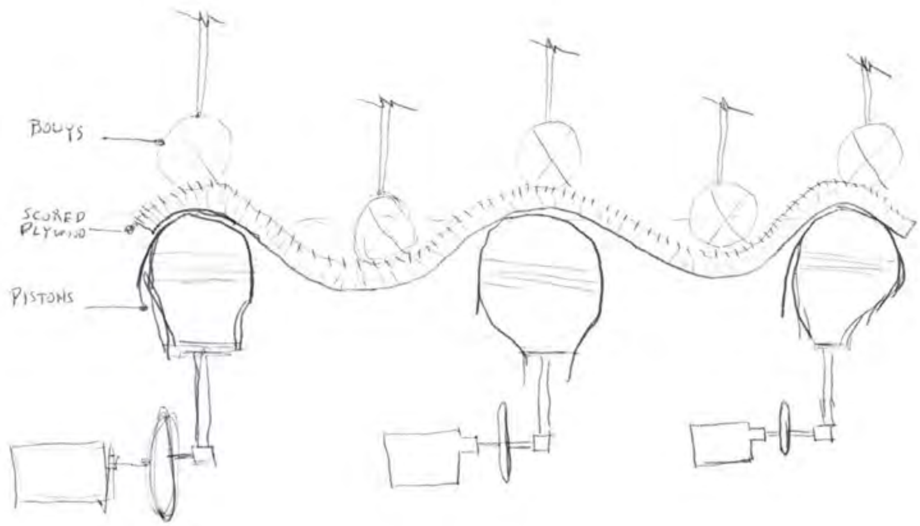


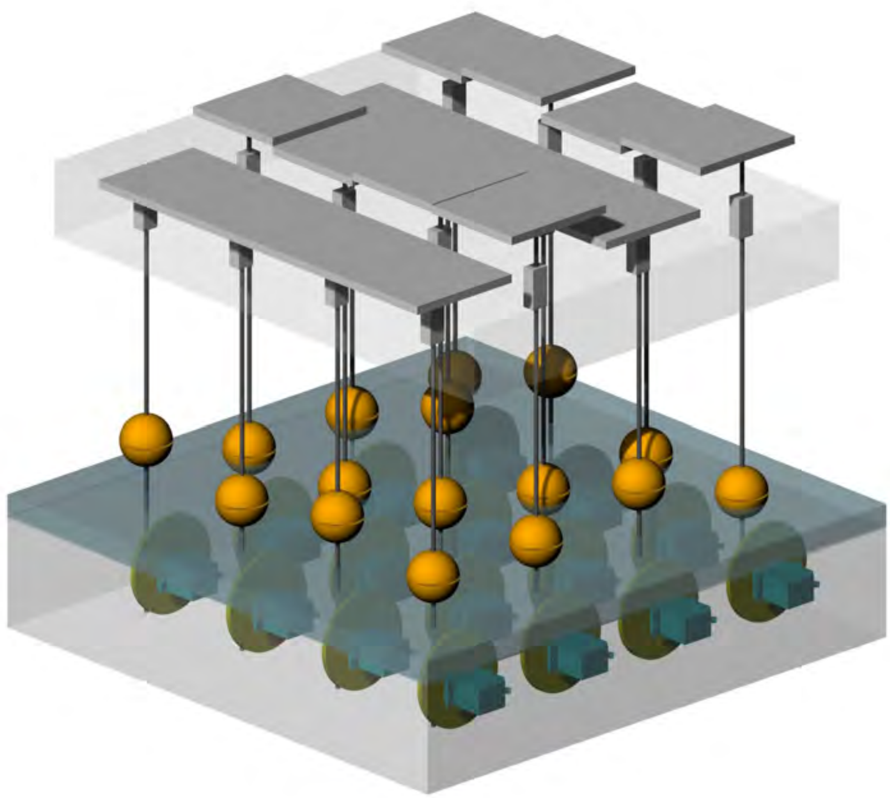


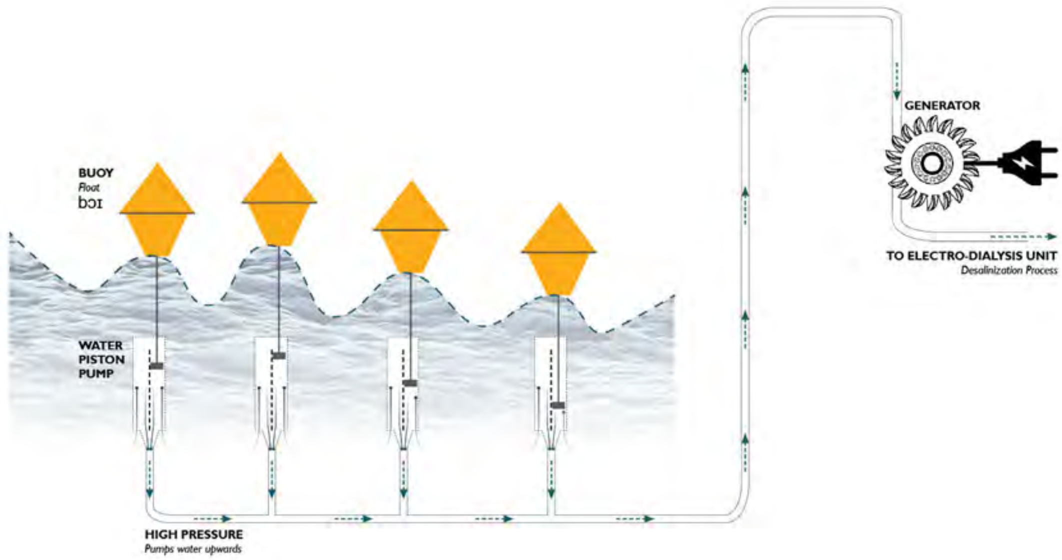


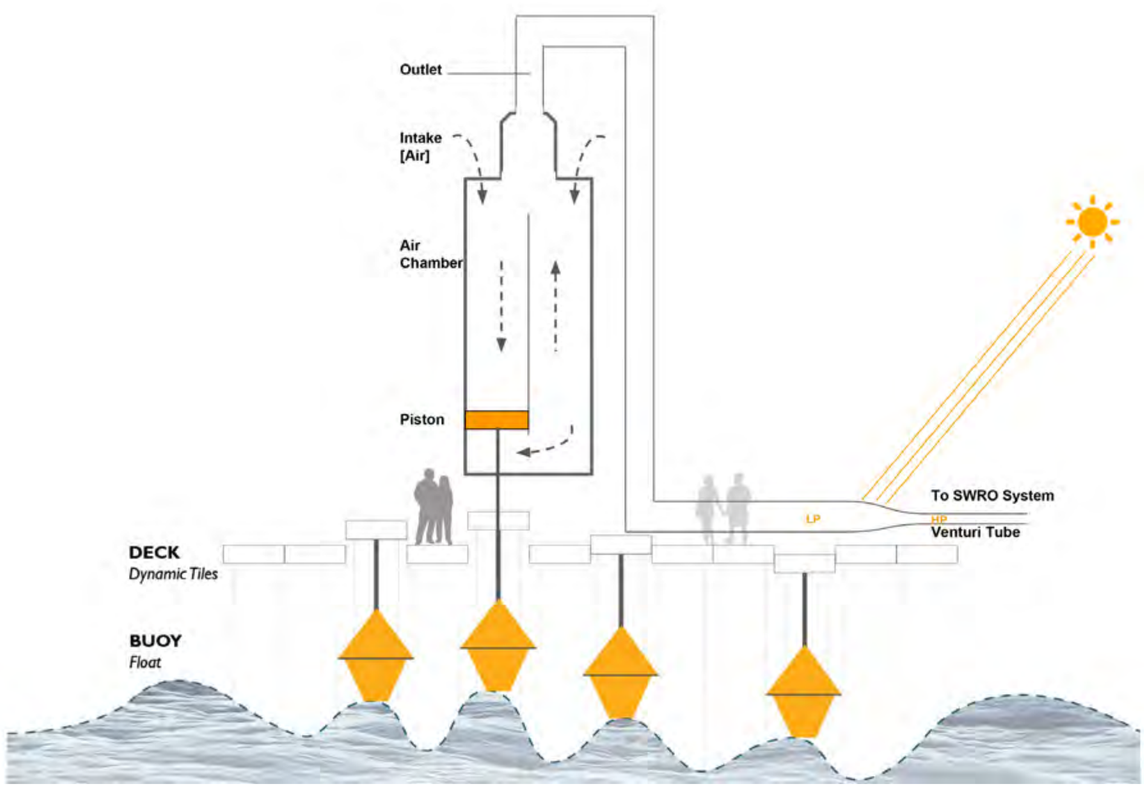


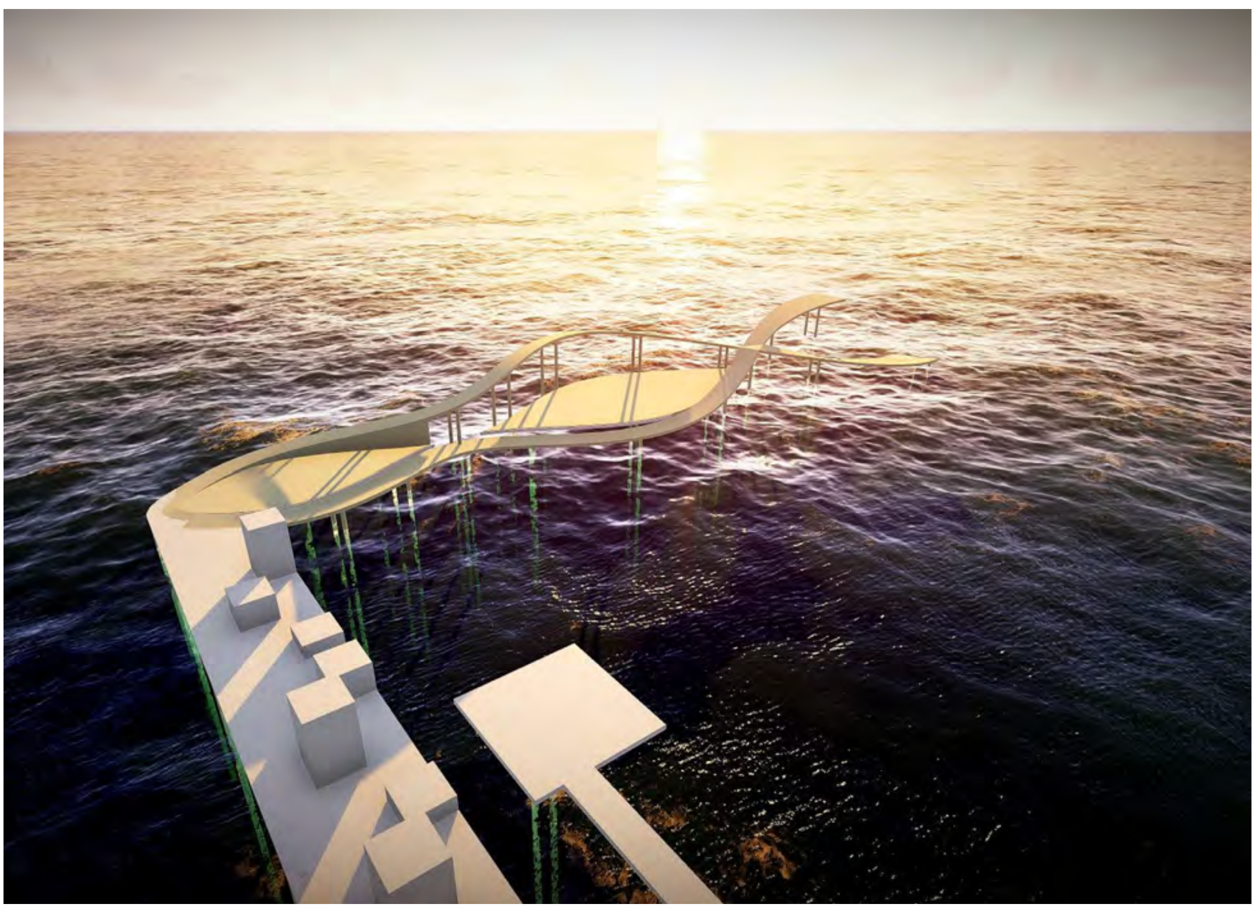
STEP 1: Actuation through hand waving (shadow casting)
STEP 2: Vertical motion (servo motors)
STEP 3: Moving Platforms


BOUYS
SCORED PLYWOOD
PISTONS




BUOY
Float
boı
WATER
PISTON
PUMP
HIGH PRESSURE
Pumps water upwards
GENERATOR
TO ELECTRO-DIALYSIS UNIT
Desalinization Process


Outlet
Intake
[Air]
Air
Chamber
Piston
To SWRO System
LP
HP
Venturi Tube
DECK
Dynamic Tiles
BUOY
Float



STUDIO PROJECTS
TEXTILE TECHNIQUES, TECTONICS AND TECHNOLOGIES + SHELTER | FALL 2016


RECYCLE

TEXTILE TECHNIQUES, TECTONICS, AND TECHNOLOGIES
This assignment provides the basis for subsequent explorations for this semester. It is comprised of two tasks.

TASK (A): Examine textile techniques, material systems, fabrication technologies, and advanced approaches that represent themselves throughout the history of architecture and other relevant technological fields of material development. Working in six groups of two architecture students and one or two textile design graduate student members, each team will select one of the six topics below. The teams should carefully compile and analyze relevant literature and project information and structure an argument that is supported by your research and findings. The investigations are situated within the larger context of architecture and textiles, and team members should collaborate to understand how the textile design and architecture disciplines overlap or diverge on these topics. It is required to consult with instructor about the topic.

1. Historic applications of textile in architecture
Study the historical background and evolution of textile applications in architecture ranging from the early tensile structures, structural and ornamental interpretations in architecture (e.g., Gothic architecture, shell structures, etc.).

2. Textile materials and fabrication technologies
Investigate textile materials; including yarns, fabric, fiber reinforced composites and manual, industrialized, and CNC fabrication technologies, and speculative construction methods for architecture.

3. Performative building envelopes
Investigate contemporary and experimental function and performance driven textile building envelopes.

4. Textile techniques and architectural tectonics
Study textile techniques and the digital and analogue translation of such to spatial and structural effects.

5. Computational design methods in textile materials
Study examples of computational processes that integrate physical and material behavior of tension active textile systems.

6. Advanced research in experimental textile strategies for architecture
Study novel speculative architectural projects and design experiments that push the frontiers of textile, fiber composites in architecture at the micro or macro scale.

The presentation has to include citations and references for images and quoted information, following the Harvard Citation Style (http://guides.is.uwa.edu.au/harvard).

TASK (B): In order to study various textile techniques, each team will manually create a series of two dimensional samples. These can include: weaving, knitting, knotting, braiding, felting, crochet, stitching, slitting, folding, and explore different types of stitches within the samples. The teams should focus on interlacing linear elements, linking individual components and manipulating flat plains.

Create at least 30 samples per group (4” x 4” minimum size per swatch; some may be much larger).

Your 2D studies should include:
- Interlaced linear elements (at least two different techniques)—knit, weave, crochet, knot
- Linked components (at least two different types of linking)—connecting multiples of an element; e.g. staples,

knots, folds, clips
• Manipulation of flat plains (at least two different techniques)—slitting, fold ing, stitching
• An exploration and inclusion of traditional and non-traditional materials
• Linear elements that you create through linking—consider a handful of paper clips, or rubber bands, or o-rings — and that you then interlace (knit, weave, crochet, knot)
• Transformation through finishing (heat, resin, glue, dye, foil, etc.)

THE PROCESS:
Begin by working with traditional materials to develop an understanding of the technique. Next explore atypical materials and linear elements that you have created. Supplement your samples with diagrammatic sketches explaining the samples and take photos to include them in a presentation along with diagrams.

SHELTER + TEXTILES:
In this phase, the students are tasked to study textiles at the different scales and question how they apply at the micro scale of textiles to the macro scale of architecture. An iterative process of applying material techniques, digital modeling and analysis, physical representation, and translation into building technologies, needs to be adopted to dxxns of massing, structure, and building skin.

PROGRAM AND SITE:
The final goal of this project is to develop a temporary shelter that provides comfort, privacy, protection from various weather and atmospheric conditixe shelter should offer exciting experiences of interior and exterior interactions, and highlight or complement the relationship of structure and internal artifacts (e.g., partitions and seating, etc.). The program is between 100sf-800sf and students should develop a system that can be adjusted to three different program sizes and sites.

Each team should identify three sites that take advantage of surrounding views and are to be situated in different settings/environments such as a waterfront (e.g., lake, sea, pond, etc.), mountain summit with panoramic view, city park/nursery, desert like setting, or high-rise rooftop, each of which could be in different climates.

TASK FOR PROJECT (C):
1. Study specific textile techniques that have potential for building skin, structure, and massing strategies. Utilizing material samples, and the use of digital models, develop parti models and diagrams. Develop a workflow that allows iterations between physical sampling, digital modeling, 3D printing, and/or industrial production methods.

2. Study and present relevant precedents for your parti.

TASK FOR PROJECT (D):
1. Identify three sites and present site and climate analysis.

2. Define three programs for your shelter which should bxigned as parametric variations.

TASK (E): SHELTER - FORM FINDING + MATERIAL RESEARCH
Continuing in the same teams, students will develop a form finding strategy that is based on previous textile material research and addresses the site and program defined by the teams. The form finding strategies can involve structural properties of textiles, application of textile patterning and deformations, composite strategies (e.g., fiber reinforced plastic, engineered fabric, etc.) that respond to structural, environmental, and constructional

considerations. The teams should identify and select proper methods and tools for this process including digital and analog experimentation. This process is driven by material behavior and interpretation of such behavior of physical scale models and digital models.

TASK (F): SHELTER - SYSTEMS

Building on the previous assignments' site, program, form and material explorations, develop your concepts for structure and skin systems. Working in the same teams, focus on how your system's geometric and material based parameters adapt to various performance requirements (e.g., spatial quality, height, structural, fabrication, assembly, ventilation, daylight, shading, etc.). Embracing analog and digital fabrication and textile production technologies develop a system that adopts a generative design strategy from a textile material strategy to architectural fabrication. This task will accommodate diagramming, analog and parametric modeling, to simulate and analyze how the structural and skin systems adapt to parameters identified by each team (i.e., structural, environmental, and constructional).

TASK (G): SHELTER – PROTOTYPING & FINAL DELIVERABLES

In task phases f and g, the teams will develop and resolve the design, and prototype scaled and full scale mock-ups. Both scaled and full scale partial models should represent the structural and surface qualities of the proposals, and represent the conditions of a joinery and assembly. This stage should bridge the research of computational fabrication with materiality and begin engaging feasibility of construction. Through the three phases the scale shifts from scale model to full scale. The mock-ups should be digitally tested and diagrammatically resolved to engage digital fabrication methods into the process. The final deliverables will be exhibited in the Paley Design Center for DesignPhiladelphia between Oct. 10-Oct.14.

BIOLOGIC: ADVANCED RESEARCH IN EXPERIMENTAL TEXTILE STRATEGIES FIELD RESEARCH CENTER

CRYSTAL BROWN
IDRIS SALAHELDIN

ABSTRACT:

The first project began with the study of textile techniques, which were produced in various iterations to showcase the team's initial findings. The team decided to research possible iterations that considered various weaving techniques, needle sizes, and textile fabrics. They applied specific properties to each item and observed the outcome. Material thicknesses between wool, cotton, and polyester were studied and the team changed the density of the textile weave by using two needle sizes, 9 mm and 4.25 mm crochet needles and 10 mm and 4 mm knitting needles. Each iteration was hand-made to create 4x4 samples, which counted the stitches needed to achieve that size, as seen in Figure 1. Samples were made to understand how many stitches were required in the warp and weft direction. The students had no previous experience of knitting or crocheting, therefore there was a learning curve to making each sample. A log was created to accurately document the amount of stitches that were made in the warp and weft direction and the team also documented how difficult each pattern was to make. It was assumed the larger needles would be easier for each type of thread and the smaller needle would be more difficult. In conclusion, the larger needles were more difficult to knit and crochet than the thin thread, which was accomplished in less stitches. The smaller needles were more time consuming and contained more stitches, which can be seen in Figure 1. The threading properties of the polyester were the most difficult to work with because the material lacked a comfortable amount of friction on the needles. The wool threads, which were the most manageable, contained much more friction to hold onto while stitching, therefore making the process much easier.

Figure 1: Textile techniques and material research iterations.

SITES AND CONCEPT:

Furthering their study of textile techniques allowed the team to create a parametric shelter project. They chose sites along the equator, such as the Salvador Wildlife area, located in New Orleans, Louisiana, and Khartoum-Sudan, located in Northeast Africa and studied how textiles would respond to these climatic locations. The shelter's structure was based on a waffle weave textile technique. The team was inspired by the weave's simple properties, which included the textiles ability to absorb large amounts of water and dry quickly due to the undulating weave pattern. From this research the group interpreted the waffle weave as a parametric undulation that would control the amount of sun and wind that would enter the shelter. They studied the waffle weave and designed many iterations that would best perform as the parametric skin for the sites, as seen in Figure 2. The form of the shelter went through multiple iterations that responded to the angles of the sun, as well as the wind direction, which can be seen in Figure 4. In conclusion, it was found that the hyperbolic paraboloid shape would be the best architectural element, which was created through the waffle weave, as seen in Figure 3.

Sources:

A scene in the Atchafalaya Basin in Louisiana, USA, in the Sherburne Complex Wildlife Management Area, a Nature Conservancy reserve. Y Corps of Engineers Digital Visual Library, Public Domain, Atchafalaya Basin. Accessed December 15, 2016.

Chris. Panorama of Khartoum. September 4, 2005. Khartoum. In Wikimedia Commons. November 8, 2014. Accessed December 15, 2016.

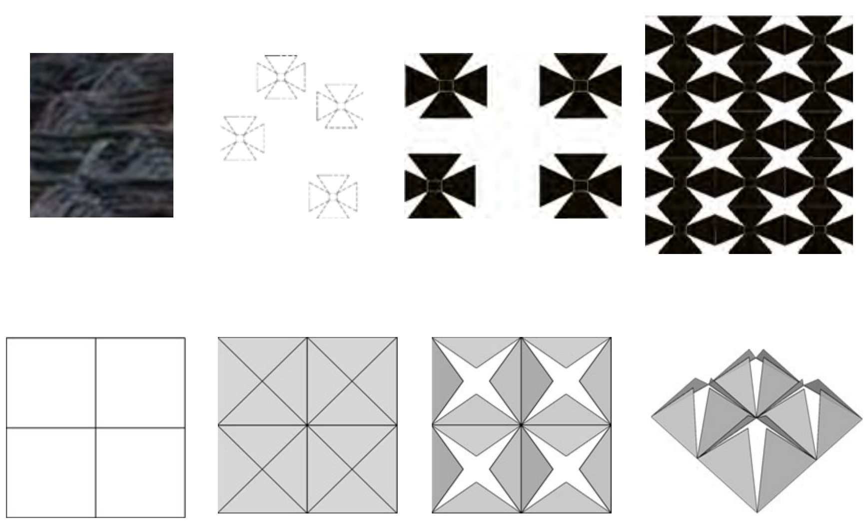


Figure 2: Concept Iterations

Figure 3: Hyperboli Parabloid

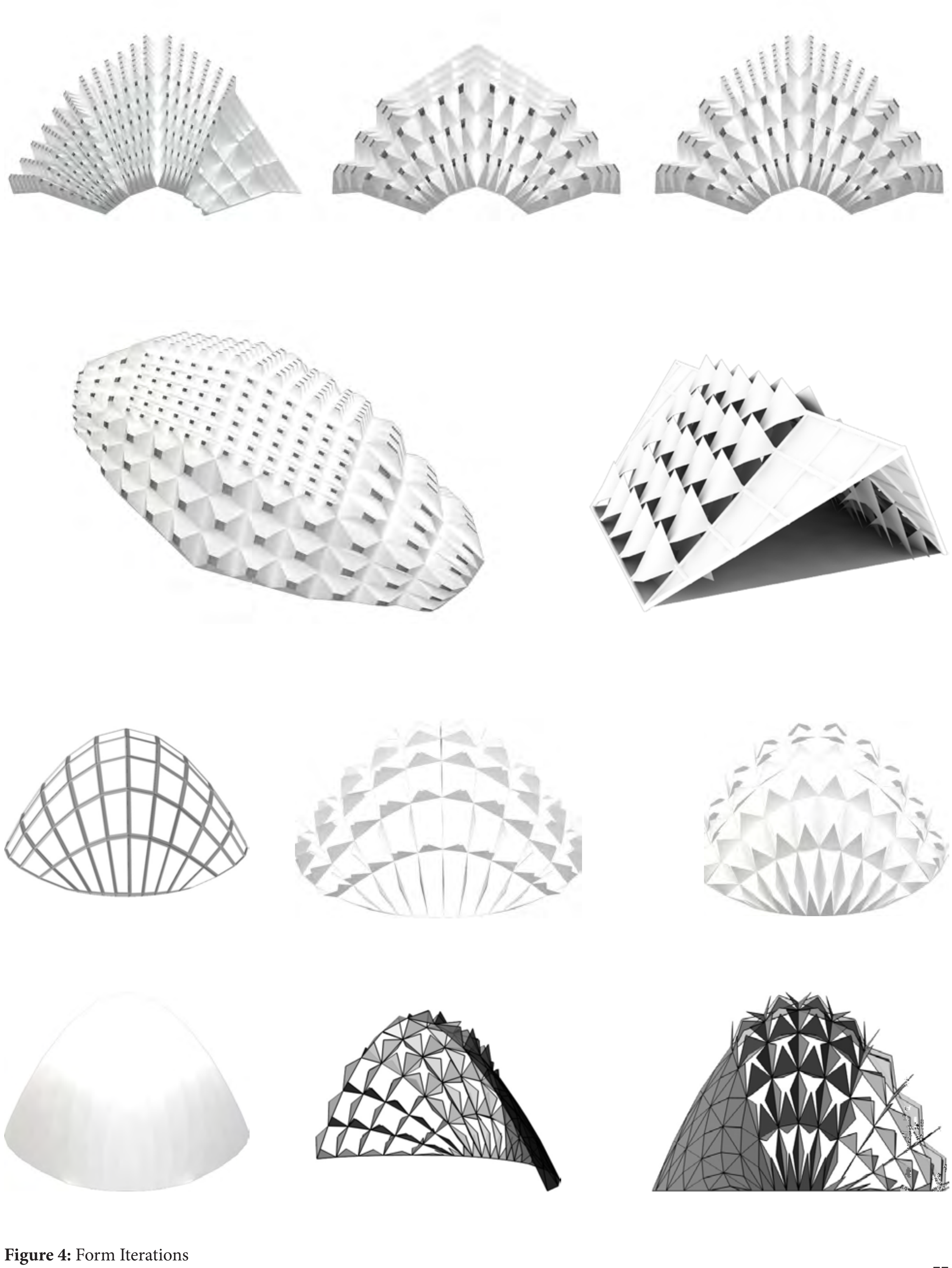


Figure 4: Form Iterations

Figure 5: Discussion between 3-D Model to Physical Model

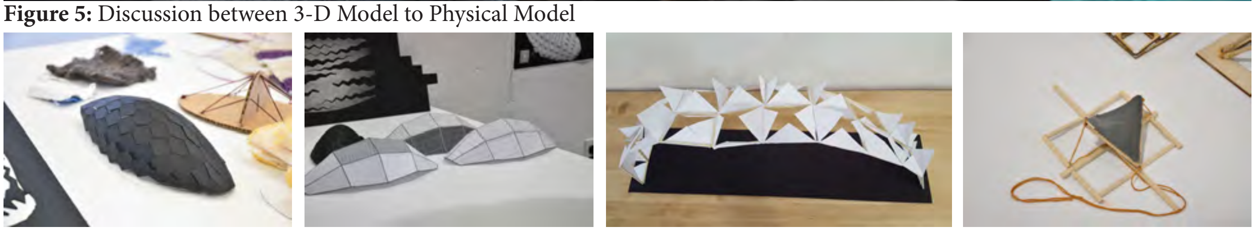


Figure 6: Physical Model Iterations: Left to Right | Panalized Model | Diagrammatic Appature | Opening Study Model | Mechanic Study Model

CONCEPT TO MODELING:

Computer iterations of the waffle weave were a challenge to physically create. Creating the structure and panels was challenging because the physical form was difficult to accurately reflect the digital model, which can be seen in Figure 6. The first iterations of the physical models were panelized to study the structure, which was unfolded in Rhinoceros 5. Making the physical model perform correctly required the team to panelize the digital model with flat surfaces that would unfold the structure using the Kangaroo plug-in in Grasshopper. After becoming familiar with panelizing the structure, the next step was to design the skin. The skin was designed to respond to the surrounding environment. The first skin iterations were conceptual and the team continued to use the unfolding technique in Rhino. The team considered how the skin would move within a panelized system. The panels were cut diagonally to represent how they would open. These iterations then led to the mechanics, which considered how the panels would actually operate. In the end, the team designed a pulley system that was manually pulled by the user

Figure 7: North Section Open Wind Panels

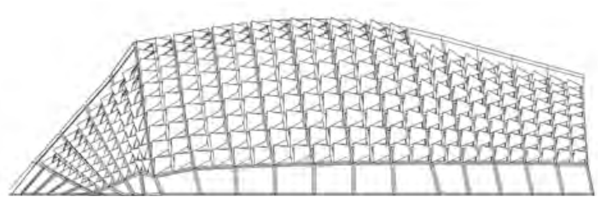


Figure 8: East Section Open Wind Panels

in one location. The wind panels were connected by a cable that secured one side of the shelter's skin. Each side, east and west, would be controlled by a lever to adjust and direct the amount of wind that was exerted on the structure from the east and west side of the shelter. Overall, the study models were key in designing the mechanical system of the skin, which was then translated into an accurately constructed Grasshopper model.

Figure 9: Fabric Iterations on Waffle Weave

WORKING WITH TEXTILE STUDENTS:

During the design process the team worked with a textile student, Megan Kohl, to create different textile approaches for the shelter project. Megan collaborated with the team to create the waffle concept, which helped achieve the textile's reaction to wind and sun. The textile student's contributions helped the team move forward to create a technique that produced many waffle fabric iterations on the jacquard machine, as seen in Figure 9. The samples were a helpful study of texture but there was a problem regarding the overall scale. This affected how the skin performed and the team received feedback from the class practitioners, as seen in Figure 10. Megan then explained how to produce larger scale iterations but also told the team that the Jacquard machine was limited to a certain scale weave. Team collaboration led to a realization of how a waffle stitch was created and Megan introduced the tools that textile students use to design fabrics. This provided insight on how the team could interpret the skin of the shelter. The team analyzed the structure of an individual waffle and found an inspiration to move forward, leading into the final project. Figures 11 and 12 are photographs that show the concept and final models that were created to show a 4-way stretch fabric and single waffle weave. The structure of the waffle weave we designed in a hyperbolic shape that would open and close. This design entailed a fabric that would stretch and then return to its original shape. Megan was able to help the team find the 4-way stretch material. Overall, the collaboration with Megan was insightful when the right questions were asked and when the team had an exact idea of what needed to be achieved.

Figure 10: Waffle Weave Fabric Scale

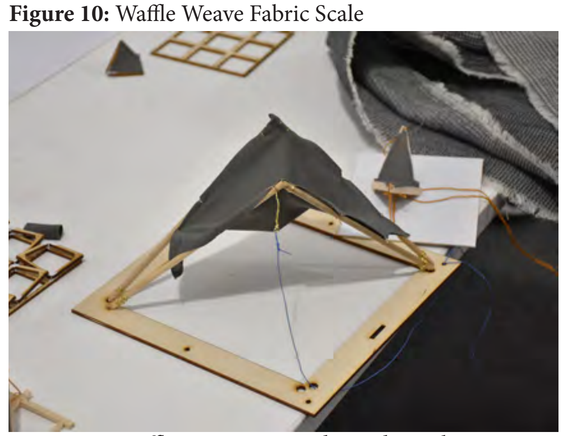
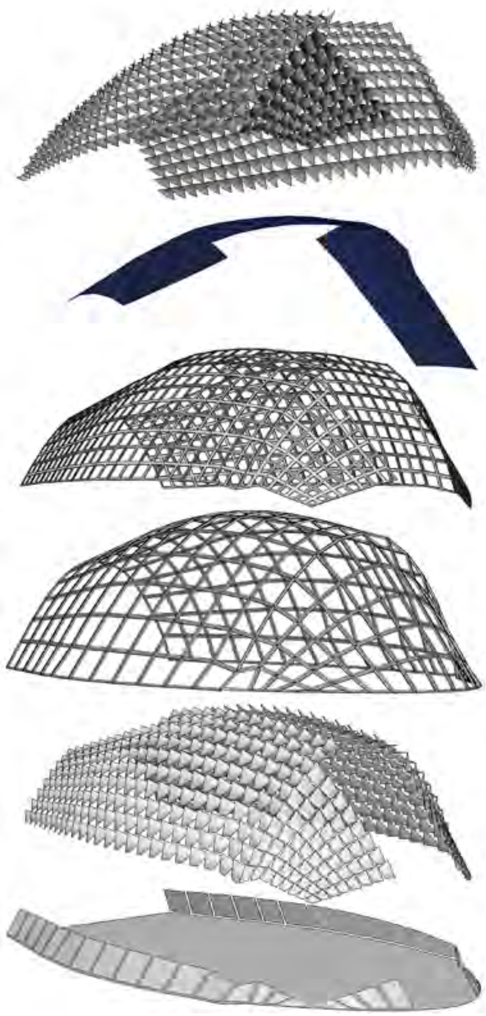


Figure 11: Waffle Weave Inspired Wind Panel

Figure 12: Final Textile Based Project



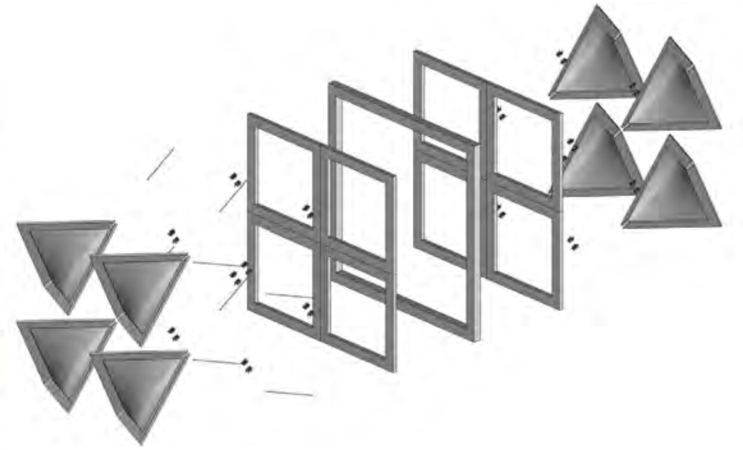


Figure 14: Exploded Assembly of Panalized Wind Panel

Figure 15: Wind Panel Movement based on Temperature

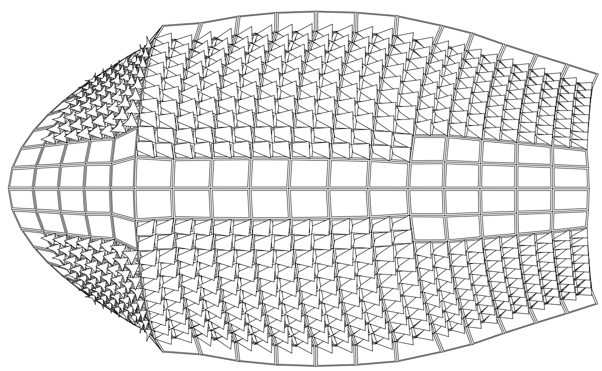


Figure 13: Exploded Axon Of Shelter's Techtonics **Figure 16:** Plan

SHELTER ASSEMBLY:

The final fabrication of the project was accomplished by using Rhinoceros 5 and Grasshopper. The 3-D model was then used as a reference to set up files for the laser cutter and CNC router. The computer separated the assembly into layers, as seen in Figure 13 and 14. The movement of the panels shown in Figure 15 provided constraints for the physical model. Collaborating with Megan allowed the team to gather the material needed, shown in Figure 15, to achieve the proper movement of the physical model. The previous physical model iterations, created by unfolding the panelized structure and mechanical studies, allowed the team to detail the 3-D model. The detailed drawings, shown in Figure 16, were used as a reference to the physical model, which was built for the final review. The team built a full scale model of one panel assembly for the shelter and a quarter-inch scaled model of the overall shelter. Templates were made from the digital model to laser cut the frame of the individual wind panels. The frame of the final models was created through files that were set up for the laser cutter and CNC Router, as shown in Figure 17 and 18. The team prepared the individual wind panels first, then attached them to the CNC frame. After fastening the wind panels, the cables were attached to create the pulley system, which provided movement. The scaled model was laser cut from the files prepared from the 3-D model, shown in Figure 19. This model was a physical representation of the shelter's massing.

Figure 17: Materials and Fabrication of Individual Wind Panels

Figure 18: CNC Panel Frame and Construction

Figure 19: Laser Cut Materials for 1/4” Final Model

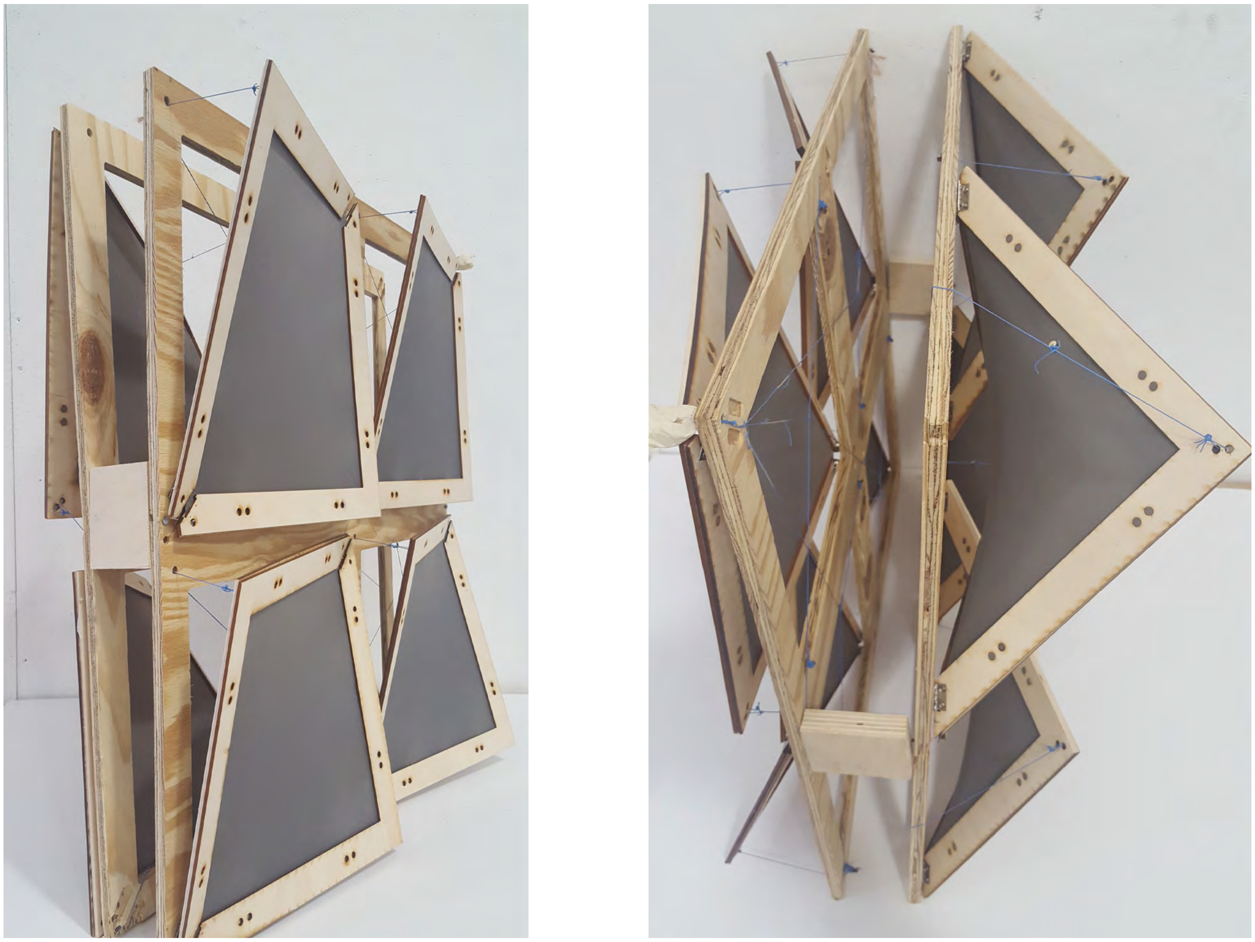


Figure 20: Final Full Scale Model

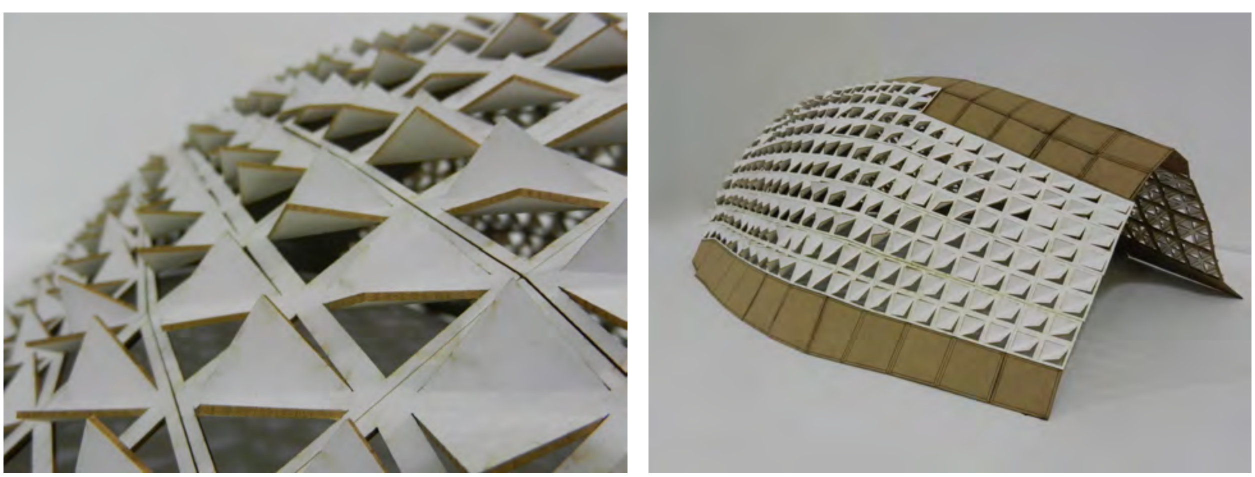


Figure 21: Final 1/4" Massing Model

Figure 22: Final Presentation

Figure 23: Final Interior Rendering

REFLECTION:

Overall, the critique questioned and challenged the scale of our waffle structure. Could the shapes be true to size as the diagrams, and do they have to be to the size of the textile shape. The waffles can be a direct link to the structure of the textile and use other materials to achieve the same basic properties.

The collaboration and iterative process of the Shelter Socket Station was a challenging experience for the group but a successful exploration as a research shelter. There was a learning curve for the beginning research as well as for the iterative process within Grasshopper. As a group effort we pushed forward to find new ways of interpreting the waffle weave. Working with Megan gave us a new approach on design methods. Our work flow consisted of a top down approach but while working with a textile collaborate we had to adapt to a bottom up scheme. We were working by understanding the form of the shelter within its environment then designing the structure followed by the skin. While working with Megan we had to view the project from the properties of the skin followed by assembling it onto the structure thus creating the form. This method was difficult but it did help us expand our skills in collaborating with another profession as well as widening our scope of design possibilities. We also expanded our design skills into the digital exploration methods of parametric design. The program Grasshopper was a useful tool to explore the many possibilities of the iterative exploration much more quickly. Although it was useful we had to be careful and mindful the physical proof. Transferring the digital model to the physical was challenging but building prototypes helped us move the project into the right direction and build the final prototypes. Overall, the project was an abstraction of the waffle weave into an architectural element as a research shelter.

REFLECTION:

The goal of the project was to utilize an abstraction of the waffle weave as an architectural element in a research shelter.

Overall, the critique questioned and challenged the scale of our waffle structure. Could the shapes be true to size as the diagrams, and do they have to be to the size of the textile shape. The waffles can be a direct link to the structure of the textile and use other materials to achieve the same basic properties.

The collaboration and iterative process of the Shelter Socket Station was a challenging experience for the group but a successful exploration as a research shelter. There was a learning curve for the beginning research as well as for the iterative process within Grasshopper. As a group effort we pushed forward to find new ways of interpreting the waffle weave. Working with Megan gave us a new approach on design methods. Our work flow consisted of a top down approach but while working with a textile collaborate we had to adapt to a bottom up scheme. We were working by understanding the form of the shelter within its environment then designing the structure followed by the skin. While working with Megan we had to view the project from the properties of the skin followed by assembling it onto the structure thus creating the form. This method was difficult but it did help us expand our skills in collaborating with another profession as well as widening our scope of design possibilities. We also expanded our design skills into the digital exploration methods of parametric design. The program Grasshopper was a useful tool to explore the many possibilities of the iterative exploration much more quickly. Although it was useful we had to be careful and mindful the physical proof. Transferring the digital model to the physical was challenging but building prototypes helped us move the project into the right direction and build the final prototypes.

SYMBIOSIS: ADVANCED RESEARCH IN EXPERIMENTAL TEXTILE STRATEGIES FIELD RESEARCH SHELTER

JACK ROGERS
NICHOLAS WILLIAMSON
VALERIE GIBBINS

ABSTRACT:

SYMBIOSIS is a combination of extensive research in textile techniques, architectural design, and digital design methods. This research shelter was designed to highlight the versatility of uses in the field. Whether it be constructed and used in the heat and humidity of a tropical forest, or the dry and cold climate of a mountain, the shelter needs to adapt to various climatic conditions. In order to provide a comfortable and effective space, research shelters must be adaptable, easily constructed, and secure. SYMBIOSIS is a shelter that was derived from the triaxial weave pattern, which is stronger and more formable. The underlapping and overlapping of the fibers creates a tectonic characteristic that is, in essence, a reciprocal structure. The shelter utilizes a reciprocal structure to create a modular, light, and basic structure. Essentially, the pieces are being weaved together. In order for the structure to work, the pieces must rely on friction, notching with one another for support. If one piece fails, the structure fails. The textile skin allows for occupants to be shielded from the exterior elements. Applying the textile skin creates more friction, which allows the structure to stretch from within. This decreases the possibility of failure. Additionally, the structure allows for the textile to take shape, therefore creating a symbiotic relationship between these two elements.

Figure 1: Textile techniques and material research iterations.

TEXTILE TECHNIQUES AND ITERATION:

The project's textile research began by understanding the different types of patterning and weaving styles. Through these explorations, the team worked with weaving, crocheting, macrame, and knitting. The goal of this was to understand the pros and cons of each stylistic fabrication. Different textile techniques have more beneficial properties than others. Some of the structural properties the team looked at were strength, elasticity, and permeability. These were some of the advantages the team thought would be most useful when it came to understanding how the textiles could be integrated into the architecture. After analyzing different iterations, the team quickly realized that while there are four different styles of textile patterning, each has its own branches of variations in them. This is where the experimentation began. The team looked into trying as many different variations on the main four styles as possible. The team mixed materials that had different properties to see how they would react together and attempted as many pattern variations as possible, even attempting to make an original, as shown in the top left of Figure 1. That was a variation of a weave meant to reflect the Silkworm Pavilion done by MIT. Towards the end of the process, the team began to focus mainly on the weaving and crocheting styles because these had the best characteristics of all the pattern styles.

