UPLanD – Journal of Urban Planning, Landscape & environmental Design, 2(2), 223-238 [2017]

UPLanD
Journal of Urban Planning, Landscape & environmental Design

Research & experimentation
Ricerca e sperimentazione

THE LIVING ARCHIVE AND THE SUBLIME NATURE OF THE ANTHROPOCENE: AN ARCHITECTURE DESIGN STUDIO

Julie Larsen

School of Architecture, Syracuse University, Syracuse, New York, USA

HIGHLIGHTS

- The Living Archive is a new architectural type that acts as a vessel for artifacts most endangered by the magnitude of Earth's inevitable transformation.
- The ultimate, open-ended system; the living archive paradoxically stores the environment it's in.
- The archive is no longer a secure place but reflects the fragility of a place invaded by human existence.
- The Archiving Machine utilizes technology to exploit the climatic shifts of the environment.

ABSTRACT

At the 2015 UN Conference on Climate Change in Paris France, 195 nations reached a decision to commit to decrease the severe effects of climate change on the planet. As we embark what some call the Anthropocene Era, we bare witness to how civilization has impacted the Earth's ecosystem, diminishing its resources and threatening its biodiversity. With this shift in our ecosystem, a new pedagogical model for a graduate architecture studio responded to the Anthropocene through a technologically sublime intervention: *The Living Archive,* a new architectural type capturing the magnitude of Earth's inevitable transformation. This archive is conceived as the anti-thesis to sustainability and optimization that consumes much of our built world. The 'living archive' program is not meant to be a stable, secure vessel but uses technological invention to bracket what is being invaded by human existence. Through the invention of an 'archiving machine', the studio used technological speculation to question what nature can or will become. The aim was to use 'living archive' as a physical commentary or critique on our current relationship to the environment. The paper describes three projects that speculate on the inevitable future of various biomes. Through environmental analysis, technological research, and formal aspirations, each project embodies a potential reality and potential future of the Anthropocene.

ARTICLE HISTORY

Received: May 31, 2017
Reviewed: July 05, 2017
Accepted: July 18, 2017
On line: July 31, 2017

KEYWORDS

Anthropocene
Architectural design
Speculations
Infrastructure
Archive

jmlarsen@syr.edu
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1. INTRODUCTION

The 'living archive' scenario is that the environment and its water bodies are changing for the worse, potentially flooded, absorbed, melted, dried up, or obsolete. As a project, the archive becomes its own critique on the abundance of global and ecological change happening in the world today. The living archive is not a stable, secure vessel but preserves the environment by using technological invention to frame what is being invaded by human existence. The production of nature, is the belief that societies make nature and force us to consider what nature has been and may yet become (Gissen, 2010). With the production of nature, there is an opportunity for a living archive to frame new potential in the role of production within a particular environment that is no longer productive or has the potential to become more so. Through the invention of an archiving machine, the studio used technological speculation as a way to define a new architectural type of production that questions what nature can or will become.

2. THE SUBLIME NATURE OF THE ANTHROPOCENE

A new pedagogical framework for the architecture design studio was derived from observations of rapidly changing ecosystems and how to begin deciphering and dismantling preconceived ideas of site and building intervention. The departure for the studio framework began with 'site,' not as a piece of land, but as a large speculation, and it began with 'building,' not as a program, but as a critical position to a particular environment. We should be looking through the territory [to] determine where the architect can intervene earlier, before being given the object to design. (Rönnskog, 2013). Given this observation, siting, or placing the 'architecture' within a site, emerged over time once students had a better understanding of what the architectural response should be, what it aimed to achieve, or what it aimed to refute. Similar to the attitude of Buckminster Fuller's vision and desire to speculate on new futures that connect ecology and the environment to architecture, the students were also asked to speculate on new futures that embody the ambition of technological advances and how that can spur new spatial interventions. The aim was to find where architecture has agency within the environment that could reveal the hidden sublimity of ecological change within nature but also create a possible future for those inhabiting these spaces.

2.1 Studio Questions

The studio used the living archive as a way to interrogate two questions: First, how does a living archive as a machine reflect on the sublime and spectacle of nature? Can the design process begin with an already tainted environment and straddle between productive engagement and social context? The initial archiving machine exercise was not intended to solve a problem but reveal the sublime qualities and extent of our impact on nature (Orlowski, 2012). Second, how does a 'living archive', as a design speculation, suggest what architecture's role is, in this new Anthropocene Era? The intent of the living archive was to reflect on nature in two ways. First, to ask how we should perceive nature and second, how, we can reveal the sublime nature of a place and its impact on a culture through new technological intervention. To reference a historical example: Niagara Falls, as an object of culture, is described as marred both by the actual senses and the aesthetic assumptions of artists who journey there [to] reveal the eclipse of the sublime as a motive force in American culture (Nye, 2007). The sublime represents a

way to reinvest the landscape [and] underlies this enthusiasm for technology. The sublime taps into fundamental hopes and fears (Nye, 2007). The living archive aimed to tap into fears but also hope for humanity to overcome the burdens we created through design intervention, similar to the first electric power plants that captured the forces of the Niagara Falls.

2.2 The 'Archiving Machine'

As the introductory assignment to the studio, students were asked to create a speculative archiving machine that emerges from a biome (arctic, desert, grasslands, etc.) of their choosing that needed to be responsive and/or reactionary to its environment. The initial exercise of the archiving machine is further developed into the living archive as not a static structure but as an emergent and responsive space that continuously adapts to its environment (Fig. 1). The premise of the Anthropocene as an event itself needs to be a subject of sustained historical and critical inquiry (Barber, 2016). Barber's notion that the Anthropocene should be seen as an unforeseen event was the impetus for the archiving machine to negotiate between spectacle ('events'), technology, and ecological constraints (water, earth, energy, resources, etc.) to create a surreal infrastructure that critiques the events of human consequence. As an ecological speculation with an open-ended response; students were not limited to a particular site but asked to define 'site' through ecological constraints, current problems or future challenges. Based on their geographic region, the students were asked to find intelligent systems that were responsive to environmental change, such as thermal dynamics, air quality, or water filtration. From there, the projects could leverage formal, spatial, and experiential potential from the archiving machine that could then scale up to construct the Living Archive.

Figure 1: Site model of 'Dunescape' Machine capturing sand drifts to create a structural framework for the future archive. *Source: Ruting Li*

3. ENVIRONMENTAL ANALYSIS

First, students were asked to analyze a geographic region on earth, assuming that most of the earth's surface has been altered, in some form or another, by human existence. If we are to understand that "human geography argues all nature is produced" and that "there is no solely 'natural' matter outside human reach or impact on the surface of the Earth (Gissen, 2010), the students were free to study almost any square kilometer on earth with the understanding that there should be some aspect of human impact on the land they study. They were asked to analyze a particular physiological context through a series of infographic diagrams on either biodiversity, depleting ecosystems, shifting weather patterns, increased storm surges, etc. Each group studied a region within a given biome around the globe, such as the Grasslands and Savannah in Africa, the Arctic Tundra, or the Desert. It was this initial research by all the groups that spurred discussions of human impact on the Anthropocene and what role architecture could play in such a broad context.

