Living Architecture: Time-Based Processes

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Architecture is for the living. What if it were also of the living? This paper will present discoveries made through a beginning design studio exploring productive exchanges between architecture and living agents. This is part of a broader field of research into *living architecture* which positions architecture as a living construct, ever changing with time. The building itself and one's experience of it continually change in ways that far exceed what architects typically anticipate. Our understanding of the work should not be solely about the object of the building itself—rather we should focus on architecture's greater role within an active ecosystem of people, living organisms, atmospheres, and environmental phenomena. These many agents animate the work in ways that are sometimes predictable, but often have surprising unforeseen effects.

This paper explores the theme of *living architecture* in three parts. The introduction addresses some of the theory demonstrated through precedent projects and practices shared with the students at the beginning of the semester to help us develop a working definition of *living architecture*. This is followed by student research exploring two short materials-based projects engaging the issue of indeterminacy in architecture in specific ways. The first explores indeterminacy of fabrication, and the second explores indeterminacy of inhabitation.

ARCHITECTURE'S CONTINGENCIES

Although we build with a sense of the permanence and monumentality of construction, in many cases architecture is quite impermanent and continually in flux. Buildings are susceptible to natural and man-made disasters, as is ever more the case as we continue developing territories that are increasingly at-risk. The weathering of materials in response to continued exposure to the elements as well as the patina that develops from how people use the space all remind us that the built artifact continually ages. In their book *On Weathering: the Life of Buildings in Time*, Mceohsen Mostafavi and David Leatherbarrow argue for reframing our sense of the completeness of a work of architecture (1993). Rather than considering it complete at the end of construction, they argue that the work is being continually finished in how it ages over time. They observe (1993, p. 16), "In the process of subtracting the 'finish' of a construction, weathering adds the 'finish' of the environment."

Buildings are modified, renovated, or demolished to suit the needs of the user well beyond the agency or foresight of the original architectural team. I'm interested in the gap between what we project in the professional photograph of the finished work, versus what's revealed in a candid shot of the building in its day-to-day use (Figures 1 and 2). This distance reveals the agency of the user as distinct from that of the architect—the building will be site to activities that were unanticipated or undisclosed. The informality of the everyday constitutes a living and ever-changing version of reality which stands in sharp contrast to the architect's memory and representation of idealized moments frozen in time.

Fig. 1. Beardsley Community Farm design-build project (credit: Bruce Cole Photography)

Fig. 2. The informality of the everyday constitutes a version of reality that sharply contrasts how the architect remembers and represents the work (credit: author)

The effort of bringing a work of architecture into existence opens up the influence of even more forces. Kiel Moe (2004) argues that architects need to account for an expanded field of influences including site, program, budget, legal constraints, labor practices, the varying interests of architect, client, and consulting experts, methods of design and fabrication, and so forth. Such elements of the architectural project's epigenetic landscape all bear influence on the outcome of a project, and call into question how much control the architectural designer ultimately has.

Technological advances add ways in which architecture is contingent to more than the agency of the architect. In *Architectural Theories of the Environment: Posthuman Territory* (2013), Ariane Lourie Harrison wonders how the envelope of the building may become responsive to a greater range of constituents, including non-human species, weather phenomena, and off-site impacts of material and energy extraction. She writes (2013, p. 3):

> A posthuman continuum between human, nature, and technology becomes increasingly evident in the smart materials, sentient systems, and ubiquitous communication networks that populate the urban environment today. The contingency of these organic and technological categories provokes new questions for architecture. For how many different species do you design? How responsive is the envelope of your building? How does your building engage the material and discursive forces of its site?

David Gissen's work collected in *Subnature: Architecture's Other Environments* (2009) argues that architecture is constituted of its relationship to sites, environments, and atmospheres that are far from idealized visions of nature. He writes (2009, p. 22):

> Forms of nature become subnatural when they are envisioned as threatening to inhabitants or to the material formations and ideas that constitute architecture. Subnatures are those forms of nature deemed primitive (mud and dankness), filthy (smoke, dust, and exhaust), fearsome (gas or debris), or uncontrollable (weeds, insects, and pigeons).

This rising discourse on the posthuman asks us to consider who we are building for, and whether that should include other life forms, from the biologic— animals, bacteria, and plants—to the technologic— nanobots, artificial intelligence, and drones.

ARGUMENT: WHY ARCHITECTURAL HYBRIDS?