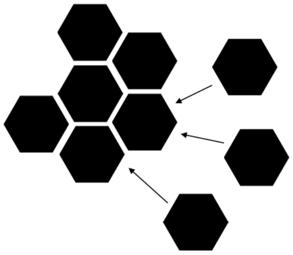


Figure 2: Modularity diagram

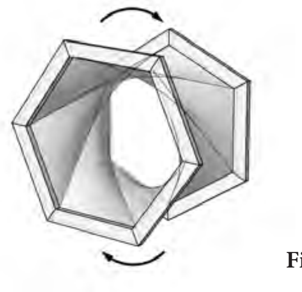


Figure 3: Aperture twist

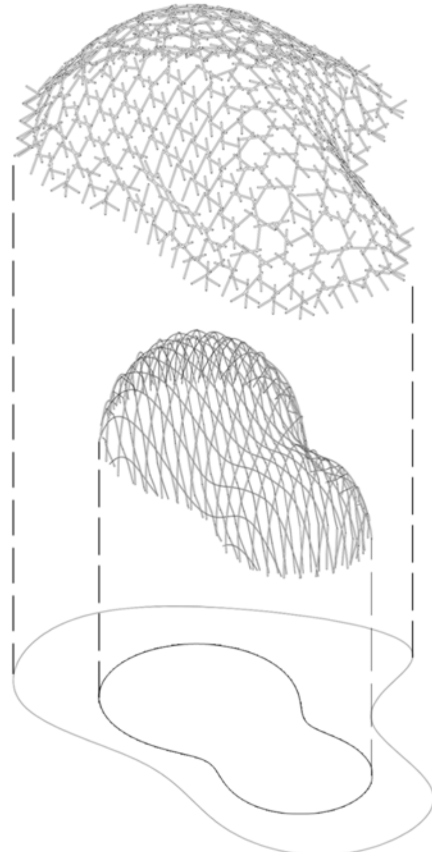


Figure 4: Initial iteration exploded axonometric

CONCEPT AND INITIAL ITERATIONS:

Prior to studying research shelters and their applications, the design began with the idea of modularity. Uniform parts could create various adaptable forms for SYMBIOSIS. Twisting aperture panels would utilize fabric as the aperture material, creating the initial piece that was developed during SYMBIOSIS's infancy. These hexagonal panels would be user defined and allow the shelter to better accommodate its occupants. Additionally, a double skin system was initially thought of in order to have this aperture panel function correctly. At first, this idea of rotation was working, however the panels were too complex for their desired application. In order for the panels to create complex and adaptable forms, each panel would have to be unique from another, resulting in a difficult fabrication process. After taking a step back and studying our textile technique research, the team found inspiration in the fabrication of the triaxial weave. The triaxial weave technique is stronger and less prone to bursting. Looking at it closely, the weave, creates a reciprocal pattern. From there, a reciprocal structure was implemented. This structural strategy would allow for each piece to be the modular, as well as lightweight and easy to construct. Reciprocal structures rely on gravity because each piece weighs on the other to hold its shape. This means that if one piece fails, the structure fails. However, the necessity of a double skin system was called into question. The team then reduced the shelter to two elements, the fabric and the reciprocal structure. These two elements were relied on each other to create and maintain its architectural shape. The fabric would stretch to create tension and friction on the memberal joints, which strengthens the structure and gives the textile its shape, lifting it from the ground to create a symbiotic relationship between the two.

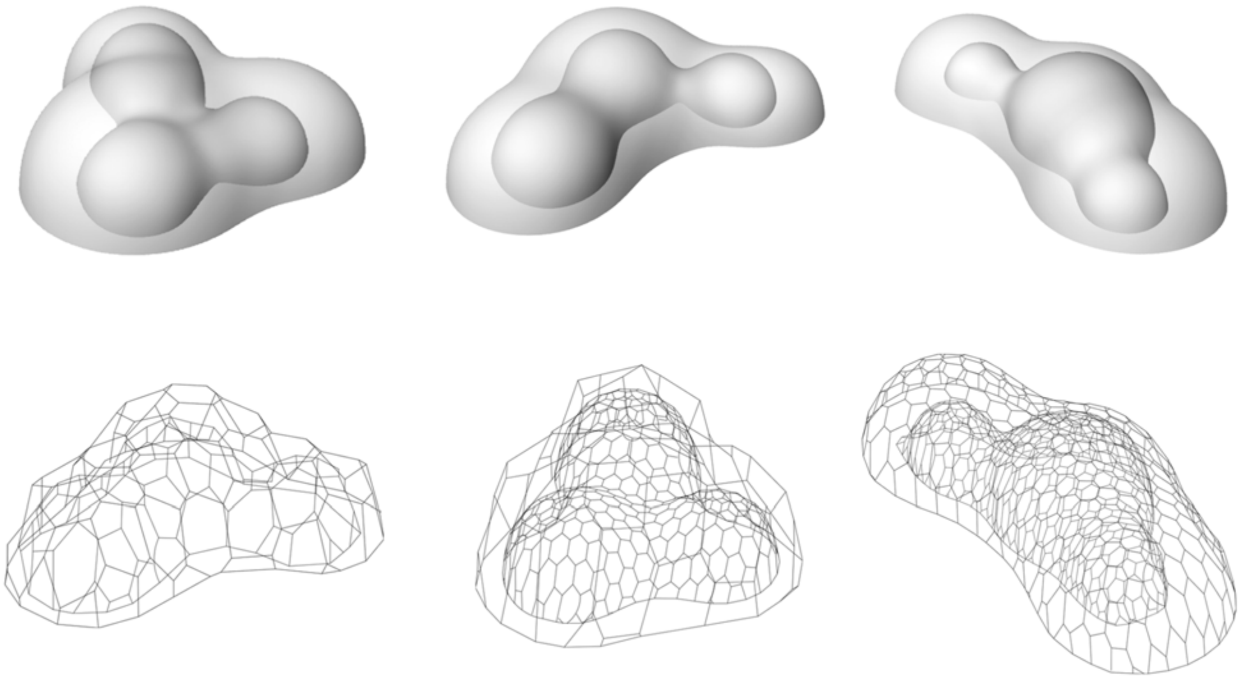


Figure 5: Hexagonal pattern mapped to surface

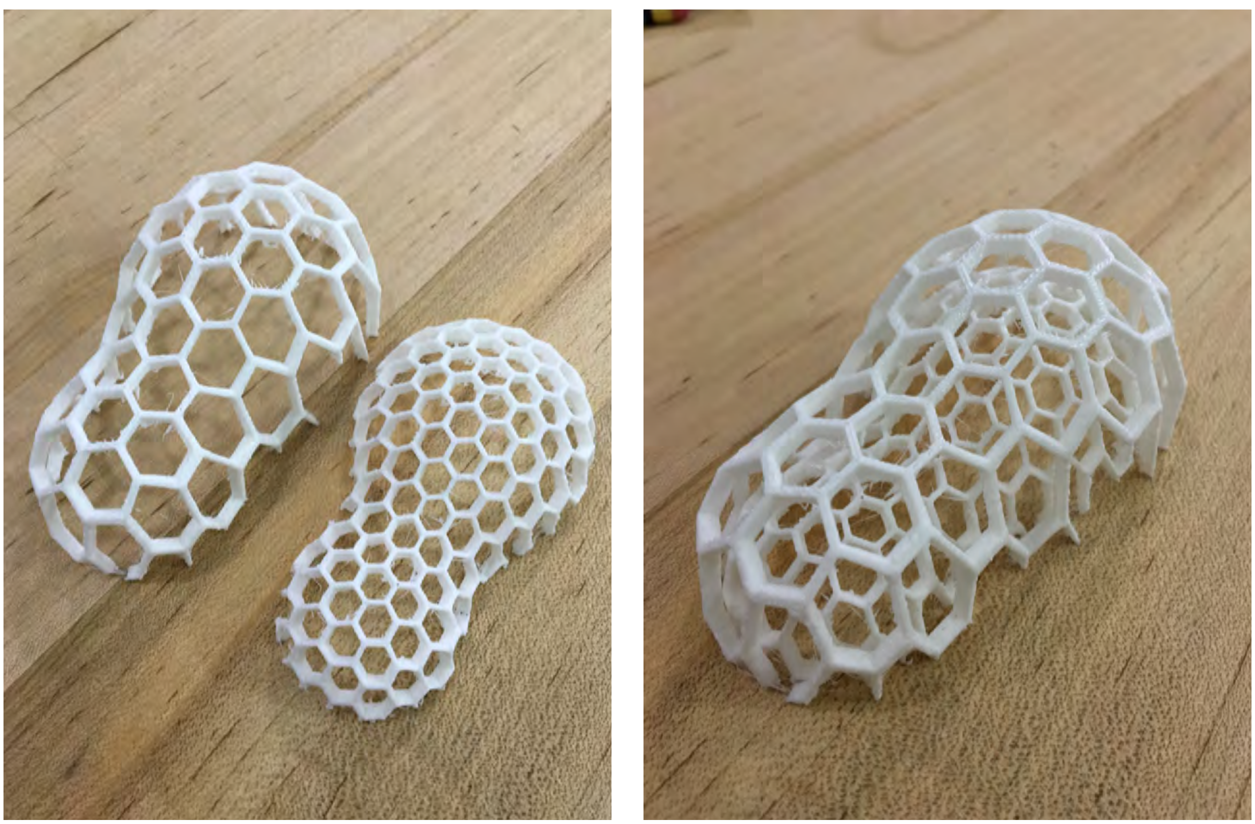
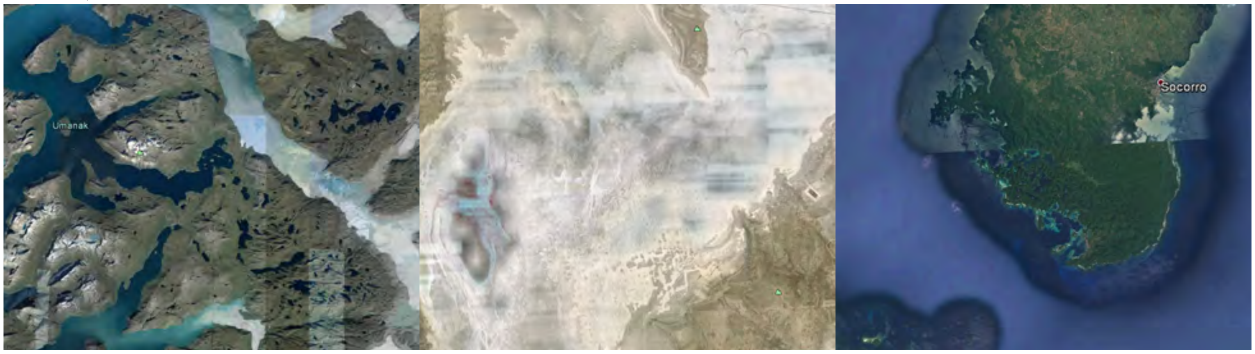


Figure 6: 3D printed model of initial iteration



Kapisillit, Greenland | Salt Flats, Utah | Socorro, Phillipines

Figure 7: Site Locations
Source: Google Earth

Figure 8: Reciprocal derivation from triaxial tectonic

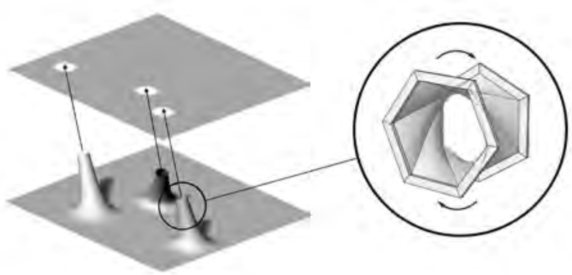
Figure 9: Plan reaction based on site conditions

SITE:

When selecting sites to locate our shelter, the team wanted to find places that were all completely different from each other. One of the goals of the shelter was to be adaptable to any climate or circumstance. Researchers go all over the world into the harshest of environments and this shelter should be able to accompany them there. Knowing this the team picked regions starkly different from each other. The first choice was Kapsillit, Greenland, a cold barren location with around two hundred seventy days of snowfall annually. The second location that was chosen was the Salt Flats in Utah. Due to its high elevation above sea level, the Flats have a arid climate that sees hot summers and cold winters. The last location that was selected was Socorro, Philippines, a very hot and humid jungle climate that seemed like the perfect final location to create a mix of different locations to test out the shelter. Between a tundra, a cold desert, and a tropical jungle climate, the team had to consider many site parameters including landscape and weather. The textiles had to withstand everything, from rain to snow, while also remaining adaptable to the environment. The triaxial weave and reciprocal patterns of the shelter were designed to adjust on site to any landscape or climatic conditions.

DIGITAL DESIGN METHODS:

Due to the complex nature of Symbiosis, various digital design methods were implemented to enforce the cohesion of the shelter. Grasshopper was the main tool used to model Symbiosis. Grasshopper is a parametric modeling tool for Rhinoceros 5. In conjunction with grasshopper, a plugin called Kangaroo was also utilized. Kangaroo is a physics engine that utilizes grasshopper to output geometry. In Figure 10, these tools were used to produce various iterations of the design. Many aspects of the design were parametrically driven. When designing the form of SYMBIOSIS, the technique of using attractor points within grasshopper allowed the plan to adapt to various site conditions, such as terrain and foliage. In the early stages of the design, grasshopper allowed hexagonal panels to be mapped to complex forms. Grasshopper also allowed the team to model a complex triaxial weave, which was initially used as an inner skin component. Grasshopper decreased the time of modeling the actual weave. In Figure 11, the structure was parametrically driven to test the quantity and spacing of the members that make up the structure. This ensured structural efficiency and enforced the feasibility of construction for the limited amount of users. Kangaroo was needed to visualize the application of the textile on the structure itself. The plugin was extremely efficient in creating textile drapery within a digital world. This allowed the team to study the application point on the structure and test various other points on the reciprocal as well.



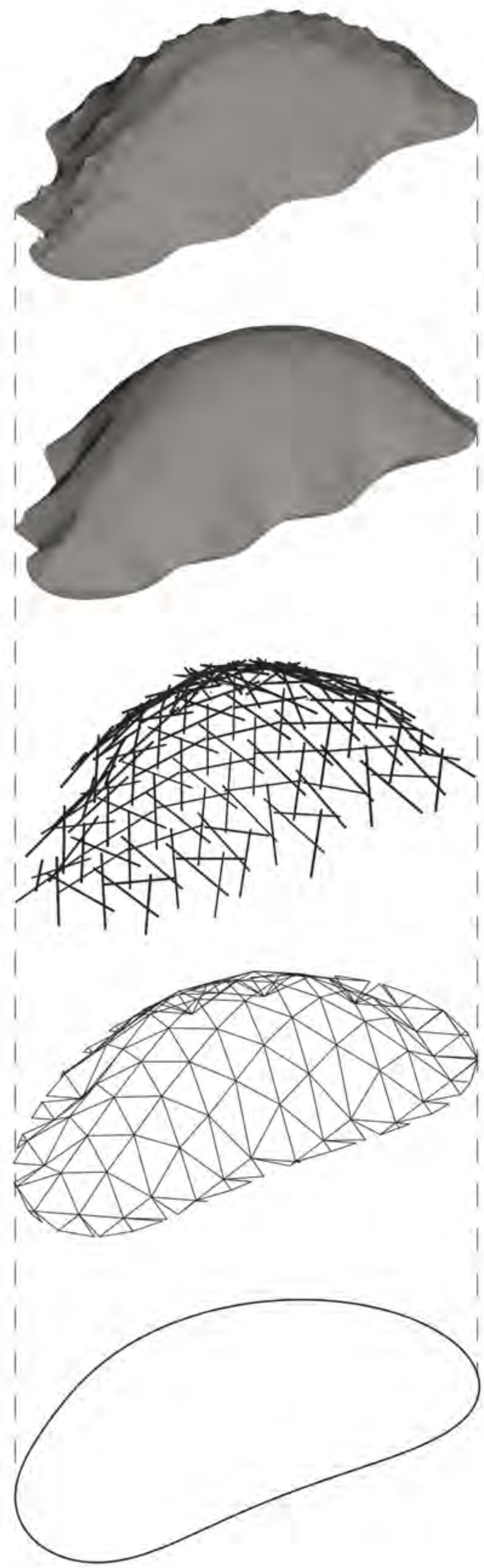


Figure 10: Initial assembly and concept of Symbiosis. Utilizing grasshopper, kangaroo, and rhinoceros.

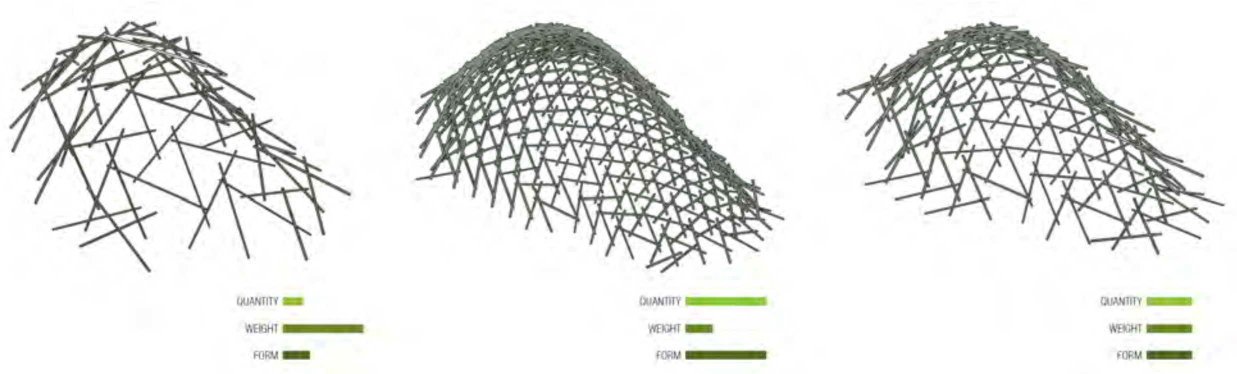


Figure 11: Member efficiency study

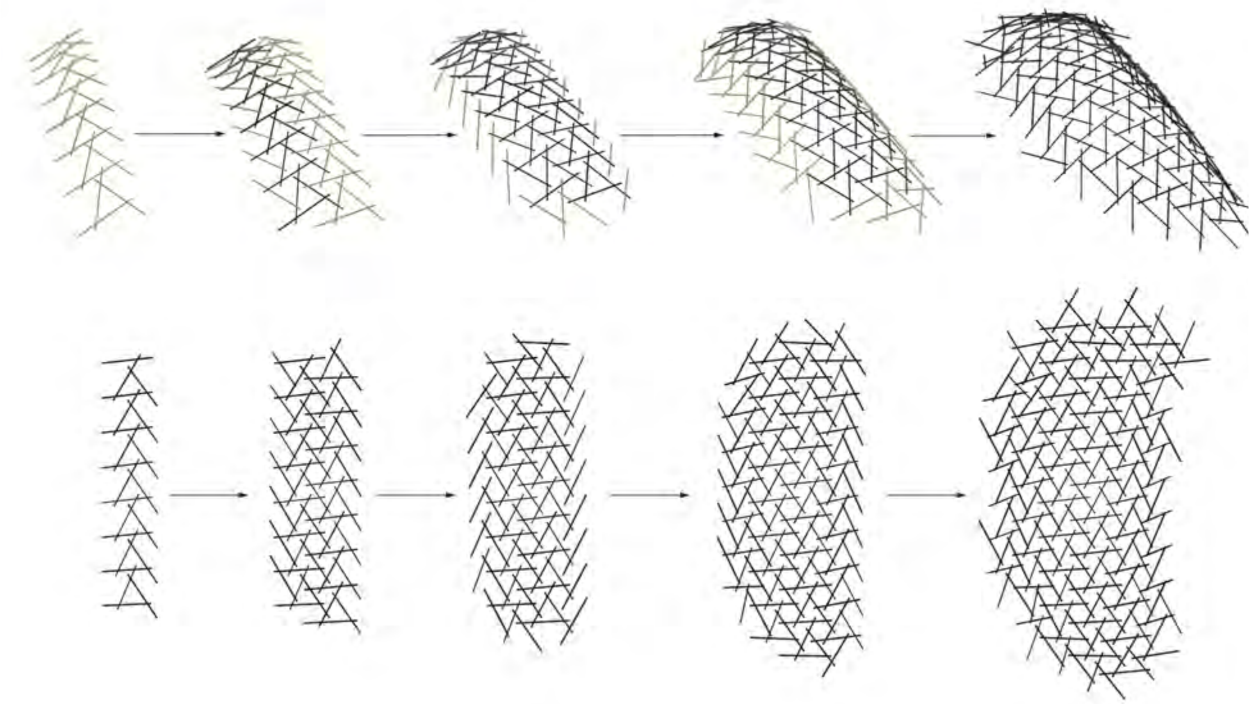


Figure 12: Assembly method of reciprocal structure

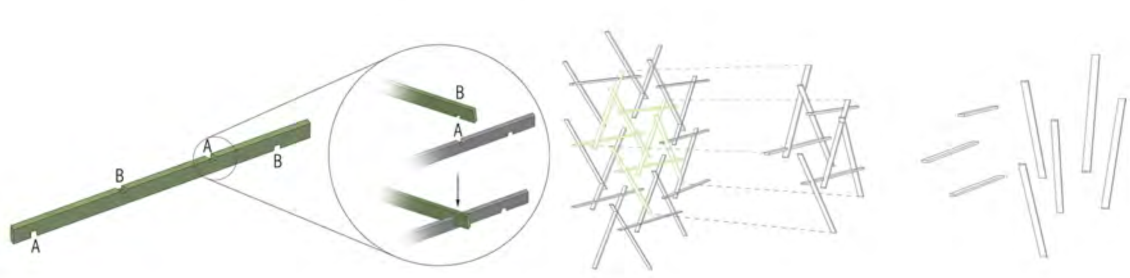


Figure 13: Assembly method of each module within reciprocal structure

CONSTRUCTION AND ASSEMBLY:

When looking at the construction of the shelter, the team wanted to create something that would be very feasible to create and easy to build. Three things were taken into consideration when designing our structure; ease of assembly, adaptability, and transportation. While traditional construction assemblies are from a bottom-up method, the reciprocal structure lends itself to a top-down construction. This means that the first pieces in the construction of the shelter are actually the highest ones in the final structure. Because its a reciprocal structure, the shelter needs the forces of the other pieces to hold itself up. This is why it can only be assembled using a specific method. You can see this in process in Figure 12. This makes assembly easier because the end-user doesn't need any other resources to assemble the shelter. The structure is very simple in create and implement into any surrounding environment. Each weatherproofed piece of lumber is precut to have four notches in them as seen in Figure 13. Two on the top and two on the bottom. The pieces are symmetrical in design, so there is no top and bottom. The notches interlock between three pieces to form a triangular form. When you have a few of these triangular pieces assembled, you can then connect them together to begin creating the overall form of the reciprocal structure. This allows the shelter to be adaptable to the surrounding environment. Researchers can make the shelter larger or smaller simply by adding or removing pieces of the structure. Because of its light-weight and easy of construction, the shelter would only require a few researchers to build the structure with no assembly tools. On every third piece of the structure, there is a notch on the end of the piece that attaches to straps, which are woven into the textile that drapes along the inside of the structure. The textile is located on the inside for two reasons; To protect from tears created from protruding pieces of the structure and to create more tension on the reciprocal structure. The elasticity of the textiles creates more tension on the structure, giving it more durability against environmental influences like wind.

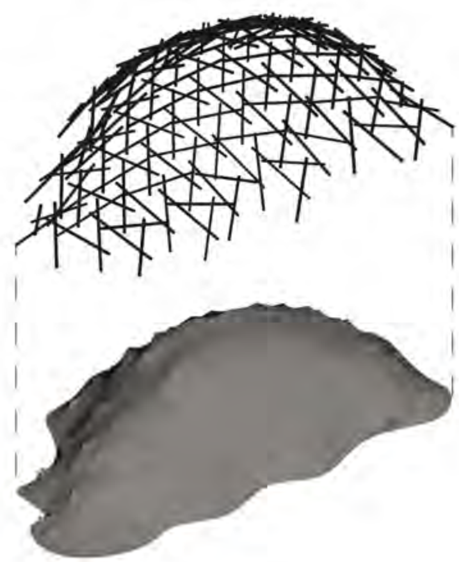


Figure 14: Exploded axonometric of Symbiosis

Figure 15: Textile samples weaved on a jacquard loom

DIGITAL TO REALITY - TEXTILE:

The textile produced for this project was created on EAT DesignScope and woven on a Staübli Jacquard loom. The beginning of the project initiated a discussion about woven structures that were dimensional and could provide depth to a textile. The team utilized the fabric to create a Honeycomb weave (also known as a Waffle weave), which creates a box-like shape in the fabric that is tightly woven in the center and looser as it goes outwards. It was woven with both wool and elastomeric yarns to further accentuate the dimensionality after washing and drying. The fabric has insulating and stretching properties that help the internal environment and exterior structure. Pockets were also woven in a plain weave, as seen in figure 16. These would be used as handles for the fabric to be hooked to the wooden beams of the structure. The team felt that weaving the handles into the fabric would allow for customization, while also being less prone to tear than if they were sewn on.

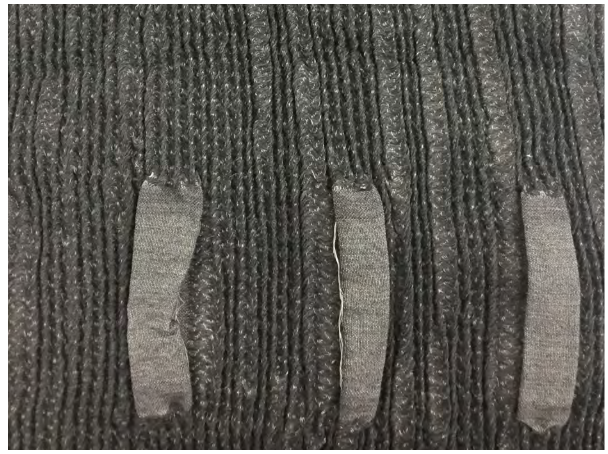


Figure 16: Final Textile with plain weave hooks

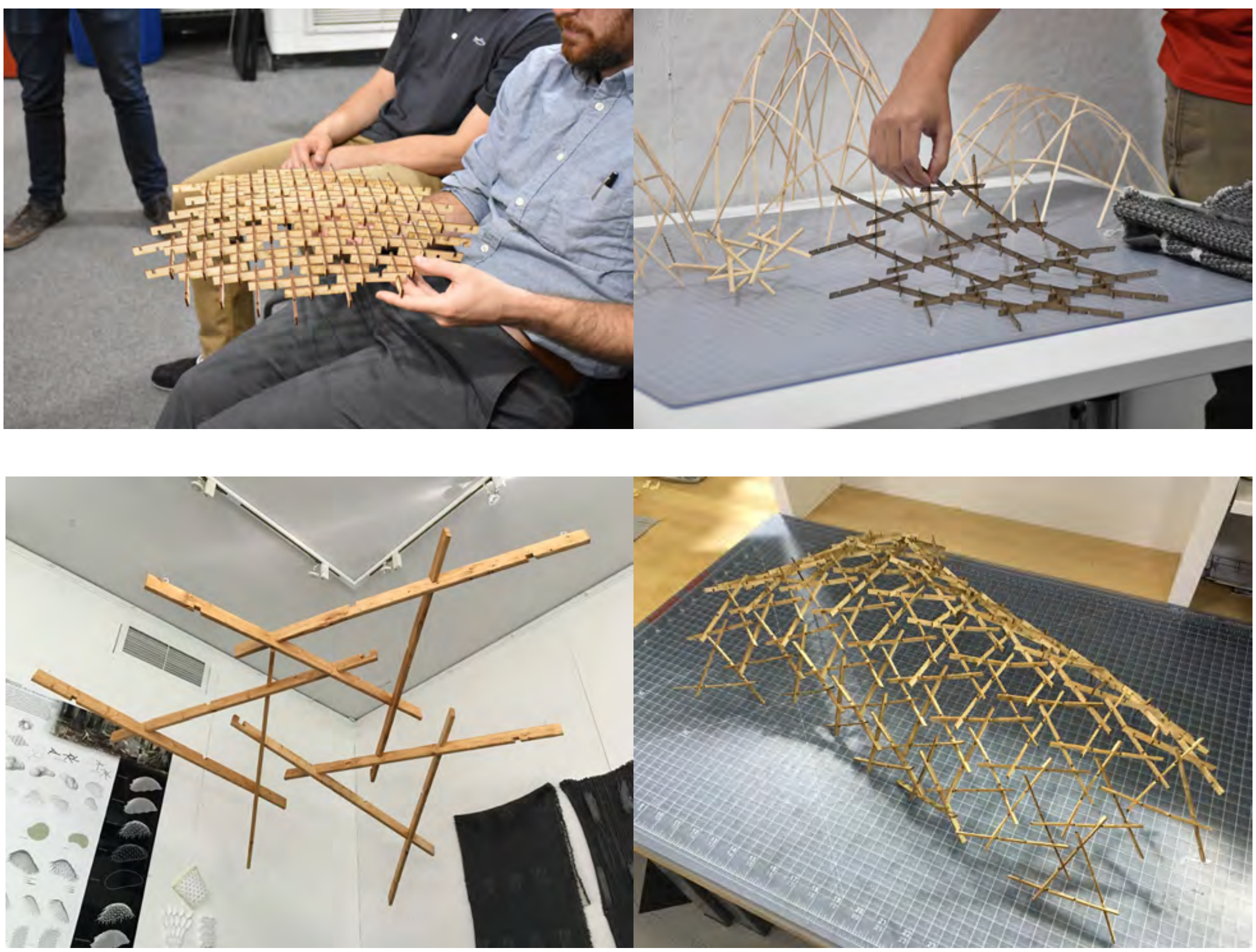
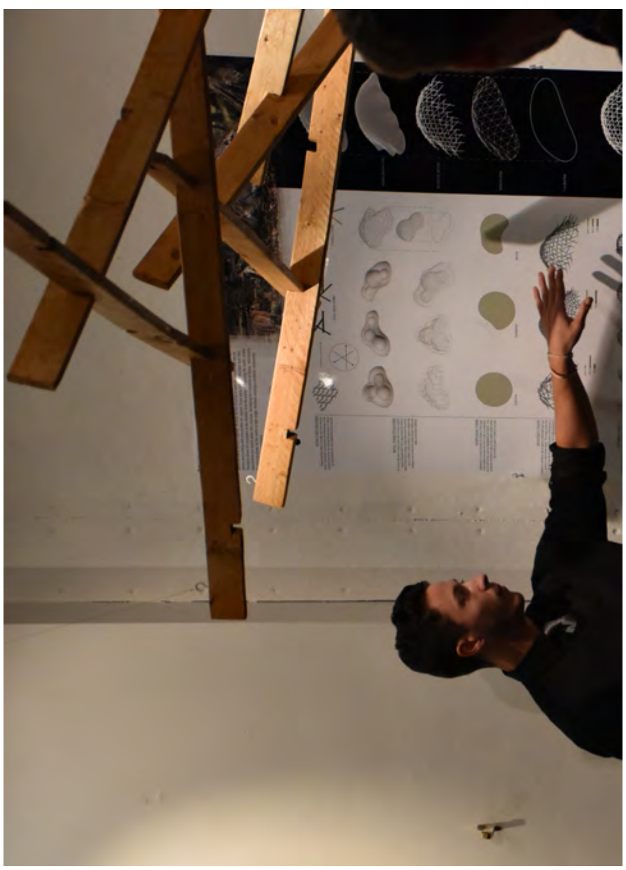


Figure 17: Form Iterations (Top Left, Right), 1:1 Scale Piece (Bottom Left), Final Model (Bottom Right)

Figure 18: Exterior Perspective in Greenland (Top), Final Presentation (Bottom left and right)



REFLECTION:

Although we know it’s prevalent, textile in architecture is a very real thing. Students often do not think to implement textile research into their designs. SYMBIOSIS did exactly that. This project was a catalyst in beginning to understand that architecture and textiles have a close relationship with one another. From working with textile designers, architecture practitioners, and faculty it allowed us to develop our knowledge in this application. It guided us to possibilities we never knew may have existed or attempted ourselves. Approaching a design challenge from a bottom up stratification offers a different perspective and an altered thought process that students may not get exposure to in architecture. The parametric and digital methods used for SYMBIOSIS are tools that should be explored by other students in order to iterate and enhance the level of design that is be presented.

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TENSEGRITY PAVILION
TEXTILE TECHNIQUES AND ARCHITECTURE TECTONICS

TEVIN WILLIAMS
JIATAI WU

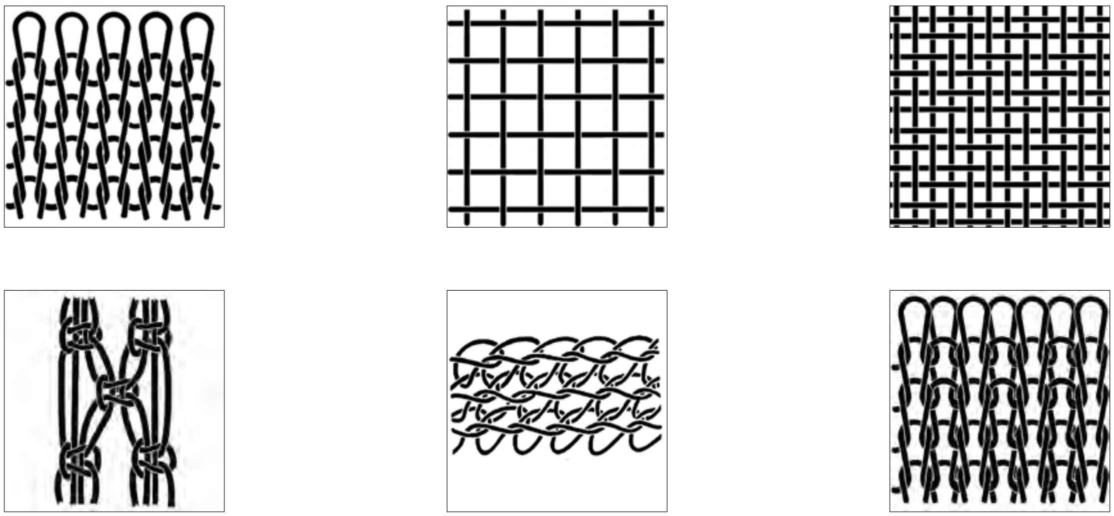

Figure 1: Textile techniques diagramed

ABSTRACT:

The team's goal for this project was to incorporate textile techniques into the design and construction of architecture. Research began by creating 30 textile samples and analyzing textile applications in architecture to understand the textile techniques and architectural tectonics. The team designed a woven pavilion based on those studies. However, there are disadvantages to the design that conflict with design goals. Tensegrity structures were found to be a better solution that satisfied all the constraints at hand.

TEXTILE TECHNIQUES AND ARCHITECTURE TECTONICS:

This project started by making textile samples as well as looking up architectural precedents in order to gain a knowledge of textile techniques, material properties, and textile applications in architecture. Samples were categorized based on the different textile techniques that were used. There are, in total, six textile techniques that were explored. These included single jersey knitting, double knitting, plain weave, four-end even twill, single crochet, and square knot macramé. There were diagrams documenting the hand movement while crocheting or knitting. There were also diagrams documenting the needle set up if the sample was made by machine. Then the team tested out how different textile techniques could influence the flexibility of the fabric itself. After running multiple iterations of the tests and carefully calculating the results, it was found that knitted fabric can stretch more laterally. Woven fabric stretches less laterally but it does stretch much more diagonally. Of course the density of the fabric and the materiality all affects the flexibility as well. This experiment provided the team with an interesting insight into textile properties and strongly influenced the design later on.

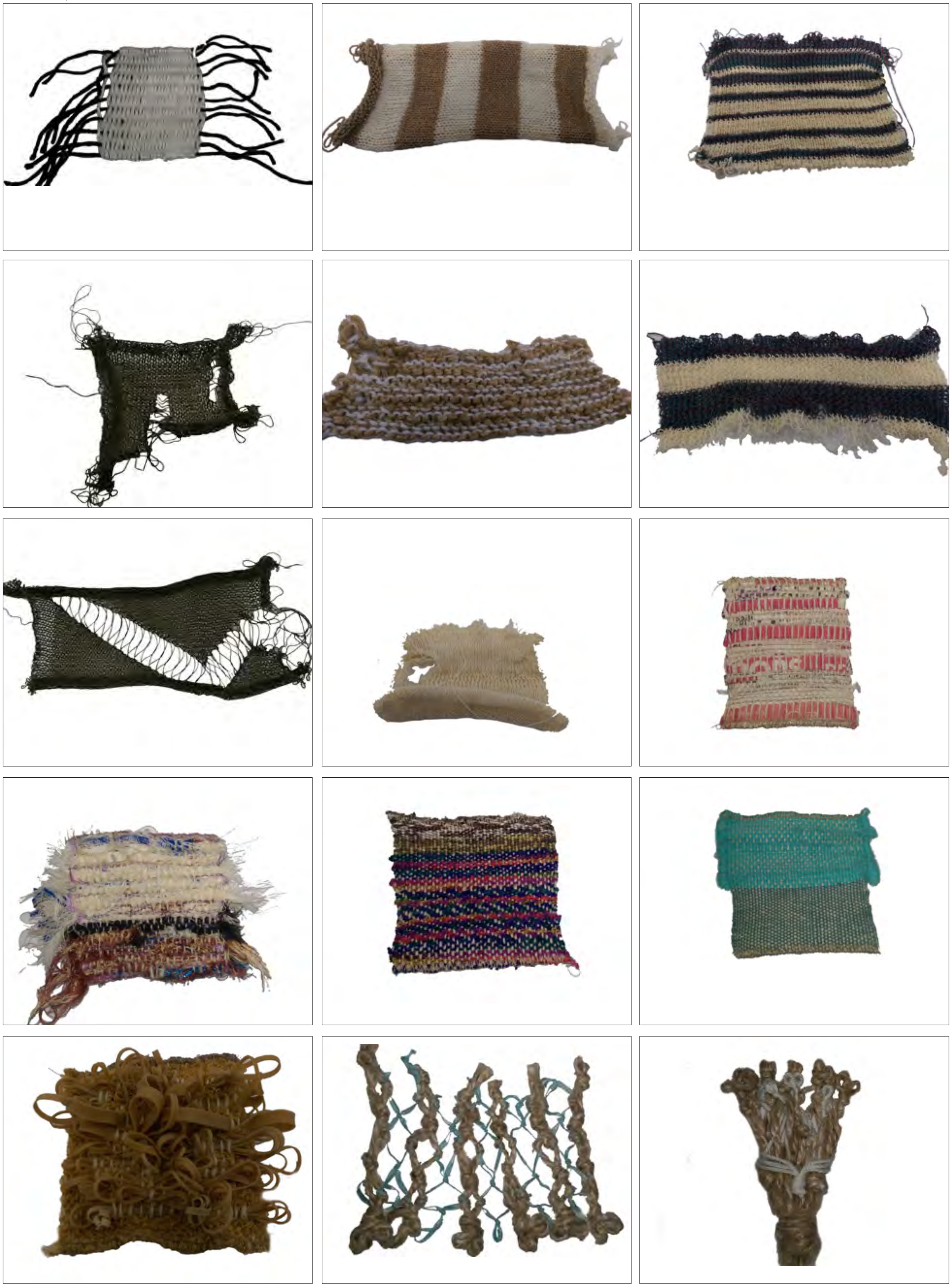

Figure 2: Textile techniques and material research iterations.

WOVEN PAVILION:

Moving from research to design, the team's goal was to incorporate the textile techniques that were just learned into the creation and construction of architecture. The flexibility experiment performed was very intriguing and the team wanted to further develop this idea, architecturally. The program of the shelter was to be an experiential pavilion that explored all the interesting opportunities that come with stretching and contracting the structure. When developing the concept for the pavilion, the team examined and thought through all the possible parameters that would affect the form and movement of the pavilion. By doing, the team was able to create a frame-work that steered the design in a specific direction, without being site specific. The pavilion would stretch and contract in response to different climates and sites. In order to do so, the geometry of the woven pavilion was designed to have the same stretching properties as a knitted textile.

The structure of the woven pavilion consists of mechanical groups of joined wooden members. There would be three connection points for each member located at the center point of the member and at both ends. The connections of the wooden members were constructed in "x" shapes. When each "x" rotates around the center point, it would pull the next "x" shape closer or push it further away. The entire pavilion would seem like it was stretching or contracting. A similar structure system was applied to the top and bottom of the pavilion. At those two locations, the center point connection for each "x" is a bit different. The wooden members at those locations have a long slit cut out, where the actual metal connection piece rests. The metal connection piece keeps two wooden members together and slides along the slits. This connection system allows the pavilion to manipulate its form, especially as it adapts to various topographic conditions.

The pavilion has knitted translucent fabric that is woven between the wooden structure and responds different climatic conditions. The wooden members have slits cut out along the long axis and the fabric would be thread through those slits in the same way a textile is constructed. By doing this, skin is weaves two completely different materials to the structure. This allows the skin and structure to respond to different climatic conditions and topographies. For example, when the pavilion stretches, the solid wooden structure would expand to create more open space and allow for a clear view through the translucent skin. This aspect allows the pavilion to take advantage of certain views and natural ventilation. When it contracts, the skin would overlap itself and act as thermal insulation for the pavilion.

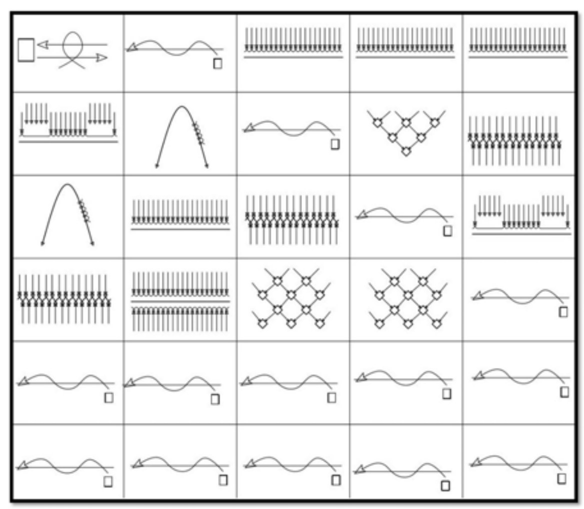

Figure 3: Hand movement diagram

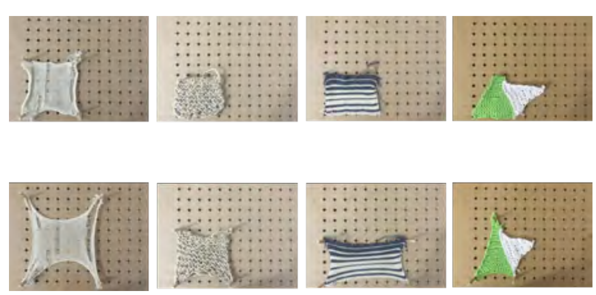

Figure 4: Stretch ability test

Figure 5: Woven pavilion rendering

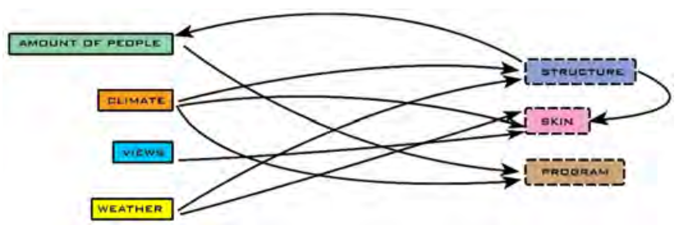

Figure 6: Design parameters

Figure 7: Concept diagram

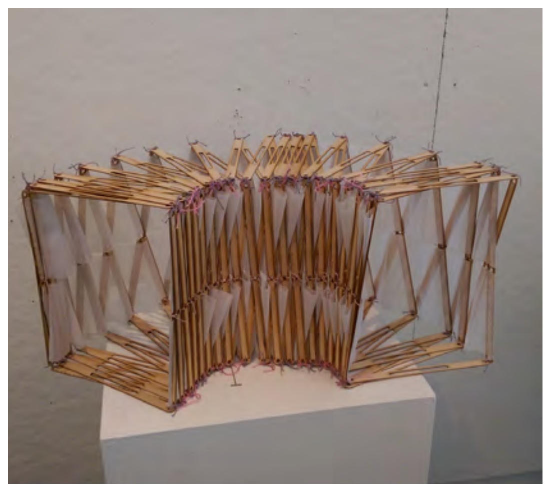

Figure 8: Physical model

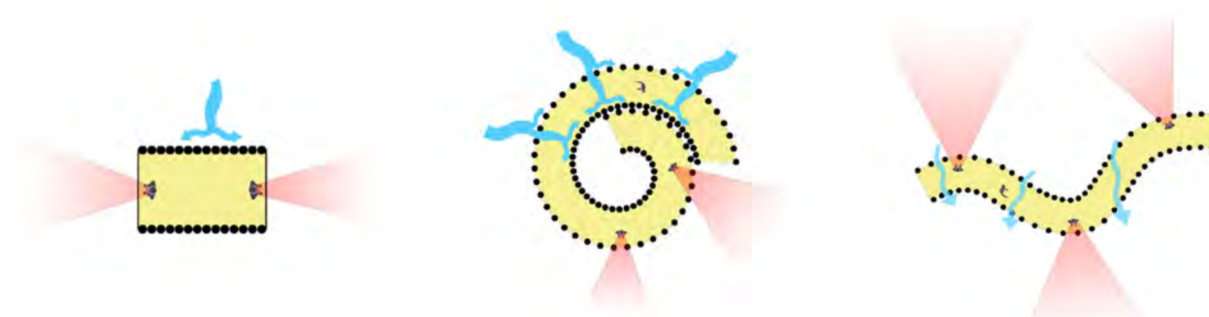

Figure 9: Pavilion adaptation diagrams

Figure 10: Tensegrity pavilion rendering

Figure 11: Physical model

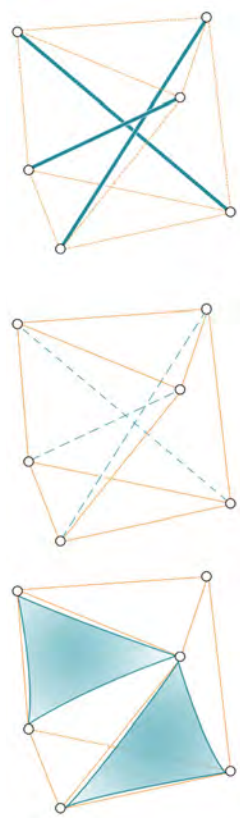

Figure 12: Tensegrity unit diagram

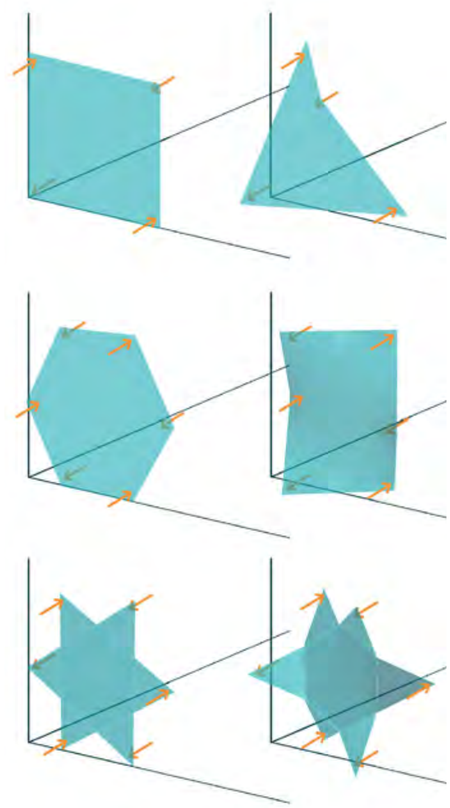

Figure 13: Tensegrity forces diagram

TENSEGRITY PAVILION:

In order to compensate for the heavy weight of the timber wood lattice within the structure of the Woven Pavilion, the team felt that it would be more beneficial to design a pavilion that was lightweight, easily deployable, and could be assembled with the greatest ease. This proved to be a very hard challenge as there were not many precedent structures that could adapt to any site while remaining light and accessible. After long hours of tedious research, the team found that using tensegrity as a structural design method was the best way to accomplish the goals that were set out at the beginning of the project. Tensegrity can be defined as a balance between compressive and tensile forces, creating a moment of opposition and unity. To fully understand tensegrity, many series of sketch models were created to helped understand the components needed to make something a tensegrity unit. Creating all of these models helped the team to understand that all compressive and tensile forces need to be opposing each other to create an equilibrium. Knowing this, it was clear that the form of the pavilion would be directly linked to the forces acting upon it. Those forces were had to be physical and qualitative for the people using and viewing the space. These ground rules helped the team to work through many iterations of different design schemes, which ultimately led to the final design.