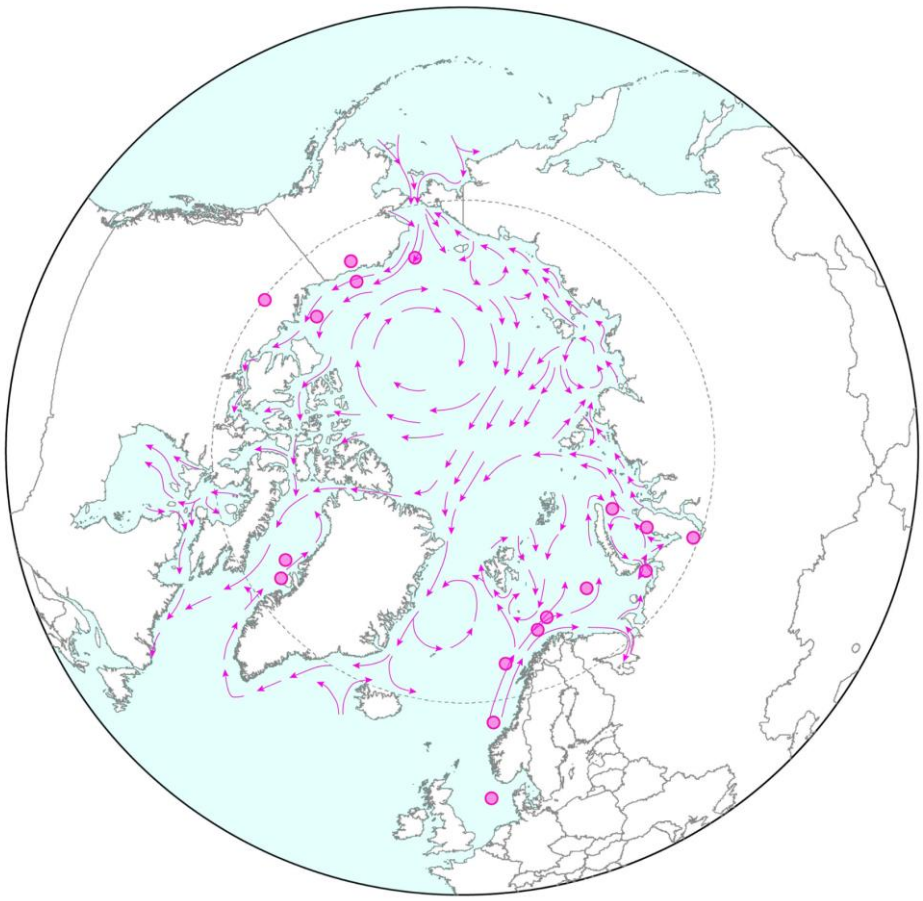

Figure 2: Mapping of wind currents in the Arctic to study shifting ice patterns. *Source: James Amicone, Sou Fang*

3.1 The Arctic

The first group studied glacier movement and the freeze / thaw cycle of the Arctic biome to understand the rate at which ice was melting and where ice patterns formed. The greater impact on the Arctic, due

to higher global temperatures, is having a profound effect on a number of wildlife in the Arctic, which is being forced to change migrations, and animal mating patterns as a result. They also studied Arctic water currents and 'fast ice' which is, by definition, sea ice that is anchored to the shoreline. The students saw the location of 'fast ice' as a potential place to ground the project and capture wave energy for artificial ice that could aggregate near the shore (Fig. 2). The recurring seasonal changes to the ice patterns showed that there is more and more ice movement during winter months than ever before recorded. The alarming rate of ice drift and glacier movement during the winter season was an opportunity to reflect on the vulnerabilities and fragility of the Arctic due to climate change.

3.2 The Desert

The second group studied desertification in the Desert biome and the loss of aquifers due to irrigation in arid regions like Saudi Arabia, China and the United States. They discovered that desertification, the depletion of soil due to human use, is causing previously arable land to become desert and unusable. This eventually led them to study the wind patterns and areas at risk in Dammam, Saudi Arabia that could potentially shift back to more arable land where agriculture and greenhouses are at a premium (Fig. 3). With the study of dune movement, the group investigated the potential to productively use and absorb the sand, rather than trying to resist it. By siting the eventual archive within the direct path of the dunes, they could optimize the abundance of sand for structural and spatial potential. They also studied the specific types of dunes and their properties, to better understand how to utilize them. They looked at issues of wind, suspension, saltation, and creep of the dunes. The more height the dunes created; the more potential that the sand could envelop a future structure for enclosure and habitation.

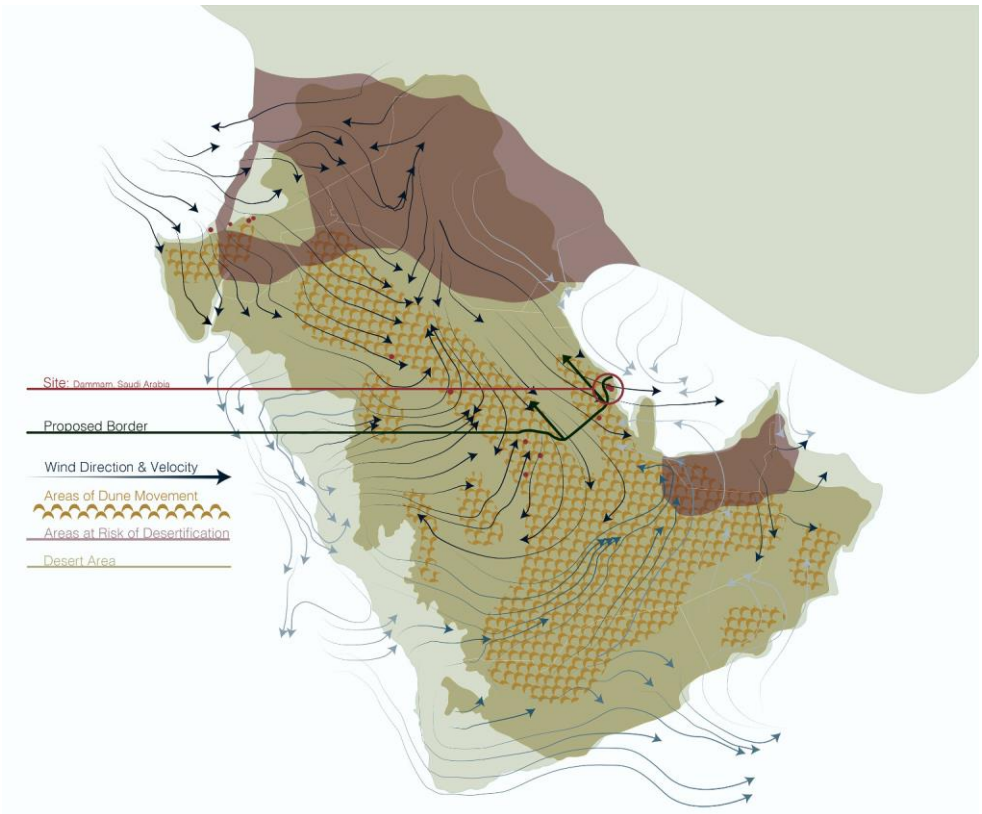

Figure 3:

Mapping of wind currents and dune movement in Dammam, Saudi Arabia.