A recent beginning design studio explored productive exchanges between architecture and living agents. These studies served as a catalyst for approaching architecture as a living construct ever changing with time.

The design studio is part of the first year graduate M.Arch. program. This is the first fall semester studio of a three-and-a-half year professional course of study. Though they are beginners it is actually their second studio as it follows a summer foundations sequence. Broadly, our hope is that students in their first year develop their ability to think abstractly and engage creative processes for generating an architectural inquiry. We want them to develop thoughtful and compelling methods for generating form, which requires unlearning conventions and spatial intuitions they've developed over their lifetime. We want them to develop a sensibility for material and effect, considering what the experience of occupying architecture could mean.

Rather than framing the building as resistant to its site or exploring a dualistic binary between architecture and nature, this studio sought a more integrated relationship of the two. Through a series of assignments, built prototypes, and speculative architectural projects, students designed a series of architectural hybrids understood to be ecosystems of constructed artifacts and environmental agents possessing qualities of life.

To start, students were asked to analyze several precedent projects and readings of figures considered as intellectual allies of our design effort. Architects such as the Office of Political Innovation, WEATHERS, The Living, R&Sie(n) / New Territories, and Diller Scofidio + Renfro frame architecture as fundamentally living, based on differing yet allied theoretical motivations. The chosen precedents consider architecture as a hybrid condition, partially built and partially occupied by living matter. Many specifically challenge the role of the envelope, seeking to define it as more of a selective filter between interior and exterior, or fully immersing their architecture within a complex environment without the use of walls or barriers. These practitioners engage technology, not via proscribed methods of best-practices, but as a generative partner, the prototype and exploratory maquette are used as tools to discover and refine architectural agendas of the engaged environment.

This studio asked students to pick up the agenda of the architectural hybrid, and to further it based on physical and representational experiments exploring the potential for architecture to more fully engage its environment and to more inclusively respond and partner with living agents in the milieu, as a means of imagining new future conditions. By inviting environmental agents such as weather, pollution, plants, animals, and their related metabolisms to inform architecture and its formation, students gained alternative understandings of the relationship between architecture and nature. They developed a much more nuanced reading of site that is physical, biological, and cultural.

STUDENT RESEARCH: INDETERMINACY IN FABRICATION

The first set of projects was mass-based, and required students to design for some kind of indeterminacy in the fabrication process. The assignment was to design a series of cast concrete construction units demonstrating controlled and uncontrolled variability. The unit family must include some form of cast void produced by embedding something into the liquid concrete that could be removed after curing.

Students were asked to give careful consideration to the nature of variability evident in the study. It could be a dimensional shift, something inherent to how the voids were made, something due to the nature of the formwork used, or something intrinsic to the chemical process of casting. The studies were experimental and open-ended, meaning though they may have held a sense or intuition on what would happen, the most successful projects made unanticipated discoveries rooted in the material and processes of fabrication. As a starting point, students were asked to select a transformative agent, or destabilizer, that would be the source of the uncontrolled variability. Some of those included: *burning, melting, carving, erasing, dissolving, delaminating, foaming, seeping.*

The following examples show 1:1 cast prototypes from the set produced by the studio. Here we see examples of indeterminacy and variability caused by casting in fabric formwork (Figure 3), casting with ice as a disappearing aggregate (Figure 4), and casting with 3D-printed plastic formwork that continually degraded between castings because of the addition of heat (Figures 5 and 6).
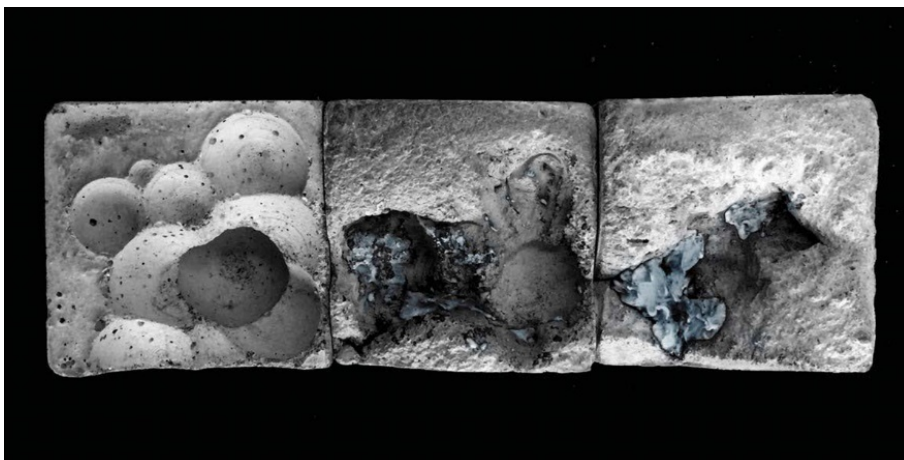