After understanding tensegrity as a unit, the team then try to design a unique system. The system would need to be lightweight and adaptable so that people could see various views that would be framed within the pavilion. Two system designs that stood out were a regularized design that drew inspiration from biology and a seemingly random design that utilized a compression member that was located in a specific spot to keep the structure standing. Each design had both positive and negative qualities. The regularized system seemed the most viable for construction but the interior spaces within this system seemed too monotonous and uninteresting.


Figure 14: Regularized system

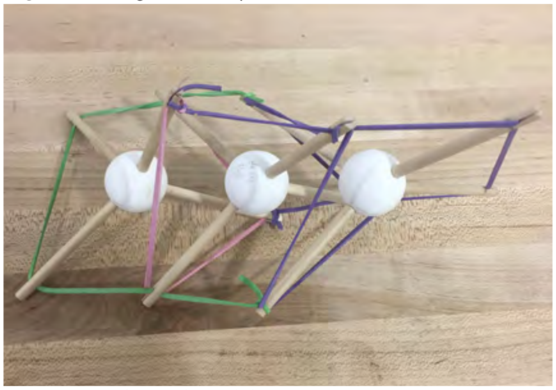
Figure 15: Physical model

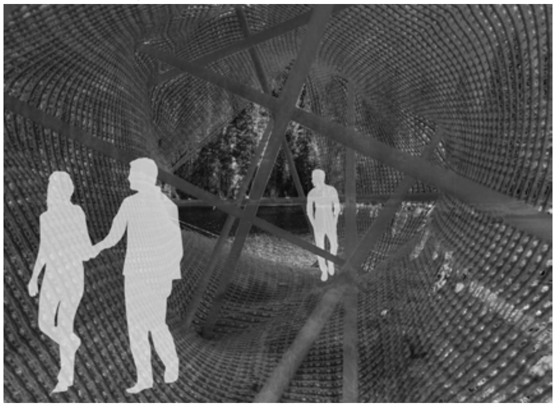
Figure 16: Randomized system


Figure 17: Physical model

On the other hand, the randomized system had a lot of interesting moments but it seemed chaotic.

In order to create a pavilion that would be easily constructed and architecturally interesting, the team took the best components of both the regularized and randomized system . These components were then combined to create a playful, yet tranquil space. The Tensegrity Pavilion guides a users view and movement to create moments that allow them to connect to the site and all it has to offer bother aesthetically and environmentally.

Figure 18: Initial tensegrity study models

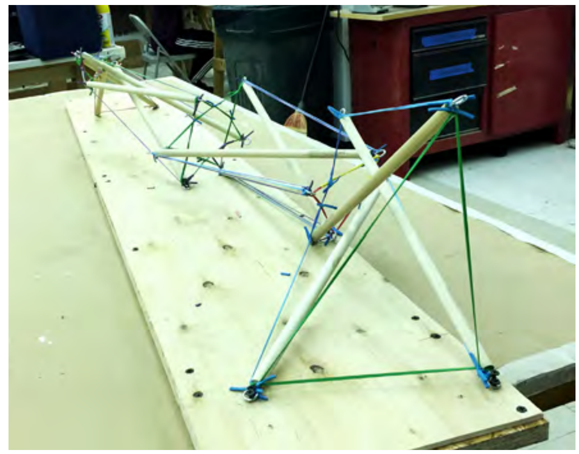

Figure 19: Physical models

Figure 20: Skin study

Figure 21: Enclosure parti

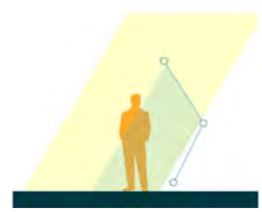

Figure 10: Light filter parti

Figure 22: User movement parti

Figure 23: Structure adapting to site

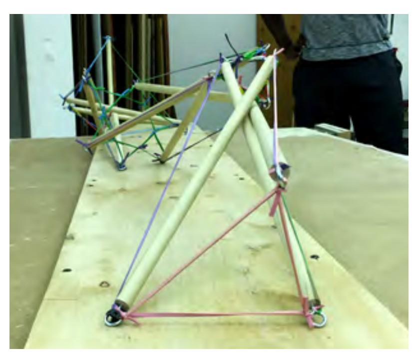

Figure 24: Physical model

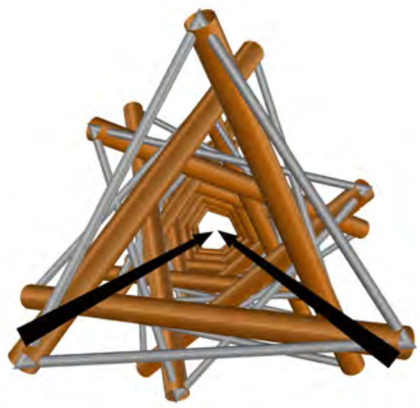

Figure 25: Framing View Parti

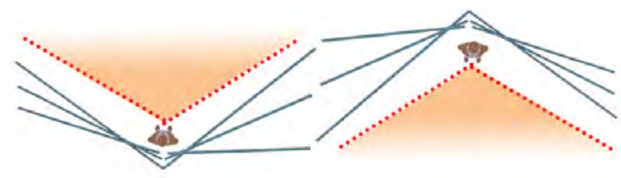

Figure 26: Guiding views parti

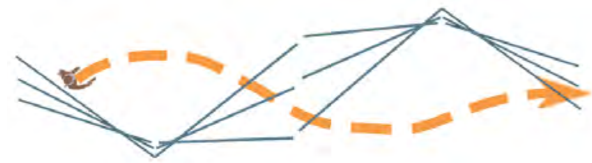

Figure 27: User movement parti in plan

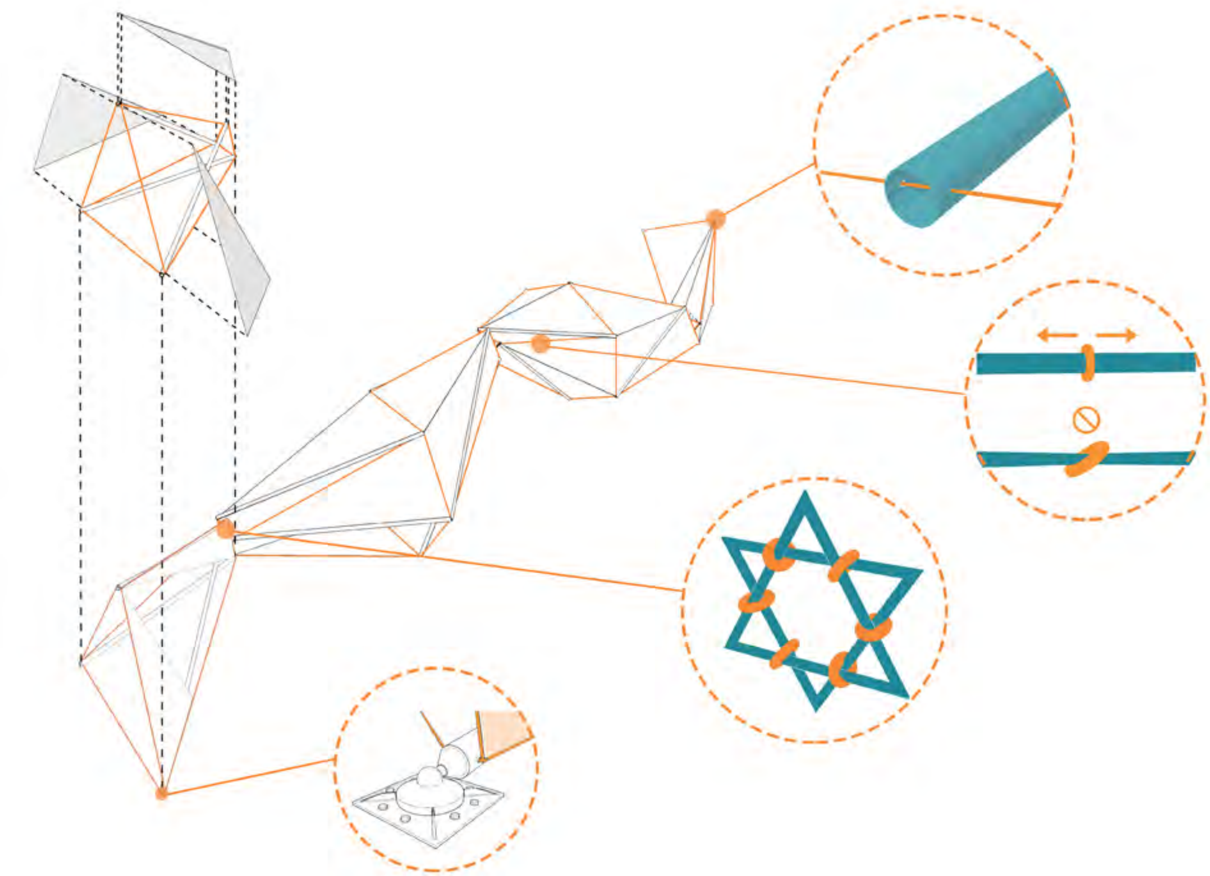

Figure 28: Axon with details

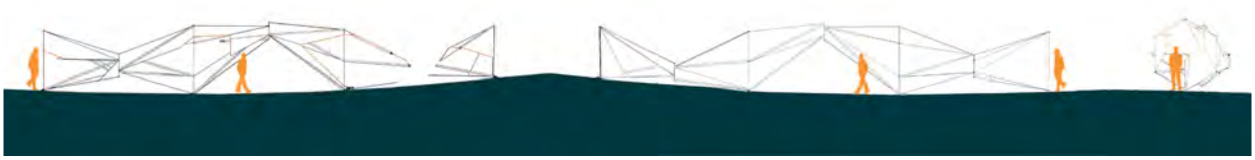

Figure 29: Sections

REFLECTION:

While I think the critique was very successful overall, there were a few comments that we disagreed with. After the critique, both my partner and I both came to the realization that the critics measured the success of each project based on how much textiles were used in the architectural space and how textiles are used in each space. However, as a group, we believe that the success of a project with based on the inspiration that was drawn from the properties of textiles and our textile studies. Otherwise, I thought that the critics responded to the structure and the form of the building very well and also the aesthetics of the textiles. If more time was alloted to the project, as a group, we would definitely explore incorporating textiles as the structure itself while still trying to maintain control over the building.

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BIOLOGIC: ADVANCED RESEARCH IN EXPERIMENTAL TEXTILE STRATEGIES FIELD RESEARCH CENTER

ANANYA BEVINAKATTI
BRITTANY EWING
RYAN SCHAEFER

ABSTRACT:

The final structure was conceived as a transmutable public space that could be assembled and taken apart with little effort. The structure has the capacity to be reconfigured in a variety of combined spaces that have different foot prints and spatial arrangements to accommodate miscellaneous activities. The idea is that the structure can be used for many reasons and transported very easily.

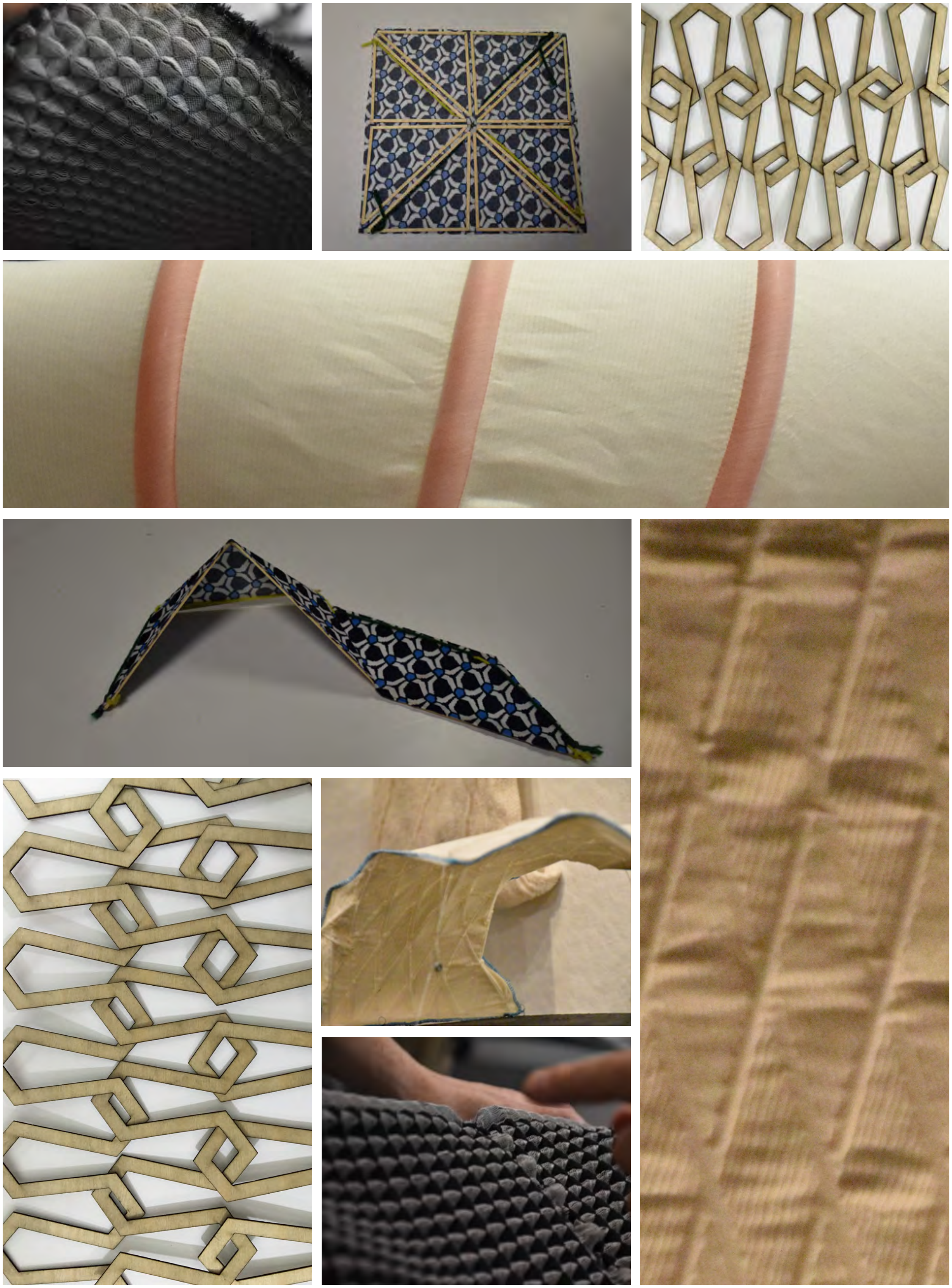
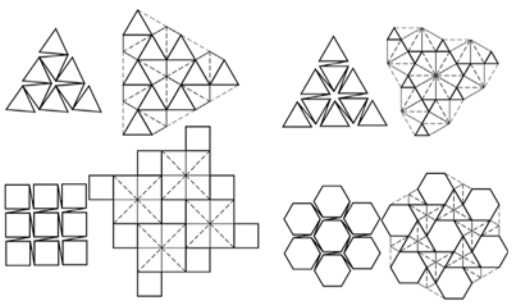


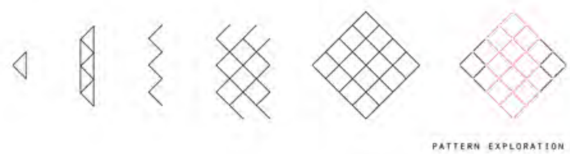
Figure 1: Textile techniques and material research iterations.

INSPIRATION:

The structure took original inspiration from the folding art of Origami, along with Ron Resch's folding and tessellation patterns. The idea of a very transportable and deployable structure came after great research into kinetic structure, along with deployable structures. One in particular was Heatherwick's Folding Bridge, which is able to curl up in a smaller and more compact form. The team also took inspiration from tensegrity design and tensile structure. These ideas influenced the design and form finding techniques throughout the process, all the while, using Grasshopper to simulate how the structure collapses on itself.

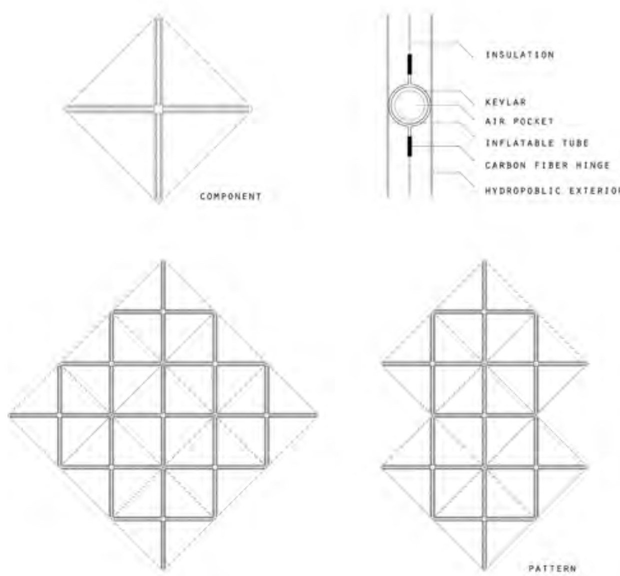
Figure 2: Pin-Up Presentation Set Up





CONCEPT:

Through the team's research, the goal was to design a singular piece, that was able to fold up into a twelve inch by twelve inch square that could be easily transported. The team wanted the shelter to be easily set up anywhere and supply relief from the elements of the surrounding environment. In order to do so, the structure would have to be light, while still being able to hold its own weight, especially under the environmental forces. To do so, the team chose to to do a pneumatic tensile structure. While inflated, the structure would create tension through the outward pressure of the tubes, allowing the structure to support itself. Tension and tensegrity were used to pull the shelter down at anchoring points to create any desired form.



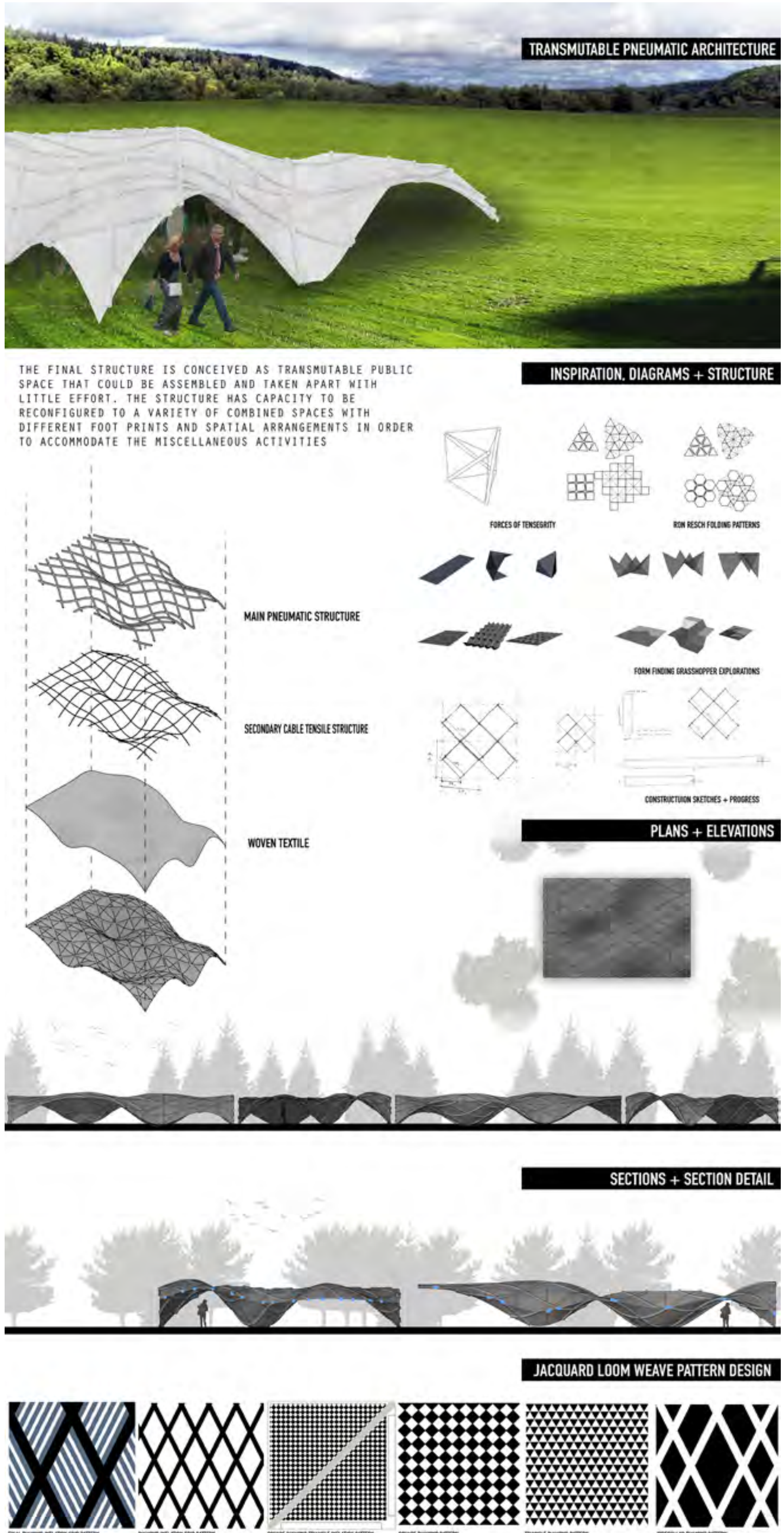


Figure 3: Final Board Layout

Figure 4: Protyping pneumatic structure and textile explorations

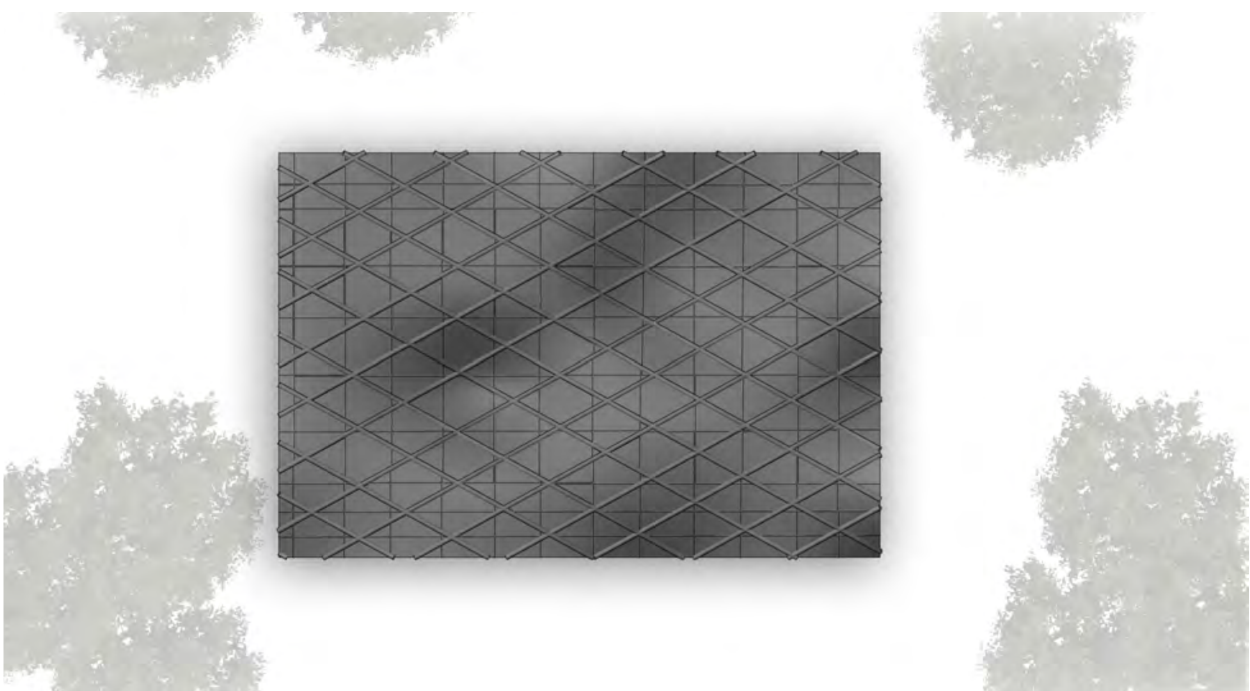


Figure 5: Site Plan of Final Shelter

TEXTILE DESIGN:

Textile design and collaboration was crucial to the design process and end design. The team developed the structure and program of the shelter, while working very closely with Anaya, a textile student, to develop the materiality, internal weave structure, and patterning that would create the best result. Anaya was able to keep the team on the correct path, providing feasibility for the design and materials. The patterning of this project was crucial do to the fact that the textile, itself, was the shelter. The team needed to develop a pattern that provided structural stability and a sense of malleability. Anaya's addition allowed the team to explore the quality of each expressed pattern. Through Anaya's help, the team was able to create a new pattern prototype design every one to two weeks. Different patterns were used throughout the process, including diamond, triangle, square, and even diagonal shapes. The team also explored the different effects of mixing fibers, for example, cotton and elastomeric. The final textile shelter was made out of a double cloth elastomeric in a one to two ratio diamond shaped grid with diagonal shapes that were contained within the diamond.

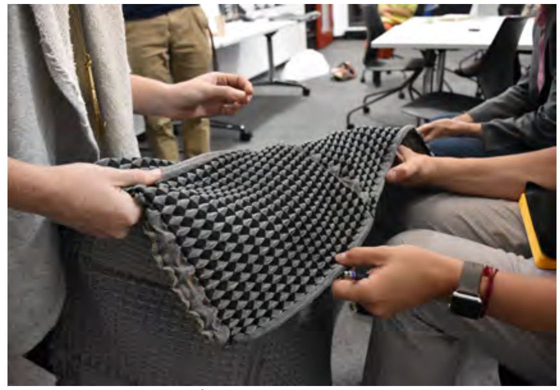


Figure 6: First Textile Prototype

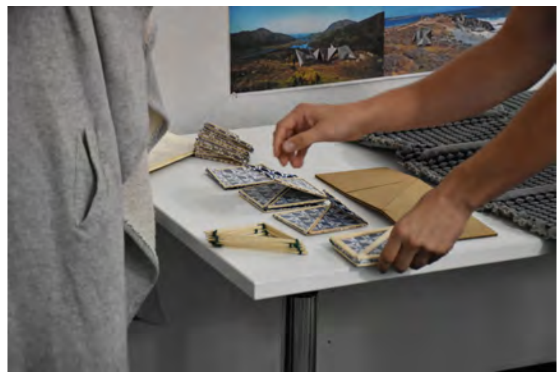


Figure 7: Folding Explorations

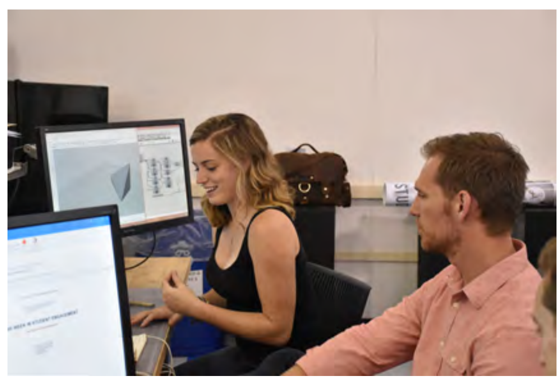
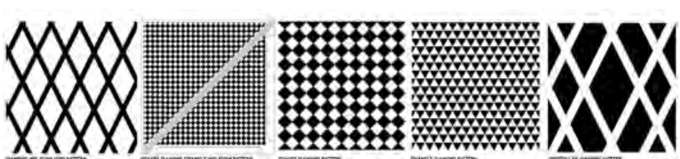


Figure 8: Grasshopper Trouble Shooting Sessions


Figure 9: Mock Model



STRUCTURE:

The pneumatic and tensegrity structures possessed challenges. The structure was weaved within the textile fabric. Overlapping the inflatable structure created points within the structure that could be staked down to create a more dynamic and interesting interior experience. On the other hand, the tensegrity structure was located on the outside of the textile fabric and weaved within itself. The team felt the user would want to layout their ground stakes in a pattern, tie it to the shelter, and then inflate the shelter, which would provide tension and tensegrity.

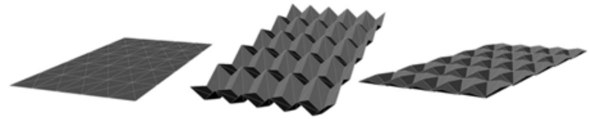


Figure 10: Grasshopper Iterations

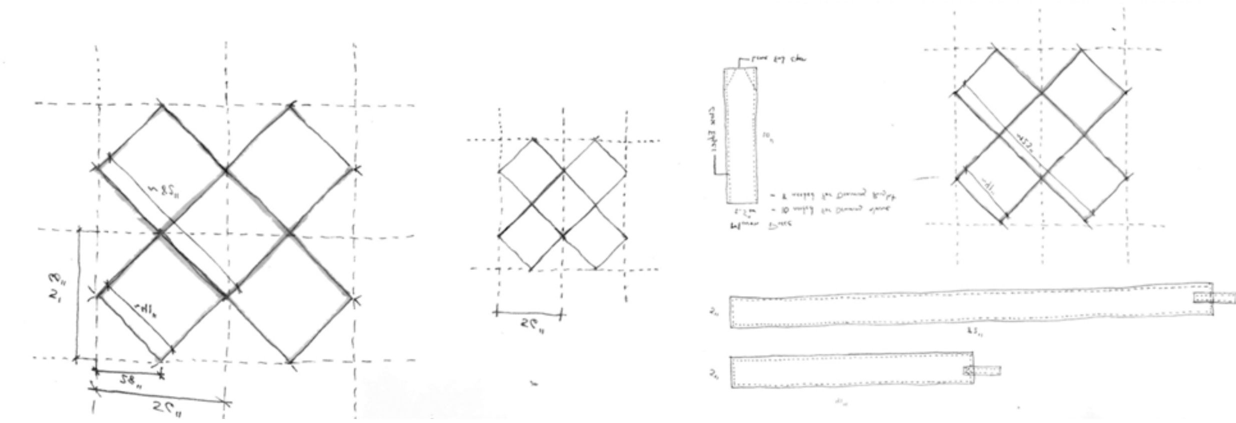


Figure 11: Diagrams and Sketches

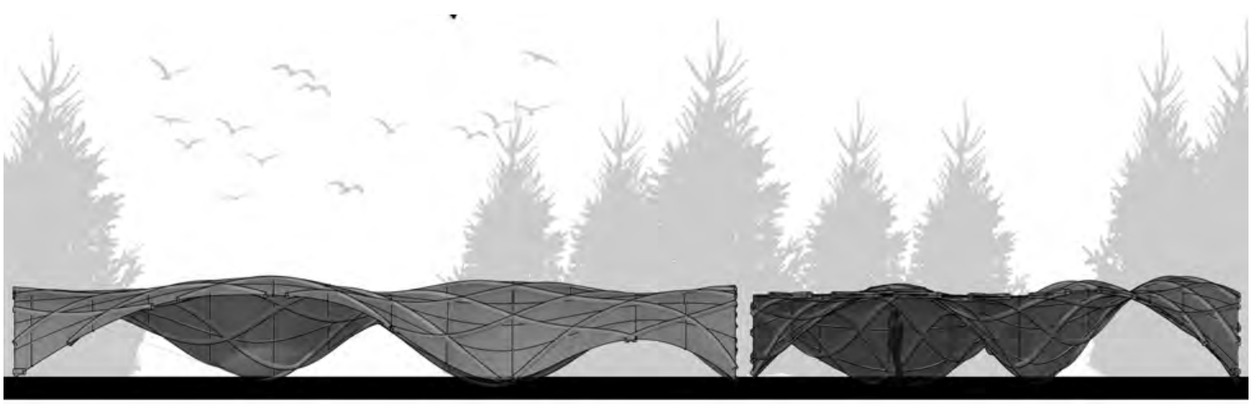
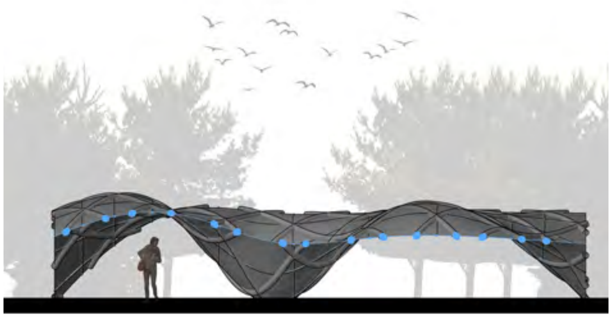


Figure 12: Elevations



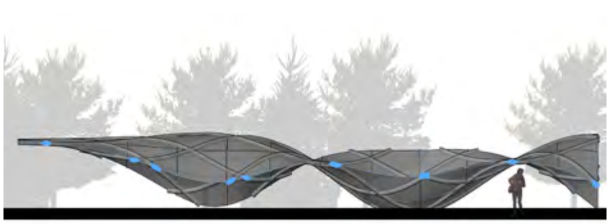


Figure 13: Sections

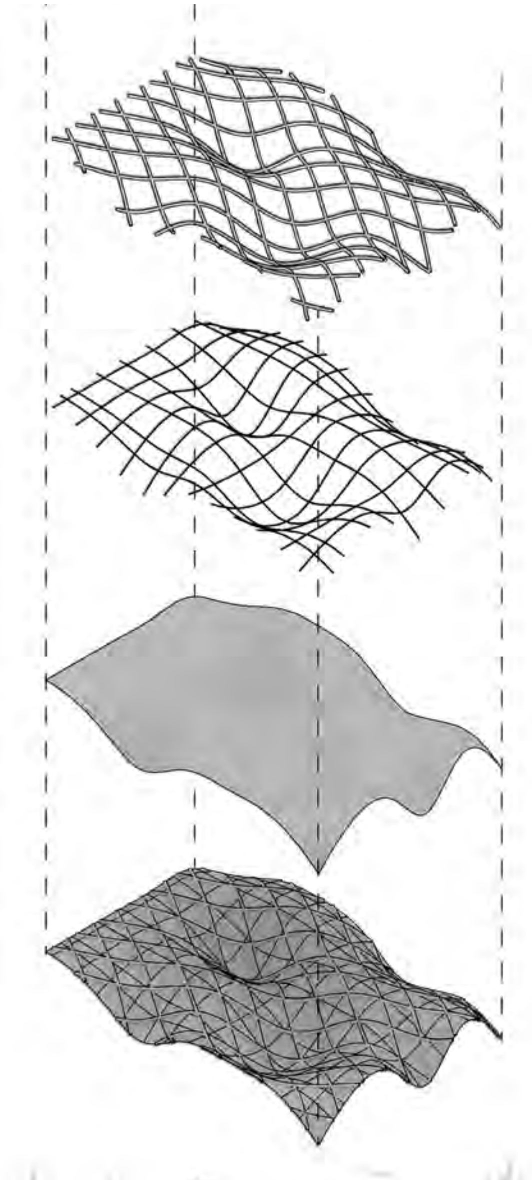


Figure 14: Structural Axonometric

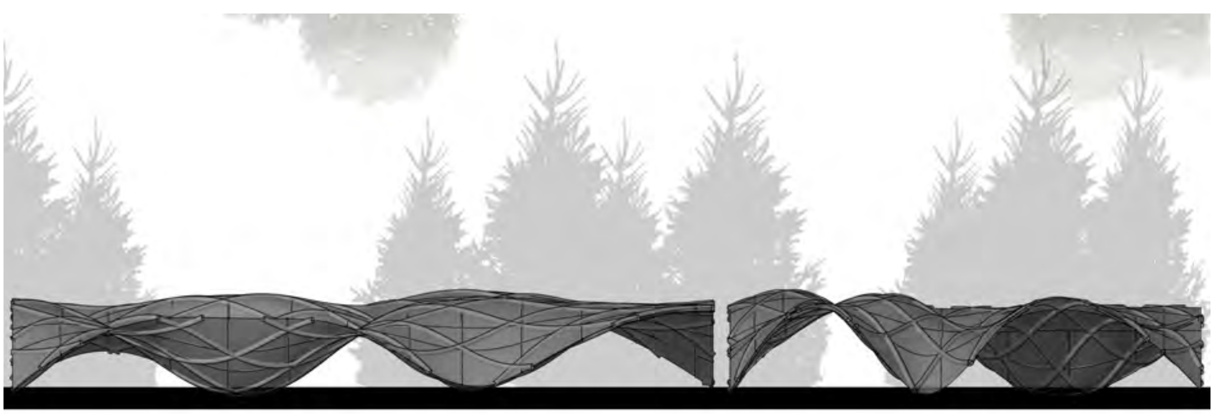


Figure 15: Elevations

REFLECTION:

The goal of our design was to create an easily assemble by one - two persons shelter that was light weight, compactable, easy to carry and could be used in a variety of ways, climates and programs.

We believe we found a way to achieve this, but we would need more to time to develop the finer details of the design. The project was a great exercise in collaboration for us and making the best of the time, prototyping, and resource constraints that we faced. We found the whole experience to be enlightening and helped us develop a useful set of skills to use later in our careers.

HISTORIC APPLICATIONS OF TEXTILE IN ARCHITECTURE
MIGRATION HUB

MELISSA GARCIA
ZILDA HIJAZIN

RESEARCH INTO HISTORIC APPLICATIONS:

The initial research of textile history provided the team with an intriguing insight on how textiles were used and applied in different geographic locations. The team started by researching Bedouin tents, which were commonly found in Jordan. Black Bedouin tents were woven together with goat hair or, in some cases, a mixture of sheep wool and camel hair. The combination of these two materials allows the wool to absorb heat and act as a passive system for its occupants. The yarn worked better in other weather conditions, especially when it would rain. The yarn would swell up so the fabric would become less permeable. The textile properties of the tent would be able to adapt to its surrounding environment. It was interesting to see how the combination of natural resources and lifestyle came together in a harmonious way. Further research into nomadic tents provided insight about construction, which was important because the tent's structure had to work cohesively with its textile skin. The team also researched the Strut design and the bender tent. The Strut was more dependent on rigid poles but the bender had a material that allowed for more unique shapes, like tunnels and domes. Looking into how the structure utilized textiles for some of its properties, the team stumbled upon the systems of Matts to wattle and Daub. A post was stuck into the ground and the use of smaller flexible twigs or branches were woven between the post to create walls. The daub part was a to provide a weatherproof characteristic to the structure.
Another textile researched was Japanese Sliding Doors. Washi paper is used for shoji screens and their thin properties alter to allow for the right amount of light to pass through. The way that the washi paper is laid allows for diffusion and reflection of light. This material also utilized natural resources from its surrounding environment that were specific to the culture. The doors also act as a filter that removes heat from the outdoor air.

SAMPLES:

The samples were an experimentation of how knitting, crocheting, and hand looming work. The team experimented with knitting a normal pattern first and then manipulated the amount of stitches used to change the curvature of the pattern's edges. Philadelphia University's yarn collection provided the team with an opportunity to experiment with yarn thicknesses and dropping stitches to allowed for more void space.
The next process of experimentation was to integrate natural resources found in the surrounding environment. Access to bamboo provided experimentation that used all parts of the bamboo. The help of a textile graduate student allowed the team to produce a floor loomed textile. The integration of this rigid structure gave the textile more weft movement.

Figure 1: Textile techniques and material research iterations.

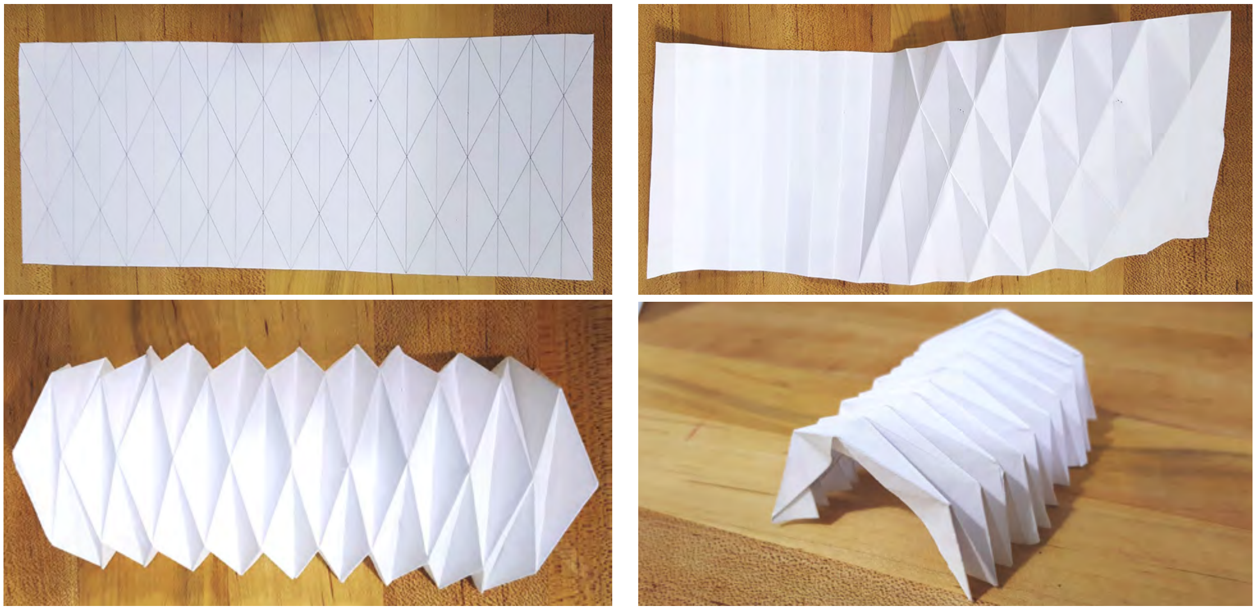


Figure 2: origami studies.

MIGRATION HUB:

The concept of this temporary dwelling was to create structure that acted as a permanent dwelling. Researching temporary shelters, the team observed that they are made of a lightweight white sheet that is stretched over a collapsible system.

The psychological implications these temporary shelters have on the end user set up the team's design narrative. The team wanted to make these homes personal and sturdy so they could be occupied for long periods of time. The initial path of team's ideas led to Origami. Finding a pattern of alternating triangles with valley and mountain folds, the team was able to create a vault-like parti diagram. This parti diagram was taken it into a digital program, where is replicated. The attempt to create a set of parameters allowed the team to think of a system that created a frame that the fabric would be held within as a flexible component.

In order to understand how a system of triangles would be working in a strip, the team focused its attention on study models. A triangular panel was laser cut to provide a way to connect each module to the next through crocheting. Although this wouldn't be the final connection method, it was helpful in finding a joint that would be able to rotate both modules along that axis, as shown in Figures 3 and 4.

The team created a model with two strips that were pinned and then separated to create different unique features.

Returning to the origami paper, the team was able to manipulate the vault shape into tunnels, caves, and posts, as seen in Figure 2. These iterations provided the team with a way to look at the special qualities that were viable in the triangular grid. These features were then applied to a wood model.