Source: Ruting Li, Margaret Petri

3.3 The Grasslands and Savannah

The third group studied the impact of CO2 fertilization and decreasing rainfall in the northern Sahel of the Grasslands and Savannah biome in Africa, which is causing parts of the grasslands to shrink and turn to woodlands. The increase of CO2 in the air creates an increase in woody plant mass in parts of the Savannah. This group eventually studied how the excess of CO2 could be captured and converted to fuel and water. They also discovered, in areas of the Savannah in Africa, that fresh water lakes are disappearing due to irrigation and agriculture. This was a disconcerting fact that does not seem irreversible with current practices. With this alarming rate of depleting fresh water lakes and aquifers, the students saw an opportunity to combine this with their research on CO2 fertilization. With water as a byproduct of CO2 fertilization, it could be a potential path to replenishing fresh water supply. One fresh water lake in particular was Lake Chad, which straddles four countries, Niger, Chad, Nigeria, and Cameroon, each with their own desire to use resources of the lake for their own individual needs.

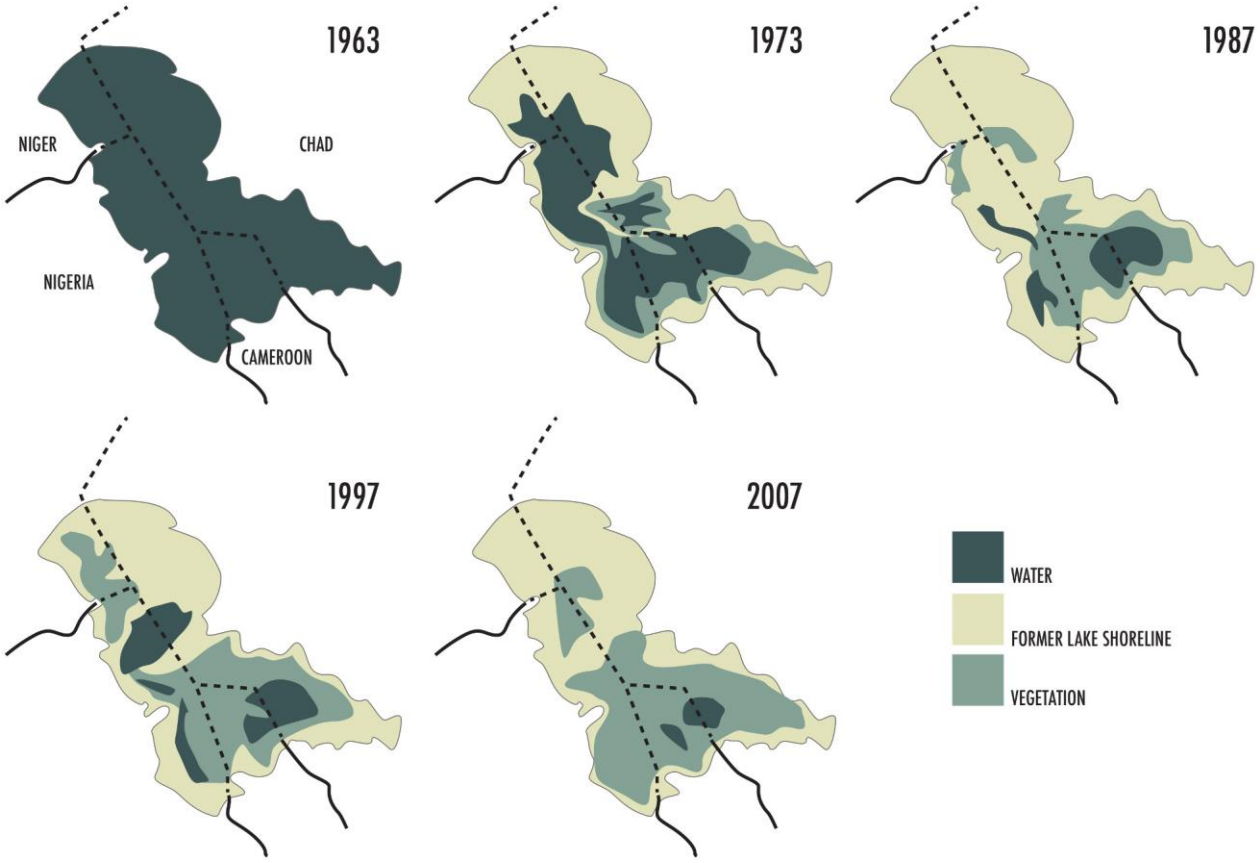

Figure 4: Depleting fresh water Lake Chad, from 1963 v- 2007, nearly most of the lake has disappeared. *Source: Nusrat Mim, Yisha Ding*

4. THE SUBLIME NATURE OF THE ARCHIVING MACHINE

Students were then asked to research an innovative or speculative technology (high-tech or low-tech) that could potentially impact their studied region and construct a new future. They developed iterative structural studies of three-dimensional modules to test thick 2D structural conditions for their

archiving machine (Fig. 5). Once aggregated, the modules would create a varied and dynamic structure that responds to both climatic and spatial conditions of a particular region. The machines were designed to perform as regulators or catalysts of existing flows and patterns (material, energy, water, etc.) within their environment. By no means, were the students expected to design a machine to 'fix a problem' or a particular crisis within a region but to call attention to it through a speculative and opportunistic solution. The machines become a formal reading and commentary of how humans are impacting nature and how design can bring about a more positive influence, rather than a perceived negative one.