Fig. 3. Cast concrete construction units with variation caused by the use of fabric formwork (credit: student A. Hickerson)

Fig.4. Cast concrete construction units destabilized by the use of ice as a void-generator (credit: student B. Virden)
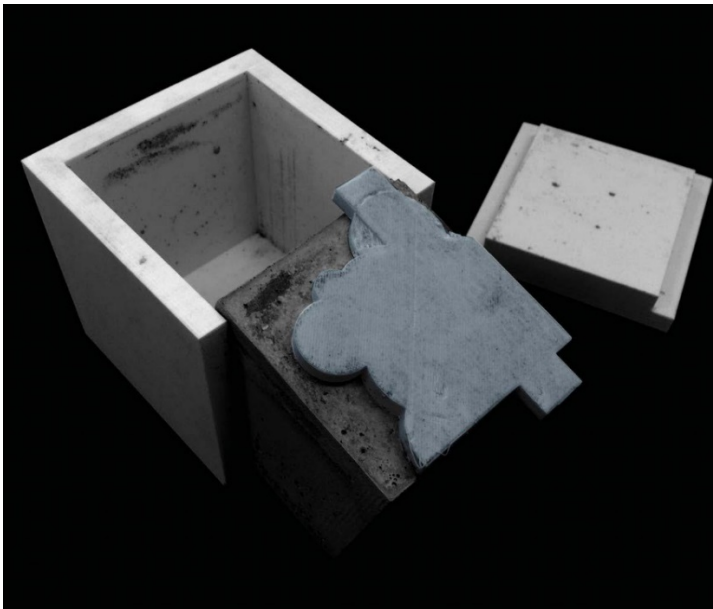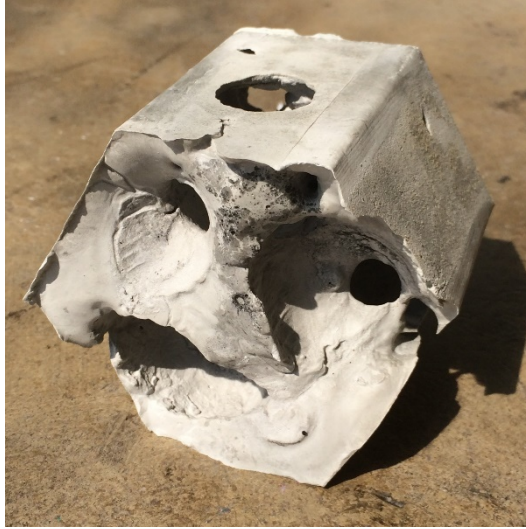
Fig. 5. Cast concrete construction units with variation caused by the use of 3D-printed plastic formwork (credit: student K. Wu)

Fig. 6. Variated concrete construction units resulting from the use of 3D-printed plastic formwork that was deteriorated by heat between castings (credit: student K. Wu)

The process went back and forth between ideation, fabrication, and reflection or further analysis of discoveries made. Students wrote narratives about the nature of their chosen destabilizing agent they worked with, trying to articulate behaviors and qualities of the process as a means of deciding how to use these forms moving forward.

Students were also required to digitally draft and model the units, using orthographic methods as well as efforts to digitally reproduce a model of the unit (figures 7 and 8). We draw as a means of observing, understanding, and remembering potentials embedded within the work. Drawing became a key agent in how they transformed the unit family to the design of a whole construct.