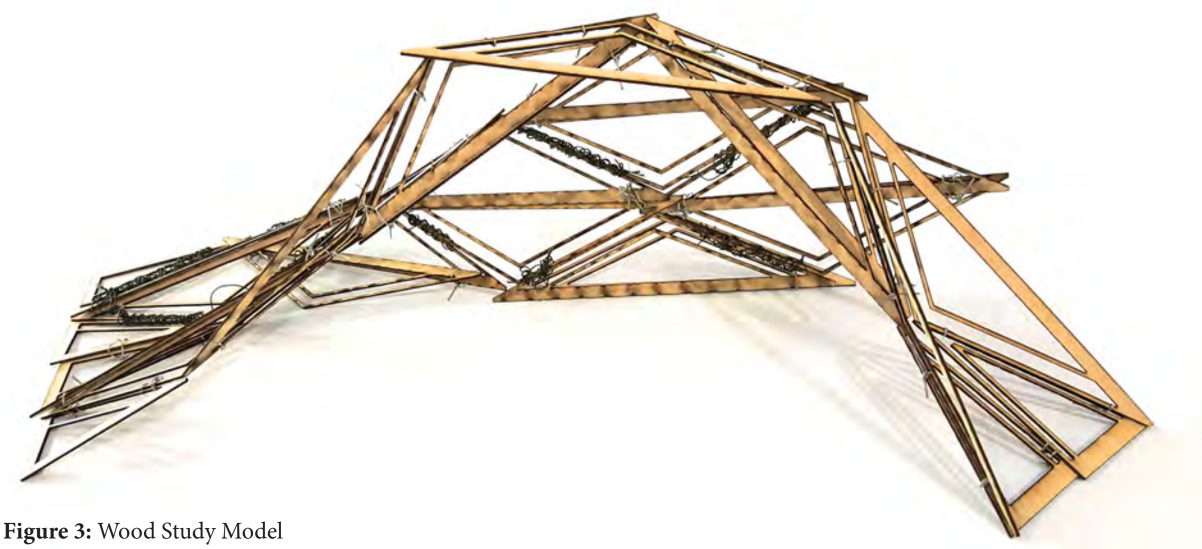


Figure 3: Wood Study Model

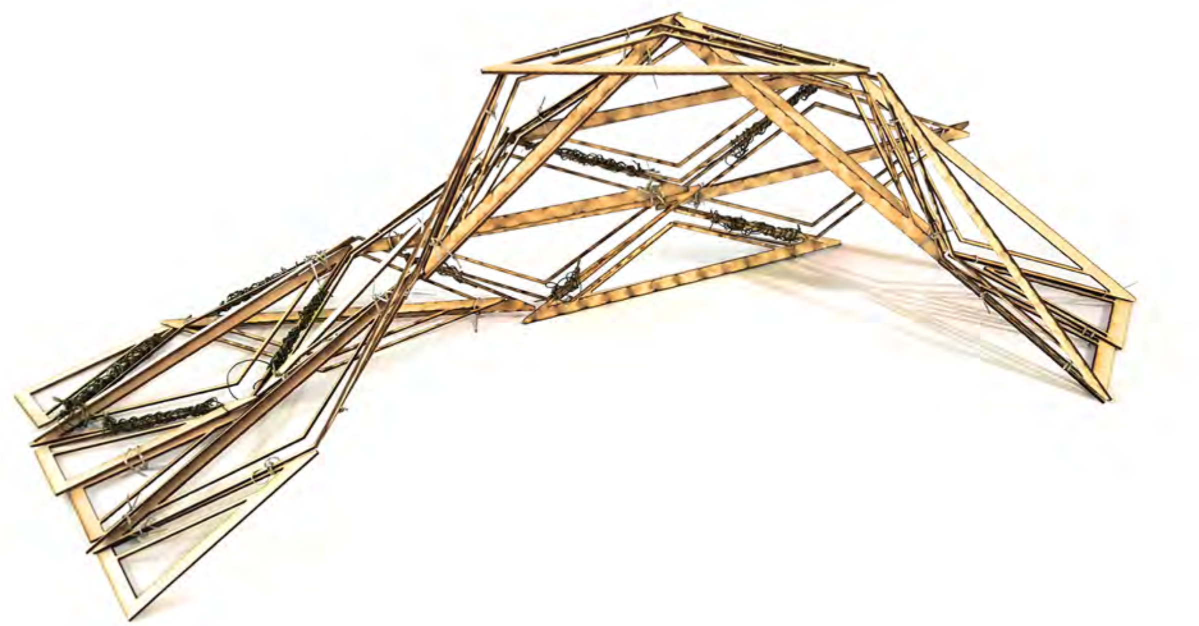


Figure 4: Wood Study Model

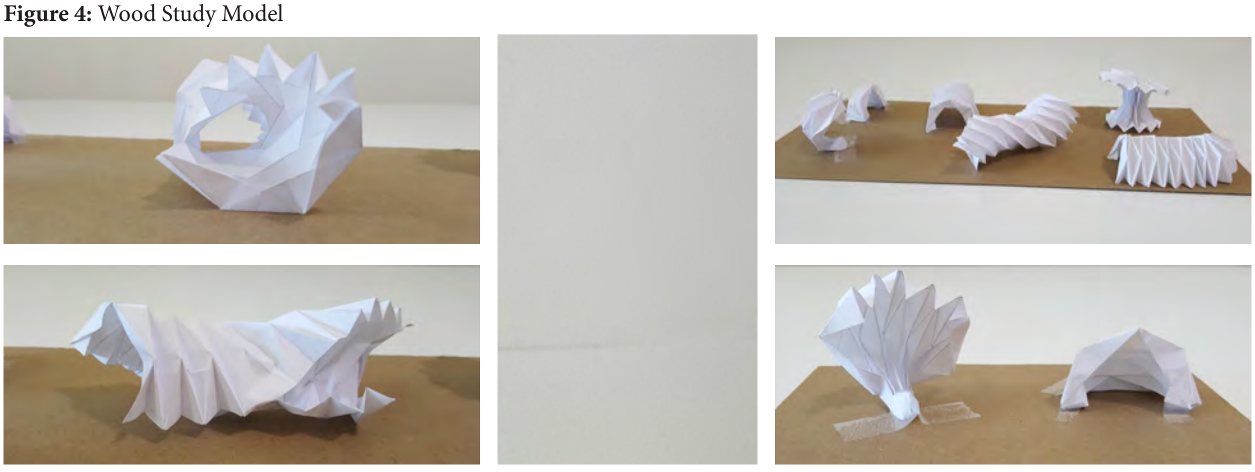


Figure 5: Manipulating the Origami for spacial experiments

Figure 6: Juror examining structural fabric.

Figure 7: Test fabrics and fabric woven with tubes, by Textile Graduate.

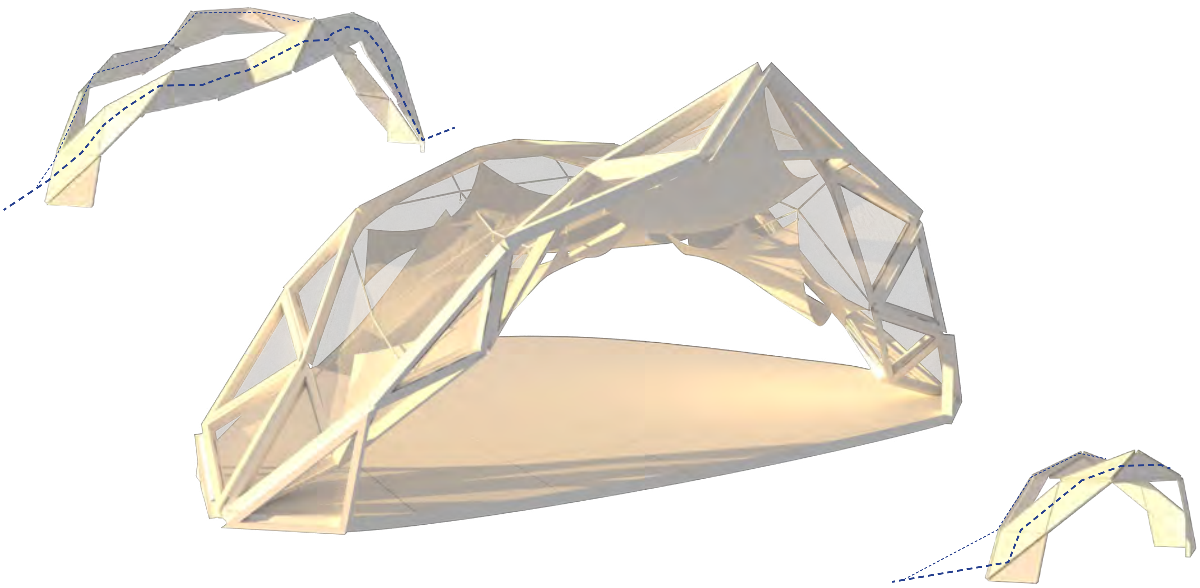


Figure 8: Diagrammatic Rendering of different hub sizes.

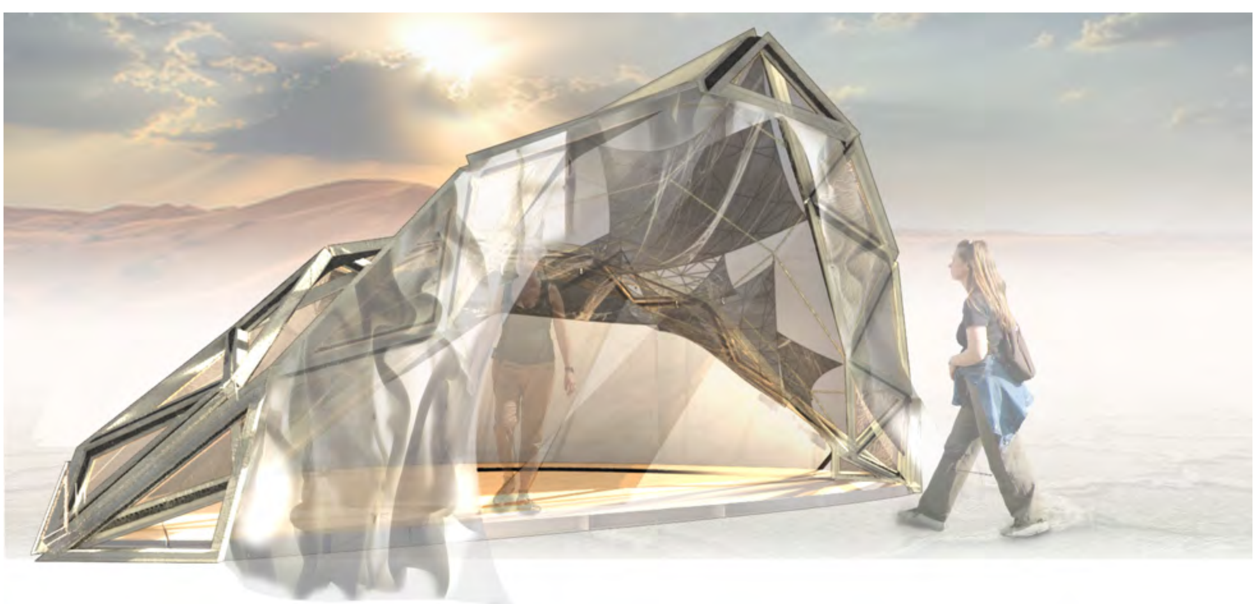


Figure 9: Rendering Showing Final Concept

ARTICULATING FUNCTIONALITY THROUGH TEXTILES:

Collaboration with the team's textile student was crucial in the advancement of the project's functionality. Initial examination began by applying different kinds of fabric that spoke to the environmental climate of the shelter.
In the textile discipline, experimentation occurs in different ways that assimilate various elements to create a product that is very different from the make up of the final product. The team's concept was to make a module and incorporate different materials that perform environmentally in order to create a system that indirectly has its own weft. This system would stretch in different ways depending on the direction of the force and the tightness of the systems.

The Migration hub ended up being a set of deployable systems that functioned together to create enclosure that brings in light and diffuses it, depending on the season. The structure consists of a set of triangular segments that take form and force a select shape once erected and pulled into one another. The triangular modules are set up on site and then anchored and pulled into form. The structure is divided into three parts: enclosure, skin and structure. The form's structure is a set of segments that, once anchored, become strong and resistant. If the form is not anchored, the structure then is collapsible.

The structure is made up of triangular modules, a tension string, and a lock. The triangles are rigid enough to formulate segments that are light but long enough to span a wider enclosure. They allow for a larger surface area of structural reinforcement.
Our structural reinforcement is a segment of fabric that was designed with the help of a textile student. The fabric in Figure 12 and13 is thought to incorporate an expandable polymer that changes depending on the weather. The second level of reinforcement is through a string that weaves its way throughout the system and pulls the system into an upright form.

Figure 10: Early concept model for textile within panel.

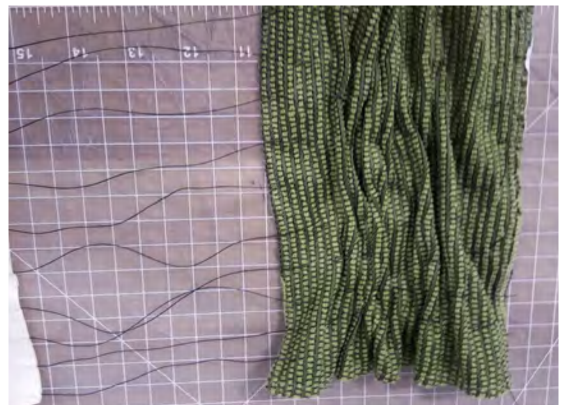


Figure 11: Textile sample of gathering for panel.

Figure 12: Examining textile connections

Figure 13: Textile Graduate surging edges of final textile.

Figure 14: Module and assembly

SYSTEM:

The designed system consists of three parts as shown in Figure 14. The first is composed of triangular composite segments that sandwich a thin material into an enclosed system to block the elements but allow light through. The second segment is the string that goes through the intermediate panel and pulls the second set of triangular composites. Finally, a skin system is cocooned in the inner most position of the hub.

SKIN:

The hub's skin is a web-like interchangeable mesh system that can be customized, taken apart, and adapted to seasonal change and user preference. Figure 14 explains how the different segments come together, conceptually. Finally, the reinforcing polymer fabric wraps around the triangular composite segments and pulls the segments together, while also acting as a waterproofing membrane. Figure 15 explains the hub's transition throughout the seasons, being the lightest in the summer and heaviest in the winter. As the project began to utilize the resources provided by Philadelphia University, the team was able to explore and visit the library collection at Material Connexion in New York City to develop a system composed of flexible parts. Starting with a structure made of expandable polymers and a tight weave system at material connexion, the system starts to examine deployable compositions that allow room for individuality and unique design. Throughout the seasons, the skin can interchange to suit the comfort of the user because a home is a place that provides comfort, but it also allows for individually. This dwelling is erected with a pull and can be customized, depending on the user's needs. The system's first layer is composed of structural yarn segments that provide strength for the softer fabrics. These softer fabrics vary in thickness and weight to remain consistent throughout the seasons.

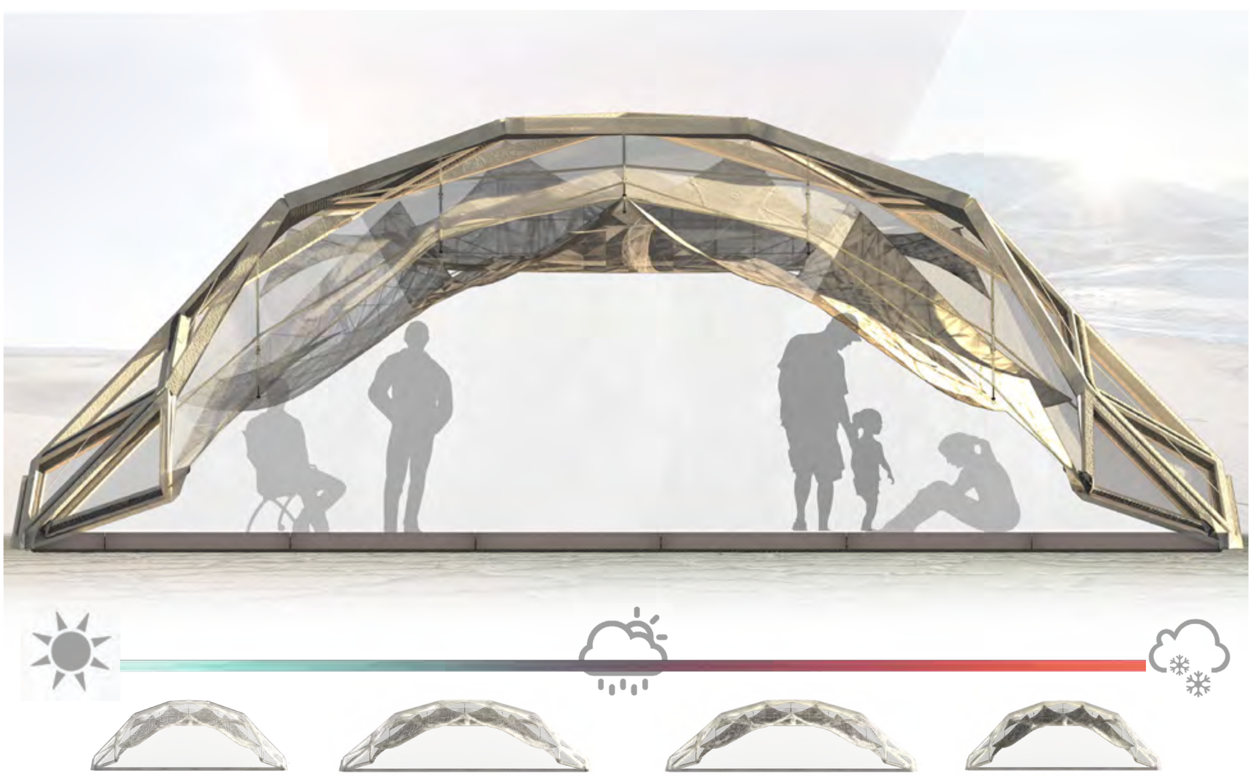


Figure 15: Diagrammatic rendering showing different climatic skin conditions .

REFLECTION:
This experience of collaborating with a textile graduate enriched our view on how a textile is integrated with a structure. One goal we had as we were progressing was questioning how we would apply the skin to the panels. We utilized a gathering technique found in textiles to make the structure deployable.

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One goal we had as we were progressing through the project, was questioning how we would apply the skin we designed to the panels.

We utilized a gathering technique found in textiles to make the structure deployable. This experience of collaborating with a textile graduate enriched our view on how a textile is integrated with a structure.

ADVANCED RESEARCH IN EXPERIMENTAL TEXTILE STRATEGIES BIRDWATCHING SHELTER

JENNIFER MCELROY
KRISTINA PULSINELLI

ABSTRACT:

Through textile exploration and research, the team developed a birdwatching shelter, which is held by tension from three trees in order to maximize flexibility and work in various environments. In Maraca Island, Brazil, the Pinelands, New Jersey, and Borneo, Malaysia there is a wide variety of birds that live in a variety of different habitats. The difference in habitat includes trees of different heights and different trunk sizes. This variety provided the constraint that the shelter would need to adapt to these different locations and situations. In order to be practical, the shelter focuses on transportability, camouflage, and structure. Working with a textile student, Rebecca Flax, helped the team to focus on these concepts and optimize the use of different textile techniques. The process included exploration of knits, wovens, crochets, macramé, and non-wovens. Ultimately, the team decided to use a combination of layering techniques, heavily focusing on wovens. Rebecca Flax, a graduate textile design student, provided extensive knowledge about atypical textile techniques. The final design of the shelter is comprised of three different parts. First, the sleeping pod, which is the interior skin and enclosed sphere that provides the shelter for the bird-watcher to sleep in. Second, is the straps, which are custom hexagonal weaves or traditional woven straps that create the structure for the pod. Lastly, is the second skin, which creates the camouflaged observation or interstitial spaces, where a bird-watchers observes.

SAMPLES:

The team's initial textile research was to physically explore the means and methods of creating different textiles. When starting the assignment consisted of creating a few very different samples and exploring variations of each. Macramé, crochet, hand knits, machine knits, hand wovens, and machine wovens were all explored during the creation of these samples. The team quickly began to realize the characteristics of each technique.
Starting off with crochet, there were three different lines of exploration. First, the team explored apertures and different ways of creating gaps within a crochet. Second, was the exploration of different types of stitches: the popcorn stitch, single crochet, double crochet, and chain stitch. Lastly, the creation of a series that focused on layering, some combining layers with other textile techniques.

The woven explorations quickly moved to different material explorations. Wovens can vary by pattern but they largely differ

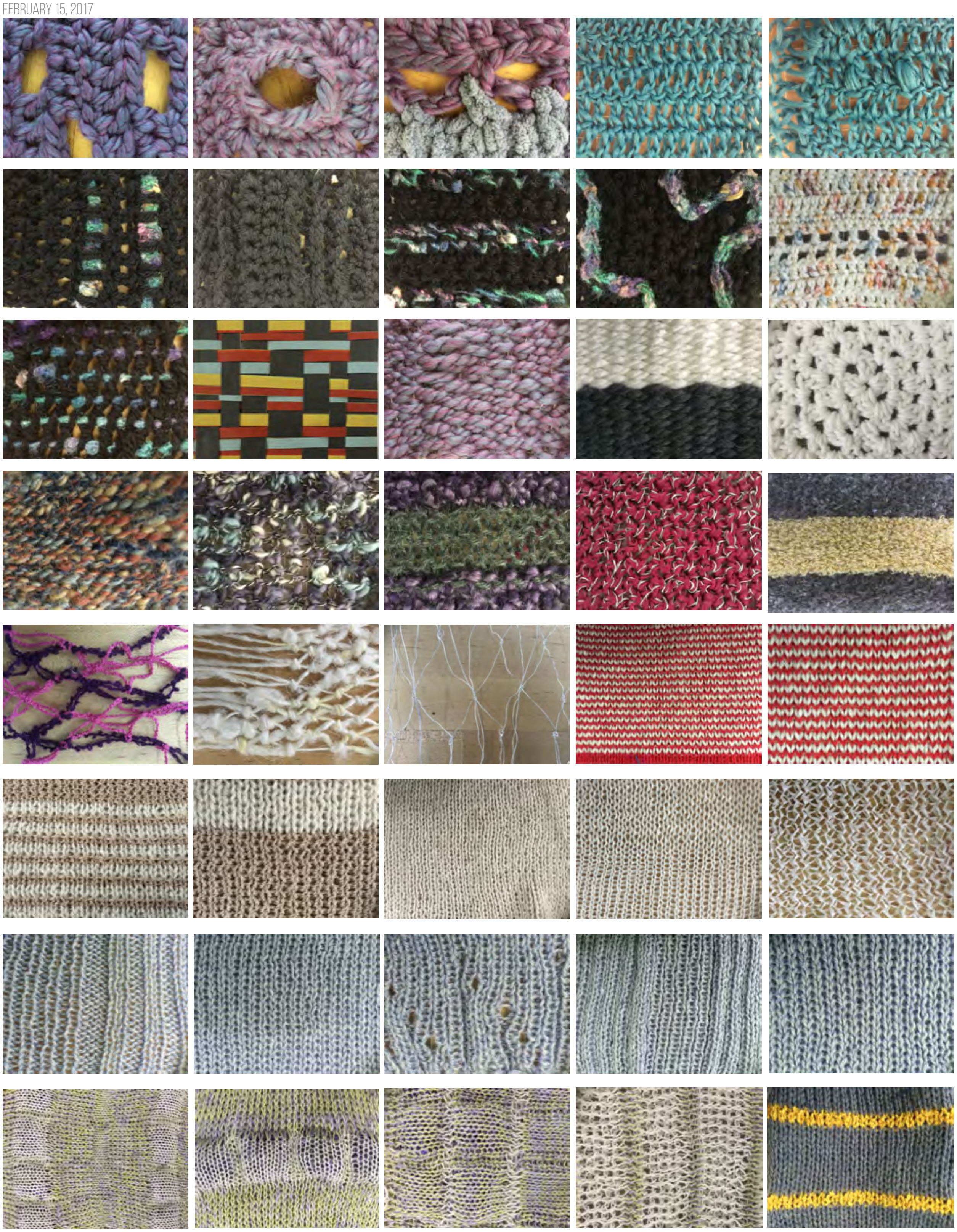

Figure 1: Sample Swatches

from other textiles in their ability to easily combine with several different materials that have vastly different characteristics. Through the explorations yarn, paper, grass and metal wire were all used. Working on the industrial machines, the team was able to explore different materials that were integrated into the weft very quickly and efficiently.

Macramé seemed to be the most different out of all of the techniques explored because it wanted to be more linear than planar. Trying to create planes out of patterns of macramé began to create very transparent surfaces.

Lastly, knits by hand were very time consuming so the team quickly switched to the industrial machine. Throughout the project many different types of knitting machines including the Dubied and the tube knitting machine were utilized. Creating variety in the knits seemed more difficult than other methods but the overall production of the machine knits was a quick process.

PROGRAM:

The textile research directly drove the program and design. The team tried to create a project that fully embraced the newly acquired knowledge of textiles and the interest of a personal portable shelter. The goal was to design a personal and portable shelter for a traveling bird-watcher. Before starting the design, a list of design constraints

Figure 2: Early Concept Rendering

Figure 3: Concept Diagrams

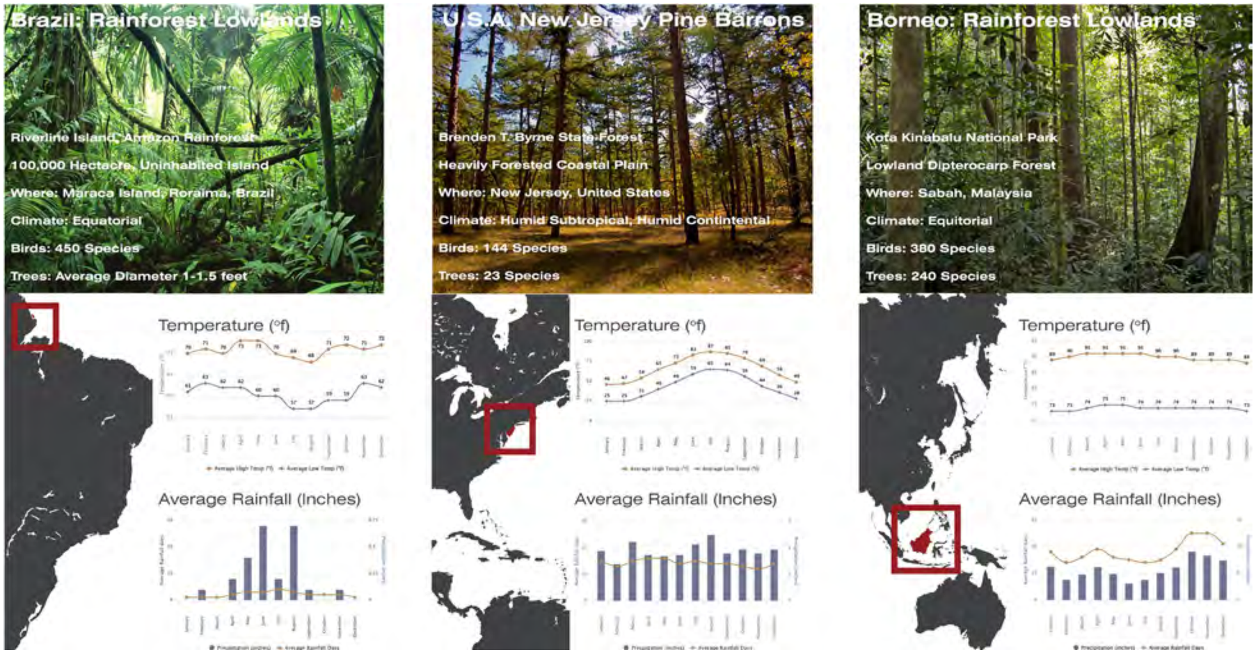

Figure 4: Site Information

for the shelter was developed in order to be successfully accomplished.

1. The shelter must be portable and lightweight.
2. The shelter must be easily and quickly assembled on site.
3. The shelter must be functional.
4. The shelter must be adaptable to any site.

The developed constraints created a two-layer program. The first layer, was the exterior non-woven camouflage and the second layer was the interior sleeping pod.

LOCATION:

Three locations were chosen to focus on the development of the birdwatching shelter in very different parts of the world, which all are home to a variety of different species of bird as shown in Figure 4.
In the New Jersey, the Pine Barrens is located at the Brenden T. Byrne State Forest. This forest is heavily populated by trees and is part of the coastal United States. The climate falls between humid subtropical and humid continental. The Pine Barrens have around one hundred fort-four different species of birds and twenty-three different species of trees.
The Riverine Island, located in the Brazilian rainforest's lowlands is the Amazon Rain Forest. The island is uninhabited and is about one hundred thousand hectares of land. The Maraca Island in Brazil is located in the Equatorial region. This area is home to four hundred fifty species of birds with trees averaging 1 to 1.5 feet in diameter.
Lastly, the Borneo Rainforest's Lowlands can be found in Sabah Malaysia. It is home to the Kota Kinabalu National Park. This park is a lowland dipterocarp forest in the equatorial region. About three hundred eighty species reside there in about two hundred forty different species of trees.

DIGITAL METHODS:

Digital methods were used to help explore the understanding of a weave on a micro level and the use of the material, as a whole, on a macro level. On a micro level, the patterns that could be woven were able to be generated very quickly through the use of Grasshopper. Figure

3 shows the diagram of how the team began to integrate loops that were later used to create connections with the structural members.
On a larger scale, the Kangaroo plug-in helped to analyze how the fabric of the second skin and pod would deform when adapted to different tree configurations. There were many challenges in this exploration, one being the creation of a second skin that would deform in a certain way to adjust to specific material properties and textile techniques. Even with the complications, the program was definitely helpful in creating many iterations of different tree configurations, as well as adapting different aspects of the design.

STRUCTURE:

Since one of the goals of the design was flexibility and adaptability to a magnitude of sites and conditions, the structure of the shelter was taken into great consideration. The first design solution for the structure of the shelter incorporated found fallen trees as the support. The idea was that a bird watcher could just carry the textiles for the sleeping pod and the exterior camouflage in their backpack in order to then use found objects to stabilize the shelter. The idea behind this was so that there would be less to carry for the bird-watcher. Therefore, lightening their backpack and making the shelter custom to each side was a must. Figure 10, shows three different design iterations that vary in structural orientation. The left most study model seen in Figure 7 shows the structure angled outwards. This orientation allows for the pod to be brought up higher off the ground. This iteration was developed for very wet climates, where the bird-watcher would need to be elevated off the forest floor up to three feet. This iteration also provides maximum coverage of the sleeping pod by the outer skin. The model in the middle of Figure 8 shows the four structural members oriented vertically to provide a semi

Figure 5: Desk Critic Showing Concept Model

Figure 6: Textile Sample with Integrated Structural Members

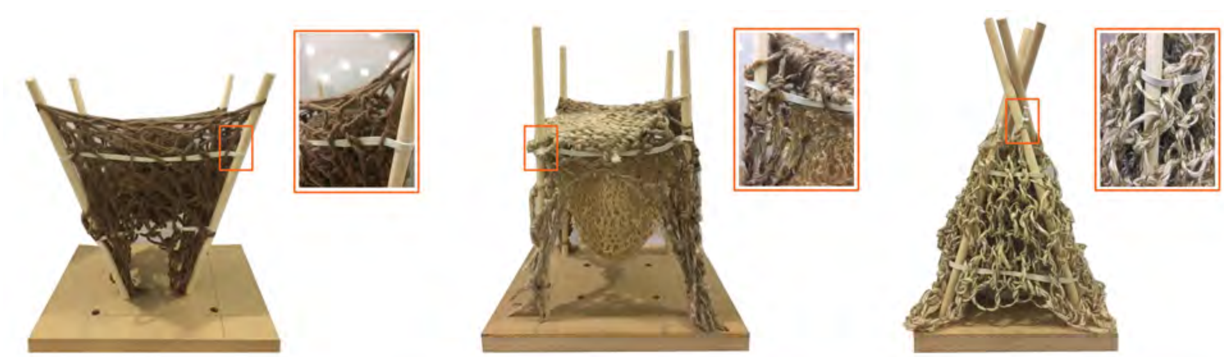

Figure 7: Three Initial Concept Models

Figure 8: Grasshopper Tree Configuration Iterations

exposed and less elevated sleeping pod. The last iteration has the structural members angled inward to create a teepee like form, which allows for maximum coverage of the pod. This iteration of the pod would make contact with the ground.

The team soon realized that the four structural member strategy wasn't very practical or realistic so the idea need a more simplistic approach. The team tested the design in Grasshopper and Kangaroo to discover that the pod needed at least three supports in order to be structurally sound, as shown in Figure 8. The team then proposed using living trees rather than found fallen ones as the support.

CONNECTIONS:

The following constraints helped the team develop a two-layer program. The first layer was the exterior non-woven camouflage and the second was the interior sleeping pod.

In the first design iteration, seen in Figure 7, the non-woven textile of the second skin was developed in a way that created pockets within the textile for the found fallen trees that would be used structurally. Embedded within the textile design was also an elastic strap that was placed at the top and bottom to serve as an adjustable connection that would hold the structure to the shelter as shown in Figure 9. As the design evolved to using trees as structure, the team needed to create a way for the second skin to attach at two points on every

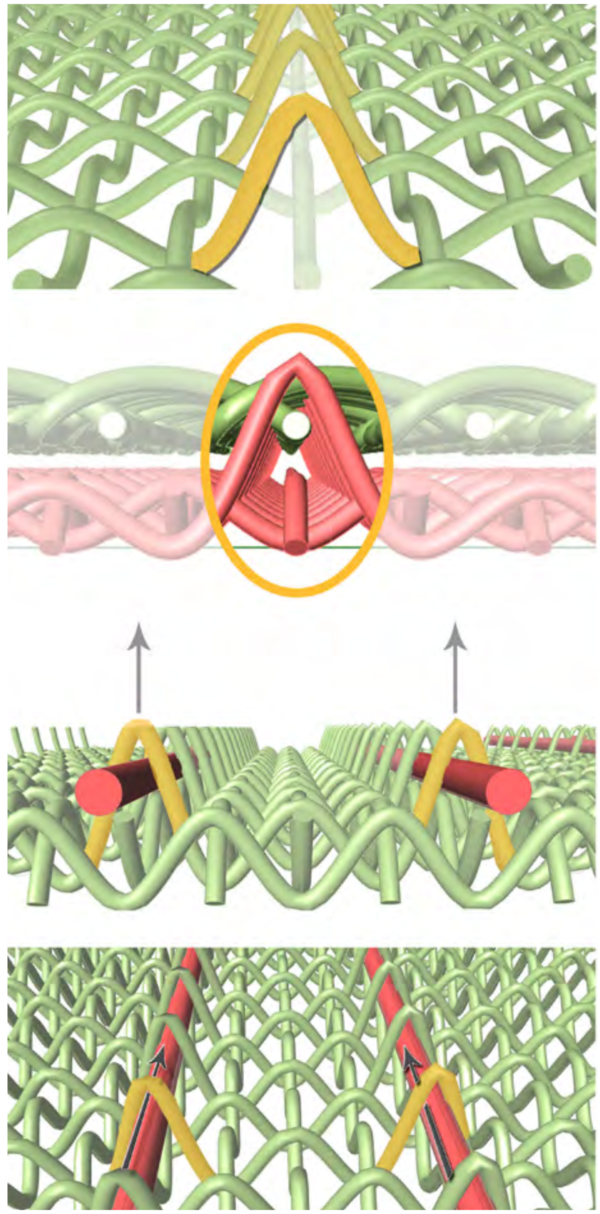

Figure 9: Grasshopper Weave Deviations

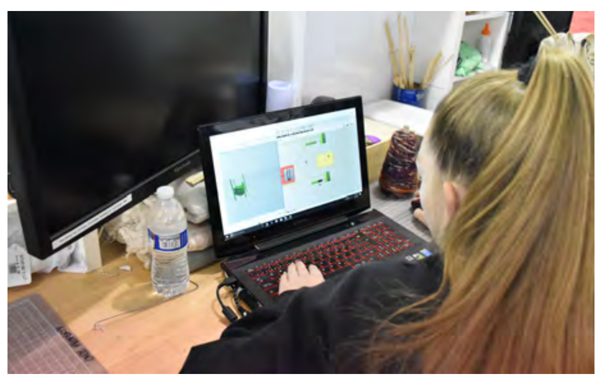

Figure 10: Grasshopper Development

tree. The first connection point was at the top of the second skin, which connected to a branch, and other one was towards the bottom to connect to a tree trunk. This connection was developed with adjustable straps to assure a strong link between the shelter and the trees. Another connection point needed for the design was the connection of the pod to the second skin. This connection happens in three places along the equator of the pod in order to stretch it open once erected, creating a cozy sleeping quarter for the bird-watcher.

THE POD:

Based on the idea of a hammock, the pod is a cozy spherical woven structure that is meant to provide a protected resting place for one individual. The pod's woven textile was created with a knit cording the team designed. Made up of three polyblends and one cotton fiber, this cording was used as the weft, and a twilled cotton string was used as the warp. Starting at the top of a twenty inch diameter inflatable ball, the the cording weave began in a classic over under pattern. This weaving pattern was chosen because of its strength and durability, as shown in Figure 11.

Weaving with over six hundred feet of cording, the pod was complete with one opening. After the ball was woven, the interior ball that was used as the form, was deflated and removed. At the top and bottom of the pod a metal ring was sewn to act as the major connection point where the straps would pass through to hold the pod.

SECOND SKIN:

The secondary skin of the design went through many iterations. The consistent idea of the second skin was the transparency to view to the outside, but also camouflage in order to not scare the birds away. The design patterning and materiality developed significantly throughout the process.

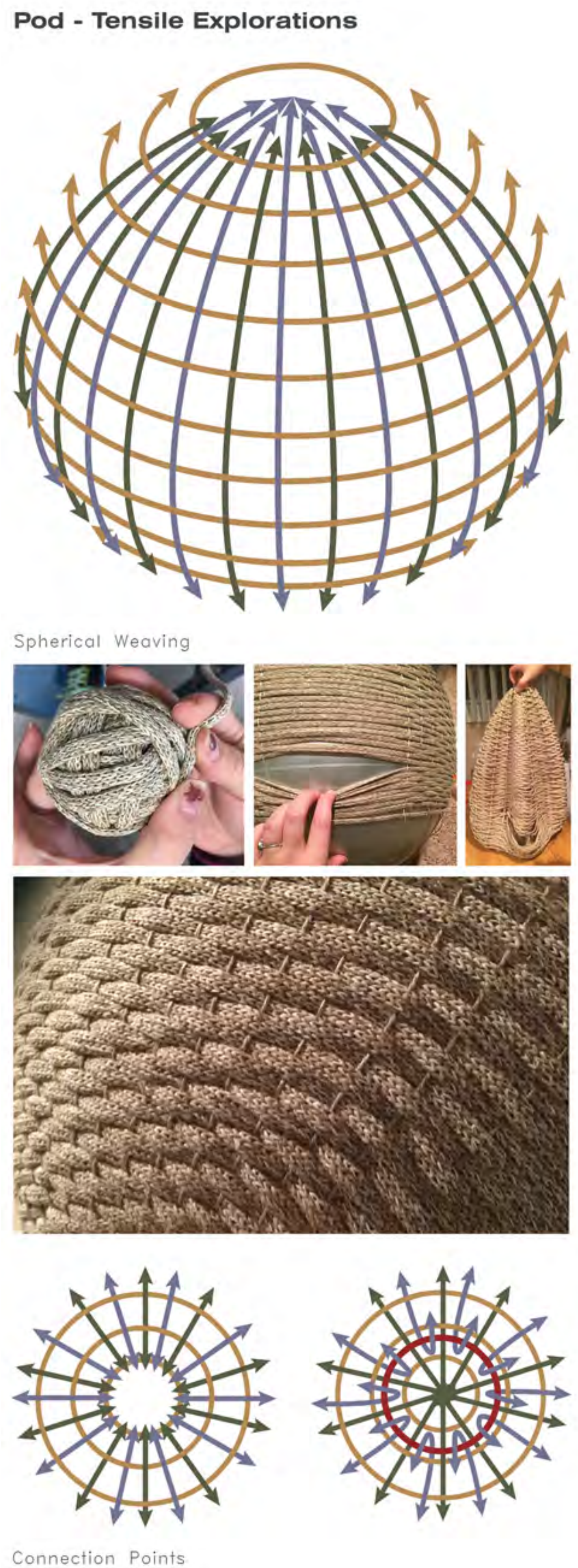

Figure 11: Weaving Pattern Of The Interior Sleeping Pod

The original idea for the second skin was to use a loose knit, which would be able to be pulled in multiple directions due to the large stitches. However, through further research, the team was inspired to work with branching algorithms that were developed using a plug-in, Rabbit, for Grasshopper that created more organic patterns that focused on density. The density could help with shading and weather protection in certain areas, mainly the top, but still optimize the views around the edges.

Coming up with a textile technique that represented the branching was another challenge. The idea of branching is dividing in order to create multiple smaller items, however, with yarn or string there is no way to do this but to start with many strings grouped and then divide them. This system did not seem efficient, so the team looked into other methods. Originally thinking that these branches could become woven together with all of the strings that split became a very tedious and not very efficient system, when speaking of density. The edges became very bulky, despite the large holes.

Next, the team was inspired by the Silk Pavilion. The idea of wrapping the branching pattern around a series of pegs that created loops became a very beautiful aesthetic. The team was drawn to this process due to its use of technology and ability to be implemented on a large scale. A CNC machine with a custom bit can easily feed the string through programmed coordinates. However, the biggest challenge with removing the pattern from the peg board. The first few attempts to re-string the end of the string back through the wholes created from where the pegs was very tedious and not realistic.

The final exploration into the second skin had to do with materiality. When trying to figure out how to remove the pattern from the peg board, Rebecca Flax, the graduate

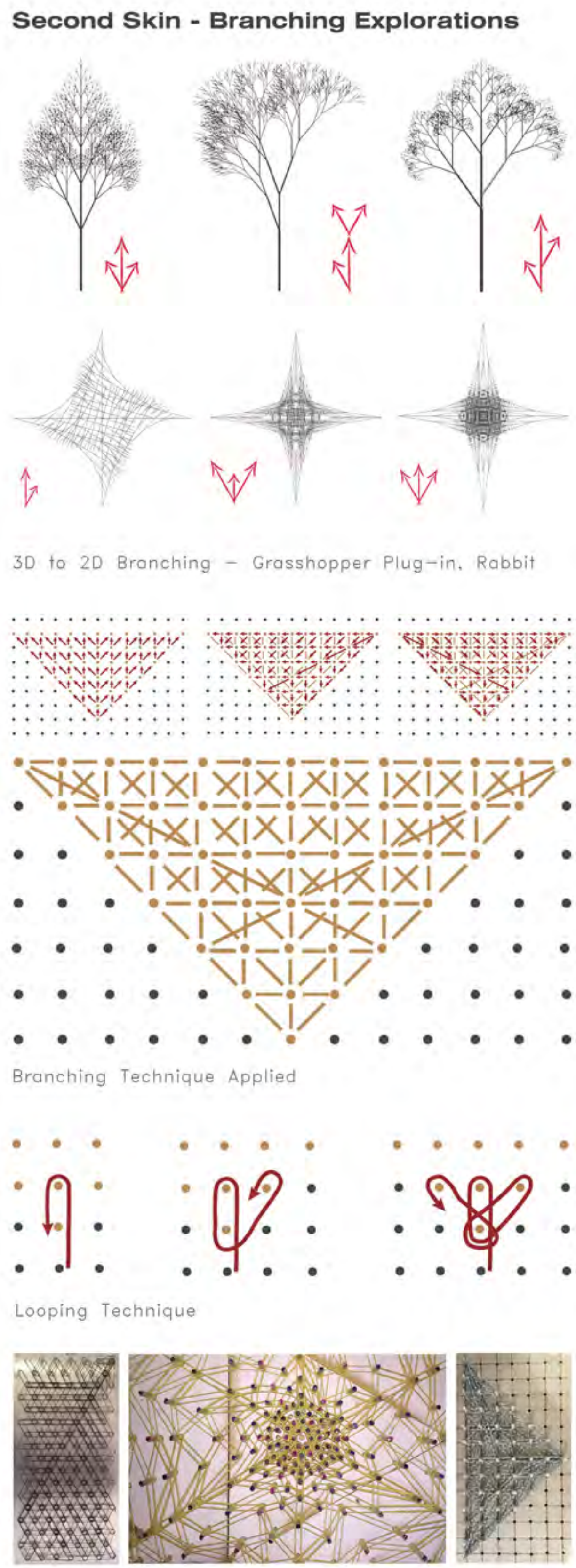

Figure 12: Branching Logic For Second Skin

textile student, suggested the team create a non-woven using Poly PVC that could be pressed together. However, this would still require the removal of the pegs before the material was set. After some more research and brainstorming, the Industrial Design shop assistant suggested making an aluminum board and baking the pattern in the oven. Unfortunately, this process was time consuming, but after all successful.

STRAPS:

The straps that support the pod were designed off of three primary points; strength, the flexibility to connect to several different configurations of three trees, and to be comfortable for the user, while also supporting the pod. There are two sets of straps supporting the pod, one below and above. The ends can be tightened around trees at varying angles. The tension on the straps holds the pod up off of the ground to make sure that the pod does not hit the bottom of the wet forest floor. The idea for the hexagonal weave was to create no end connections at the central point and have all ends of the chord attach to the straps. This provides the center with the greatest tension, while still remaining comfortable. The increased surface area in the center creates a broader base for the pod to sit on. The pattern and method used to weave the straps can be seen in Figure 13. The weave begins with three sets of chords folded in half. They are then woven together using a hexagonal weave with each set of ends one hundred twenty degrees from the previous set of ends. Once the central hexagonal weave is complete, each group of chords are woven within, using a traditional weave that creates the extension of the straps.

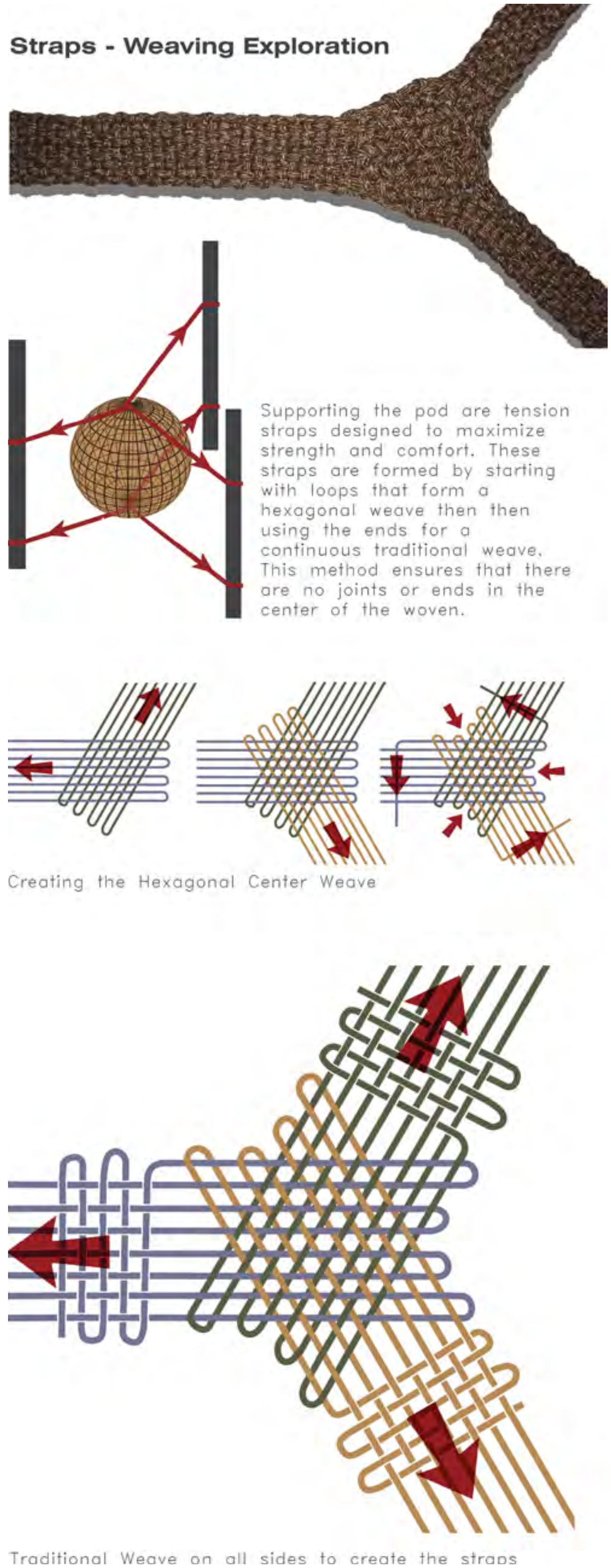

Figure 13: Hexagonal Woven Straps

Figure 14: Final Presentation

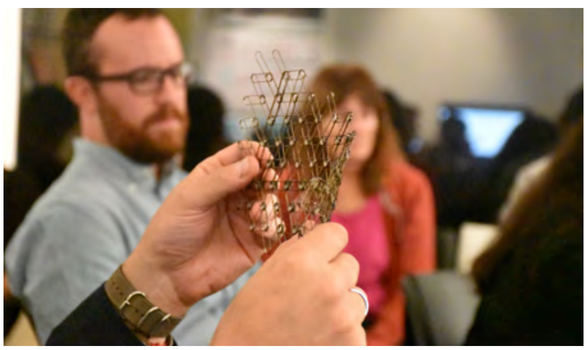

Figure 15: Materiality Study

Figure 16: Final Presentation

Figure 17: Final Model Scale: 3”=1’-0”

REFLECTION:

Overall this project was successful in its thorough exploration of different textile materials and strategies. Our project focused on using traditional textiles in architecture instead of a system solely inspired by textiles. Our goal for this project was to create a shelter which clearly exhibited the textile techniques which we explored and maximized the properties which define them. The three parts of our project reflect three different parts of our textile exploration.

This challenge was only achieved through the support of our partner and textile graduate. The collaboration was a very valuable experience with working with someone from such a different design discipline. She was a valuable partner who is very knowledgeable about textiles as a whole. The background she had helped facilitate our research and explorations. She assisted the timing of our project by teaching us a variety of the school’s industrial textile machines.