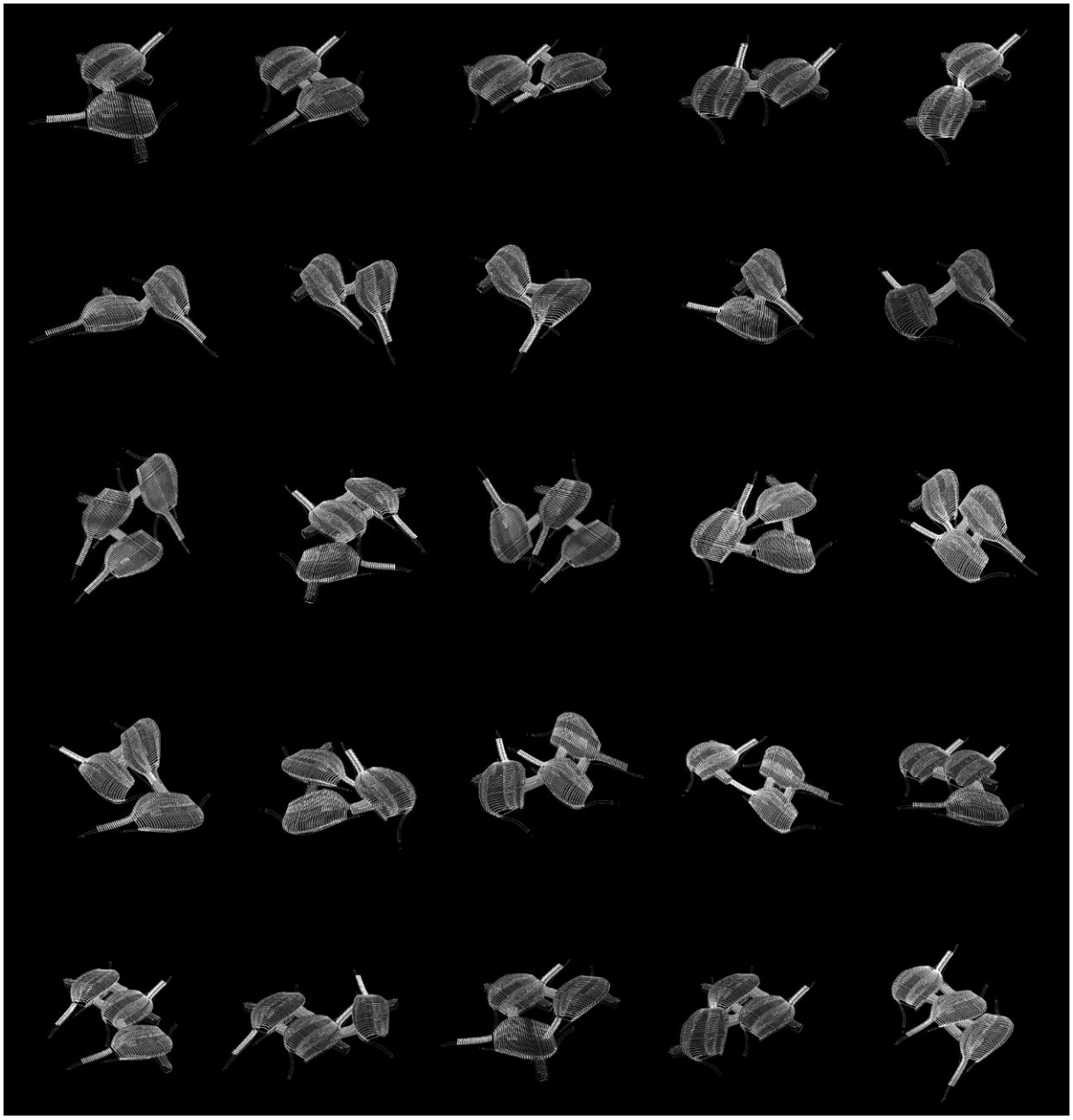

Figure 5: Iterative formal studies of modules for machine. *Source: Nusrat Mim*

4.1 The 'Constructing Ice' Machine

The first group, that studied the Arctic biome, used the machine to speculate on 'Constructing Ice' as a way to combat melting ice caps in the Arctic. Similar in spirit to physicist Steven Desch's "novel solution to pump water to the surface, where [ice] would freeze, thickening the cap (McKie, 2017) the students aimed to show the absurdity and length we need to go to, in order to maintain the status quo of the arctic ice shelf. Their machine was designed as a water tank system, run on wave turbines that freeze and move water through liquid refrigerant piping to produce ice modules for artificial icebergs. The result was a series of iterative formal studies of ice module accumulation. The tri-prong modules interlock with one another as they float to the surface and form deep, stacked formations (Fig. 6).

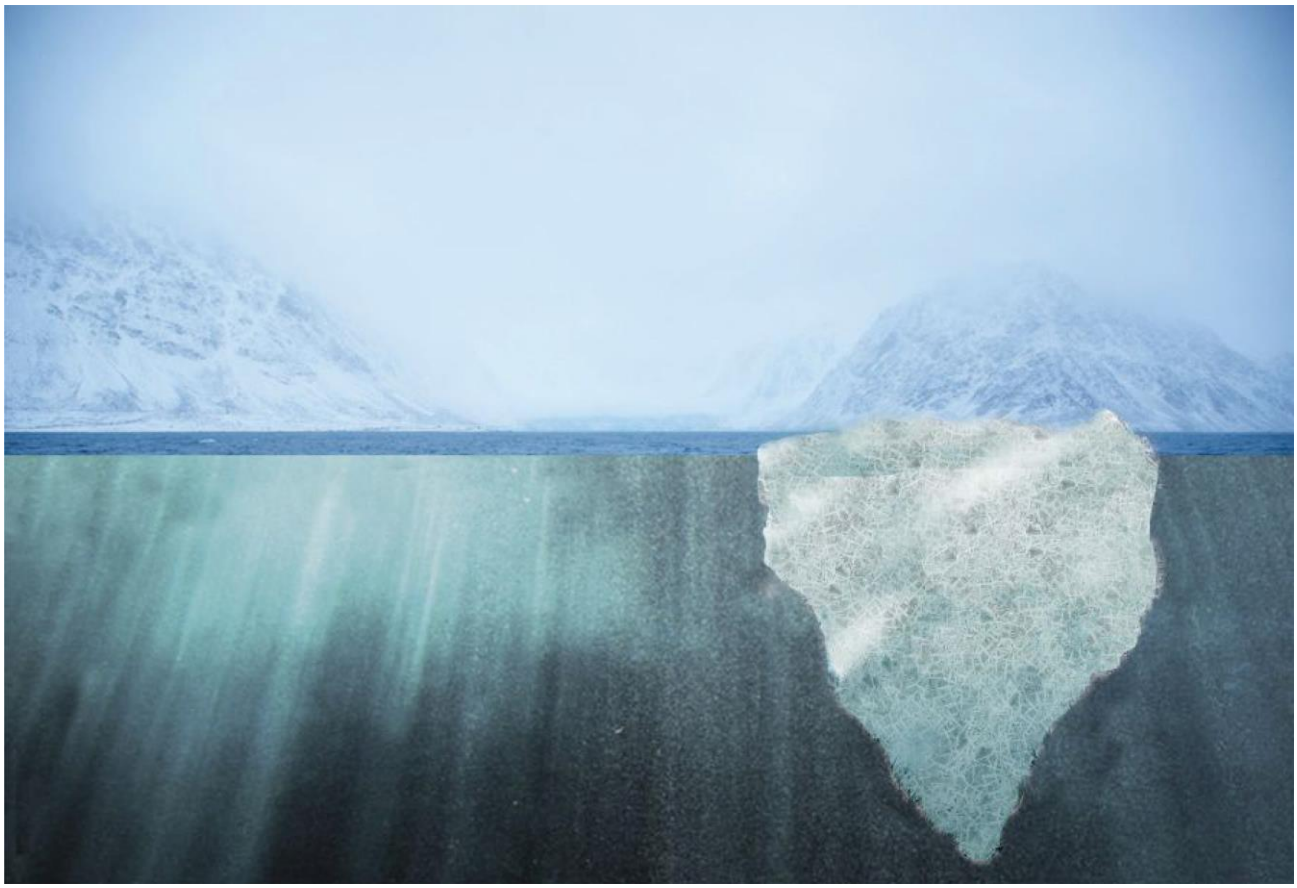

Figure 6: Machine makes modules to interlock and form an artificial iceberg. *Source: James Amicone*

4.2 The 'Dunescape' Machine

The second group, that studied the Desert biome, coined their machine 'Dunescape', which was in response to depleting aquifers in the desert of Dammam, Saudi Arabia. Desertification in the region is caused by irrigation and agriculture that pose a major threat to society as population grows and demand for food increases. The students studied Magnus Larsson's research on bacillus pasteuri, which is a bacterium that turns sand into sandstone when combined with water, urine, and calcium.