Fig. 7. Cast concrete construction units with variation caused by sugar aggregate that dissolved slowly throughout the curing process (credit: student B. Cunningham)

Fig. 8. Orthographic drawing of a sugar-cube dissolve unit (credit: student B. Cunningham)

The next step for these units was to design a research facility for scholars in residence in a post-industrial urban wilderness located in Knoxville called the Meads Quarry at Ijams Nature Center. Though the full program and site parameters will not be discussed here, these examples are shared to demonstrate that the students grappled with how to evolve a sensibility of the unit to a sensibility of the whole, shifting their thinking from the 1:1 scale to an architectural scale that could be occupied.
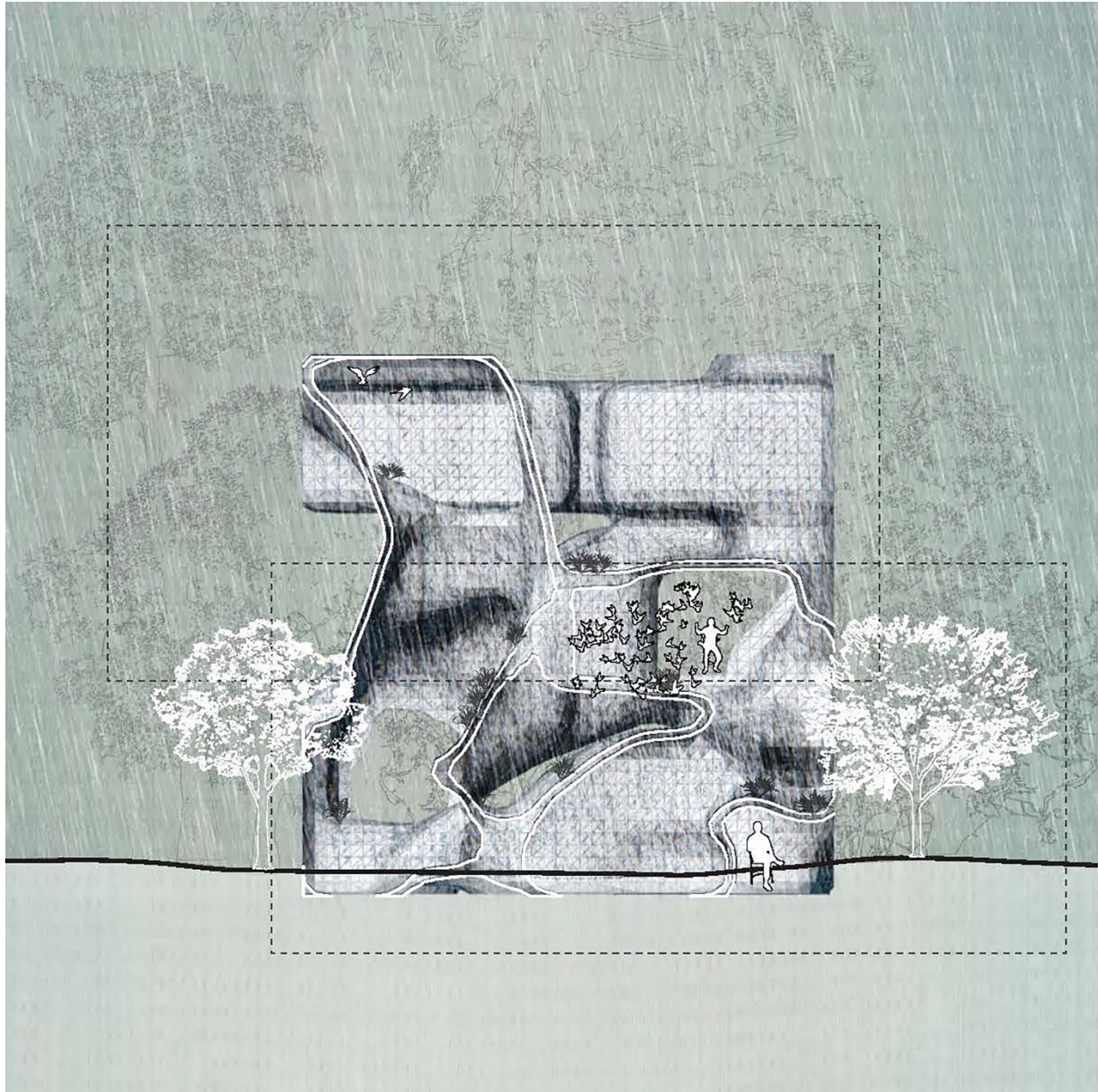

Fig. 9. Section perspective of Researcher's Outpost composed of variable cast-concrete units designed as produced by progressively delaminated 3D-printed formwork (credit: student K. Wu)

STUDENT RESEARCH: INDETERMINACY IN OCCUPATION

The second set of projects required designing for indeterminacy in occupation, with each student developing a system to be inhabited and animated by a living organism. Whereas the previous projects were about casting porous masses, these are tectonically more about creating spatial frames and thickened skins through aggregations and layering.