The difficulties of the project which could be improved through further iteration mainly include structural complications and connection details. These parts of the project were restricted by time and scale and could still be improved.

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STUDIO PROJECTS
SURFACE ASSEMBLY + FACADE RETROFIT AND ADAPTIVE REUSE | FALL 2016

SURFACE + ASSEMBLY:

Working individually, each student will adapt their team's previous project, and develop a 1'x1' square module that has to be assembled as part of 3x4 units vertical wall surface matrix (the final assembled model is 4" wide x 3" high x depth determined by the class). Incorporate the main aesthetic, structural/environmental aspects of your previous team project. Working collectively, the class will collaborate to develop a 12 unit array. The individual unit developed by each student must be resolved at its edges with each adjacent individual unit to structurally and materially.

Develop a corresponding digital model that can be digitally assembled into a collective digital model.

Project Constraints:

- Previous member modules should not be adjacent
- Resolve shared edge conditions (structural connection, depth, and material)
- Develop a collaborative and coordinated 12 unit surface assembly

The class will present the digital assembly model and the physical array on Wednesday, October 19.

FAÇADE RETROFIT AND ADAPTIVE REUSE:

In this project you are charged to investigate and propose a façade retrofit for a site and building in the Philadelphia area to be determined by the class. The aim is to develop an adaptive reuse program that will offer the context for exploring the possibilities of textile material strategies for retrofitting existing facades that involve technological, social, and aesthetic issues. The building envelope is redesigned and prototyped to satisfy the changing programmatic needs and to improve energy performance and visual identity.
This project is composed of a number of subassignments.

CHARRETTE - SITE SELECTION AND PROGRAM PROPOSAL:

You will work in six teams of two members assigned by the professor in class. Each team is tasked to identify and propose three sites each which are from three different neighborhoods (for example, consider neighborhoods with distinct building typologies such as warehouses in Old City, Callowhill, South Philly, Fish Town, etc., or other legacy structures in other neighborhoods, etc.). The three sites/existing buildings should be of different sizes (i.e., define your own metric of small, medium, large). At least one of the three site/buildings should be on a corner lot.
Each team will develop their own program for the identified three sites.
Subsequently, the six teams will present their three sites and program at a charrette on Monday, October 24, and from the total 18 options three final sites will be selected. Consequently, two teams will be assigned to one of the three sites.

SITE & DATA COLLECTION/MAPPING:

Your team will select three sites from three different Philadelphia neighborhoods. You will need to collect, map, and analyze site data to study the social, cultural, economic, physical and spatial conditions to convince stakeholders of your selections. Visit, document and record the existing conditions of the site and building by obtaining maps, building records, field sketches, and photography. Consider what is significant about the information you discover. You will document your observations and findings in both graphic and written form into a comprehensive visual format. Sample aspects to consider : Architectural context, building typologies and size, building heights/setbacks,

building characteristics, programmatic uses, physiographic/physical form, public/private, solid/void, focal points or nodes, circulation (car, bikes, people), parking, mass transit (proximities and potentials), sidewalk/street characteristics, views, socio-cultural history, population demographics, sensorial effects, city initiatives and master plans, etc.

Analyze:
To draw conclusions take a personal, critical, spatial and creative approach.

Program development:
Develop a new program for a schematic design proposal.

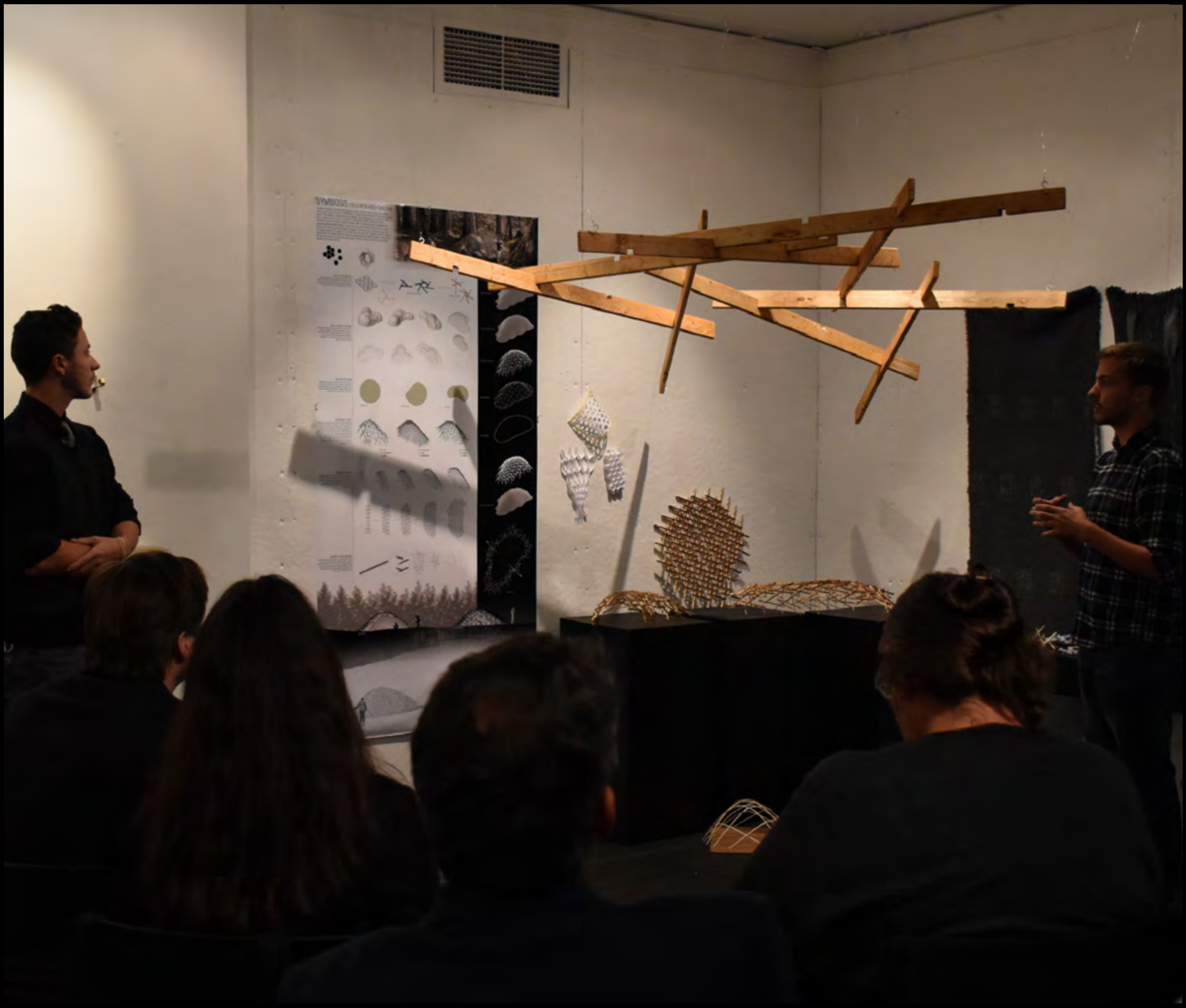
Presentation: Site Analysis and Program:
We will hold a review, with full participation of all students as both presenters and critics on October 26 in class.

Program development and Massing/Concept:
From the previous project submissions, the instructors selected the three sites below, considering a balanced mix of sizes and massing, the existing building structural/constructional systems, and accessibility/availability of project data:

Small: 941 North 2nd Street (from Melissa & Tevin)
Medium: 212 Walnut Street (from Kristina & Ryan)
Large: 1221 Frankfort Ave (from Jack & Crystal)

Working in your assigned teams, you will develop your program, and corresponding massing, site, and schematic layouts, and façade concepts to be adaptable to each site. Thus, each team will develop a concept/program and present three variations that are adapted to the three sites (consider creating a system of variation that can scale the program and adjust the façade strategies to the three different conditions).

Space program/Site & Concept:
Refine your program based on your assessment of client and user needs, and establish a detailed inventory of spaces and their requirements. Also, further analyze the site conditions (including existing buildings, climate, etc.). Include citations for referenced material and validate your data.
You may consider slight adjustments to the building perimeter but may not increase the gross floor area to avoid dimensional variance. Any adjustments must still meet egress conditions. Include a zoning/use analysis whether your program requires use variance. This information should become part of your definition of site and design assessment criteria. Develop three massing and façade concept sketches (which may incorporate textile material strategies) that respond to your site analysis and design criteria.
Façade concepts & Textile material strategies: Continue working in your assigned teams to develop your façade concepts for the three sites. Your envelope strategies should be adaptable to the three sites and programs. Define your performance criteria (i.e., aesthetics, program, existing and new structure



connections, material, environmental and energy, etc.) and identify applicable textile strategies based on your previous research.

Site & Program refinement:
Refine site (include property boundary lines) and program studies as necessary in support of your façade concepts. Your program decisions may be influenced by your façade strategies and vice versa. Use scaled drawings for documentation.

Façade concepts & Textile material research:
Consider how textile based materials and techniques can introduce innovative ways of retrofitting existing envelopes while achieving higher performance, enhance visual identity, and acknowledge context. Define design criteria and priorities including sustainability requirements, codes, standards, etc. The façade development process requires understanding of theoretical and applied research methods in textile material design, computational design, and fabrication. As part of your final outputs, you will fabricate a full-scale partial mock-up of your façade system.
Continuing your development of three massing and façade schemes (one per site) you will design and develop a façade system that can be adapted to the three site conditions.

HEXAGONAL WEAVE NETWORK:

JENNIFER MCELROY

For project two, the team partnered with Kristina Pulsinelli and created a design that was made up of three parts; the pod, the straps, and the second skin. For project three, each student drew inspiration from different elements of the design. The woven straps, which formed the support of the pod from project two were chosen to work with during project three. The custom woven straps were meant to maximize strength and efficiency. The straps were made with knit chords that were folded in half and then woven in a hexagonal weave pattern, allowing the ends to move in only three directions. Each group of ends going in the same direction were then woven together with a traditional weave. When creating the wall system, the hexagonal sections of the woven were explored to determine how to create a network.

The density and arrangement of the network was determined by the connection points of the surrounding modules, as seen in Figure 1. In order for the structure of the module to work with the whole assembly, it had to be in tension and connect only to the other compression modules at the sides. In order to strengthen the adjacent module, the points of connection were

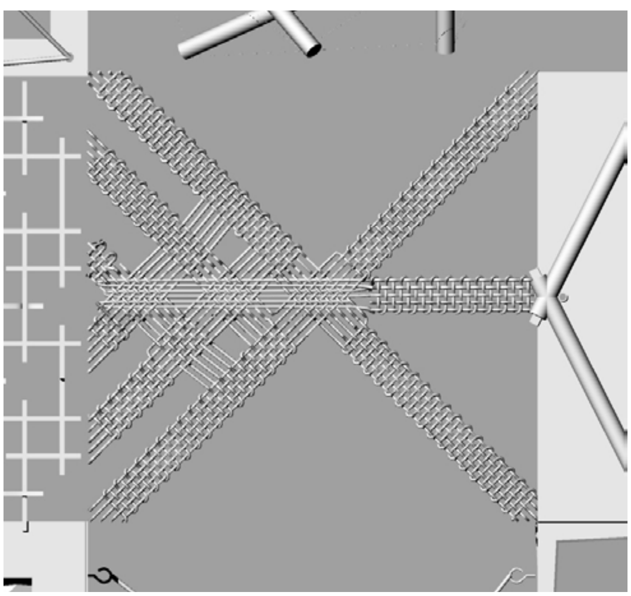


Figure 1: Digital module of the hexagonal weave network

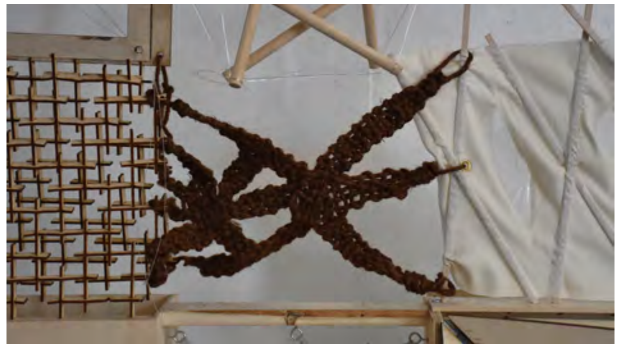


Figure 2: Physical module of the hexagonal weave network

Figure 3: Physical module of the hexagonal weave network

arranged to pull at different depths. In order to create a well integrated and cohesive wall assembly, the class decided to focus on the least destructive connections between each adjacent module. Since the material of the module was rope and the surrounding modules were sticks, the loops would be appropriate connections given the constraints, as seen in Figure 2. These loops also formed a connection to the straps, which was inspired from the tree attachment logic used in Project two.

The biggest digital modeling challenge was recreating the physical characteristics of the material. The digital model acted more as a representational diagram of the design than a replication of the material's physical properties, which can be seen in Figure 3. This was constant throughout the process, especially with textiles.

SURFACE AND ASSEMBLY:

IDRIS SALAHELDIN

This project pertained to surface and assembly, to continue the ideas from Project two. A one-foot by one-foot square module was assembled as part of a three-foot by four-foot vertical wall matrix. The main aesthetic, structural, and environmental aspects of our previous project were implemented to the design for continuity. The module represents the skin of the building in Project two which was designed with a double skin system. This system had double surfaces, the inside being static and the outside being operable as seen in Figures 1 and 2. The outside surface is flexible, closing to provide shading and protection against the dust storm as in Figure 1, and opening to provide ventilation and cooling the interior of the building as seen in Figure 2. Through collaboration, the team developed a twelve-unit array, working together to build cohesive connections with each adjacent unit both structurally and materially. This is seen in the Figure 3 drawings and as a physical model in Figure 4.

Figure 4: Facade Module in Physical Model Connected with Others Facades

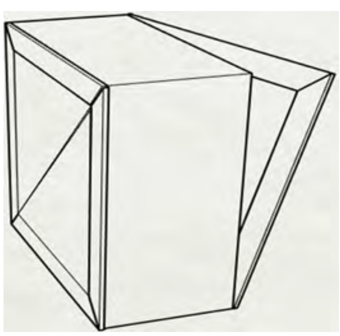


Figure 1: The Skin in Close Condition

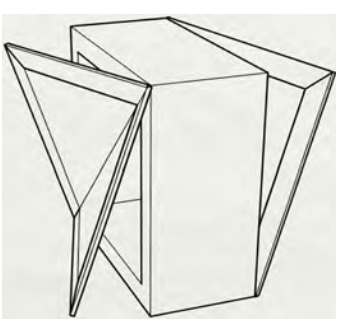


Figure 2: The Skin in Open Condition

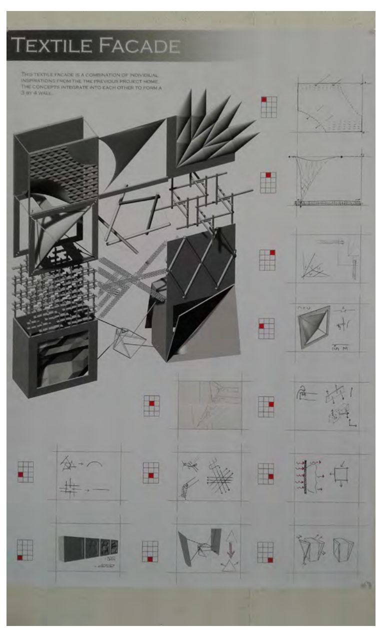


Figure 3: Facade Section in Connection with Others Facades in 3Dimenesion Drawing

Figure 4: Facade Section in Physical Model Connected with Others Facades

EASTERSEALS INCLUSIVE DAYCARE CENTER PHILADELPHIA, PENNSYLVANIA

JENNIFER MCELROY
IDRIS SALAHELDIN

Figure 1: Presentation of the Modular Panel System

ABSTRACT:

Easterseals is a non-profit organization with locations nation-wide, now seeking to expand their early childhood program to Philadelphia. The buildings under consideration for the new facility are located at 1226 Frankford Avenue (Figure 2), 941 North 2nd Street (Figure 4), and 212 Walnut Street (Figure 3). The differing scales of each building will determine the program of the structure. In order to adapt these three buildings into high quality daycare facilities, this project proposes new facades on all of the non-party walls of the facilities. The design strategies focus on optimizing daylight, engaging the children, and maintaining sufficient privacy.

EASTERSEALS:

The client that this project serves is the national non-profit Easterseals, an organization that has helped differently-abled individuals and their families for nearly one hundred years. Easterseals services range from child development centers to physical rehabilitation and job training for the disabled. These services help to empower those with disabilities to face their unique challenges and achieve their goals. Easterseals provides health and human services from 550 locations throughout the United States and Puerto Rico. Every year they assist more than one million people of all ages with disabilities. Funding for the non-profit is through private insurers, government agencies, and fee-for-service. For eighty years, Easterseals has strived to provide children with environments for productive learning and development. These settings welcome children of all physical, emotional and academic levels, allowing differently-abled children to learn alongside their typically-developing peers. In this inclusive setting, they learn age-appropriate communication and social behaviors. In turn, the children without disabilities are taught the value of working alongside their peers of all developmental levels and abilities.

Easterseals has a wide range of locations and is looking to expand their early childcare program to the city of Philadelphia. Currently the company has four locations in Pennsylvania but feels that the inner city would largely benefit from having a center (Figure 6).

Figure 2: Textile techniques and material research iterations.

Figure 3: Textile techniques and material research iterations.

DAY CARE IN PHILADELPHIA:

This daycare facility project is needed to serve the sixty five percent of Philadelphia's working mothers with children between the ages of zero and six. With this substantial number of children with working parents, there is a greater need to provide daycare for such families. As of November 1st, 2016 in Philadelphia, government assistance will only be provided for children attending licensed daycare facilities, there is a greater need for licensed daycare centers for low income families. As of that date, funding will no longer be provided for unlicensed programs or babysitters such as neighbors or family members.

Reliable daycare centers are needed to provide quality care for all children. “Today, fewer than 3/10 of four-year olds are enrolled in high-quality preschool programs” says President Obama. Supporting his claim, as determined by the DVAEVC, only 14.1% of early childhood programs in the city are high quality. Easterseals' widespread reputation gives assurance that they will provide the city with a high quality daycare.

1. "Child Care in America: 2016 State Fact Sheets." Child Care Aware of America. N.p., n.d. Web. 03 Feb. 2017.

2."PhiladelphiaChildCare.org CCIS Philadelphia." PhiladelphiaChildCareorg. N.p., n.d. Web. 03 Feb. 2017.

Figure 4: Textile techniques and material research iterations.

LOCATIONS:

The three locations considered are all in different parts of the city. The first site is located at 941 N Second Street in Northern Liberties, just north of Center City (Figure 4). The boundaries of the neighborhood are Girard Avenue and Callowhill Street to the north and south and North 6th Street and the Delaware River to the East and West. The area is easily accessible by both car and public transit and has an abundance of bike racks and sidewalks.

The population of Northern Liberties is 8,071 people, 23.8 percent of which is children. The neighborhood has a higher percentage of both married-couple families with children and single-mother households than the average in Philadelphia. The area is densely packed with 12,007 people per square mile, which is higher than Philadelphia's average at 11,497 people per square mile.

The area was formerly a manufacturing district but transformed during the early 1990s when artists gravitated to the area in reaction to affordable studio spaces. The area gained mixed-use complexes such as the Liberties Walk and Piazza at Schmidt's which helped progress the up-and-coming neighborhood.

The second site is located at 212 Walnut Street in Old City, the historic district of Center City (Figure 3). The boundaries of Old City are from Front and Sixth Streets to the east and west and Vine and Walnut to the north and south. This area is near the Delaware River where William Penn and the Quakers first settled. The public transportation provides easy access throughout the area via both bus and subway.

The population of the area is 10,229 of which 1,227 are children. Old City is a growing district with an increase of fifteen percent in residential population over the past decade. Being in such close proximity to Center City, there are over 200,000 people that live within a five-minute drive.

3."Northern Liberties Neighborhood in Philadelphia, Pennsylvania (PA), 19123 Detailed Profile." Northern Liberties Neighborhood in Philadelphia, Pennsylvania (PA), 19123 Subdivision Profile - Real Estate, Apartments, Condos, Homes, Community, Population, Jobs, Income, Streets. N.p., n.d. Web. 03 Feb. 2017.

4. "Northern Liberties - Philadelphia Neighborhoods — Visitphilly.com." Philadelphia - Official Visitor Site - Visitphilly.com. N.p., n.d. Web. 03 Feb. 2017.

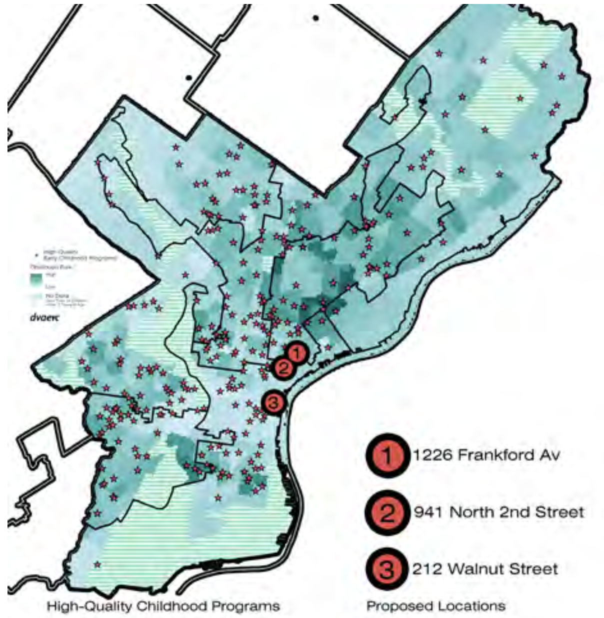


Figure 5: Location Plan,
Current High-quality Daycare Centers &
Proposed Daycare Centers

Figure 6: Location Plan, Local Easterseals Daycare Centers

Figure 7: Site Plan, Walnut St

Figure 8: Site Plan, North 2nd St

Figure 9: Site Plan, Frankford Av

Old City is a part of Historic Philadelphia, the birthplace of the nation. The area includes Independence Mall, where the country's founding fathers declared liberty and built a free nation. Independence Mall is also home to many cultural institutions. The cobblestone streets still possess an eighteenth century charm. The neighborhood is full of restaurants and boutiques, contributing to its lively nightlife. Penn's Landing is an area full of family-friendly attractions, hosting a variety of events all year long.

The third site, 1226-8 Frankford Avenue is in Fishtown, northeast of Center City (Figure 2). The Boundaries are roughly defined by the triangle created by the Delaware River, Frankford Avenue, and York Street. SEPTA's public transportation allows access to the area by trolley, bus and subway. The area is easily accessible by car and bike as well.

The population of Fishtown is 33,130 people with 8,911 children. The density of the area is almost double the average density of the city. Fishtown has 20,906 people per square mile, whereas Philadelphia as a whole only averages 11,497 people per square mile. Of the households in Fishtown eighteen percent of them are married couples with children and twenty five percent of them are single-mother households.

Like the aforementioned neighborhoods, Fishtown is a haven of the arts. It is a working-class neighborhood, originally home to the commercial fishing industry. Today there is great opportunity for families and young people in the area.

5."Olde City Neighborhood in Philadelphia, Pennsylvania (PA), 19106, 19107 Detailed Profile." Olde City Neighborhood in Philadelphia, Pennsylvania (PA), 19106, 19107 Subdivision Profile - Real Estate, Apartments, Condos, Homes, Community, Population, Jobs, Income, Streets. N.p., n.d. Web. 03 Feb. 2017

6."Fishtown Neighborhood in Philadelphia, Pennsylvania (PA), 19125 Detailed Profile." Fishtown Neighborhood in Philadelphia, Pennsylvania (PA), 19125 Subdivision Profile - Real Estate, Apartments, Condos, Homes, Community, Population, Jobs, Income, Streets. N.p., n.d. Web. 03 Feb. 2017.

RESOURCES:

There are many resources provided for daycare centers both nationally and locally. The national accrediting body for daycare centers is the National Association for the Education of Young Children (NAEYC). The Pennsylvania overarching inter-agency which regulates

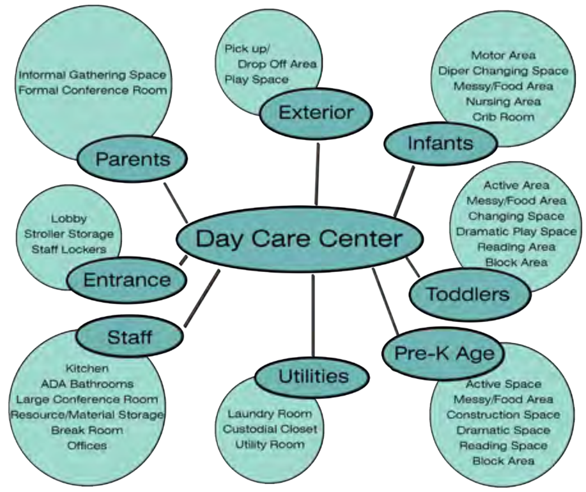


Figure 10: Programmatic Spaces

daycare centers is the Office of Child Development and Early Learning (OCDEL). The official rating system used in Pennsylvania is STARS – Standards, Training, Assistance, Resources, and Support (0-4 scale). The regulating departments for the city are the Department of Human Resources, Department of Public Welfare, Administration for Children and Families (ACF), and Office of Child Care (OCC). The official department websites include philadelphiachildcare.org, childcareaware.org, and the online search engine COMPASS.

7.Buysse, Virginia, Dina C. Castro, Tracey West, and Martie Skinner. "Addressing the Needs of Latino Children: A National Survey of State Administrators of Early Childhood Programs." Early Childhood Research Quarterly 20.2 (2005): 146-63. Web.

PROGRAM:

The basic needs for a daycare include classrooms for each age group, multi-purpose spaces, exterior space, designated parent areas, staff areas, and utility spaces (Figure 9). The entrance of the facility should provide ample storage for strollers and diaper bags for all children at the facility. Designated parent areas include both informal gathering spaces for parents to socialize with one another and

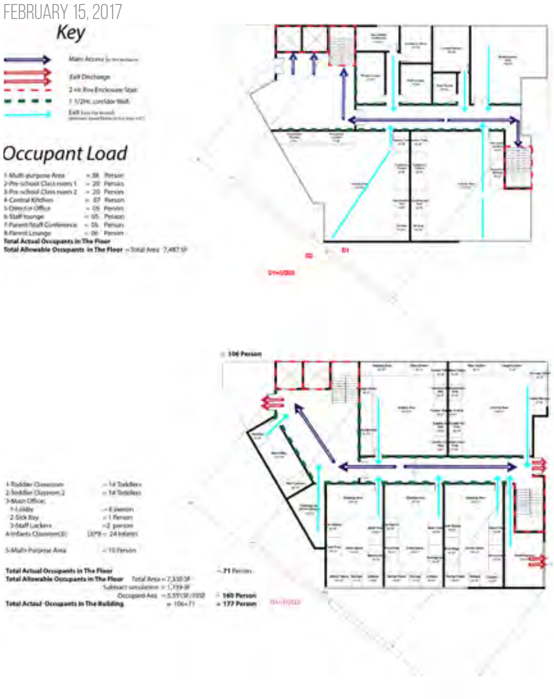
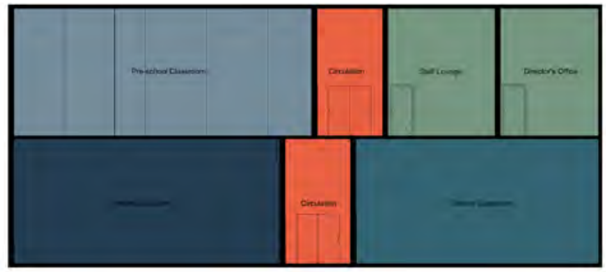


Figure 11: Walnut Street Egress



Section North-South

Section West-East

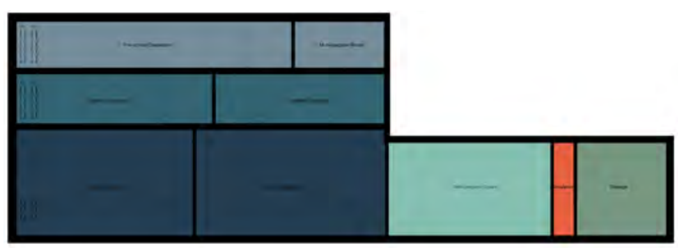
Figure 12: Walnut Street Programmatic Sections

formal conference rooms for parents to meet with teachers. Staff facilities include a kitchen, ADA bathrooms, a large conference room for staff meetings, material and resource storage, a break room, and offices. Exterior space should include a portion dedicated to play space and a pick-up and drop-off area safe for children. Utilities necessary for a daycare include a laundry room, custodial closet, and a utility room. Infants should be allotted diaper/changing areas, nursing areas, a crib room,

Second Floor Plan

First Floor Plan

Figure 13: Walnut Street Floor Plans



Section West-East

Section West-East

Figure 14: Frankford Street Programmatic Sections

eating areas and motor areas. These spaces do not necessitate individual rooms but rather can be designated by furniture in an open floor plan to allow flexibility. Toddler classrooms should include changing spaces, eating areas, bathrooms with toddler toilets, active areas, dramatic play space, reading space, and block areas. Preschool-age children need eating areas, active spaces, construction space, dramatic space, reading space, and block areas.

The size difference between each of the three buildings determined the amount of classrooms and therefore the capacity of each facility. The number of children in each classroom was determined by the age of the children in the class. Easterseals early childhood facilities accommodate children from aged 6 weeks to 5 years-old. The classes are grouped by age with infants being 6 weeks to 1 year, toddlers are 2 to 4 years, and Preschool age is 5-6 years old.

PLAN:

In developing plan for the buildings, the focus was efficiency in both space and function: keeping younger children on the lower levels for ease of stroller access, with adults and staff on the upper floors. In order to make the program adaptable to multiple buildings, modular class rooms were chosen. These modular units allowed for simple, efficiently functioning classrooms specific to each age group. The square footage is based on the functional areas necessary for each classroom. Circulation is based on double-loaded corridors allowing the rooms to receive maximum lighting from the edges of the building and a singular path for ease of egress.

FACADE:

A facade retrofit is an appropriate and necessary strategy for this project as children are highly receptive to all elements of their environments. Constant visual, tactile, and auditory sensory stimulation contributes to growth and development. Many children spend up to 12,000 hours in some

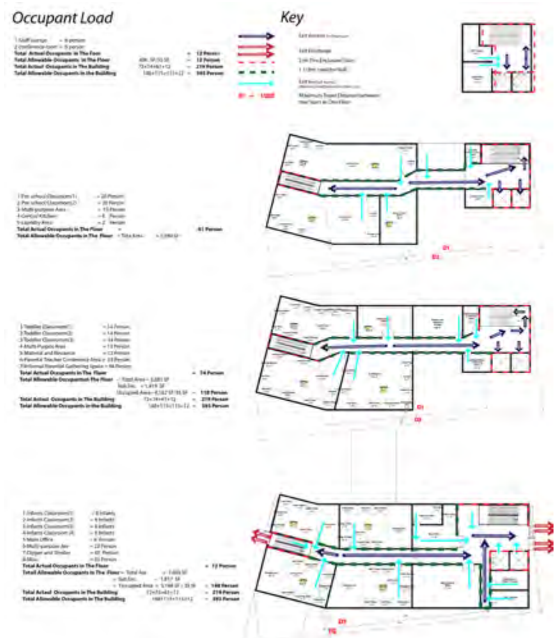
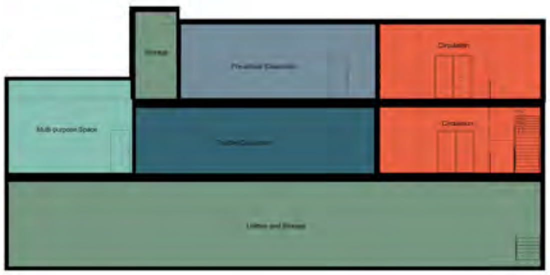


Figure 15: Frankford Street Egress

Figure 16: Frankford Street Floor Plans

Section North-South



Section West-East

Figure 17: North 2nd Street Programmatic Section

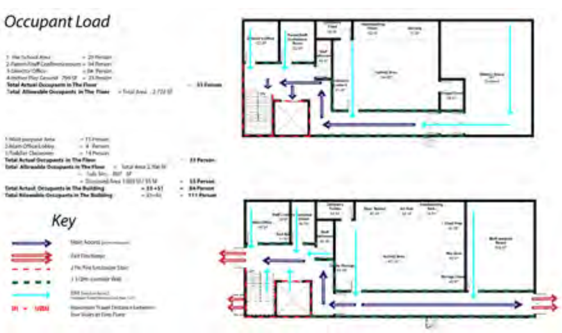
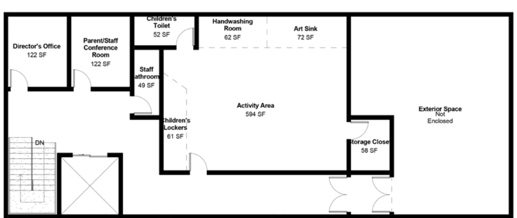
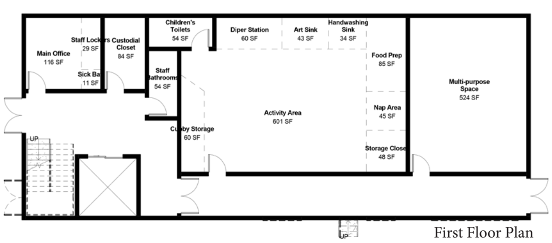


Figure 18: North 2nd Street Egress



Second Floor Plan



First Floor Plan

Figure 19: North 2nd Street Floor Plans

Figure 20: North 2nd Street Egress

form of daycare during their childhood. Studies show that the comfort and quality of the space has a direct impact on a child's growth and learning. Central to the fascade studies are the following elements: privacy, daylight, and engaging the children. The largest obstacle was identifying a facade that was both effective in function and engaging for the children. The precedents that were studied featured images of large scale windows with children sitting inside them. This inspired the main idea of depth. The concept of a facade with depth, and not just something applied to the face of a curtain wall or other typical wall system, was challenging and produced further ideas with many iterations.

8.http://www.earlychildhoodnews.com/earlychildhood/article_view.aspx?ArticleID=334
9.Child Care Center Design Guide. New York: U.S. General Services Administration, Public Buildings Service, Office of Child Care, 2003. Web

Another primary goal of this element was to engage the children visually. However, instead of trying to create a facade that was interactive and mobile, another innovative solution was considered: a shape-shifting facade to engage the children. Several different and constantly-changing geometries were considered, from mathematical tessellation, to morphing shapes across the facade, and finally, to the voronoi algorithm. The algorithm is generated and controlled through a series of points.
In addition to visual engagement, physical engagement was also prioritized. Growing children possess seemingly boundless energy and enjoy activity. The idea of a faceted facade could be brought into the interior spaces to be used as a

climbing wall for the older kids.

VORONOI:

The voronoi pattern of the facade is generated through a series of steps that relate the program and the environment (Figure 24). The facades are first divided into regular grids of points that are two feet by two feet apart in each direction. Those points are then culled in densities related to the program behind it, which then generates Delaunay curves. These are bisected with perpendicular lines to create the voronoi cells (Figure 20,25). Once the organization of the voronoi is complete, they are then extruded based on the scale of the cell. The extrusion acts as a brisole shading system so the larger cells require greater extrusion. The cells are then transformed into individual physical units which can be stacked and clipped together. The scale of the apertures is proportional to the program behind them as well. The 'glass' within the aperture will be at different depths depending on the program, and determines whether they will be occupiable or not.

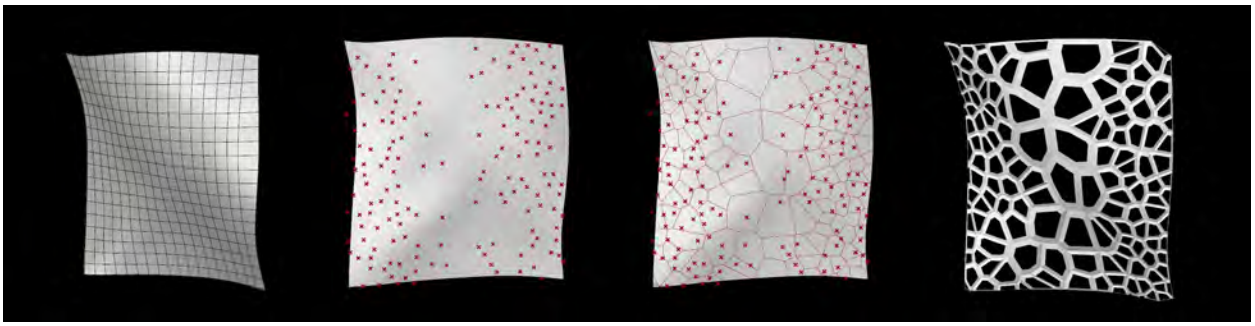


Figure 21: Voronoi Early Process

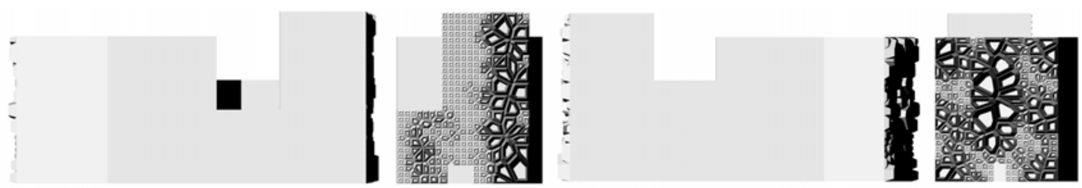


Figure 22: Frankford Avenue Elevations; South, East, North, West

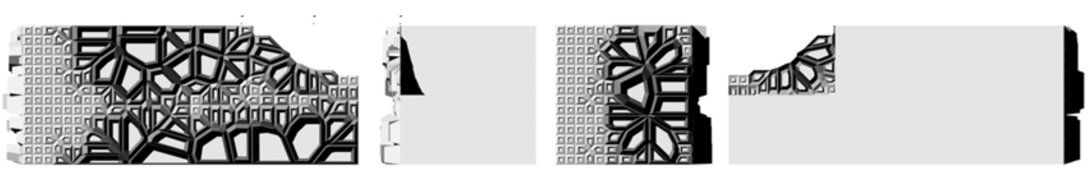


Figure 23: North 2nd Street Elevations; South, East, North, West

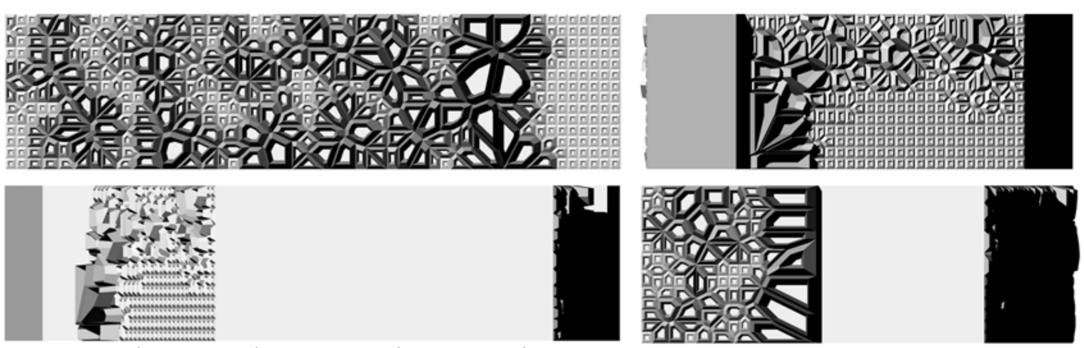


Figure 24: Walnut Street Elevations; North, West, South, East

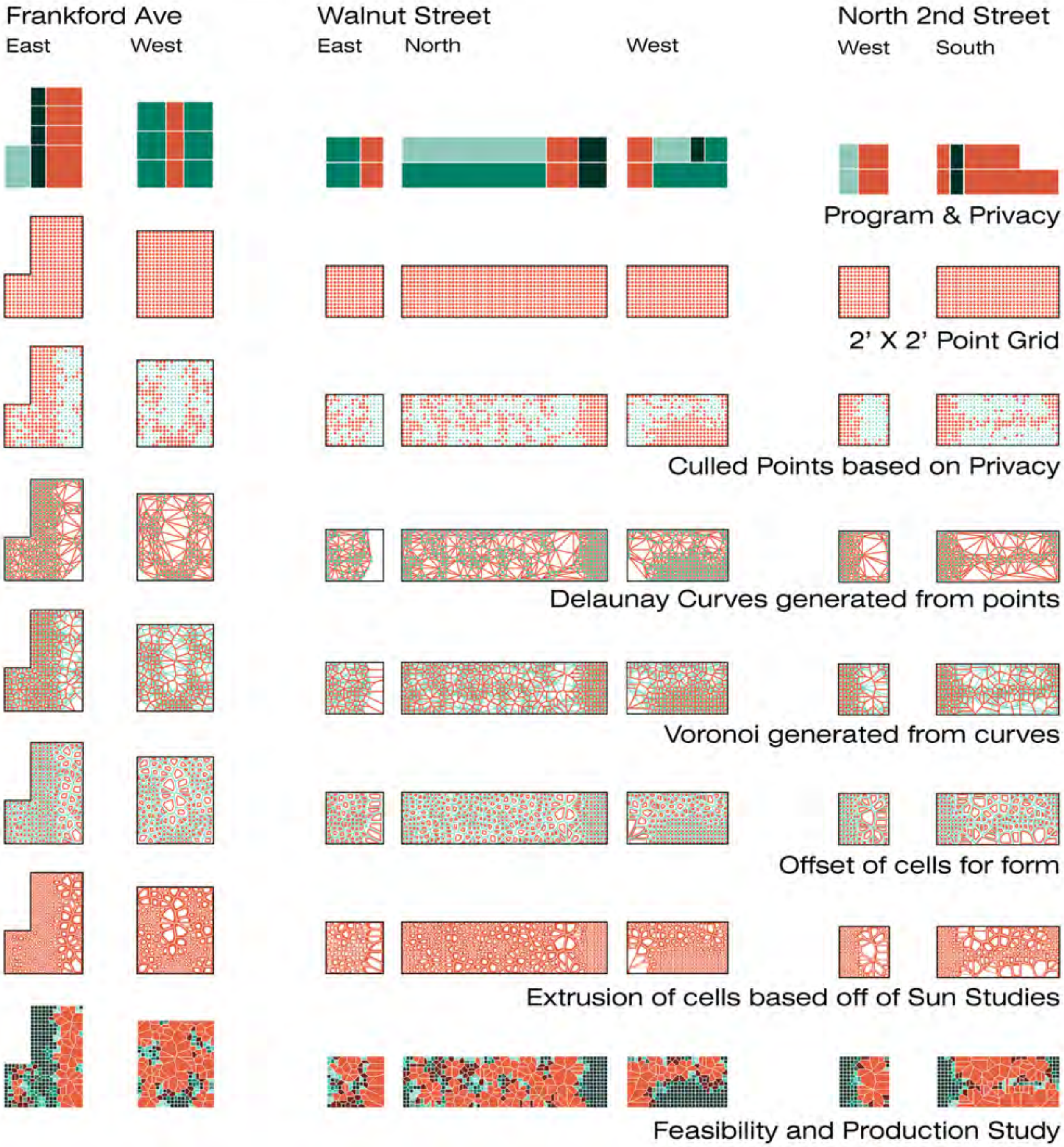


Figure 25: Facade Forming Logic

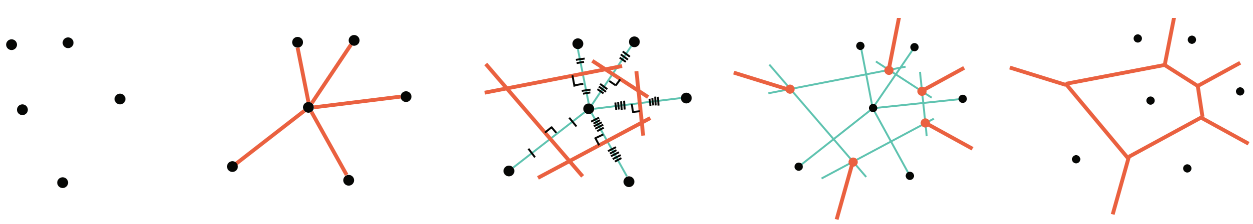


Figure 26: Voronoi Algorithm

FEASIBILITY:

After creating the voronoi pattern for all of the facades, the critique feedback suggested that such an organic pattern would not be feasible and practical to create. Therefore, other pattern precedents were researched in order to find one that appears random but possesses an underlying system. However, instead of creating sections of voronoi into groups which would then create a module independently, the goal was to maintain the organic design by only replicating certain panels. The more organic, larger panels denote the more public, circulation spaces. The plug-in, Python was used to analyze the voronoi cells and group them with like cells. Based on the number of like cells, the points that generate the voronoi would be altered searching through multiple iterations in order to find the most feasible solution. In Figure 24, the bottom set of diagrams denotes the feasibility. The orange cells show the most organic and unique cells whereas the dark green are the regular ones. The teals in between are the areas that are most adjustable based on the code in order to maintain the consistency of the idea. The physical models shown in Figures 27 through 30 show different stages of the voronoi definition, some before the Python code that regulated the quantities and some after.

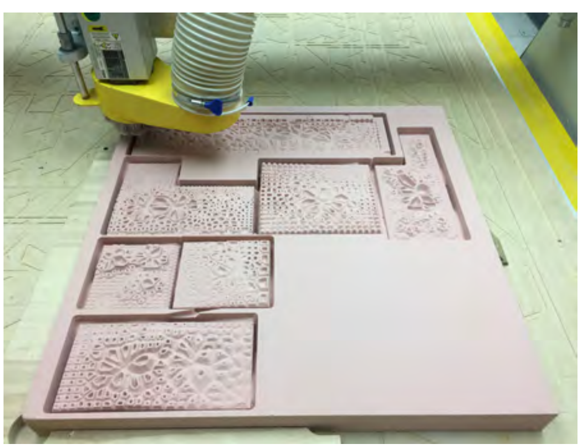


Figure 27: CNC Milling the Facade Iterations

Figure 28: Final Model Facade Iterations

Figure 29: Final Presentation

Figure 30: CNC'd Model Foam Facade Representation

MATERIALITY AND RELATION TO TEXTILE:

In order to determine the materiality for the voronoi modules, precedent facades with similar geometry were considered. Many angular modular geometries seemed to have been made of light weight pre-cast concrete. However, after studying recent technologies and material strategies it seemed that a textile composite would be better-suited for the overall aesthetic and functional qualities needed.

In general, textile composites are strong, and lightweight. The material is easy to insulate and coat to perform in a variety of ways. The modules that were studied were composed of fiberglass, carbon fiber, and Kevlar. They all have the same general characteristics, while each possessing unique attributes that make that particular material appropriate depending on the situational need.

The modules cast in Figures 33-37 were ultimately not included as part of the design but were an integral aspect of the design process in both geometry and materiality.

In the beginning of the design process, the feasibility of the voronoi patterned was investigated by creating a series of panels which would then be arranged in a random pattern to create an organic facade. However, implementing the design at the desired scale for this particular project did not seem feasible nor true to the concept. The panels disrupted the idea of the facade depth and extension for interaction with the children.

However, the exploring the way in which these composites were molded helped to reinforce the idea that the strength of the composites would be maximized by the faceted geometry of the voronoi.