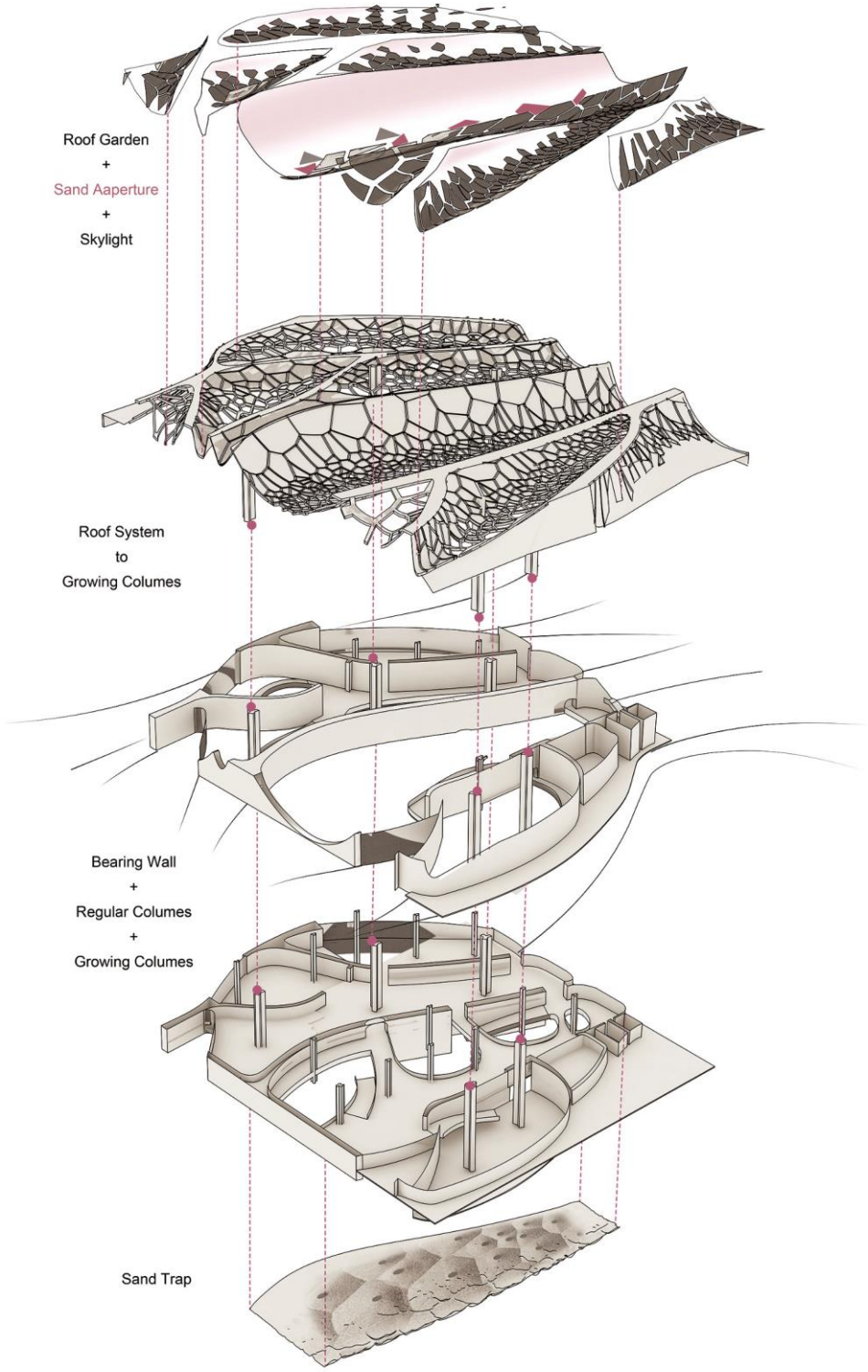

Figure 7: Axonometric of sand capturing machine. *Source: Ruting Li*

The structural framework of their machine is built to connect to local water treatment facilities to harvest untreated water, that contains urine and calcium, for new agricultural growing on the roof. Dune and sand storm patterns were studied for the design of the machine's skeleton to capture sand (Fig. 7). The result is a machine that reflects on the current state of water depletion but also encourages new agricultural growth through natural phenomenon of dune movement.

4.3 The 'Bloom' Machine

The third group, that investigated the Savannah biome in Africa, found that due to global warming, high concentrations of CO2 were quickly converting grasslands to woodlands, which is known as the carbon-dioxide fertilization effect (Hille, 2016). Their archiving machine, known as 'Bloom', sequestered the CO2 by capturing it in a series of absorbent, balloon-like structures with sensors on the skin that begin to 'bloom' as CO2 is absorbed (Fig. 8). The skin captures the CO2 from the ambient air and feeds it into a convertor that creates carbon monoxide, hydrogen, and water. As a result, the structure expands and zeolite begins absorbing C02 to slowly bring back the Savannah grasslands. In turn, the byproduct of water is captured to replenish small water bodies within the Savannah.