These designs started with a biophillic form-generating exercise, with students curating a set of images of a specific biological or organic system. Examples included: rivers, tree bark, ice, neural pathways, butterfly wings, bone structure—a variety of sources, intended to provide for analysis a formal and compositional system that had its own biological or ecological functionality. Students developed a set of diagrams helping them understand the formal logic of their selected system. They then built a series of models that re-spatialized or thickened the diagram into a spatial construct related to but distinct from its source material. Each student then developed an architecture based on inhabitation by a living organism.

The following examples were derived from river systems viewed from satellite (Figure 10), the cellular structure of plant matter (Figure 11), and the complex micro-structures found within communication networks of human nervous system (Figure 12).
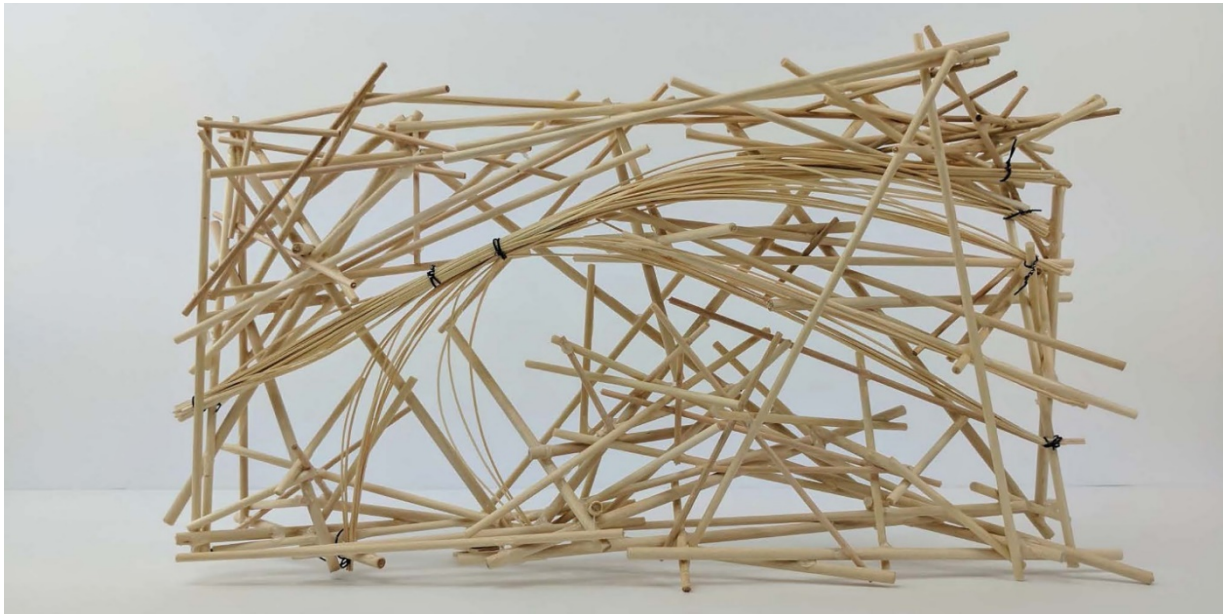
Fig. 10. Aggregate artifact based on a river system viewed from satellite (credit: student D. Rose)