Figure 31: CNC Milling the Mold

Figure 32: Waxing the Molds

Figure 33: Fiberglass Composite Mold

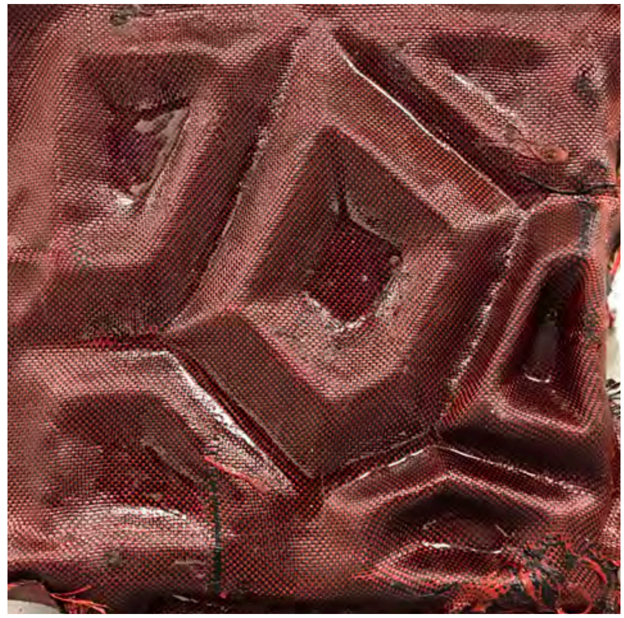


Figure 34: Kevlar Composite

Figure 35: Carbon fiber Composite

Figure 36: Carbon fiber/Fiberglass Composite

REFLECTION:

Overall the project was successful in its exploration of ideas. We received extremely helpful feedback regarding methods in exploring parametric and algorithmic schemes. Throughout the timeline of the project the feedback from the practitioners allowed us to push the overall design of the facade. Understanding what Python can do and how to use it most effectively will help develop future projects further and faster.

Through our rigorous exploration of program, we were commended on how much it was able to show through in the facade. Our design goal of creating a facade which focuses on sunlight control, engagement of children, and attention to privacy was achieved through the design. The use of Ladybug for Grasshopper allowed us to accurately evaluate daylight and sunlight. The detailed plans allowed us to achieve privacy where desired, and the level of engagement of the facade seemed to be successful by the support of the jurors.

We have hopes of continuing the project, focusing on developing a working wall section which correctly depicts the design that we have created.

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JAPANESE THEMED INN

ZILDA HIJAZIN
JIATAI WU

ABSTRACT:

Japanese architecture—the traditional Japanese outlook on art and architecture—has always been grounded in ecological values that are not only esthetically pleasing but are grounded with simple and deliberate design moves that are articulated to harmonize the user's relation to the context, the sun and to the user himself, even in an urban and contemporary society.

Through Japanese architecture, this hotel brings order to and improves contemporary ecological relations and creates a stylistic Japanese atmosphere that is inspired by the meticulous historic art of Japanese living, harmony and intellect.In addition to its deliberate order and its emphasis on simplicity, Japanese architecture puts emphasis on nature and their therapeutic capabilities.

ADAPTATION OF JAPANESE ARCHITECTURE INTO AN URBAN FABRIC:

Over the course of our research we started to define what dictated Japanese architecture and that is always developed from a focus on function. Each space is deliberately ordered and sized to fit the functions it is meant to hold. Its order stemmed from a set of modules and a series of arithmetic variation that instill order and simplicity.

As we were starting to contextualize our translation of Japanese architecture into the urban environment, we started by bringing in more light to the core of our buildings. at the center of each scheme, a light well and an interior winter garden opens up the space, and brings in light and greenery into the spaced overlooking the light well

Due to our limited access to natural sun coming into the building, we wanted to bring in as much natural light into though our facade, bring in sensory calming sounds that dilute the sounds of an urban environment, yet disseminate visual access into the hotel while allowing selective integers of outward visual access depending on surrounding views.

To further control viewports and incorporate passive cooling, we went on to push in segments of our facade in order to segments spaces within the building and provide strategic locations for operable windows based on wind analysis studies that take advantage of summer winds coming into each of our buildings. These push-backs also create advantage points for people within the building to gain more visual access to the outside without losing privacy.

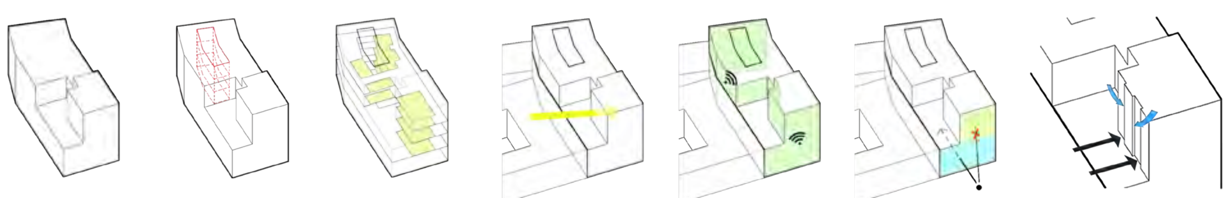


Figure 1: General design process and principles

Figure 2: Interior rendering

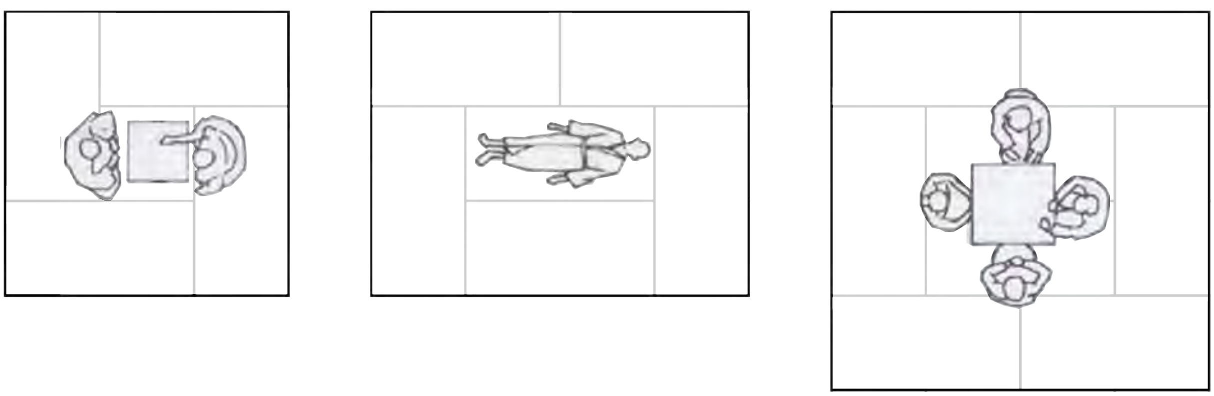


Figure 3: Hotel room sizes and layout

As we started to translate the contextualized nature of traditional Japanese architecture into the urban context, we began to format our rooms so to maximize their functional purpose and use of space. We began to use tatami mats to define the proportions of our rooms, restricting them to a set of squares grids that combine the 3' by 6' tatami mat module. Within rooms, these tatami mat modules allow for the exact space needed for their specified function as shown in the illustration above. The tea room, Sleep space and a larger gathering space insures that these functions can take place within these grids and can also double as a space that opens up and can compromise of a larger quarter.

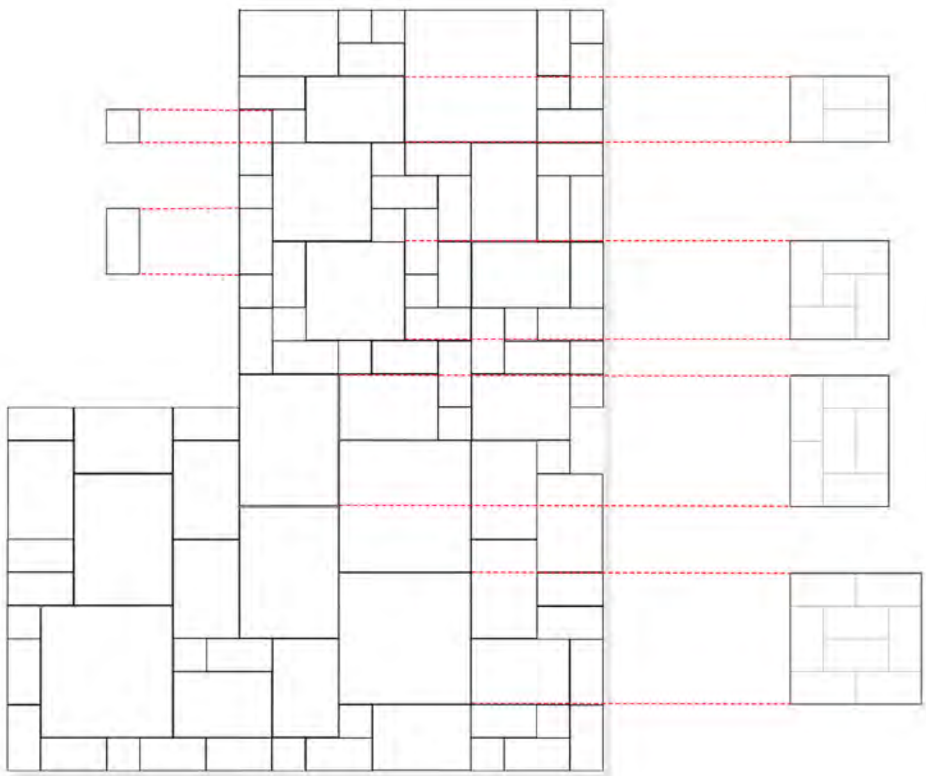


Figure 4: Facade parametric application

FACTORIALS OF TATAMI MODULES:

As we went on to study our facade compositions, we found that in order for such a hotel to succeed in an urban environment, it must have the ability to tell a story about what might lie within, yet be mysterious. It needed to express its internal order as it is essential for the hotel to express its tranquil and deliberate use of a mandate that governs its modularity. Not only do the tatami mats create a strict module, they also present a factorial limited by ideologies of order in Japanese design.

Our facade, as well as our room tatami module, uses a 3' by 6' and a 3' by 3' set of tatami modules that are placed together to form a larger set of modules these modules limited by the ideologies of tatami placement in comparison to one another and with the constriction that no groups of four tatami mats can create a larger module as the combination of four mats is considered bad luck in Japanese architecture.

The facade system goes on to take those modules into a series of another arithmetic variations that respond to privacy, changes in function, and an order of transition.

The set of facade modules start gather in 3' by 6' increments at its most private sectors and expand to a 12' by 12' module at is most private sector. These changes go on to alternate depending on the functions that lie beyond the facade. Storage and restrooms being characterized as most dense and Entrances, hallways and restaurants as one of the least dense. These changes also take place in increments. For instance, if a space, such as a room stars with 9' by 9' it uses a fractal to dictate its transition to either a bigger segment of modules or to a smaller segment.

Figure 5: Building section

Figure 6: Layers of facade system

Figure 7: Exterior rendering (small)

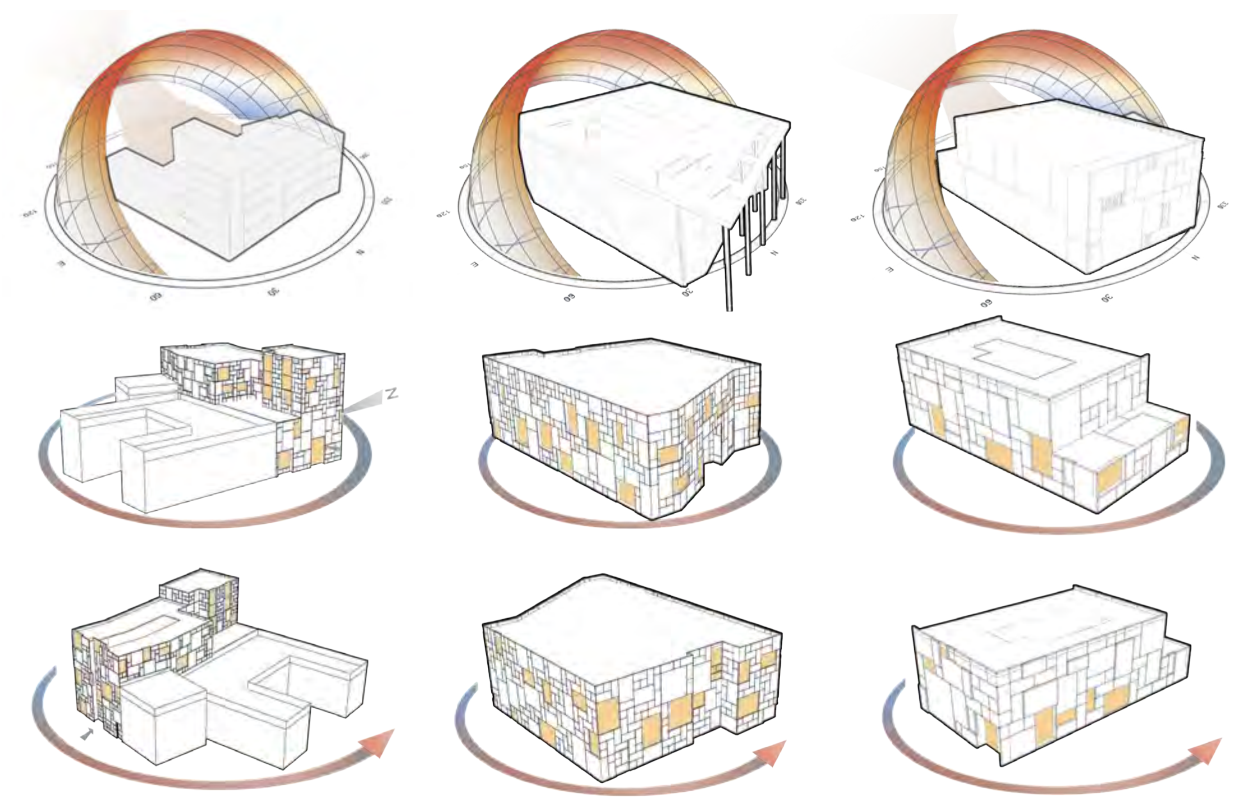


Figure 8: Sun & wind study, facade responses

Figure 9: Exterior rendering (large)

Figure 10: Process photo

Figure 11: Wall assembly detail

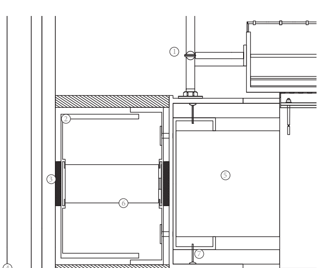
THE FACADE SYSTEM:

Our facade system as it transitions further to reflect the spaces beyond, decimates into three different layers at have a specific purpose. In order to find a place for Japanese serenity and architecture in an urban environment, we translated its spatial transitions into three thresholds of Japanese harmony: biophilia and context, a moment of transition and finally a space of internal focus.

Our outermost layer express our first level of privacy. It is also our weather barrier and the factory that instill order in all other layers. The intermediate layer is a wire grid of plants that provides sound, wind distributions, as well as sensory stimulus to focus the person inwards. That layer also instantiated depending on need for privacy.

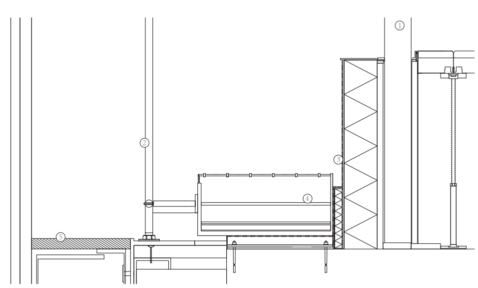
Our final layer, similar to our intermediate, also instantiates depending on privacy and dissipates depending on outward views. It acts as a screen that initiated the beginning of livable interior space.

In order to bring these three layers together in a system that transitions in a seamless manner, we started by designing a raised floor system that separated the height where the layers are place from the usable space so to make the system appear as though they continue beyond the barriers for walls and floor plates. We also used a mullion mate at instances where the grid of the outermost layer deviates from the floor lines.



1 Planting wire hook
2 Metal Stud
3 Gasket with Adhesive on both sides
4 Window mullion
5 Partition
6 Spring
7 Field Fastener

Figure 12: Mullion Mate assembly detail



1 Interior Louvers
2 Planting wire
3 Flashing
4 Planting pot
5 Gasket

Figure 13: Wall assembly detail

REFLECTION

The goal of this design was to find an urban translation of Japanese architecture in way that creates a mysterious yet inviting face to a Japanese hotel. The design goal was to bring in as mush light into the building, yet control outward views as well a clear visual access into the building. The systems interact with one another to play on mystery and privacy. They also set up a gradual transition into an inward focus, as Japanese architecture does. Moving forward, we would like to develop our three thresholds of harmony so that they correlate to one another. We would also examine a wider array of factorials based on iterative stimulations. That way we can bring more order and repetition into our facade's frame work. Our exploration was based on the design processes in textiles. The facades layers beyond its primary face creates a textured look, that all stem from a smaller portion of modules; 2 sets of tatami modules: a 6' by 3' and a 3' by 3', that then expand and generate the bigger picture in both our facade systems and in our plans.

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TESSELATED TEXTILE

MELISSA GARCIA

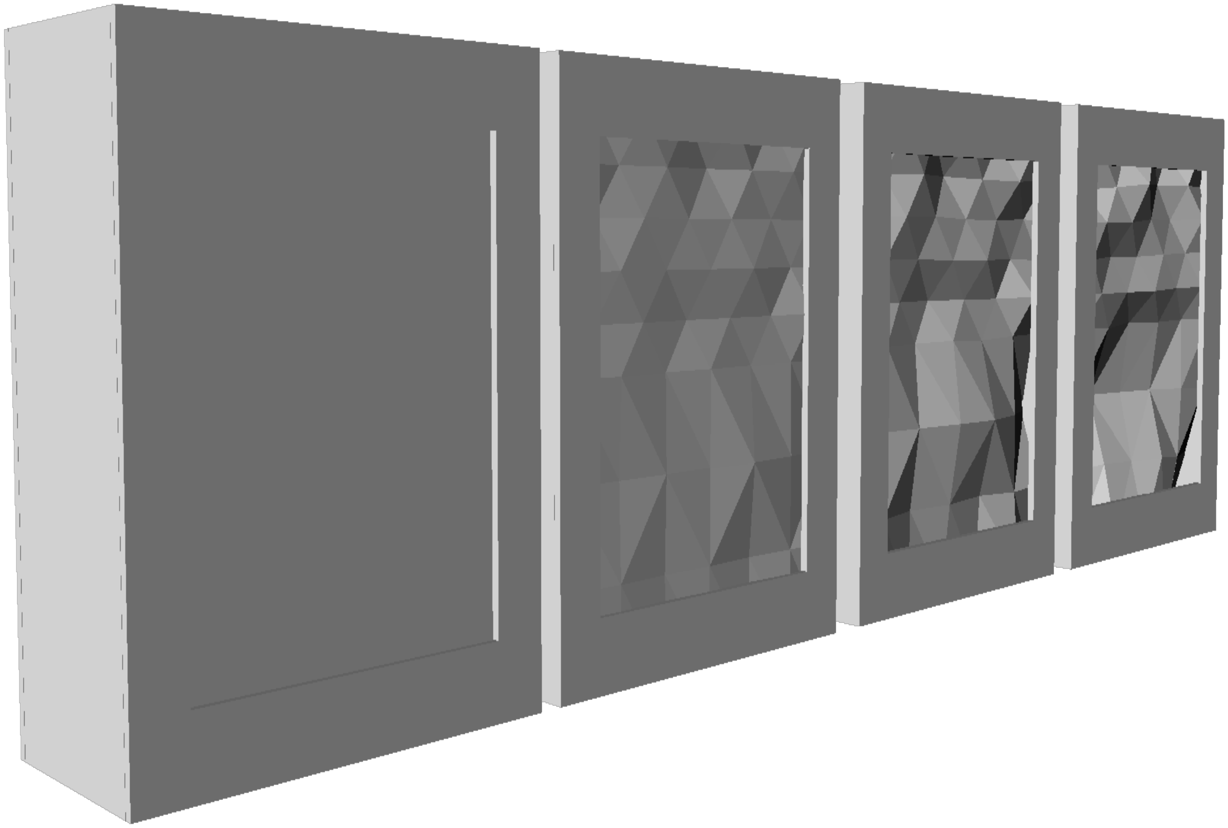
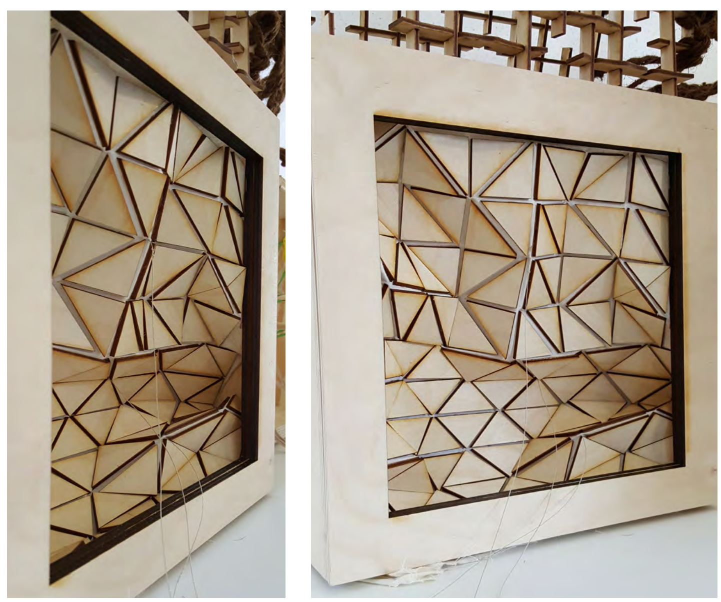


Figure 1: Diagram showing progression of fold

WOODEN PANEL FOLD:

The foldable system element that is present in this project was used in a previous project completed during the Exploration of Textile Strategies and Architecture course. Inspired by Elisa Strozyk's Wooden Textiles, the idea of applying this folding rigid structure to a wall panel took shape. In the panel, there are rows of triangular wood pieces that are configured in two different patterns. These iterations helped to visualize the effect of the pieces on the way the panel would fold. Creating this system with interactive strings allowed the user to attain their desired bends.



Figures 2 & 3: Images of final model

TENSEGRITY APERATURE

TEVIN WILLIAMS

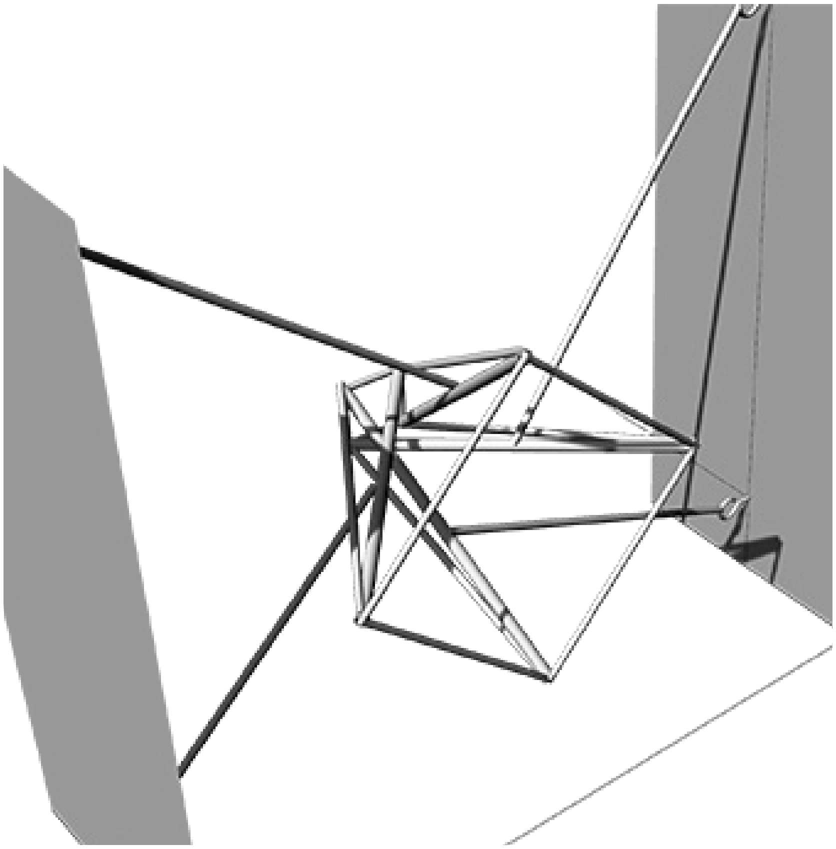


Figure 4: Digital Model showing tensegrity module at rested state

Figure 5: Model in tension

Figures 6 & 7: Show model aperature open and closed

TENSEGRITY APERTURE:

The "Tensegrity Aperture" wall module was heavily influenced by the tensegrity studies that were used in projects one and two. This wall module is designed to be an aperture that opens and closes using both external and internal forces. The external forces are applied by the user pulling on it, and the internal forces are created by the tensile and compressive forces within the aperture itself. The aperture is entirely dependent on the modules adjacent to it. Without the sturdy nature of its neighboring modules, the aperture piece would collapse inward on itself. Attached to the module are wool strings that allow people to interact with the module. As more pull is placed on the module, the wider it gets. This piece is illustrative of the balance that is needed between compressive and tensile forces in order to create tensegrity structures.

CAFE HAVEN: RESEARCH IN EXPERIMENTAL MODULAR BRICK SYSTEMS CAFE CHAIN

MELISSA GARCIA
TEVIN WILLIAMS

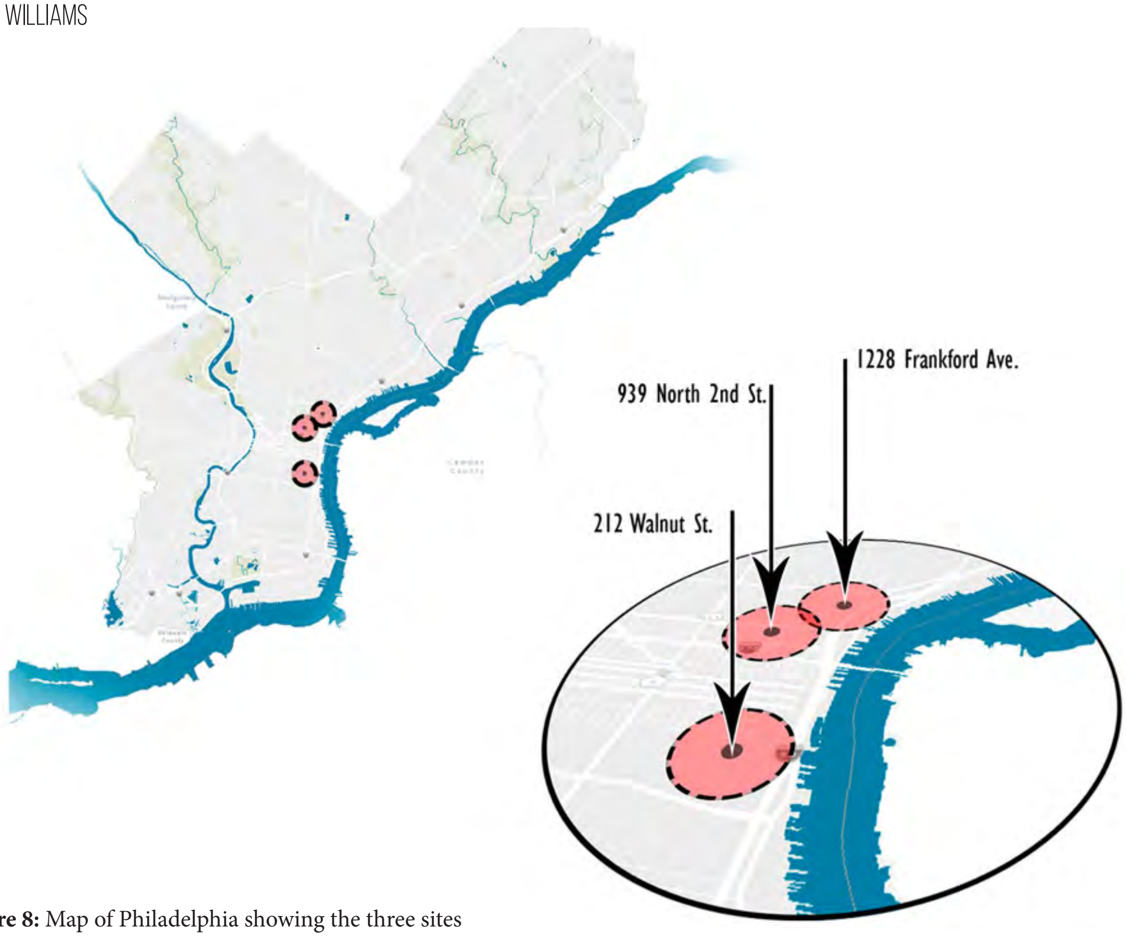


Figure 8: Map of Philadelphia showing the three sites

SITE:

This project began with the selection of three sites, in different neighborhoods of Philadelphia, Pennsylvania. The three chosen sites were to be of three different square footages. The smallest site location is 939 North 2nd Street in Northern Liberties. The building was constructed in 1920 and is currently being used as apartments. The site is a corner condition that is surrounded by buildings that have been recently updated. The facades that will be utilized for the retrofit are the South and West sides of the building. The medium sized building is located at 212 Walnut Street in Old City. The building was broken up into multiple programs, the upper level being a restaurant, while the lower level was broken up into smaller uses. The building occupies an entire block, with all four facades being alterable. The building's structure is visible from the street level, and the building itself has a gridded structure system. The largest of the three sites is 1228 Frankford Avenue in Fishtown. The building is in a dilapidated state and abandoned. The building is surrounded by other buildings on two sides, making the East and West facades the alterable sides for design. All of the buildings had a common building material: bricks. This material commonality became a key component of the overall facade design project.

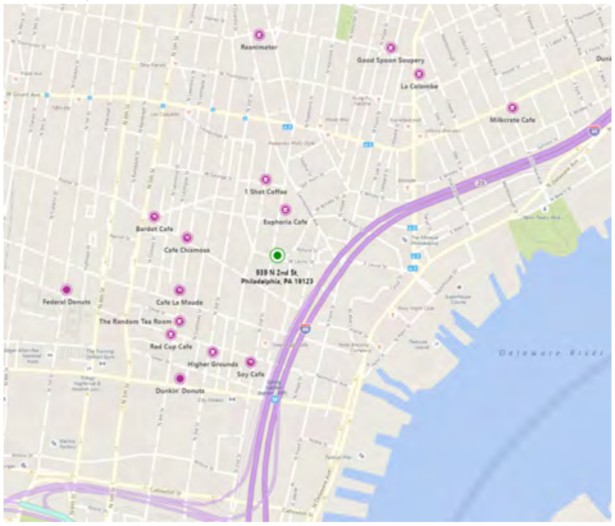


Figure 9: Image of 939 North 2nd Street (Google Maps)

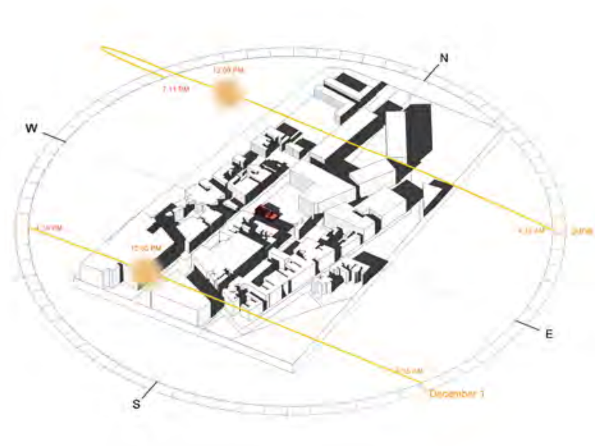


Figure 10: Sun Analysis of 939 North 2nd Street

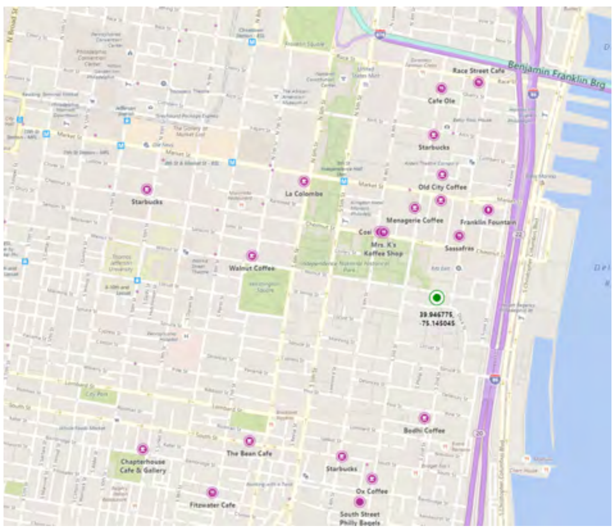


Figure 11: Image of 212 Walnut Street (Google Maps)

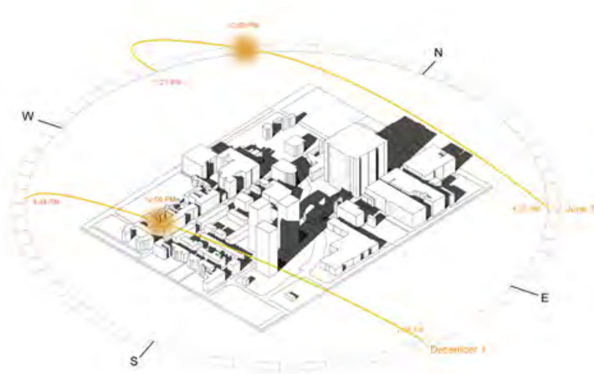


Figure 12: Sun Analysis of 212 Walnut Street

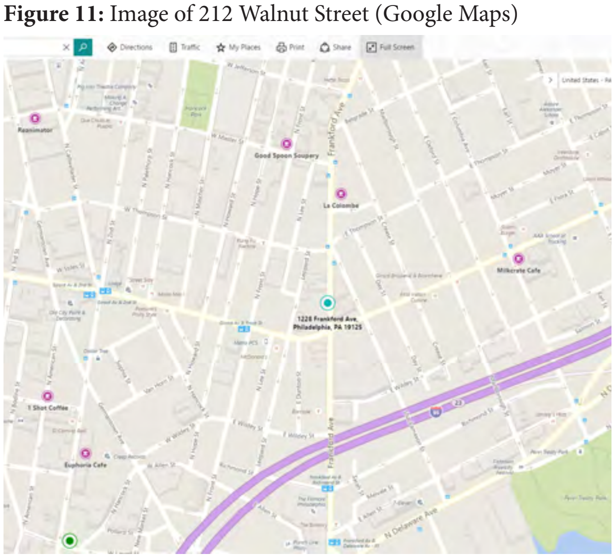


Figure 13: Image of 1228 Frankford Ave (Google Maps)

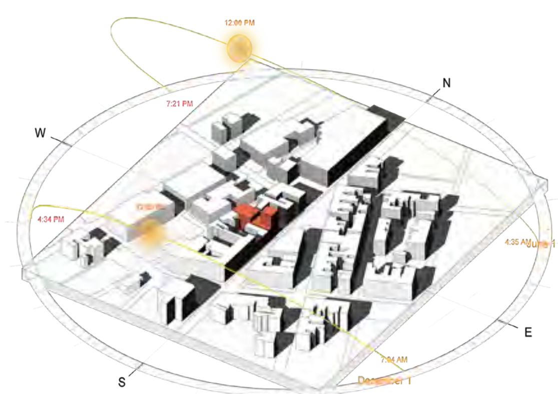


Figure 14: Sun Analysis of 1228 Frankford Ave.

Figure 15: Analysis of North 2nd Street, Cafes and transportation within a 2000' radius

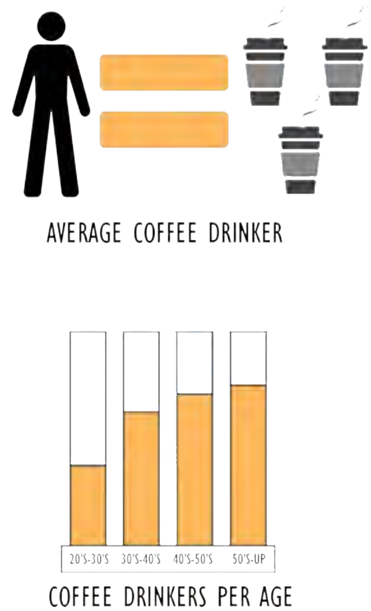


Figure 16: Coffee Drinking Statistics

PROGRAM:

Within the existing context, there was room to provide a more unique experience to users, through the addition of a coffee shop that would be utilized throughout the day. To initiate this, zoning codes for all three sites were researched to determine whether the desired program would be allowable in these locations. The buildings were zoned at Commercial Mixed Use 2.5 and Commercial Mixed Use 3 which allowed for restaurant programs. The next step was to research how coffee is made, from planting to brewing. The process itself is complex and intriguing, and this element became central to the user experience. It became a central goal of this project to bring aspects of the coffee-creating experience into each location. It became clear in the initial stages that it would be difficult for each site to produce enough coffee to sustain itself. After working through the feedback received from several critiques, a narrative was created that would connect all of the sites as one chain of cafes. The Starbucks Willy Wonka Café is one precedent that demonstrates the aim of this project. The building is ninety percent glazing and transparent, which allows for passersby to view and understand the interior. The interior showcases in copper the machines for brewing the coffee. The goal of this project was to create a similar experience, showcasing the machinery involved in the process and educating the connoisseur about the process itself.

The Frankford site would house most of the machinery from processing the beans, to drying them, hulling, roasting, grinding, and brewing it for the café located on the first floor. Part of the floor plans shows the machines being centralized, and the users would be walking on the outskirts of the building with some moments of interaction. The creation process was divided into floors, with the beginning of the process being on the upper levels. As the user ascends within the building, the process is seen in reverse.

The medium-sized building accommodates less of the coffee making process but still showcases the large machinery used for roasting, grinding and brewing. Because this location has less square footage allotted to producing coffee, it will be supplied the special blend from the bigger factory. The parti for this building shows the centralization of the machines.

The smallest of the buildings would act solely as a café that is supplied by the bigger factory. A breakdown of program square footage was created for each site.

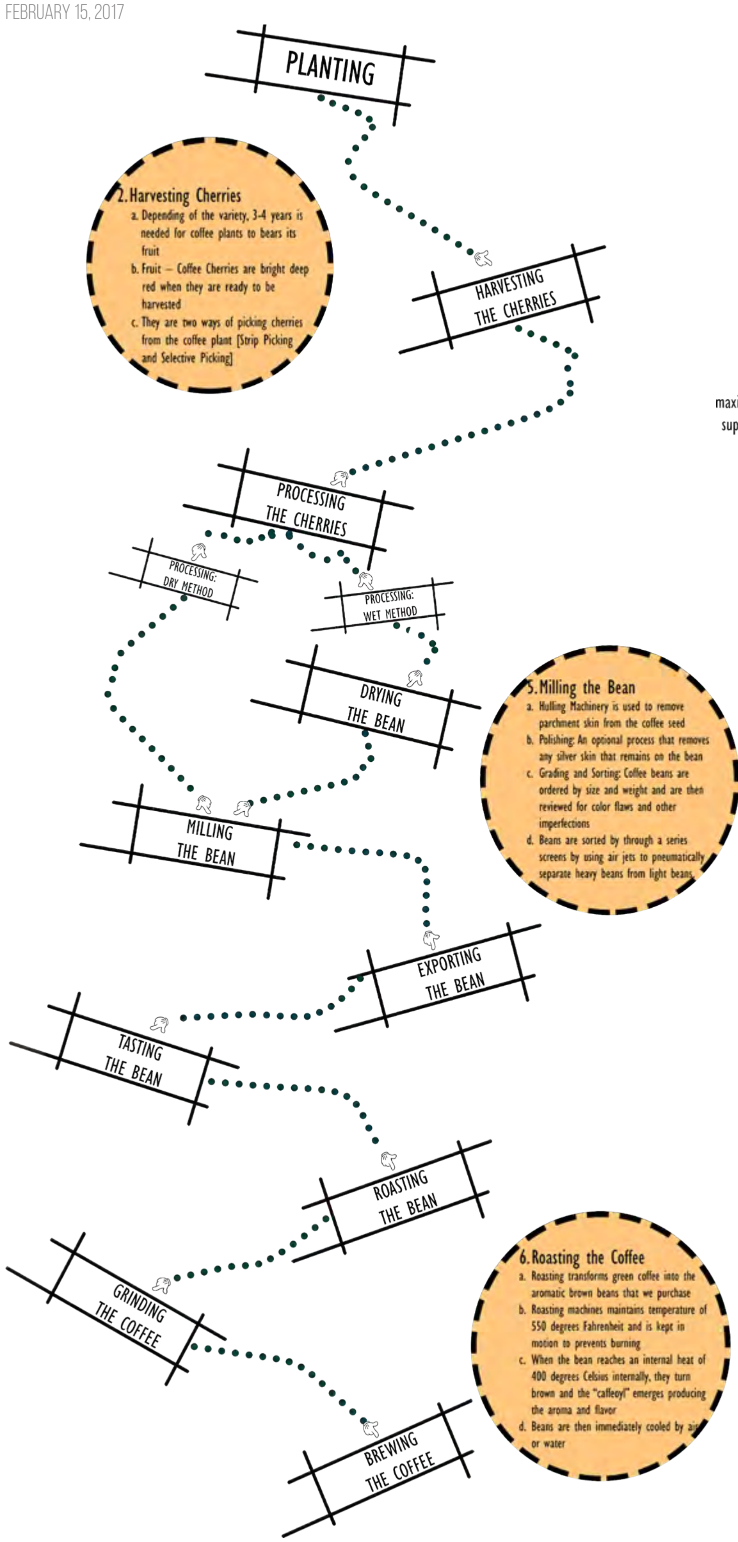


Figure 17: Coffee Process from Bean to Brew

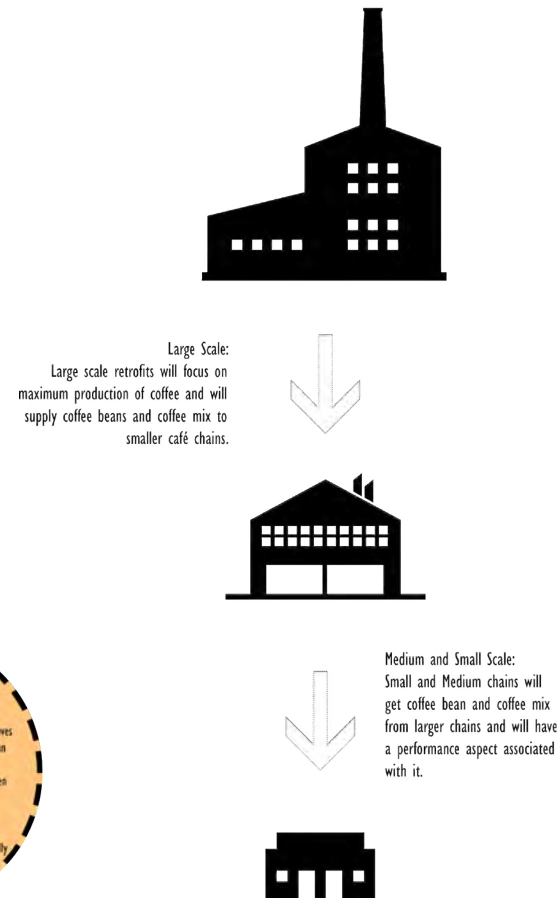


Figure 18: Coffee Distribution

	939 North 2nd Street	212 Walnut Street	1228 Frankford Ave
Building Square Footage	4,255	15,508	16,708
Restroom	237	476	889
~ Unisex	200	400	789
~Circulation	37	76	100
Food Preperation	578	2122	1095
~Food Storage	0	171	310
~Counter	85	0	260
~Kitchen|Food Prep	393	1157	340
~Circulation	100	794	185
Seating	2917	8796	3868
~Bar Seating	124	430	0
~Lounge Space	1117	4000	1013
~Café Seating	1433	2800	2249
~Circulation	243	1566	606
Performance	313	517	1200
~Stage	313	500	800
~Backstage	0	0	0
~Mechanical	0	0	76
~Storage	0	0	194
~Circulation	0	17	130
Beans	210	3597	9656
~Planting	0	0	0
~Harvesting	0	0	513
~Processing	0	0	605
~Drying the Bean	0	420	1473
~Milling	0	427	1046
~Roasting	0	420	2441
~Grinding	83	600	1823
~Brewing	87	600	1055
~Circulation	40	1130	700
Remaining Square Footage	0	0	0

Figure 19: Program Square Footage Break Down

Figure 20: Interior Rendering of Frankford Ave, from Brewing room

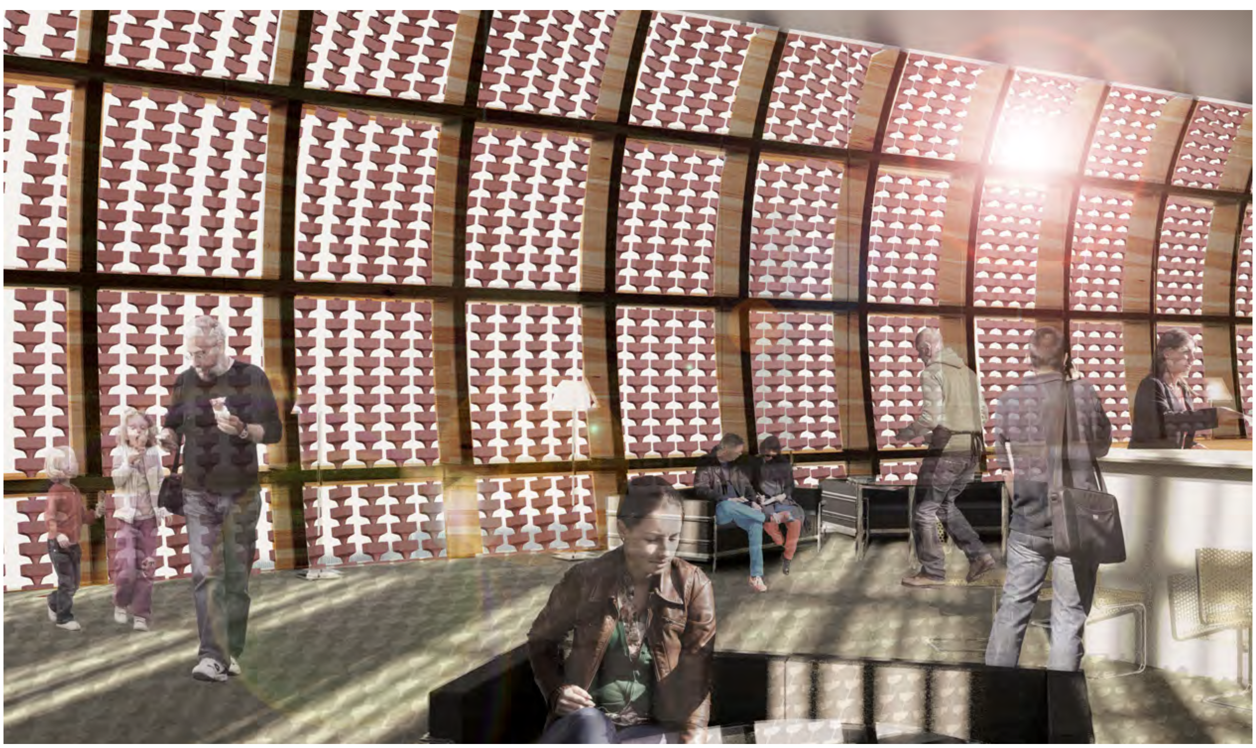


Figure 21: Interior Rendering of Walnut St

ICONOGRAPHY:

Central to the exploration of the facade was the goal to relay the interior happenings of the building to the exterior in order to draw in the community. This idea evolved from having the process living within or even on the exterior of the facade. Through this evolving thought, the idea of iconography became central to the project. In this way, the goal was to show images that implied and expressed the coffee-making process that occurs within the interior.