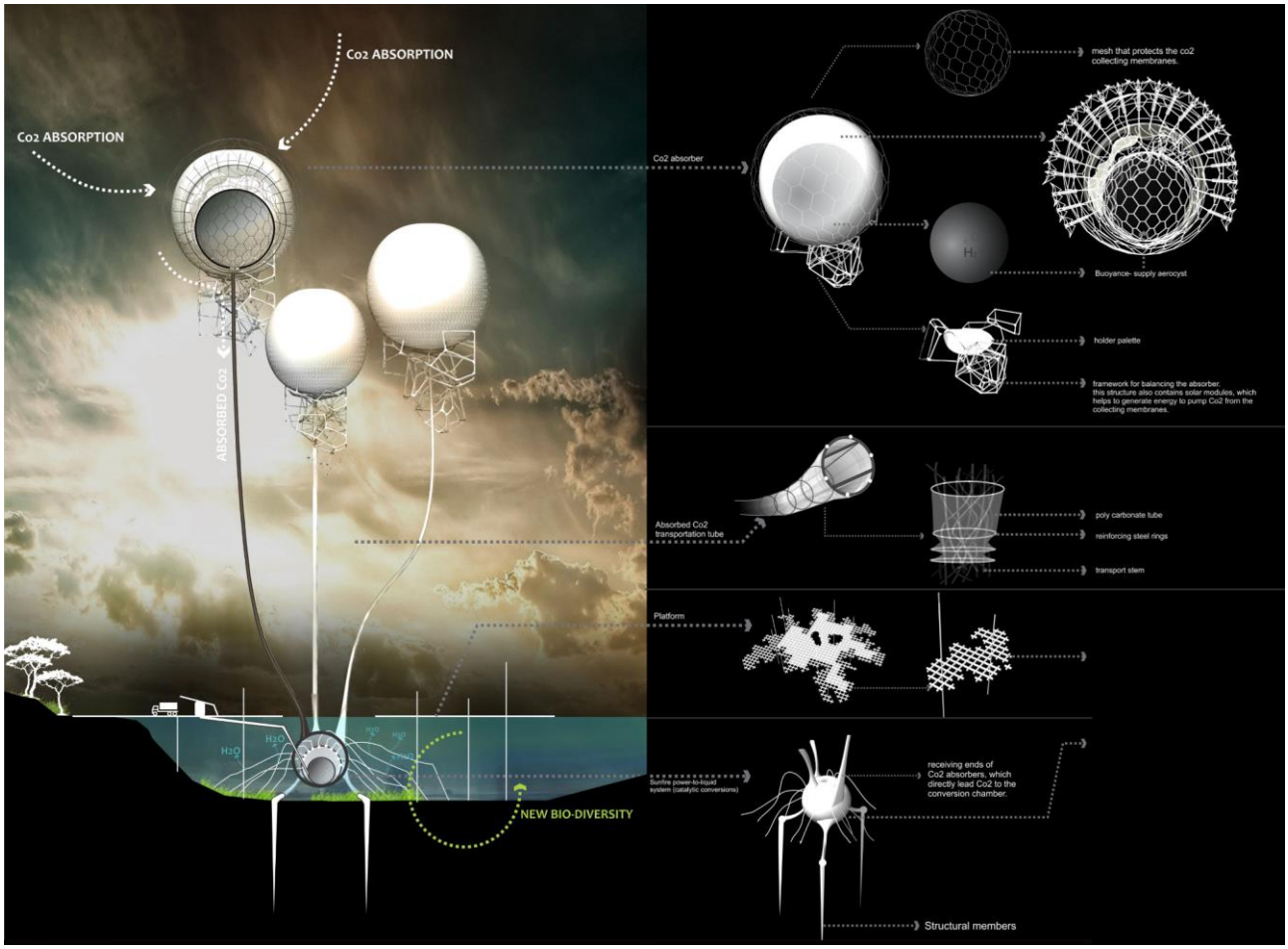

Figure 8: Section diagram of 'Bloom' machine capturing CO2; the machine separates the hydrogen and the water; thus replenishing the water body below. *Source: Nusrat Mim, Yisha Ding*

5. THE SPECULATION OF THE LIVING ARCHIVE

For the final design problem, the archiving machine was developed into the design of a living archive for the interrogated biome or region. As a traditional form of archiving, the Doomsday Seed Vault in Svalbard, Norway, built to protect over 2 billion seeds from around the globe, was used as a reference. Similar to Svalbard, the living archive is a 'regional safety net' but unlike the vault, the living archive becomes the ultimate, open-ended and open-sourced system that paradoxically continues to store the environment it's in. As the archiving machine becomes a living archive, the architecture becomes a depository of preserving and securing the most significant environments on the planet, therefore continuously readapting to the ever-changing environment. For example, both the Dunescape and Constructing Ice project originally used wind patterns to generate a machine that responds to its surroundings. In turn, the natural phenomenon of wind is exploited and secured in the actual making of the living archive; allowing both to continually grow over time as responsive and expanding infrastructures that continually archive nature. In the case of the Bloom project, the recurring phenomenon of CO2 is captured and begins replenishing fresh water supply. As water is replenished, the Bloom balloons and temporal pods shift to different sites; becoming a responsive infrastructure that adapts to new surroundings before it outlives its stay. As will be discussed, the Bloom archive expands its 'program' to become temporal housing for refugees and migrants and creates a 'living 'archive' of CO2 and water by virtue of its ever-changing and expanding site.

5.1 The 'Constructing Ice' Living Archive

In the Constructing Ice Archive, the ice modules form a series of smaller artificial glaciers that can link together to form a field condition with larger aggregations. The challenge with the Constructing Ice Archive was the scale of the Arctic and the ability to negotiate between an edge of a glacier and the field condition of the vast ocean. Various configurations were made possible through the aggregation of small (5-10 meters) modules that form ice particles and the large (100 meters) modules that form each section of the archive. The field configurations of the archive are loosely bound aggregates characterized by porosity and local interconnectivity (Allen, 2012), with a 'fast ice' scenario to generate a new edge condition that captures ice through the larger modules (Fig. 9). The living archive never stops growing as additional ice modules continually accumulate to form larger aggregations of ice sheets that can expand along the Arctic Ocean. While the living archive produces ice, it also captures natural icebergs that migrate into the 'fast ice' composite along the shoreline.

The students did not see the living archive as a place to preserve the ice in the Arctic but rather as a dystopia of what lies ahead. The archive sheds light on the magnitude of human impact on this seemingly impenetrable place. The archive is not a tourist attraction but a tool to see the Arctic as a deteriorating environment, to the point that we now need to make thousands of acres of ice to replenish what is lost. This living archive would provide scientists with space for underwater viewing of natural and artificial glaciers in order to evaluate the progress of the Arctic. Visitors have the potential to see melting, natural glaciers underwater and the newly formed artificial glaciers above water. This strange juxtaposition of the natural versus the artificial glaciers reflects where we are at today with our relationship to nature. The natural glacier is on display and seemingly fake as it floats in an enclosed building; while the artificial glaciers, albeit don't look real, create a seemingly natural glacial form (Fig 9). The aim of the archive is to reflect the changes happening within the Arctic, the impact we have, and the foreseeable future of the coldest regions on earth.