These units then served as the basis for two different architectural explorations with territory and program. First they were developed as an outpost for fog generation and collecting weather and climate data in the Sonoran Desert. The material construct studies were then reconsidered as a research institute located on the banks of the Tennessee River in downtown Chattanooga, with two examples illustrated below (Figures 13 and 14). There was an understanding that these constructs were sensing and reporting on specific climatic events, and that they also provided habitat for a specified living organism and provided a minimal amount of shelter from the environment for visitors passing through.
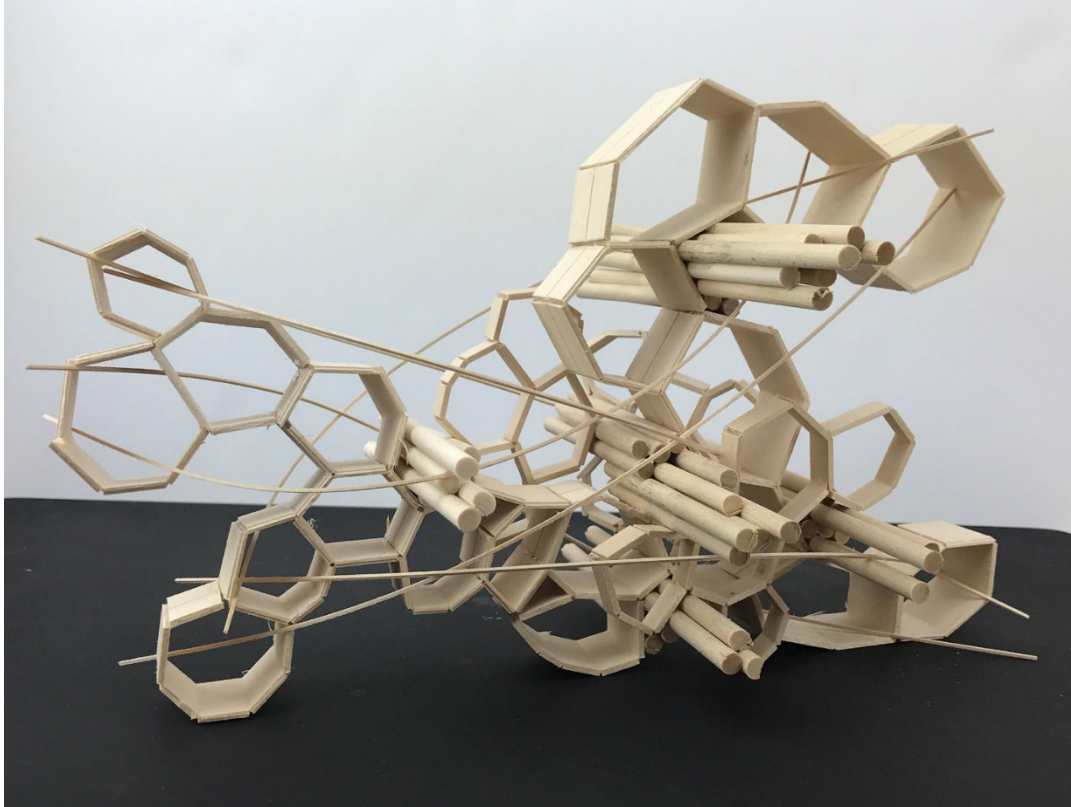
*Fig. 11.
Aggregate
artifact based
on the cellular
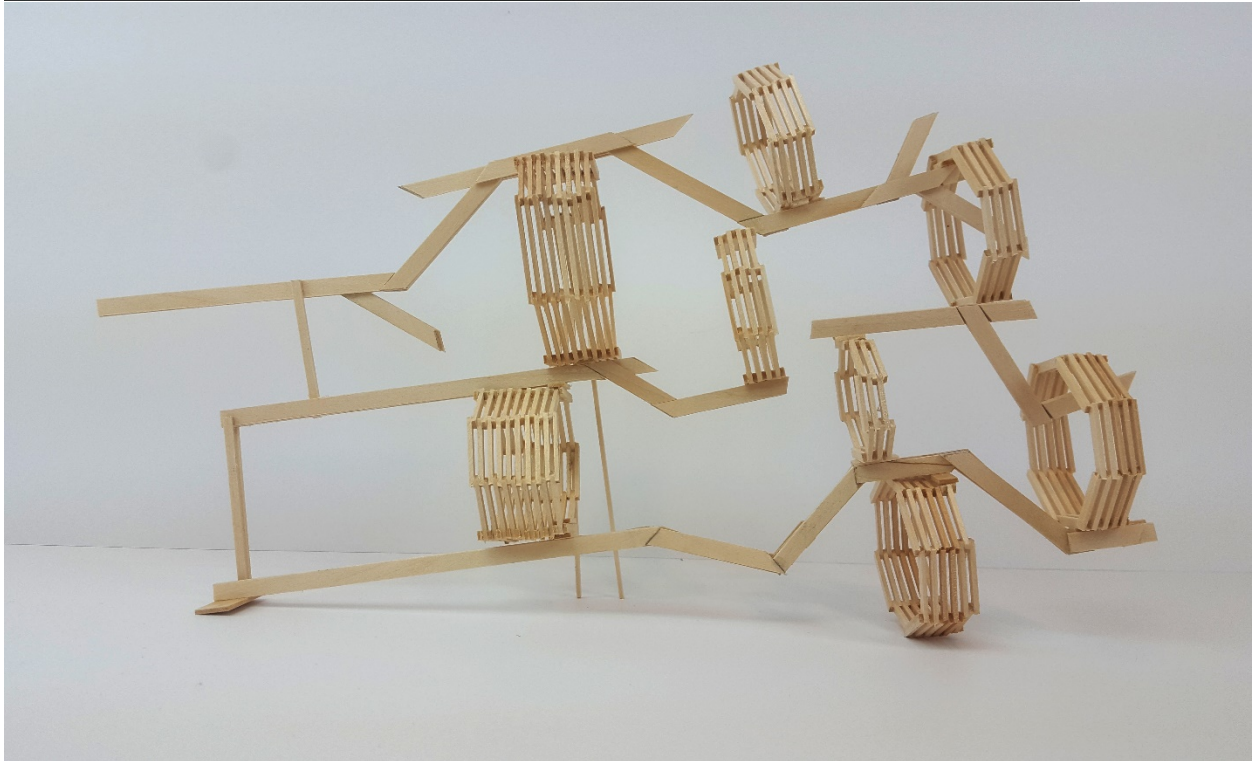structure of
plant matter
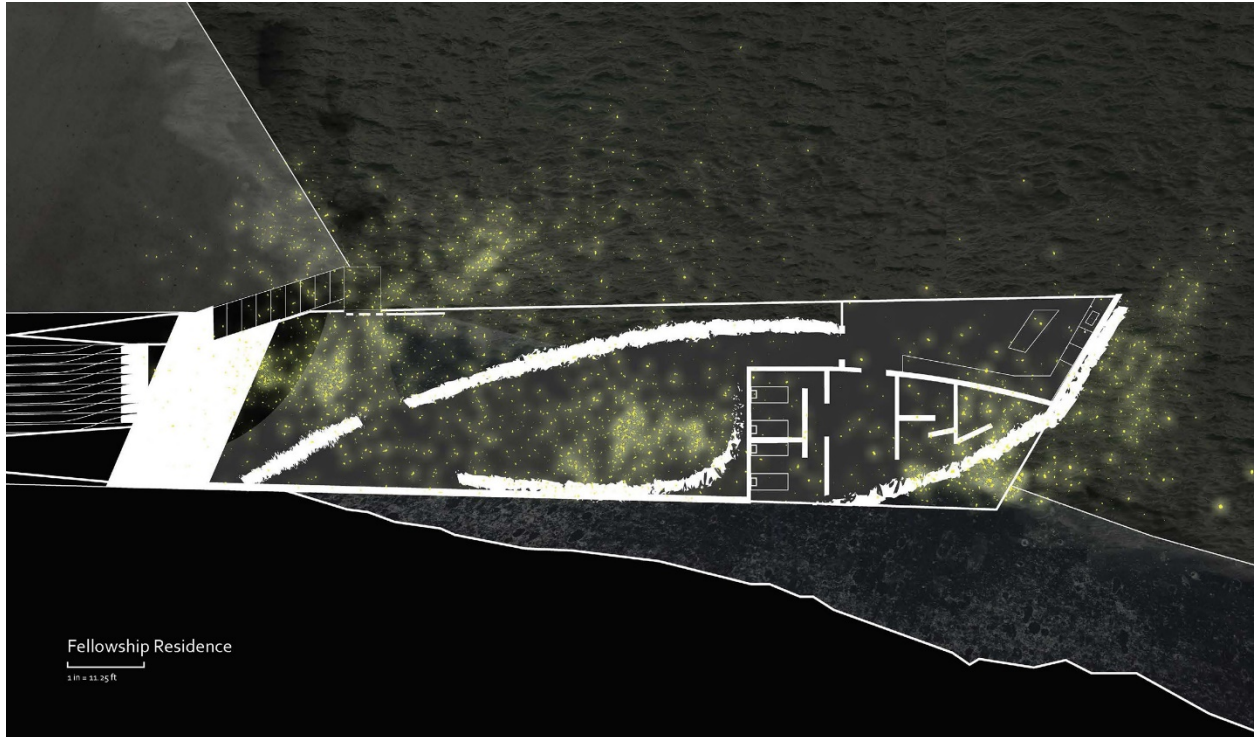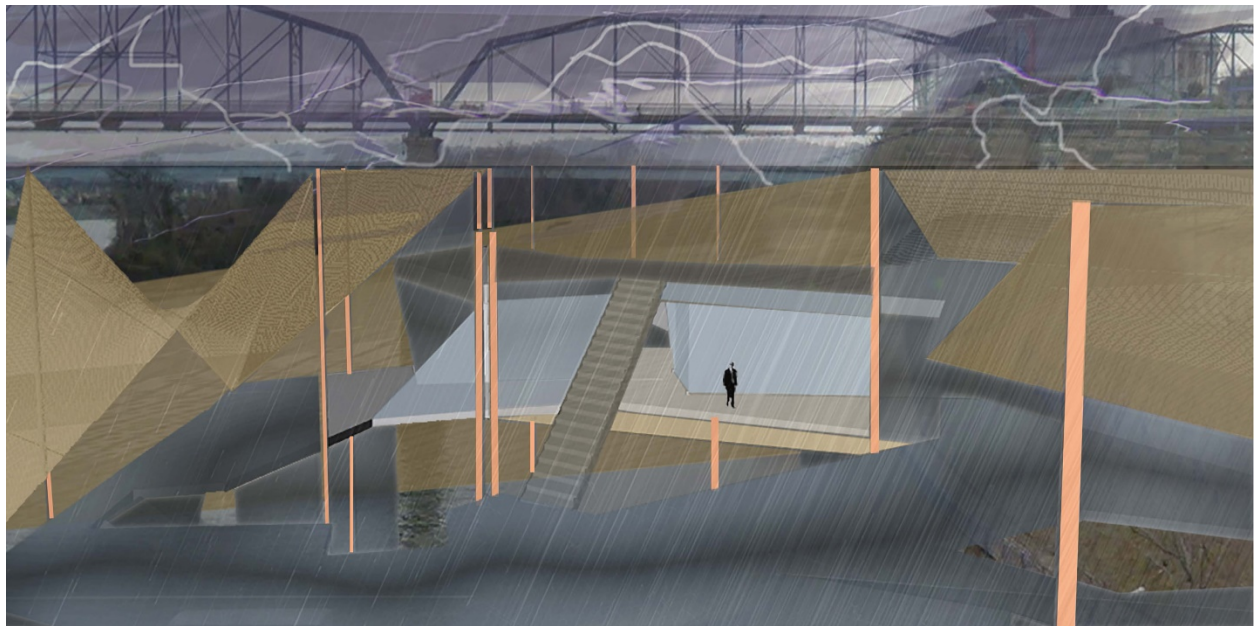(credit:
student I.
Robinson)*