The next step was to decide on materials, and to determine how to incorporate the brick. After researching precedents of brick facades that altered the direction of the brick, the idea of rotating brick was decided upon. The brick would be strung on a rod that would span the facade vertically. With the use of Grasshopper, a script was created to analyze an image and break it down in a gray scale. The color would correlate with an angle, and the brick associated with that pixel would rotate from zero degrees to ninety degrees. After a critique review, further consideration was given to the structural feasibility, and the most advantageous ways to use the inherent properties of brick.

The next iteration took the idea of iconography and simplified it in such a way to allow more sight into the space. A gradient image was used to allow for certain points in the facade. With the smallest and medium-sized buildings, the closed brick was placed in closer proximity to entrance points in order to form a more grand entrance. For the largest building, a more diagrammatic approach to the gradient was taken. Black patches were created, which signified that the bricks would stay at a zero-degree state, covering the floors. This was chosen because that particular program did not require as much natural sunlight, nor did it need to be viewed from the exterior.

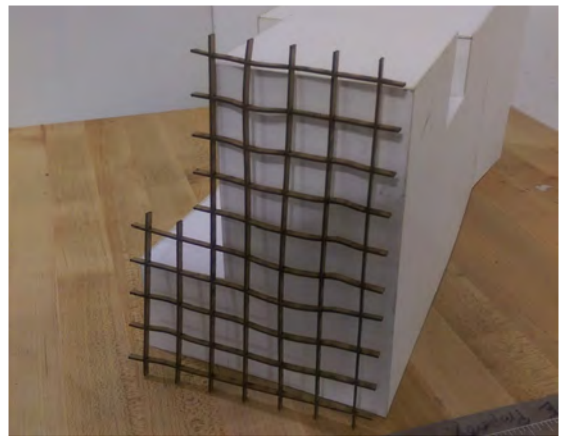


Figure 22: Lasercut chipboard model representing enjulating glulam structure

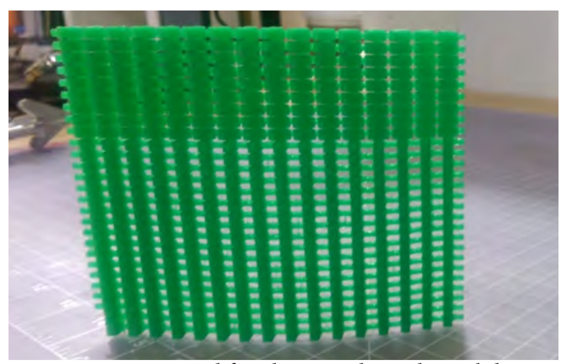


Figure 23: 3D Printed facade, to study void vs solid

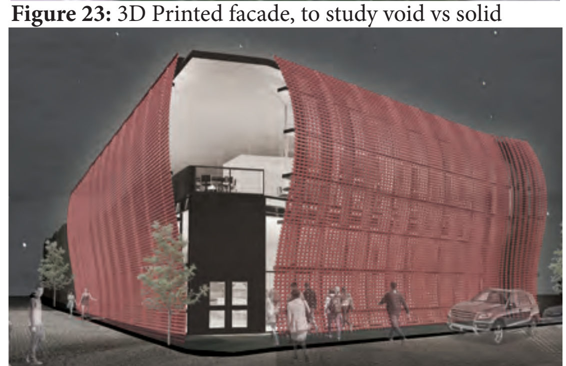


Figure 24: Exterior Rendering of Walnut St.

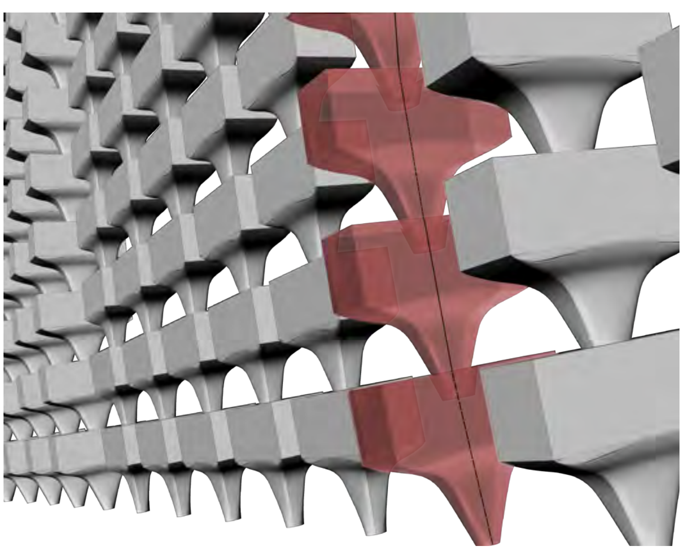


Figure 25: Close up of Brick modules, turning and center axis.

STRUCTURE:

The sight lines from the exterior to the interior was an important driving factor in our structure. The bricks of the structure were restricted to a lateral and vertical rotation. Diagramming sight lines from a person across the street and on the sidewalk in front of our building, the team found that the sight into the building was limited. The team examined how the structure could curve to allow for a better angle of sight. Points along the facade were pulled away from the building and into the building to create new angles. To accommodate for these curves, different types of structures were examined to see if they would allow the curves to be vertical, holding the panels of brick or horizontal, allowing the panels to be inset into the structure. A space frame system, which is a type of column system, and a glulam weave were both examined by the team. The exposed structure made the team feel that the glulam weave provides more sunlight to come through, while maintaining a minimal expansion width. The negative space also allowed the structure to accommodate a glazing system behind it.

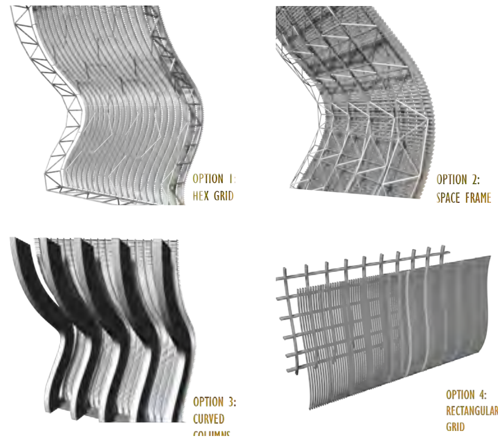


Figure 27: Different Structure Explorations

BRICK MODULE:

The inherent compressive properties of the standard brick were utilized to stack them on top of each other. While prototyping, the team designed a standard brick with a tapered end that could transfer the weight to the next brick, while allowing light and views to happen along the edges. A divot at the top of the brick was created to act as a ball and socket joint. Stacking these modules allowed the team to better understand scale and how the bricks would interlock with each other.

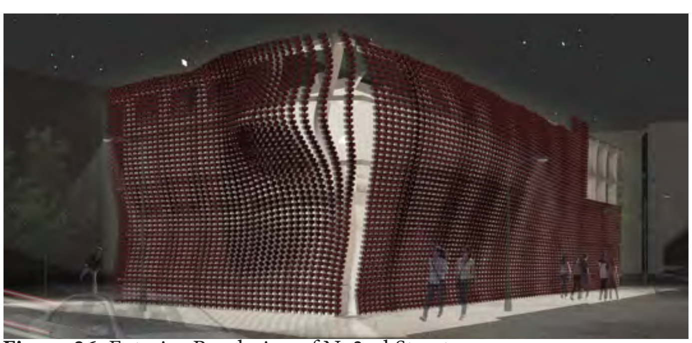


Figure 26: Exterior Rendering of N. 2nd Street.

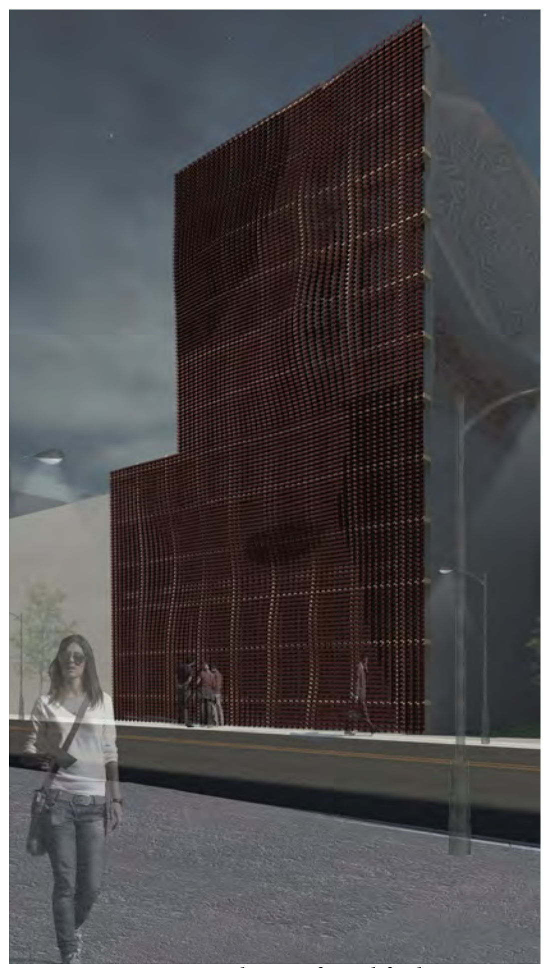


Figure 28: Exterior Rendering of Frankford Ave.

Figure 29: Bending of proof of concept model

Figure 31: Bending of proof of concept model

Figure 30: Rested state of proof of concept model

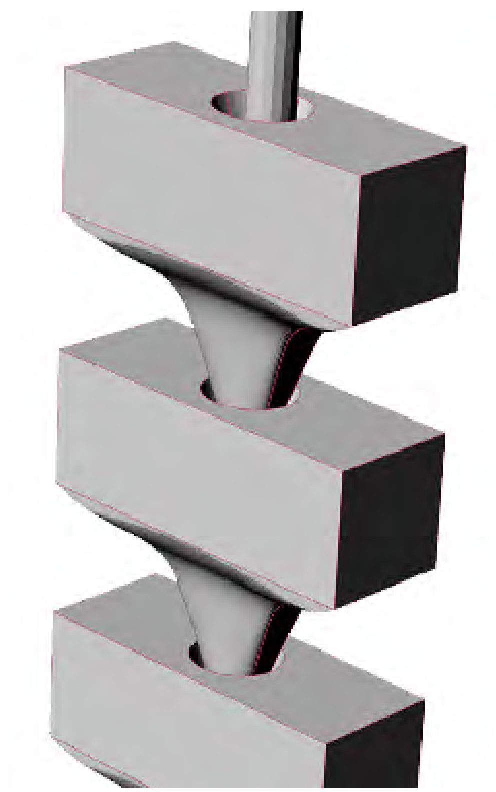


Figure 32: Digital Model of bricks

REFLECTION:

The progress we made on this project was surprising. When we began the project we were unsure what our goal was, it then became to create a panelized system. With further experimentation and criticism we focused our efforts into redesigning the brick module. The goal of our project was to design a brick that would rotate in the XY plane as well as conform to a curved facade. Creating a module that adapted to the criteria while being in a compressive state was the challenge. Overall we came to a good ending point that was able to showcase what we have learned and show the starting point of many iterations.

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CRIME AND PUNISHMENT BREWERY: FACADE DESIGN PHILADELPHIA, PA

BRITTANY EWING
NICHOLAS WILLIAMSON

Figure 1: Perspective of Walnut Building

ABSTRACT:

Crime and Punishment Brewery is a microbrewery located in Brewerytown, Philadelphia. Their theme derives from Russian influences and namely, the book Crime and Punishment. This unique concept creates their own niche, distinguishing them from the other breweries in the area. The goal of this project was to create a facade that was just as unique as the brewery itself. Tasked with three different site locations each ranging in scale and shape, it quickly became a challenge to consider how to adapt one design to multiple facades. The existing Crime and Punishment brewery has a industrial style, mixed with the flair of Russian influences and the history of Brewerytown itself. The namesake book has a very dark and moody tone, and this influence is reflected in the aesthetic of the brewery. These characteristics helped to inspire the facade design. Through an abstraction of the brewery's logo, a Russian mandala, multiple pattern designs were developed. These patterns were layered to create a screen system, which in turn created an atmosphere specific to the brewery. The facade has three layers: an outer screen, a fritted glass system, and an inner screen. Specific apertures are taken out of the facade to highlight circulation and public spaces. The rest of the facade maintains the original brick. The screens are made of iron to continue the industrial aesthetic. With the layered screens on the facade, a unique shadow effect is cast on interior of the brewery while adding intrigue to the exterior look.

PROGRAM: MICROBREWERY:

By researching each site represented in Figure 3, the design development for each microbrewery was based on the demographics of the respective surrounding areas. All three sites possessed people of corresponding ages, incomes, or genders in which a microbrewery would succeed (Figure 2).

The "real life" client of the brewery, Crime + Punishment, was chosen based on the size and style of the brewery. The project was proposed as three potential levels of expansion for the brewery. As it currently stands in the basement and first level of a mixed-use townhouse style building in Brewerytown, Philadelphia, the three buildings have enough space for multi-level expansion.

The programing of the buildings allowed for the addition and subtraction of varying types of programs as deemed suitable for the amount of space available per building.

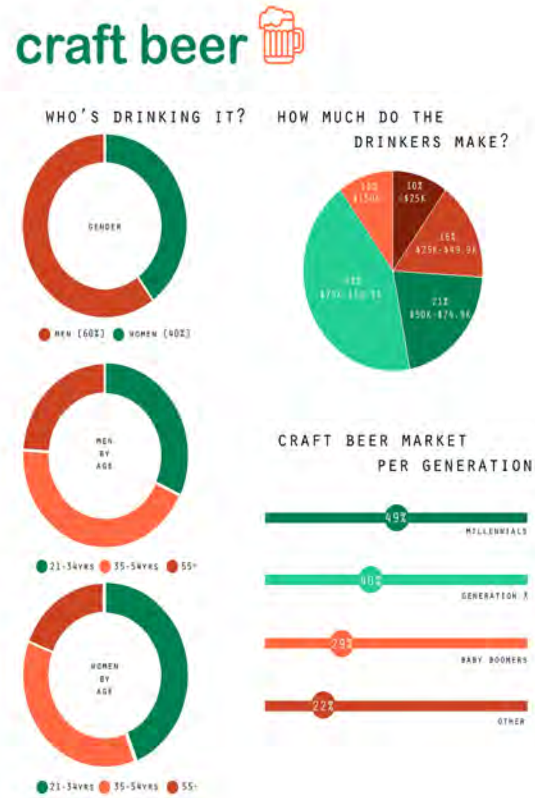


Figure 2: Craft Beer Infographic

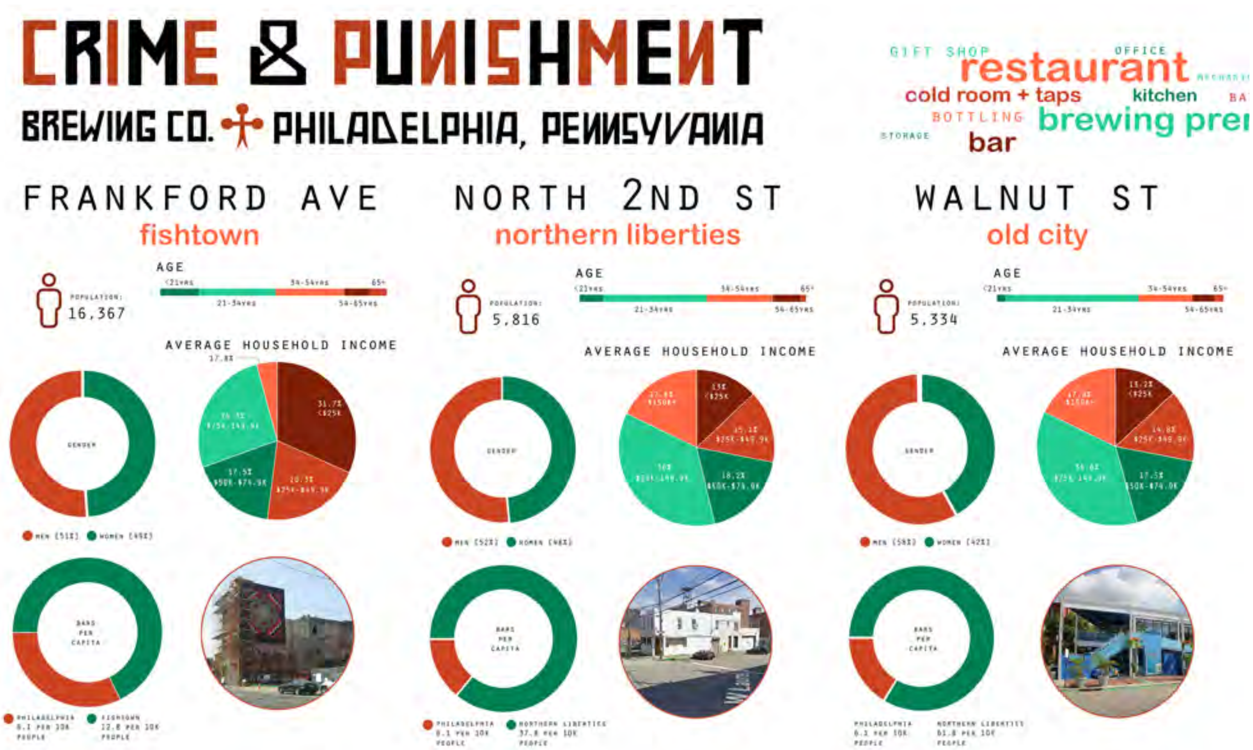


Figure 3: Neighborhood Infographics

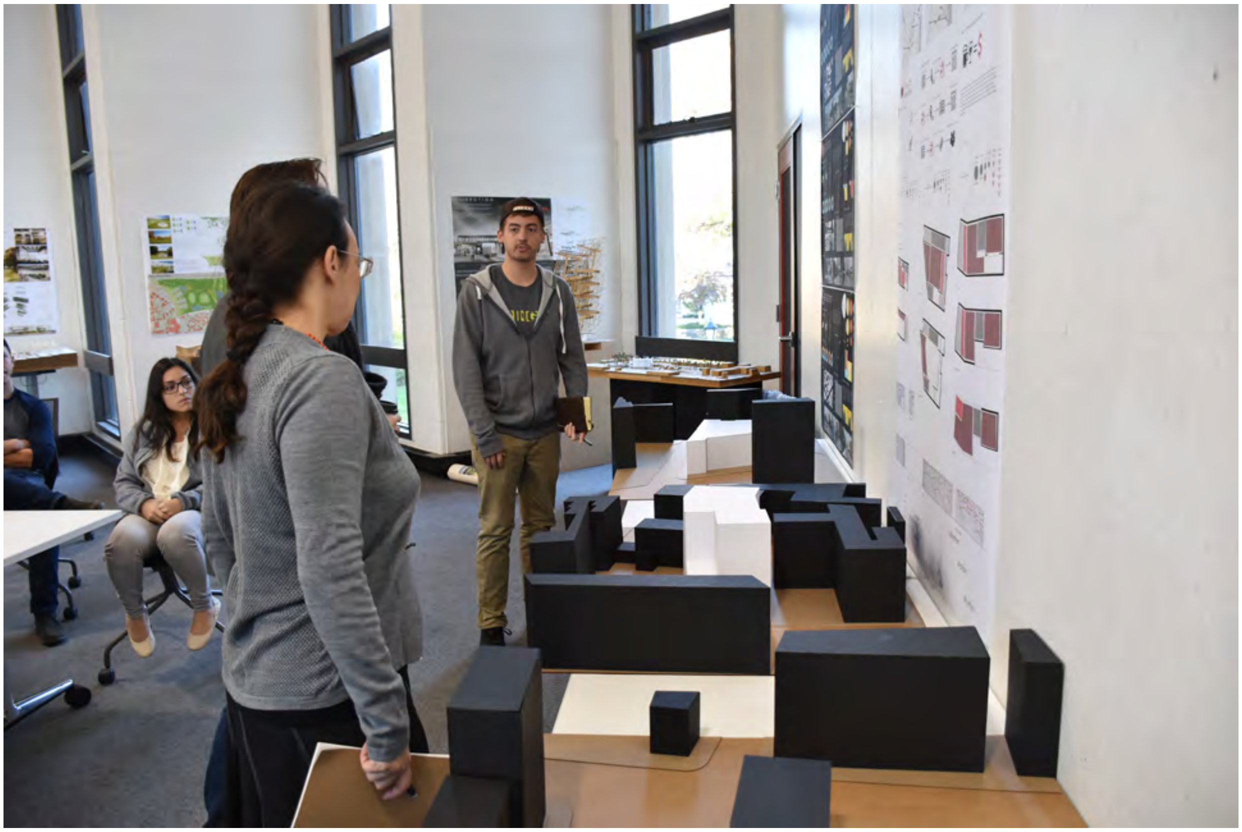


Figure 4: Initial Design Review (top); Fermentation tanks in Crime + Punishment (bottom)

INSPIRATION:

Crime + Punishment serves craft beer in the Philadelphia area, currently residing in Brewerytown, Philadelphia. The microbrewery was found by Mike Wambolt and serves unique, originally named beers to the area. Crime + Punishment's aim is to blend local brewing with newer craft techniques and international inspirations. The brewery currently has a rotating menu of distinctive brews and Russian-influenced dishes done their own way.

The style, influences and name of the brewery come from the book *Crime and Punishment* by Fyodor Dostoyevsky, with overarching influences from Russian literature. These themes inspired and influenced the overall design of this project.

CONCEPT:

The overall goal of the design was to manipulate light as it passes through multiple layers of the facade, creating a shadow and light effect to exude a specific mood. The following quotation from the namesake novel captures the desired sentiment of the project: “It’s the moon that makes it so still, weaving some mystery.” The book’s plot revolves around a man’s horrible crime of murder, which leads to his ultimately self-imposed demise. The man moves through multiple stages of regret and anguish, losing his sanity in the process. The design concept aimed to capture and replicate the book's dark and eerie overtones, namely through the shadow effects of the multi-layered facade seen in Figure 5.

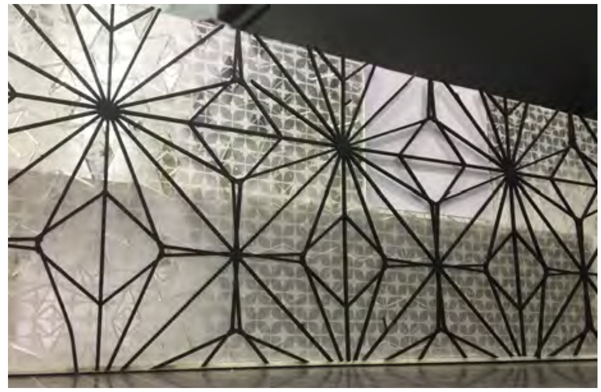
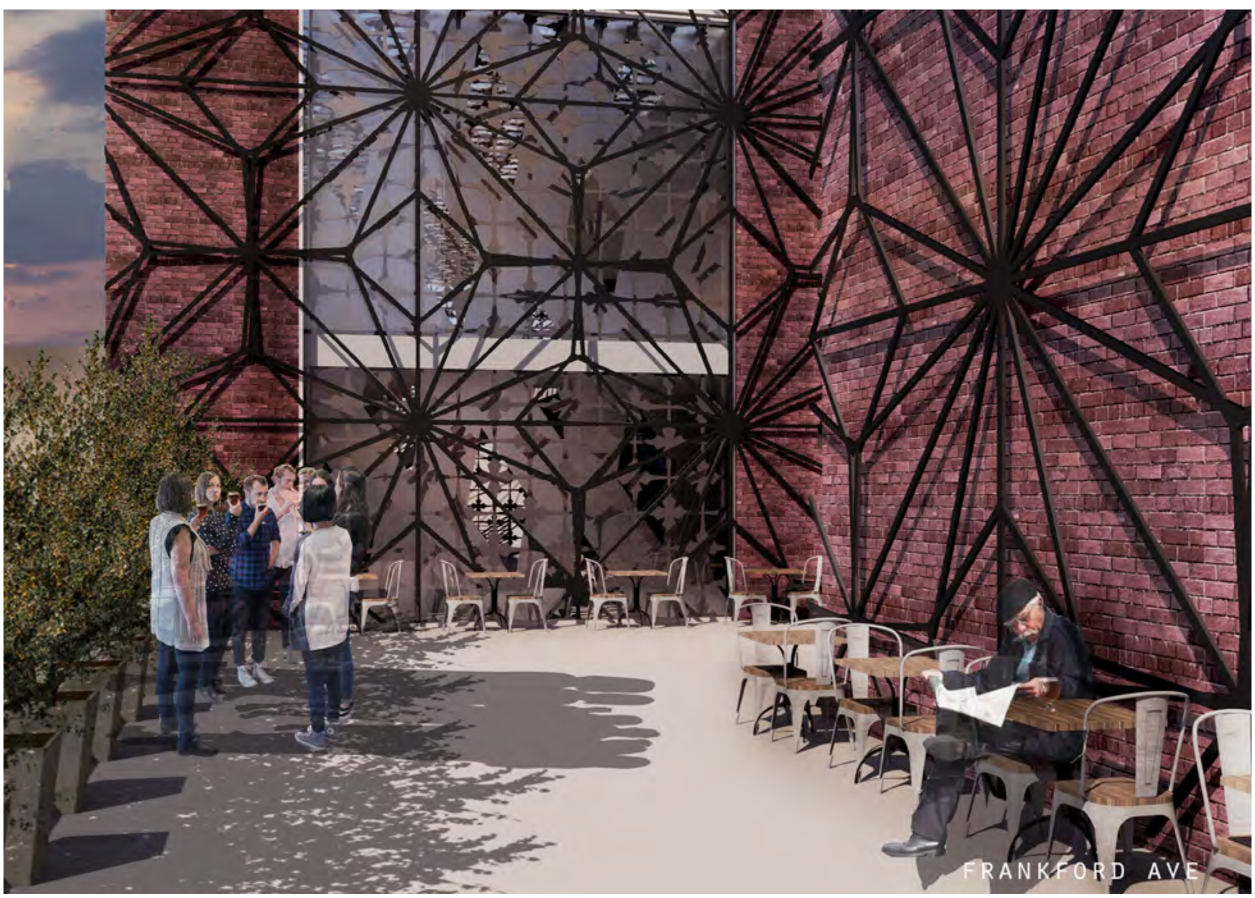


Figure 5: Interior Perspective of 2nd St (Top right), Interior Perspective of Frankford (Right), Rooftop Bar of Frankford (Below)



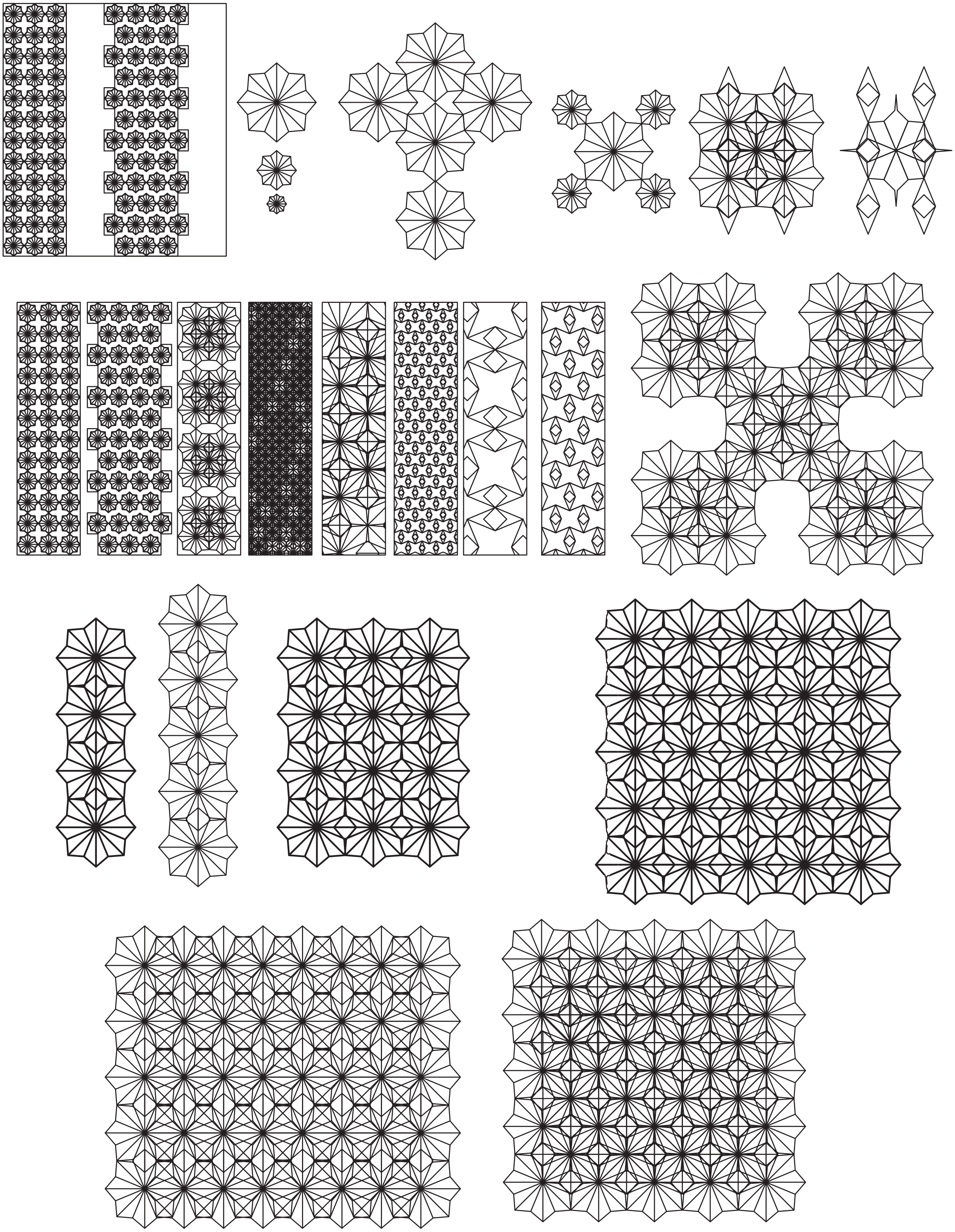


Figure 6: Pattern Iterations based off the Mandala

PATTERNS AND ITERATIONS:

In order to further promote the brewery's brand, with the goals of expansion and continuity in mind, the Crime + Punishment logo (Figure 7) was used to develop the design and patterning of each facade layer. The mandala design, which is seen throughout their current cafe-style brewery and merchandise, was abstracted and simplified to form the mandala's axes. This was then used in multiple patterning iterations and designs.

The iterations began in the simplest forms of quilting-like style, which then evolved over multiple iterations seen in Figure 6, diverting from one pattern to another be means of scale, overlap, and weaving. The patterns and designs were then taken and abstracted further into the shapes and solid-versus-void moments of the previous patterns. As each pattern progressed in complexity, a simple abstract form emerged.

The final patterns in Figure 8, 9, and 10 were then tested in different scales to determine the scale and arrangement of each pattern in the layered facade system.

Figure 7: Crime + Punishment Logo

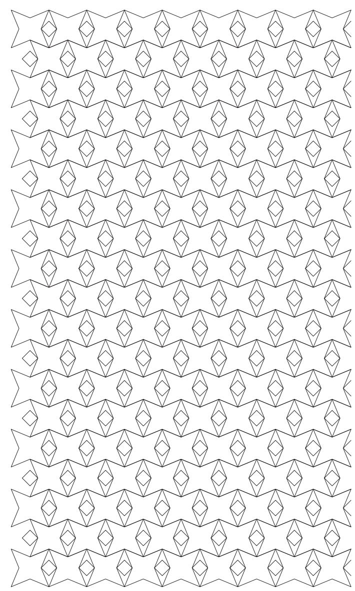
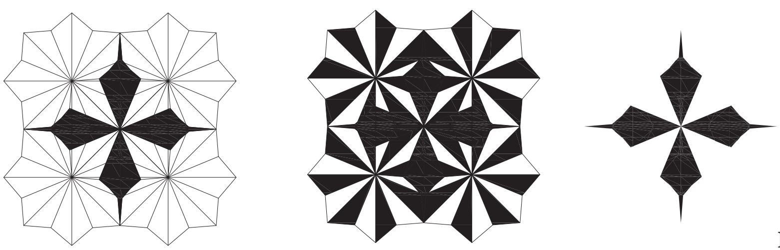


Figure 8: Final Glass Panel Iteration



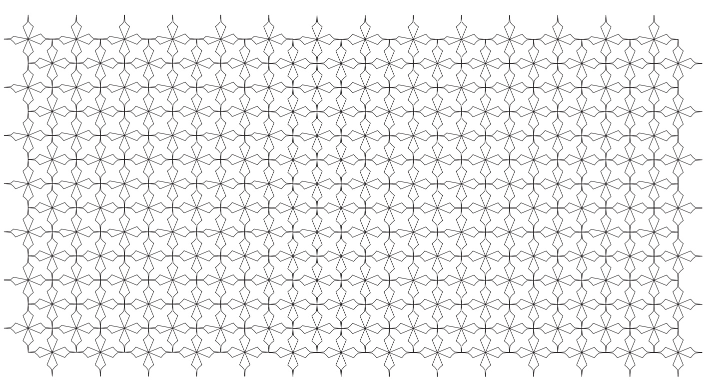


Figure 9: Final Interior Screen Iteration

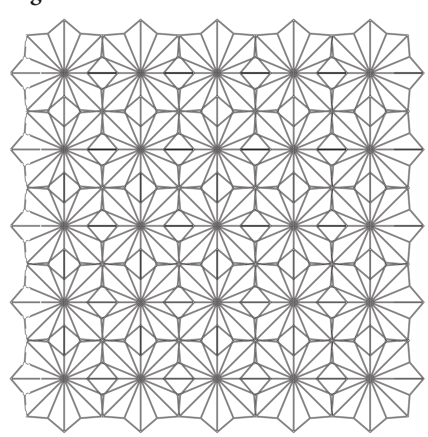


Figure 10: Final Exterior Screen Iteration

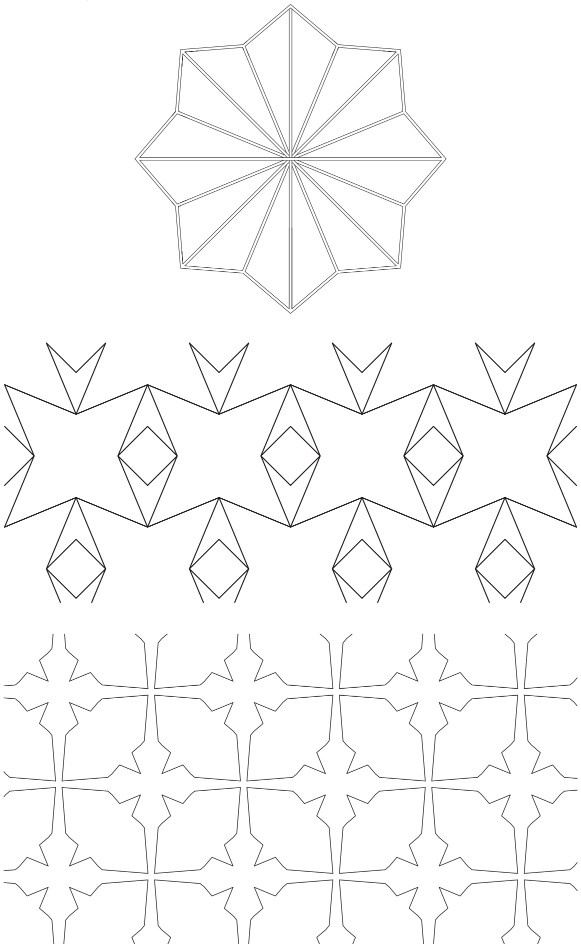


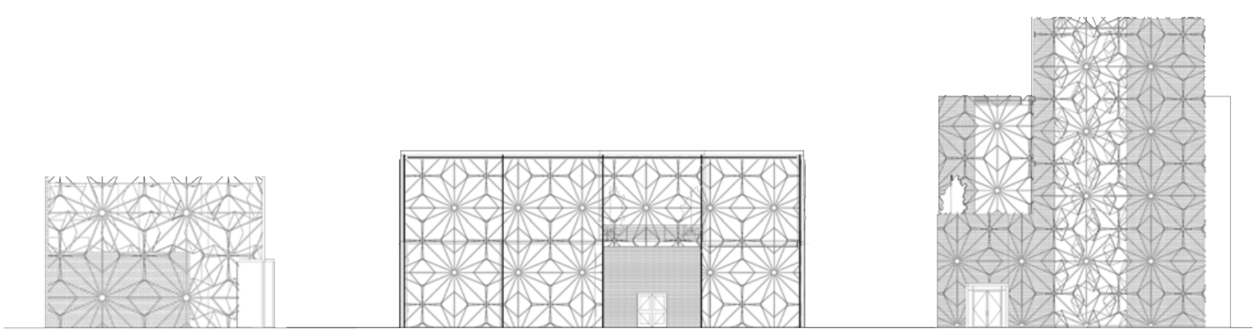
Figure 11: From top to bottom: Outer Screen, Fritted Glass, Inner Screen

FACADE LAYERS:

The facade of the Crime and Punishment brewery is a three skin system. There is an outer screen, a glass facade, and an inner screen (Figure 11). The glass facade and inner screen were attached only in areas where the existing facade was strategically cut out. The outer screen is continuous with all usable facades. Each layer has its own scale and unique pattern. Each pattern is a deviation from the original pattern of the company's logo. When overlapped, the different layers of the facade create a shadowing effect on the interior of the brewery. These elements collectively create a mood within the interior and exterior of the building. This design, coupled with the materiality further distinguishes the brewery from the neighboring buildings, giving it a recognizable presence. Both the exterior and interior screens are made of iron which adds to the industrial feel of the brewery. The glass facade is designed with mix of frosted patterned and translucent glass.

CONSTRUCTION OF THE FACADE:

The inner screen is bolted to the concrete floor plates using ninety degree angles and concrete screws. In Frankford where it continues onto the roof, it also bolts to the roof where pieces of it hang from the ceiling. The glass panels are spider clipped to the floor plates and structure of the building. They suspend out past the floor plates leaving a small opening for light to shine through from floor to floor. At night the space is able to be illuminated to show the patterning in the dark. The exterior screen is more complicated that the rest. It varies in attachment based on the building. In Frankford and 2nd Street, there are mullions that either run vertically



or horizontally along the front face of the glass panels. The exterior screen is bolted at the corners of each individual panel to extensions that come out from the mullions. On Walnut though, the screen is completely detached from the rest of the system and is bolted to the structure grid that hangs out past the facade of the building. All this can be seen in the 1:1 Model in Figure 12 and the Wall section in Figure 13.

Figure 12: 1:1 Scale Model of Facade

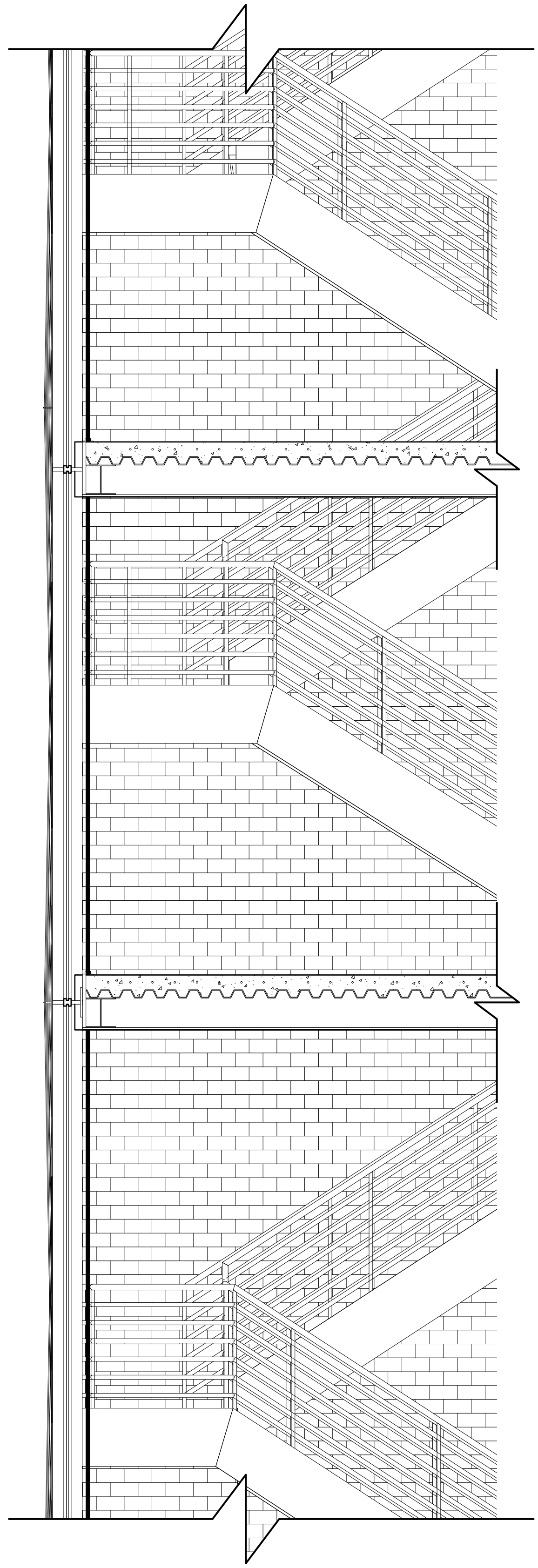
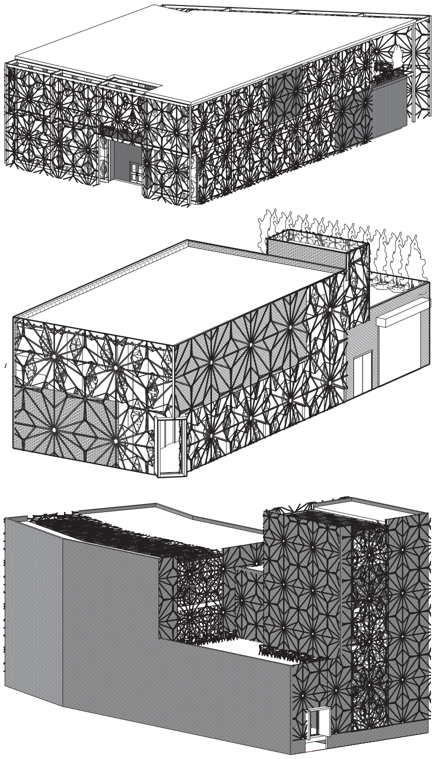


Figure 13: Wall Section of Frankford building



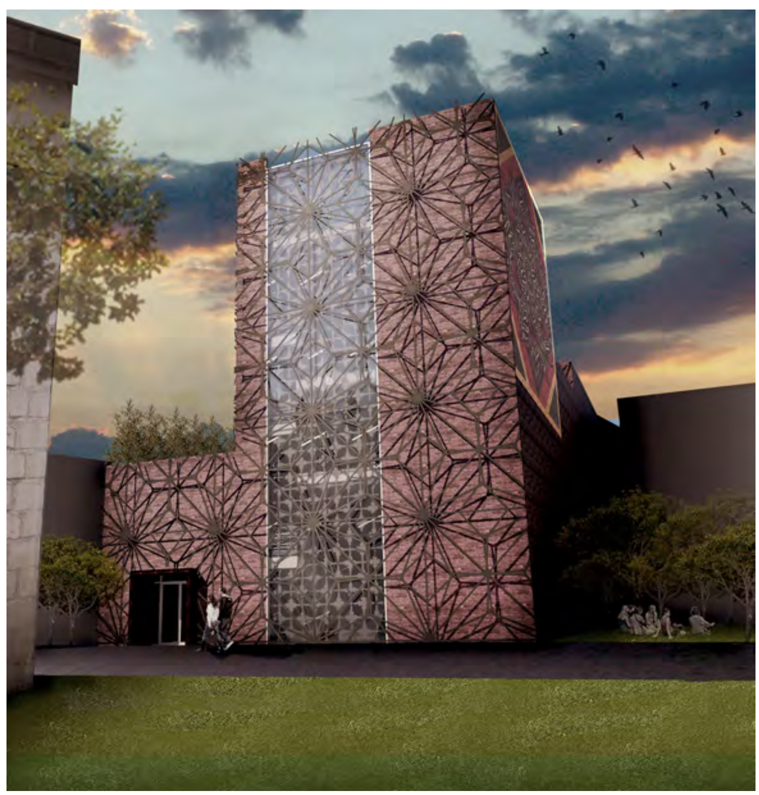


Figure 14: Building Axons w/ Facade

Figure 15: Perspectives and Building Elevations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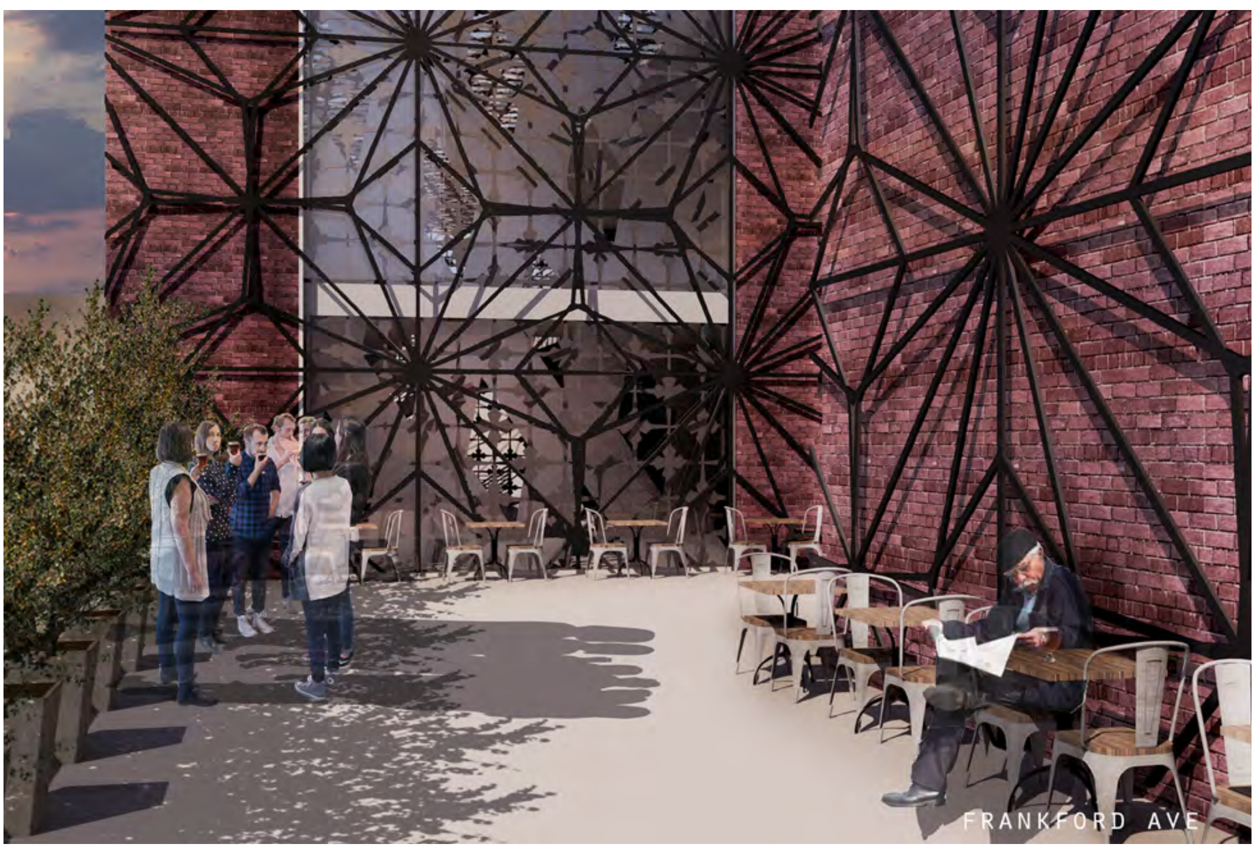
FRANKFORD AVE

REFLECTION:

This project presented many challenges to us, with a real life client, along with the site limitations and the constraints put on us through our concept and inspiration, we were able to iterate through many different designs solutions and ideas that could help us reach our goal. While we sought to design a certain mood, we were also constrained by our clients and their overall style and intent of their brewery. While we feel we fell a little short of the mood we were trying to create, we feel we were able to keep the design style and integrity of the brewery and how they wished to present themselves as a business.