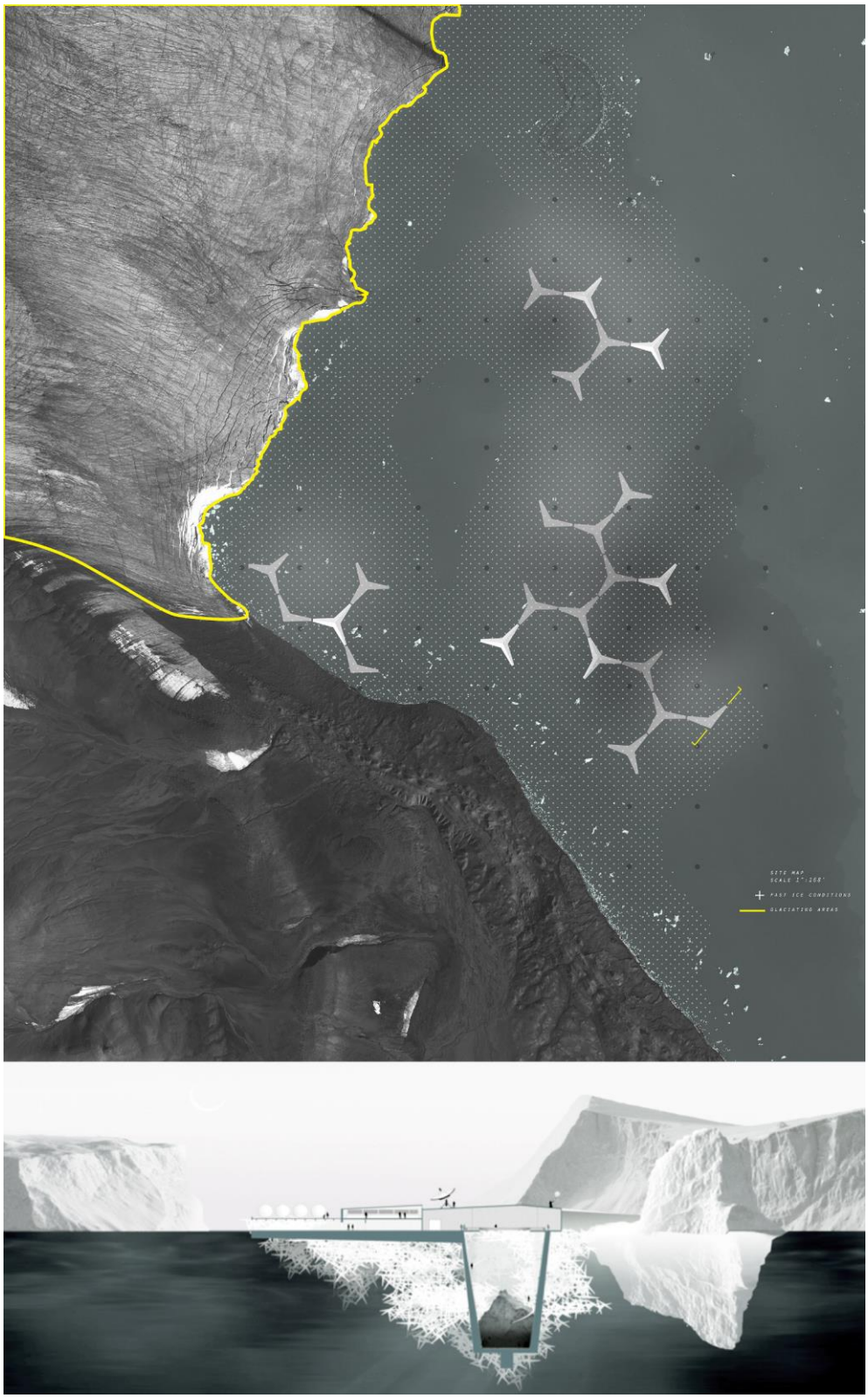

Figure 9:

Plan of modules forming a surface along shoreline, dots denote 10 square meters of potential 'fast ice' configuration growth; Section shows natural glaciers captured inside versus artificial glaciers forming outside.

Source: Google Earth image edited by James Amicone

5.2 The 'Dunescape' Living Archive

The Dunescape Archive used the wind-generated bacteria-formed structures to create an ever-expanding sand to stone roof structure. Based on their knowledge from the archiving machine, the students designed the structure to continually grow along the northern edge of the city that is most affected by sand drifts. As the living archive expands and creates a natural boundary or buffer around the city, so does the roof surface potential for agricultural growth (Fig. 10). The living archive is continually adapting and reframing the sand storms and allowing the sand to envelope the building to create more structure for agriculture. As more sand storms accumulate; the more potential for new structures to grow and contribute to the growth of agriculture for the city. This has a direct impact on the spaces of the 'living archive' below the roof as well with the structure continually getting wider and stronger as sand accumulates. The living archive becomes a register of potential growth while creating a visual effect below the roof where small sand dunes form and drift within the space. The bacterium-clad structures provide a place for new food sources, potentially using the archive to protect the city from harsh sandstorms, mitigate aquifer depletion, and serve as a series of 'greenhouses' for additional agriculture in Dammam.

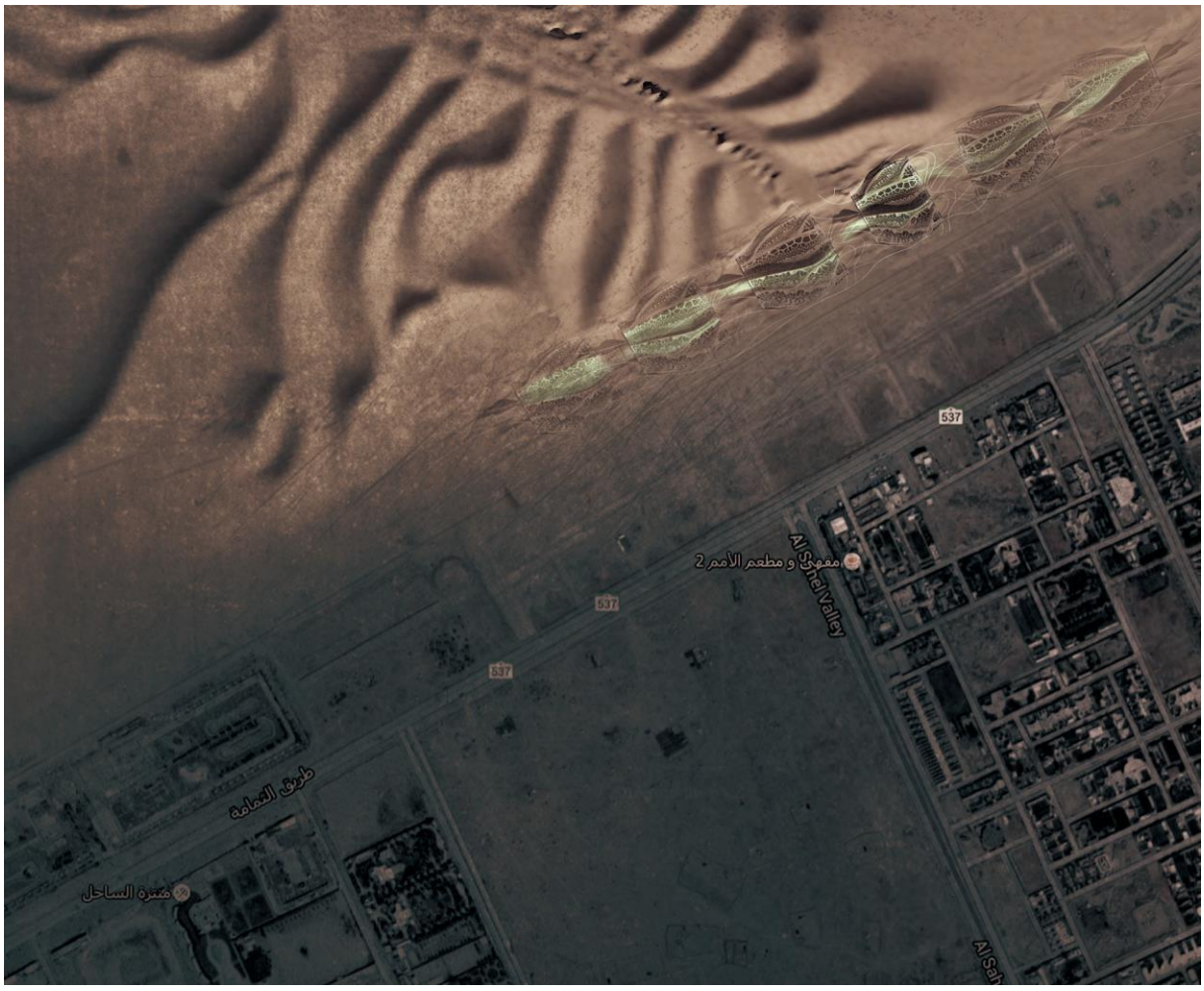

Figure 10: Archive becomes a protective boundary against sand storms as sandstone structure expands; while creating more surface area for growing on or below the roof in greenhouses. *Source: Google earth image edited by Ruting Li*