Fig. 12. Aggregate artifact based on complex micro-structures found within communication networks of human nervous system (credit: student S. Principe)

Fig. 13. Plan detail of the Firefly Conservatory, a research facility for musicians and biologists studying the synchronous firefly phenomenon (credit: student S. Principe)

Fig. 14. Perspective detail of the Lightning Institute, an exploration of instability (credit: student I. Robinson)

A significant outcome of this assignment sequence is that it helps beginning students quickly gain comfort generating form while also requiring them to continually interpret the form's behaviors and aptitudes. Design decisions evolved throughout the semester as they reflected on how the construct wanted to act.

ARCHITECT AS ORCHESTRATOR OF CONTROLLED UNPREDICTABILITY

Within the discipline of architecture, this way of working opens questions about our professional role in the future. What if the architect's role becomes one of orchestrating controlled unpredictability, seeking unexpected behaviors as inspiration for further work? The students' model-based research included designing time-dependent production methods with inherent instability and chaos—casting concrete units using unstable formwork such as ice, expanding foam, or sugar cubes to generate spatial conditions that are uniquely tied to their means of production and also cannot be perfectly anticipated or reproduced.

Design education is uniquely positioned to imagine and create the future by critically investigating complex conditions of the present and past. Our role as teachers is to instill in students the ability to identify problems that architects may be well-suited to address in critical and productive ways, even when such thinking takes them outside of the norms of conventional professional practice. As is true in many creative fields, architectural projections about the future reveal complexities of the present. Architect Emily Grosz (2013, p. 151) frames it this way:

> *Fantasies about the future are always, at least in part, projections, images, hopes, and horrors extrapolated from the present, though not simply from the present situation but from its cultural imaginary, its self-representation, its own latencies or virtualities. Whether self-fulfilling and thus prophetic, or wildly fictionalized, these fantasies represent neuralgic points of present investment and anxiety, loci of intense vulnerability, anxiety, or optimism.*

Exploring forms of *living architecture* could bring about a more nuanced and productive relationship between architecture and nature, but may also serve as a reflection of the anxieties and latent potentialities of the current moment.

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