Though our project did not involve textiles directly, through patterning exercises and different uses of a weaving effect, we were able to incorporate textile techniques to develop our project. We used a layering technique along with different patterning and quilting effects in combination with multiple scales of pieces that weaved together to create our final design. Even if the ideas were only hinted at or taken from as inspiration, a lot of the research done this semester has greatly influenced the final design.

REFLECTION:

The goal of this project was to utilize a patterning and layering technique to create a certain mood, all the while keeping the constraints presented to us by our clients and their overall style in mind.

This project presented many challenges to us, with a real life client, along with the site limitations and the constraints put on us. Through our concept and inspiration, we were able to iterate through many different designs solutions and ideas that could help us reach our goal. While we sought to design a certain mood, we were also constrained by our clients and their overall style and intent of their brewery. While we feel we fell a little short of the mood we were trying to create, we feel we were able to keep the design style and integrity of the brewery and how they wished to present themselves as a business.

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BIOLOGIC: ADVANCED RESEARCH IN EXPERIMENTAL TEXTILE STRATEGIES FIELD RESEARCH CENTER

CRYSTAL BROWN
JACK ROGERS

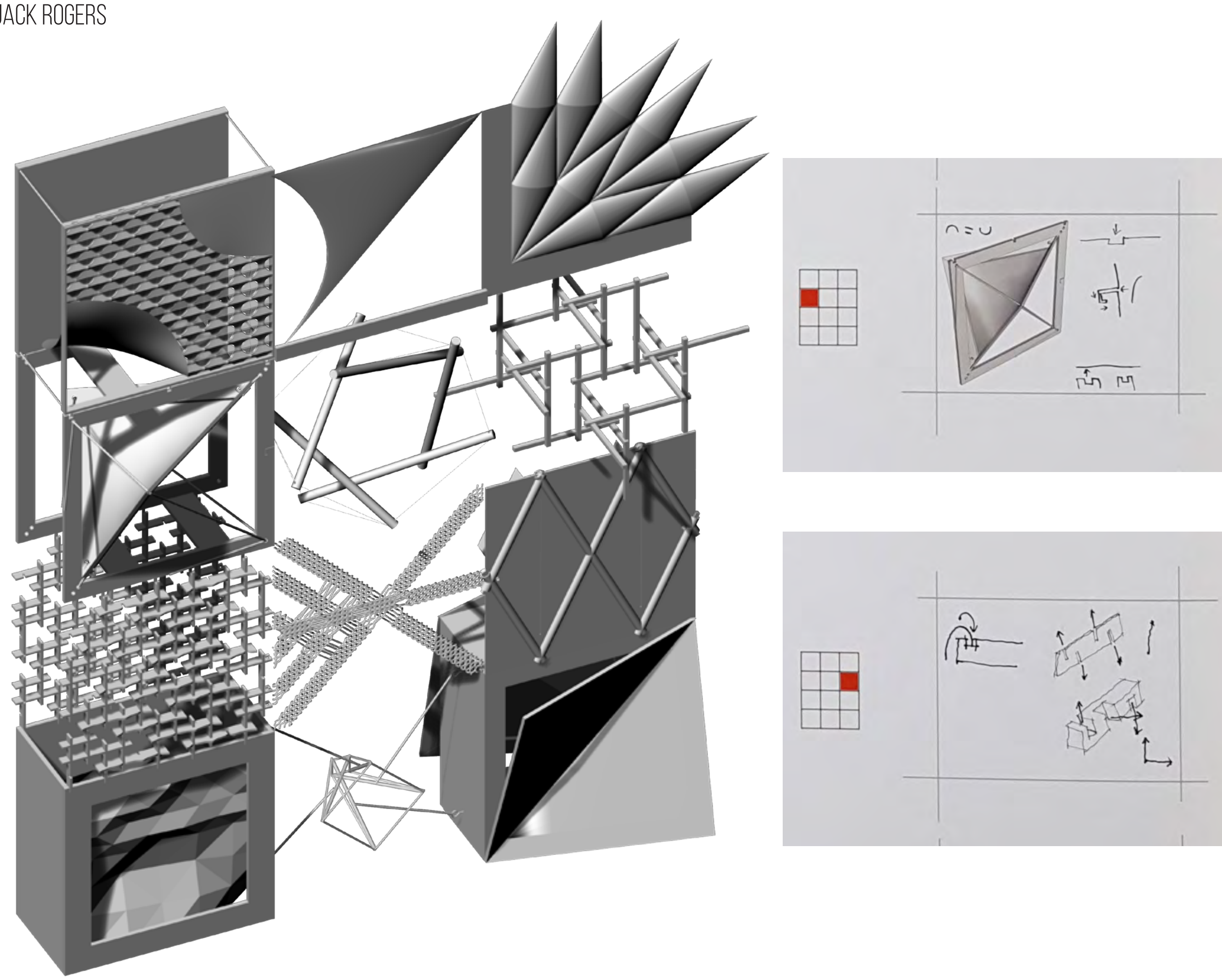


Figure 1: Wall Facade Digital Model and Concept

ABSTRACT:

In continuation of the previous project the groups were broken up to design one foot by one foot modules for a three foot by four foot wall. The objective was to create twelve independent modules as seen in Figure 1 and 2. These modules were based on each team's most inspirational concept from their textile research and they were then tasked to reinterpret it. This project led into the next project by furthering and sharing each team's research and inspirations to provide new knowledge for the newly formed final project groups. This project intended to be a conversation starter for the group to find possible connections or inspiration and begin research for the next project. The concepts chosen by each team for this project were reciprocal structures and inverse surfaces. Each member designed a module and, as a class, collectively arranged the wall according to the compressive and tensile structures seen in the top and middle photos of Figure 2. These designs were used as a starting point for the final project.

Figure 2: Wall Facade Presentation

ABSTRACT:

In order to further analyze the relationship between textile strategies and the built environment, the team was tasked with designing a facade retrofit for an adaptive reuse project. Three existing buildings at different scales were chosen in various Philadelphia neighborhoods to be repurposed. 1228 Left Street, 212 Walnut Avenue, and 939 North 2nd St were analyzed at various architectural scales and the teams found that each site had different topographical conditions and buildings. Existing program, site, building, and surrounding zones were all examined in Figure 3. Chamber is a design that resulted from this research. The program was a live music venue that would be implanted into these three buildings. The concept was closely linked to the aspect of performance and derived from stage curtains. The main driver of the design was sound, generated from the performances inside the venue. The exterior screen responds to the density of sound generated on the facades and rotates to create views to the interior and exterior of the venue.

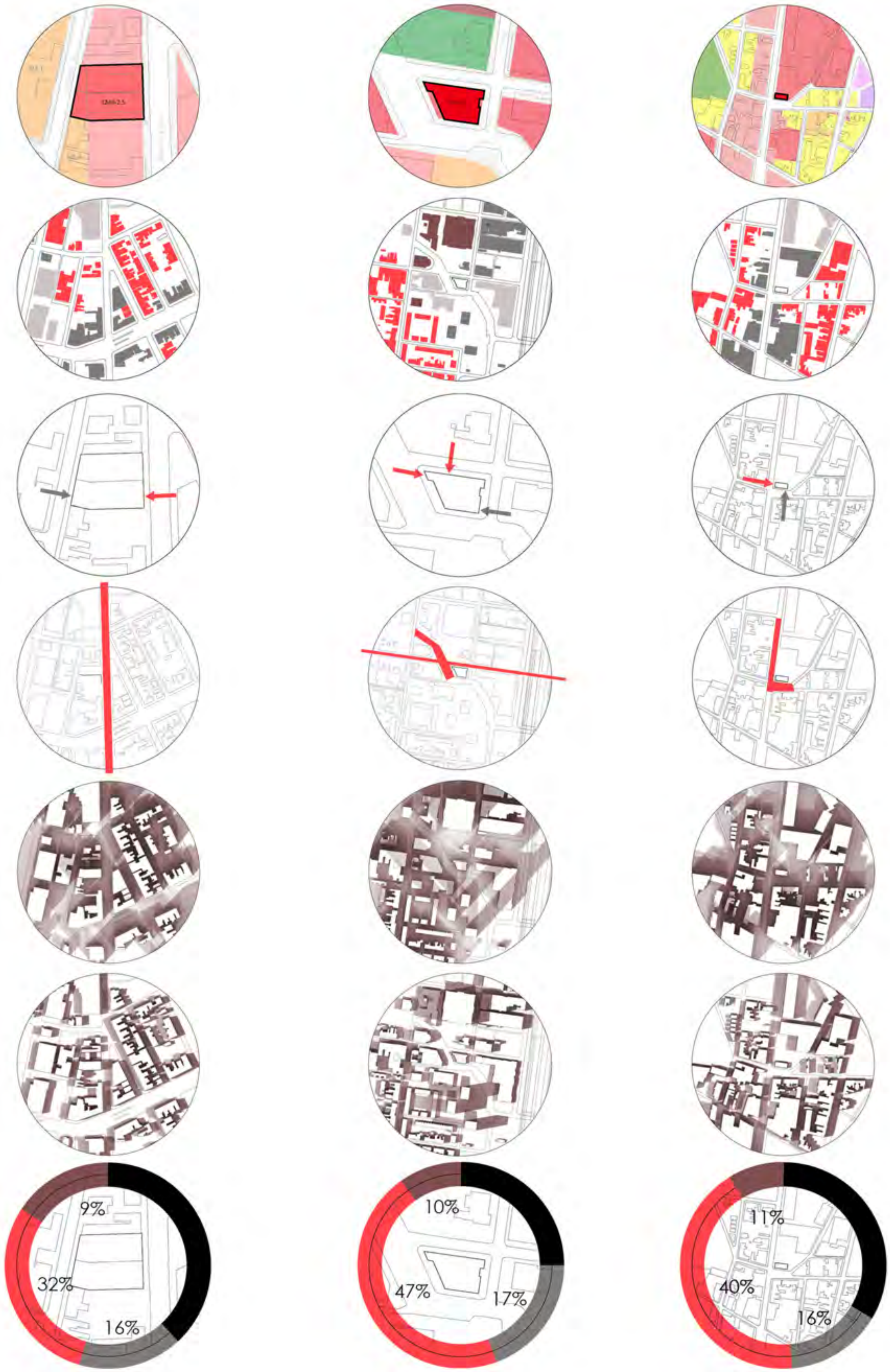


Figure 3: Site Analysis

PROGRAM NEIGHBORHOODS:

Fishtown, Northern Liberties, and Old City were the three neighborhoods where the existing buildings were located, as shown in Figure 7. Philadelphia is the number one live music city in the country. Many genres of music are popular within the city. After analyzing each neighborhood, the team found that there was a prominent amount of venues, where artists could perform, as seen in Figure 5. However, there was a lack of venues that appealed to local artists. The existing venues appeal to larger mainstream artists. Chamber seeks to the change this the aspect of Philadelphia. The intent was to create venues at each location that would provide performance space for local artists. This would help to inspire local bands and artists, while also creating a new entertainment venue for the surrounding neighborhoods. Each venue would have similar programmatic schemes, seen in Figure 8. While the music performances would primarily be hosted during the evening, each building could be occupied during the day for various daytime programs, such as art and design exhibitions or other gala functions.

Figure 4: Top Live Music Performance in Philly

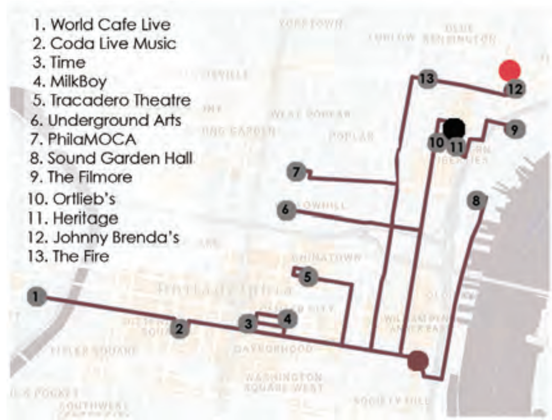
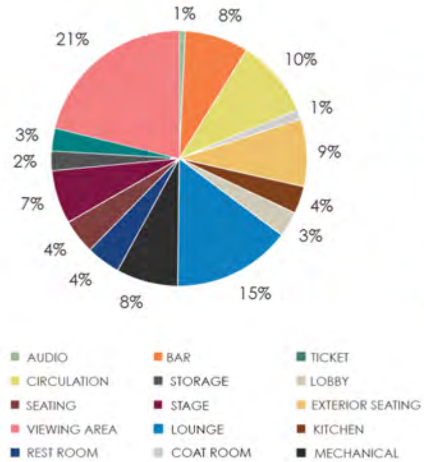
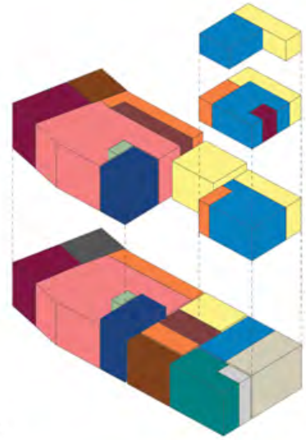
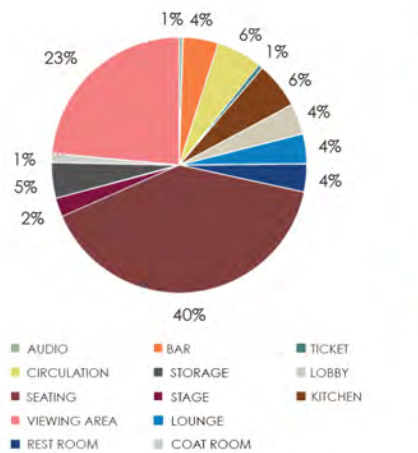


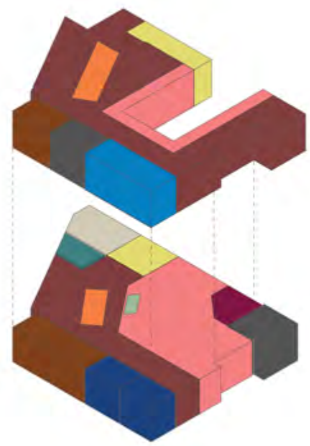
Figure 5: Site Relation to Local Music Venues

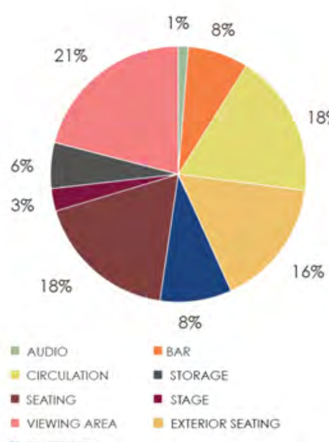
Figure 6: Site Analysis and Program Study Presentation











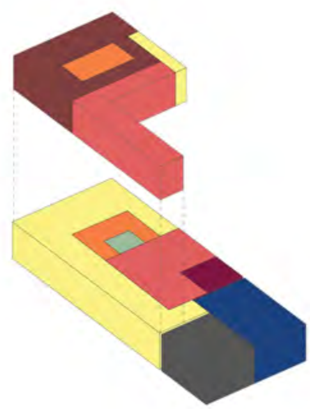


Figure 7: Existing Buildings Top Down: 1228 Frankford Ave., 212 Walnut Ave., and 939 N. 2nd St.

Figure 8: Program Percentage and Massing

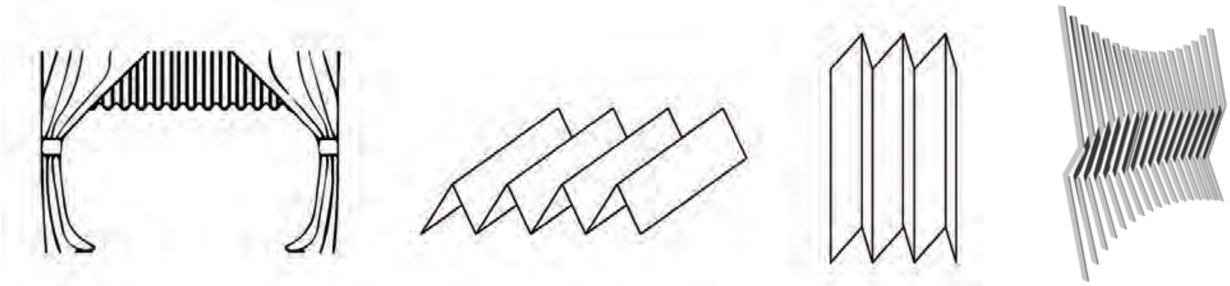


Figure 9: Performance and Pleating Concept

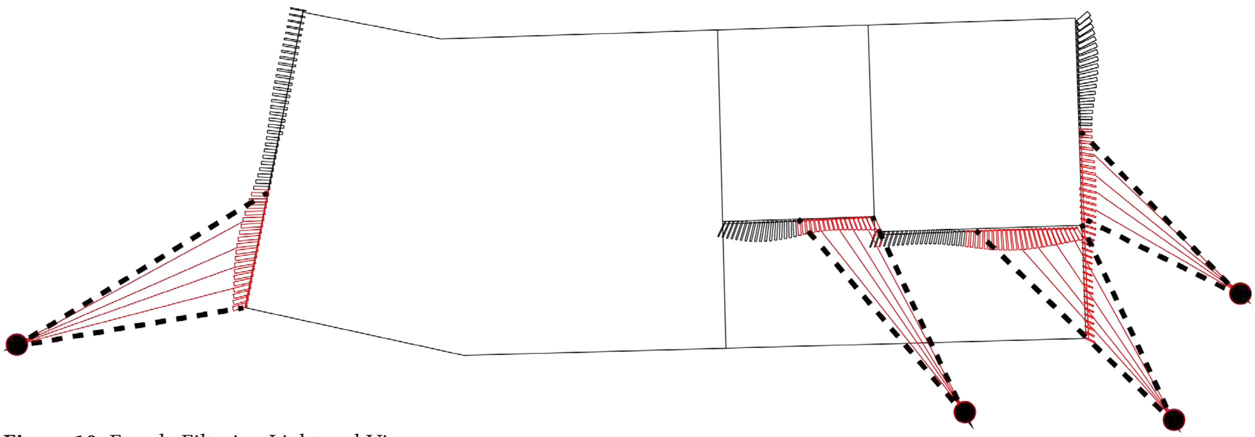


Figure 10: Facade Filtering Light and Views

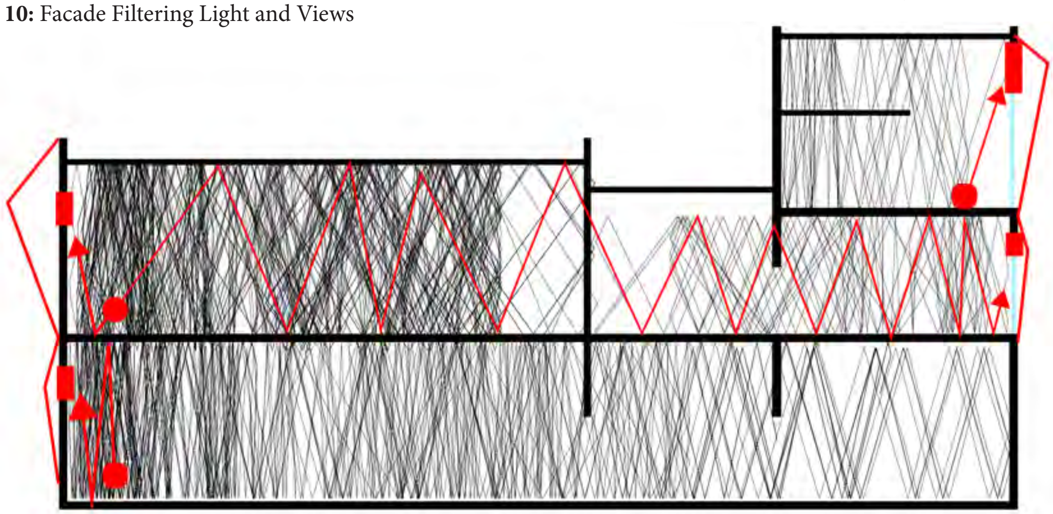


Figure 11: Facade Reaction to Sound Study

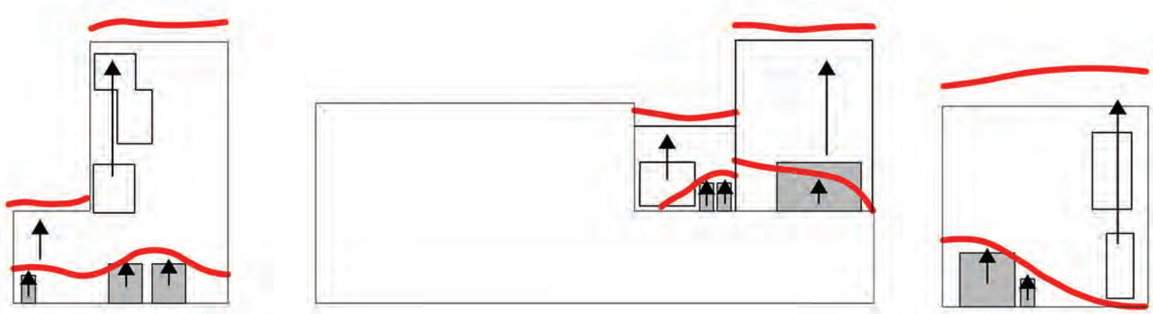


Figure 12: Facade Strategies

CONCEPT IDEAS:

The main idea of this project was to link the retrofit closely to an aspect of performance. Inspiration was then taken from stage curtains, which are used in order to increase sound quality within performance venues. The technique used to achieve this is called pleating, which is shown Figure 9. The team research pleating to understand the way other venues combat sound through various folds of the curtains. Pleating was implemented through the use of undulations on the facade, which is seen in Figures 14 through 16. This was achieved by utilizing louvers that are bent at different points. Louvers would also aid the design in filtering both views and light, as seen in Figure 10. Since sound was huge drive of the design, the facade needed to react to this element. Louvers would become parallel with the exterior wall, where sound waves would be the most dense. The louvers would also repel and become more perpendicular with the exterior wall, where the sound waves are the least dense in order to create a "chamber" of sound, this is shown in Figure 11. This aspect of the design would also inform where openings and windows are placed along the facade, as seen in Figure 12. Stage curtains also create a reveal aspect to the stage. The team wanted to created a reveal factor to the interior of the building through the use of large openings that would mimic garage or large swing doors. A relationship was created with the floor plates and roof by utilizing these as connection points for the louvers. This would enforce the vertical undulation direction, as well as the horizontal direction, as shown in Figure 13.


Figure 14: Frankford Facade


Figure 15: Walnut Facade


Figure 16: North 2nd St. Facade

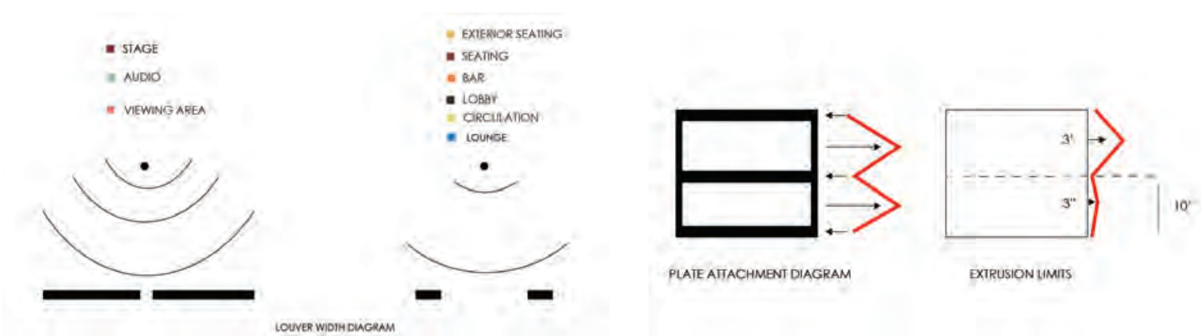


Figure 13: Facade Conditions

DIGITAL DESIGN METHODS:

The use of various digital design methods were used during the process of Chamber. Grasshopper, which is a parametric design plug-in for Rhinoceros 5, allowed the team to simulate sound waves and their reflection in order to visualize the sound density of the each building's exterior walls, as seen in Figure 17. The average of these points was then taken and an attractor point was used to define the "chambers" of the exterior screen. Grasshopper also allowed the team to define the inputs and create a reaction of the façade, such as views and undulations. A combination of Autodesk, Revit and Rhinoceros 5 were used to create building plans sections, and elevations, shown in Figure 18. These programs were also used to create plans to laser cut for scale models.

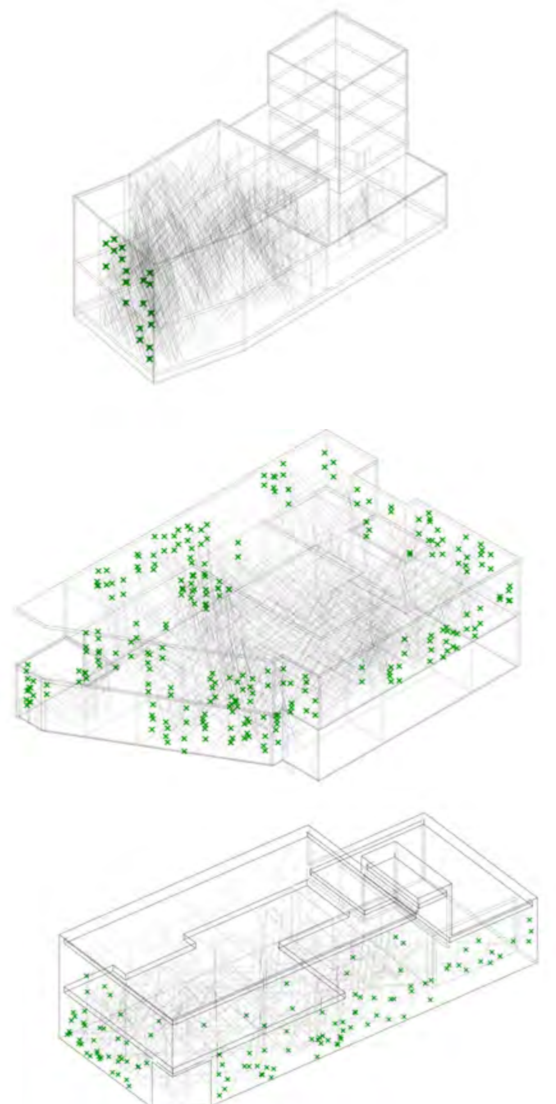


Figure 17: Mosquito Plug-in/ Study of sound travel within designed spaces

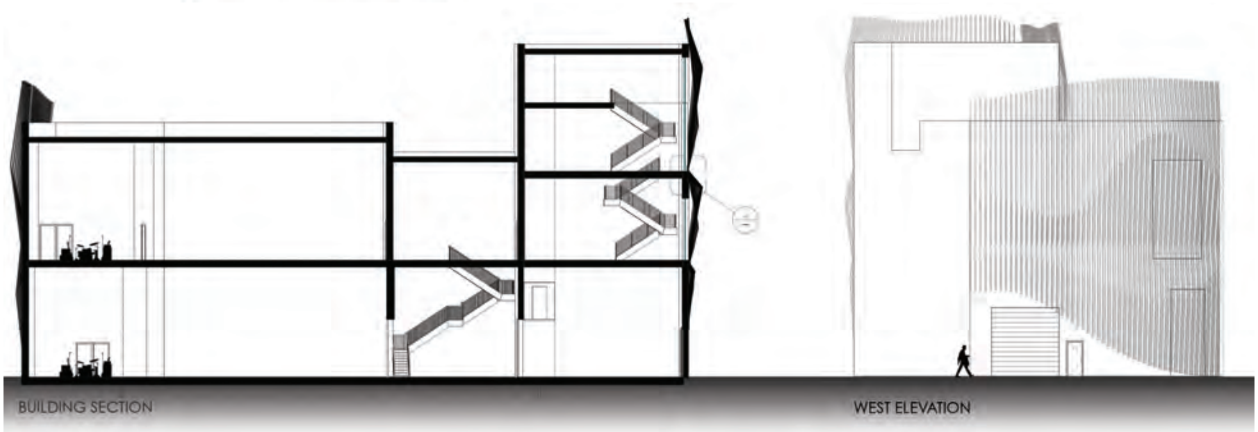


Figure 18: Fankford Plans, Section and Elevation

CONSTRUCTION AND ASSEMBLY:

In order to ensure that the acoustic level would not disturb a number of surrounding sites, research was done to study architectural techniques that are used to combat noise and sound. The main idea was to create a "box within a box" because the more air between surfaces allows the less sound to travel through the wall assembly. The exterior walls would be made up of acoustic insulation and a large air gap to combat sound, as seen in Figure 19. Originally, the finish of the exterior walls was brick, however, this would be replaced by a slate cladding system to achieve the most color and textural contrast, along with the wooden louvers. The connection between the floor plates, roof structure, and louvers needed to be solved. It was decided that a bracketed connection from the louvers to the structure would be implemented on the facade. This would then affect the cladding system because a long horizontal seam would need to be placed along the connection points. Flashing would then be required to decrease water penetration on the facade assembly, as seen in Figure 20.

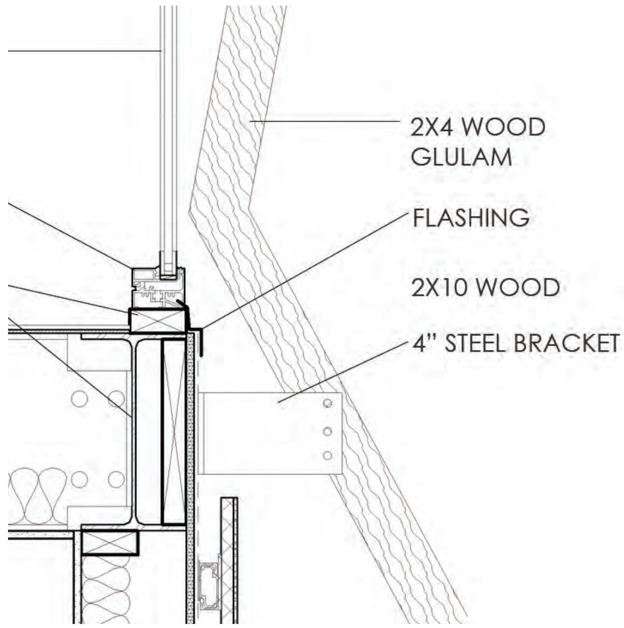


Figure 20: Louver Connection Detail

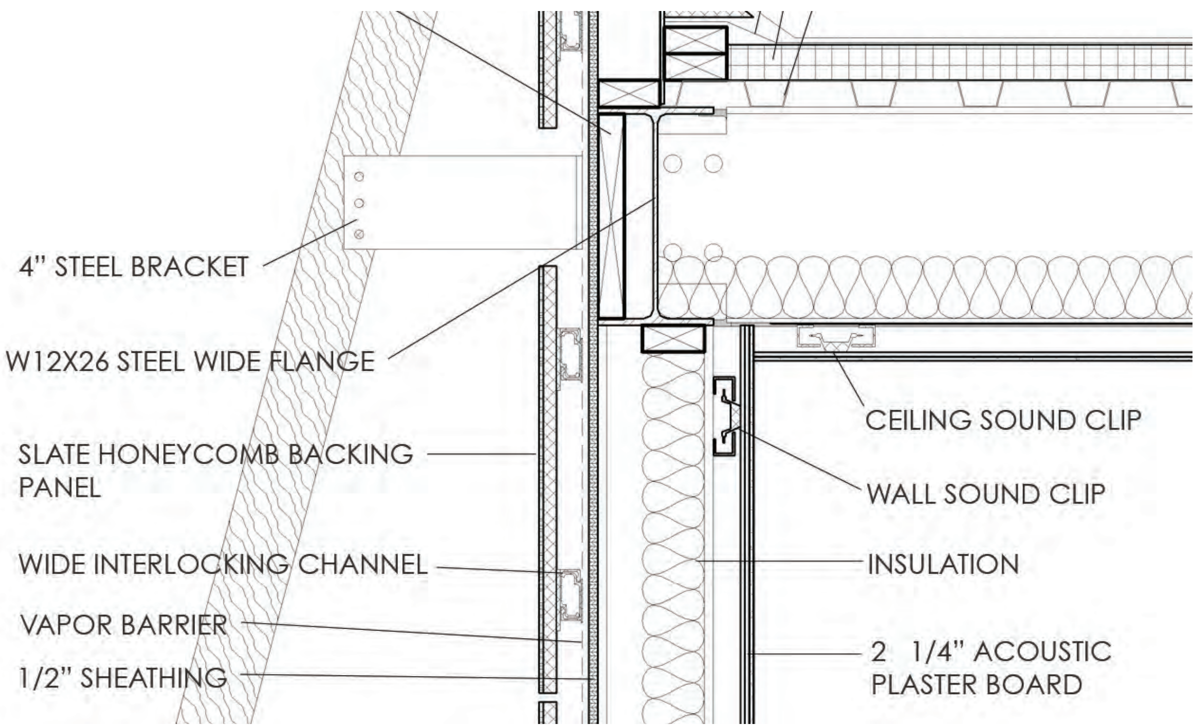
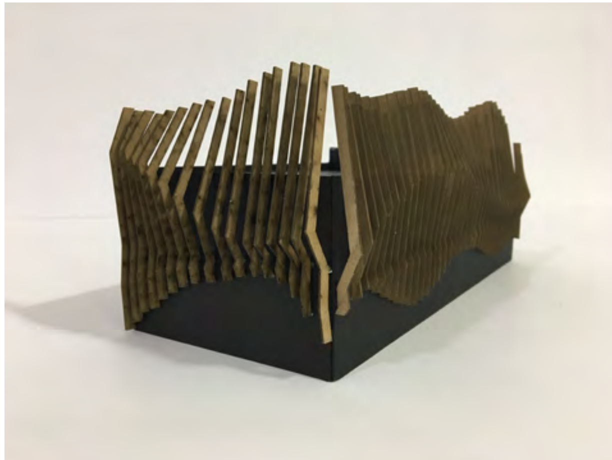


Figure 19: Connection Detail to Soundproof Ceiling and Wall



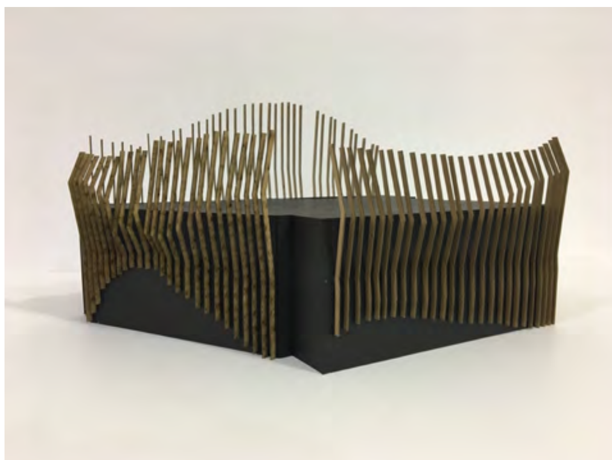


Figure 21: Final Massing Models

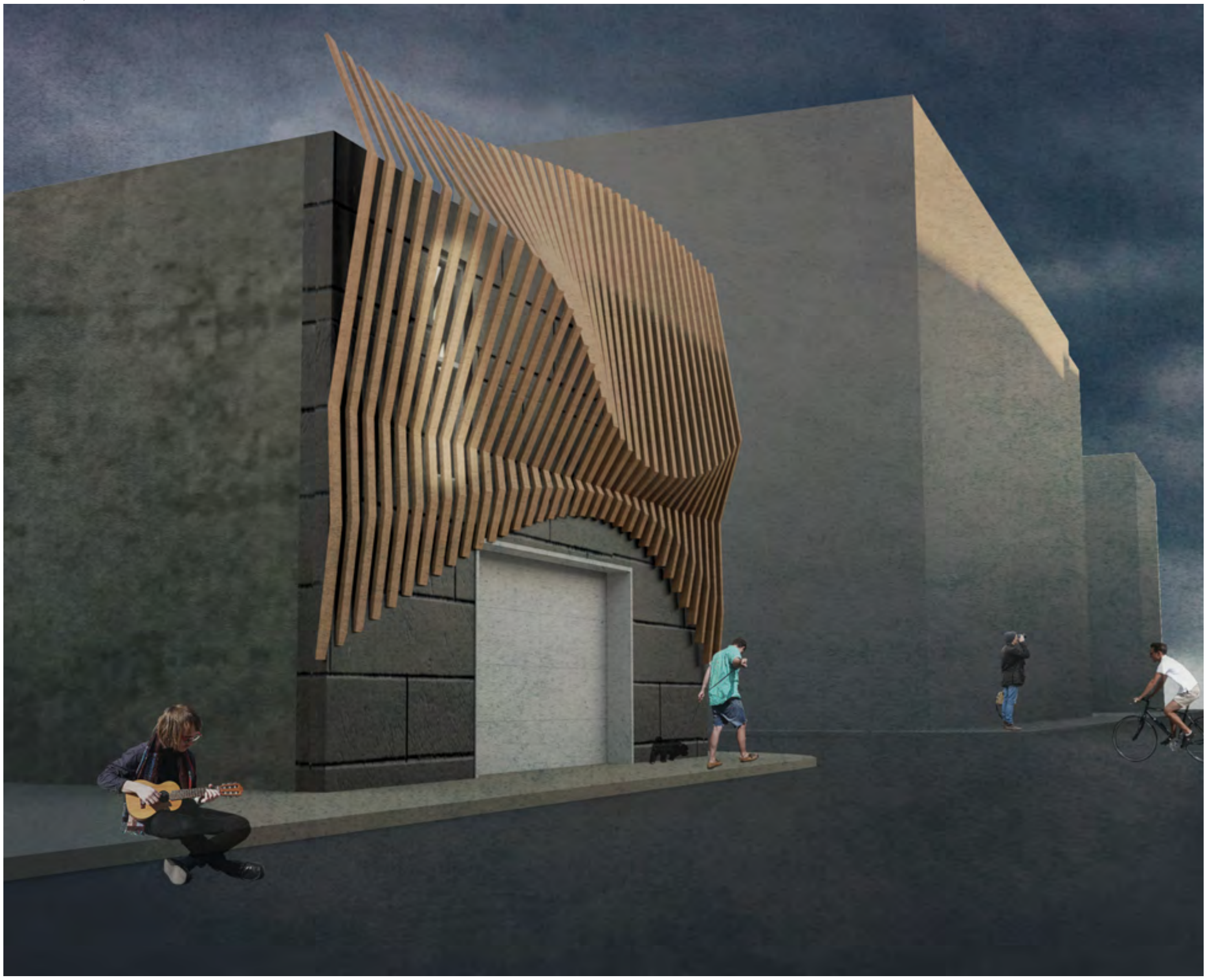


Figure 22: North 2nd St. Final Rendering

Figure 23: Final Presentation

REFLECTION:

Chamber involved the design of a building part that sometimes is never really designed, but rather informed. This process was long and required many aspects of research to be delved into in order to make decisions. This project helped us realize that facades are a very crucial component to every design as they are what occupants and user perceive first about a piece of architecture. It was questioned how we may make this design a more integrated part of the building itself. Nevertheless we felt that our process and our design was strong, and the amount was enough to enforce our design decisions.

REFLECTION:

The goal of this project was to actively design an aspect of the building which is usually never designed but rather imformed, i.e. the facade.

Chamber involved the design of a building part that sometimes is never really designed, but rather informed. This process was long and required many aspects of research to be delved into in order to make decisions. This project helped us realize that facades are a very crucial component to every design as they are what occupants and user perceive first about a piece of architecture. It was questioned how we may make this design a more integrated part of the building itself. Nevertheless we felt that our process and our design was strong, and the amount was enough to enforce our design decisions.

PRACTITIONER INVOLVEMENT

THOUGHTS ABOUT THE STUDIO

RYAN LOHBAUER
STANEV POTTS ARCHITECTS

To share my experiences as a non-faculty practitioner participant in the Philadelphia University Interdisciplinary Design and Experimental Architecture Studio (IDEAS), I would like to express my thanks to the NCARB Award for the Integration of Practice and Education. From my perspective, it was a valuable and unique program that I hope can continue and serve as a model for other programs in the future.

The goals of the interdisciplinary studio were uniquely well suited to Philadelphia University, an institution with leading programs in both Textile Design and Architecture. The depth of technological resources available for the students led to interesting research and provocative ideas about textiles in architecture. Throughout the year-long program, my colleague Petra Stanev and I were tasked with providing a practicing professionals' perspective to the students.

Working closely with Professors Ku, Jordan, Weiss, and Godley (Faculty Project Directors), Petra and I helped develop a curriculum for the two semesters that allowed a thorough exploration of the interdisciplinary and professional themes of the studio. The design of the curriculum provided an excellent background to frame design issues as they relate to practice.

For the first semester, Petra and I spent our time working closely with the students through frequent desk crits and reviews. We led a week-long assignment based on a real-world architectural project, that focused on teaching design strategies within different cost constraints. We also made a joint presentation on how to think about architectural competitions, so that the work invested in them can help hone larger conceptual ideas employed in practice.

For the second semester, textile design strategies were at the forefront in their beginning assignments, as the architecture students worked with assigned textile students to learn in detail various fabrication techniques for textiles. They learned the intricacies in weaving, knitting and felting, and used this knowledge to design a temporary shelter. From the practitioner's perspective, real world structural constraints were important to communicate, as the properties of the textiles inherently constrained the students to unfamiliar architectural morphologies. As a result, the students worked intensely, with many models to test their ideas and find where their structures would behave differently than expected.

The last assignment of the final semester combined the material research with the challenge of urban redevelopment. Petra and I made a presentation outlining some of the common concerns and desires for many of our developer clients, and how zoning and building codes constrain how you can accommodate their aspirations.

Throughout this studio, Petra and I kept a focus on how the lessons presented by the assignments tie back into the real-world responsibilities of the architect. We presented specific responsibilities about professional practice that are sometimes overlooked in education (for example, how to read a zoning code). But we also highlighted broad concepts and attitudes that become useful daily tools as a professional, like how to ask questions to get to the heart of new material, or how to see possibilities for the application of new knowledge in unusual ways.

I am thrilled to have participated in this innovative curriculum. It was a pleasure working with Philadelphia University's excellent faculty. I also deeply enjoyed getting to know the students and listening to their visions for the direction of their careers. Being a part of this program required that I should be specific in my thoughts about what it means to be a professional. This allowed me the opportunity to reflect on my own philosophy of design and practice, and certainly helped me grow as an architect.

PETRA STANEV
STANEV POTTS ARCHITECTS

As a non-faculty architect practitioner who participated in Philadelphia University's Interdisciplinary Design and Experimental Architecture Studio (IDEAS), I share my assessment of this yearlong program and to express my strong support for the pedagogical approach it pursued.

The initial IDEAS curricular proposal was focused on enriching architectural education by exploring the power of fresh points of view. This ambitious undertaking aimed at harvesting the benefits of both interdisciplinary and intradisciplinary collaboration. In bringing together designers from different fields and on different professional paths, the proposal provided students with access to a broad range of perspectives focused on a common goal. My expectation that this would be beneficial to all the participants in ways pragmatic and conceptual was heartily confirmed. Additionally, the faculty team showed diligence, eagerness to collaborate and passion for this project that is a great credit to the team members and their institution.

My involvement was as described in the initial proposal. My colleague Ryan Lohbauer and I were closely involved in the architectural classes both semesters, with an especially strong presence in the second. During the Spring semester, we participated in desk crits, reviews and lead a week-long assignment based on a project which was also ongoing in our office. In the fall, we were closely involved in defining the project assignments and participated in the class weekly. Throughout the year, we gave presentations on how we would approach the student's assignment as practicing professionals.

This collaboration generated a layered range of benefits for all participants. It allowed the architects, both student and teacher, an intimate look at the process of two closely related fields. Product design and textile design work on a more precise scale than architecture. Focusing at that level is an important design lesson in the value of details and small iterations. It was also an important opportunity to start thinking about the value of material selection. During the fall term weaving exercise, the students had a first hand chance to see what a small change in the composition of their thread would do to a weave. Typically, it is difficult for students and young architects to grasp the importance of material qualities and interactions in architectural project detailing because they have not been exposed to much empirical study of the subject. Any opportunity to understand this concept is of great benefit to the built environment.

The presence of a design professional introduced a group of considerations that are not necessarily a part of the regular university curriculum and which, I believe, are very useful for the students to start familiarizing themselves with. They started thinking generally about budgets, different types of codes and client requirements that may not at first pass be beneficial to the project's aesthetics. These unavoidable constraints face the professional practitioner with each project and if not well addressed, can have a dampening effect on the quality of design. However, familiarity with their existence and mastery of their intricacies are essential to the production of fine architecture. Students should at least have a passive understanding of them in order to have a smooth transition from school to work.

I think it was also useful for the students to have a consistent non-faculty architect's input for the semester so that they can see that academic and professional approaches are not so dissimilar. We, practitioners and faculty, strongly encouraged them to think innovatively. Our goal was to give guidance as to how to achieve their conceptual design goals without ignoring real constraints.

From a practitioner's point of view, there were also many types benefits to participation. From a practice management perspective it gave me, the principal of a small firm, a strong understanding of the abilities of recent graduates and also of their goals in trying to prepare their resumes for interviews. There is some disconnect between what graduating students think strengthens their resume and what I look for in hiring for my practice. (We discussed this topic briefly in class and I hope that our conversation will also be helpful to the students in their job searches.) From a technical perspective, it was a chance to delve deeper into current thinking about façade design and to learn something about jacquard weaving. Additionally, giving students design critique on their projects was an outstanding opportunity to consider my own design process, priorities and presentation skills. However, by far the major benefit for me, was that I had a chance to get to know professors Ku, Jordan, Weiss and Godley better and to begin a collaboration with Philadelphia University that we all expect to continue in the future.

Overall, I believe that this collaboration was very successful and beneficial to all participants. IDEAS was a very ambitious undertaking and I think it would show even greater results if it can be sustained over a longer term. I think that the NCARB Award was an excellent SEED grant that supports innovation in architectural education.