5.3 The 'Bloom' Living Archive

The Bloom Archive was designed to be a commentary on the future of water bodies in the Savannah region that have depleted due to desertification, irrigation, or agriculture. The Bloom machine in the Savanna expands to a living archive on Lake Chad; a lake that was once one of largest freshwater bodies in Africa but has been shrinking since the 1970s. What was once a 25,000-square kilometer lake is now reduced to only 1,350 square kilometers due to massive amounts of irrigation by neighboring nations that is now draining it to extinction. With little possibility to regain water that was once in abundance on Lake Chad, the archive provides the potential for future growth of the lake over several years as the Blooms of the archive generate water from the capturing CO2. The living archive is comprised of temporal pods and Blooms that can be easily transported and moved to other areas once the lake regains substantial amounts of water (Fig. 11). The pods store excess energy and water from the Blooms. As a living archive, this provides the potential for temporary refugee housing to gain access to fresh, filtered water, grey water, and electricity. The pods are capable of aggregating into a larger community or a set of small ones. Since the archive works as a responsive infrastructure, it is constantly producing energy, and subsequently converting CO2 to water that is captured in the Blooms and then used to fill the depleting Lake Chad below the structure. The entire system can be dismantled and transported to new locations as enough CO2 is absorbed and water bodies are fully recovered.

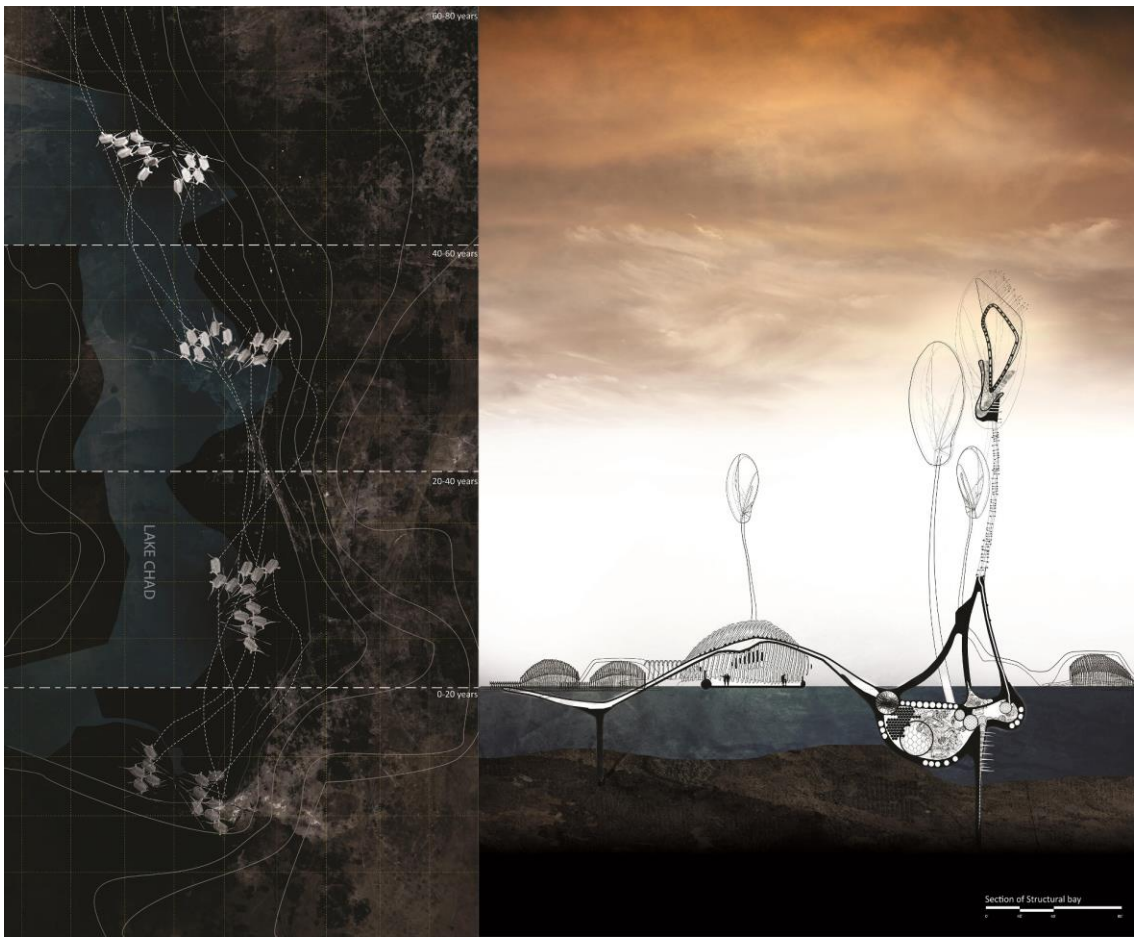

Figure 11: Site plan shows transient Bloom Archive transported to many sites over time as water replenishes Lake Chad. Section shows module of one Bloom and refugee pod. *Source: Nusrat Mim*

5. CONCLUSION

Looking at a design project through the lens of the Anthropocene offered students the opportunity to look beyond program of the 'Archive' as such and question whether the environment should be protected, was it worth preserving, or should we accept the environment as is? And depending on the answer to that question, the challenge to the studio was in knowing where to begin in the design process of the Anthropocene. However speculative the results were, the design methodology of the studio was to provide the students with an approach to understand larger issues of site and nature, which helped them gain a broader understanding of the environment beyond a typical 'given' site.
Studying the environment at this scale is an overwhelming task, but to offer possible claims on what to do with the environment is a skill that becomes more valuable as we understand the complex and global impact we have on the environment. The design of the Archiving Machine gave students a narrower framework to set up a clear thesis and position their relationship to a particular region or landscape. Many students struggled with an urgency to rewrite past wrongs and revert back to hopefully a more 'stabilized' nature. But "whenever nature remains stable for a time, its efficiency decreases" and as "its diversity often decreases at the same time…developmental processes lose their impetus (Reinchholf, 2002) So, it became apparent that trying to create stability in nature was impossible and unnecessary to accomplish. What students discovered is, rather, nature will probably survive, in some form, beyond our existence anyway. But it is our role, as designers and architects, to progress the discourse further, continue to have foresight into the problems we face, and imagine where to intervene at any scale.

ACKNOWLEDGMENTS

I would like to give thanks to Lori Brown, Professor at Syracuse University, who co-taught the graduate studio with me. I would also like to thank the students from Syracuse University who participated in the studio and contributed outstanding design work.

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