DESIGN FOR CLIMATE ACTION

2020 AIA/ACSA INTERSECTIONS SYMPOSIUM

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ABOUT THE SYMPOSIUM

The American Institute of Architects (AIA) and the Association of Collegiate Schools of Architecture (ACSA) are pleased to continue their partnership dedicated to the INTERSECTION of Education, Research and Practice. Through a series of virtual sessions, the symposium featured exemplary peer-reviewed research projects which address issues related to our Symposium theme: DESIGN FOR CLIMATE ACTION.

We want to thank the Intersections Symposium co-chairs Phoebe Crisman and Kyle Konis; our presenters: Ashlie Latiolais, Richard Mohler, Sasha Plotnikova, Ann Yoachim, Stephanie Davidson, Ariane Harrison, Zaneta Hong, & Jeffrey Huber along with their co-authors and students. Without their contributions, there would be no Intersections and sharing of this important work.

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DESIGN FOR CLIMATE ACTION

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The symposium explored **Design for Climate Actio**n from multiple, intertwined perspectives. In support of the recent **AIA Resolution for Urgent and Sustained Climate Action**, we encouraged submissions of research and projects that addressed climate change across scales—from building, to community, to the planet. We posed the following questions as a provocation to explore intersections between equity, environment and economic considerations.

> How are specific issues of climate justice and environmental equity being identified, prioritized and addressed through architectural design, research, education, practice and advocacy?
>
> What innovative economic models and practices might transform decision-making and hasten the decarbonization of the built environment?
>
> How can the imperative for Climate Action be translated and scaled from the production of relatively few, singular works of sustainable architecture to evidence-based processes for achieving climate goals across virtually all buildings, landscapes and infrastructure?
>
> What new theories, research, tools, technologies, processes and collaborations are needed to educate and support architects in designing and implementing effective interventions?
>
> How can architects help foster and realize community-based visions of equitable development and climate responsive design?

The following papers arose from this call. They were selected from 120 submissions through a blind review by peers from both the American Institute of Architects and the Association of Collegiate Schools of Architecture. The papers are grouped into two chapters and explore possibilities for work that connects architectural practice and academia with global and local sustainability challenges. We were encouraged by the rigor, systems thinking, concern for equity and inclusion, and creatively embodied in each research project.


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CHAPTER ONE

ACHIEVING CLIMATE ACTION THROUGH PRACTICE, ACADEMIA, & POLICY

Climate Action calls for design innovation, research, education and community-based visions of equitable development that is also climate-responsive. This session featured papers that addressed these issues from diverse perspectives and geographies.

In their paper, **Cultural & Climatic Actors: Shifting Roles of Architects and Practice**, Ashlie Latiolais and Phanat Xanamane explored how collaboration and envisioning across practice, academia, community and government can be part of the answer. A University of Louisiana Lafayette architecture studio partnered with Envision da Berry, a community organization in New Iberia, LA, to develop new modes and methods of architectural education and practice. Together they sought to inspire a new generation of architects to re-imagine conventional deliverables in architectural community work. Richard Mohler's paper, **Transforming Single-Family Neighborhoods: A Climate Action and Social Equity Mandate**, investigated the historic impact of single-family zoning in Seattle on climate and social equity. This collaborative research between a University of Washington architecture studio and seminar, AIA Seattle and Seattle city government showed how revisions to public policy could simultaneously align with the city's climate and social equity goals. Finally, Sasha Plotnikova examined the systemic problems that a growth-driven economic model poses for sustainable architecture and climate action. Her paper **Designing for Degrowth: Architecture Against Climate Apartheid** proposed an alternative degrowth model that could reshape conventional US urban development and design practices to create a more equitable society. These engaged research and design projects offer models for developing effective change in architectural education, practice and policy to realize climate action.

Cultural & Climatic Actors: Shifting Roles of Architects and Practice

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University of Louisiana - Lafayette

PHANAT XANAMANE
Envision da Berry

Keywords: community, alternative methodologies, collaborative, practice.

As the skills required for creating architecture continue to broaden and deepen, integrating professional experience into architectural education will be increasingly necessary. This integration will create graduates that are more adaptable and versatile than through academic experience alone. Professional Practice discourse is an obvious venue for discussing and exploring the broader skills required for success and advancement in architectural practice, however, this paper entry discusses a shift of conventional practice to a practice that addresses community work - from product to processes - through a semester-long studio experience. The studio was dedicated to the students' professional development of social and environmental responsibility using a transdisciplinary and collaborative approach. The impacts of intersecting architectural practice and interdisciplinary collaborators with architectural education through community engagement dissolves the notion that these actors are mutually exclusive. Rather, what yielded is an inclusive approach to creating environments that are more socially conscious; benefitting both the students and community patrons.

The year 2020 has exacerbated systemic failures evident by continuing global socio-political unrest, worsening climate change events, and the COVID-19 pandemic. Though discussion around these vulnerabilities have been in focus for the past decade, the urgent call for architects to rethink their roles and methods, at all levels, is imperative. Architect and urban designer, Brian McGrath states,

> "Architecture will only grow in importance, not in catching the latest wave of the globalization of data and capital, but in creating environments for making a place that is socially equitable and ecologically sustainable."

This call for reexamination is especially relevant when mitigating the impacts to the most vulnerable communities through a range of project types, from the scale of a city to the scale of an art installation. Public artist, Mary Miss, places emphasis on this stance in her statement,

> "The path to meaningful action is forged through a long-term process of relationship building… Facing an intractable problem like climate change can seem overwhelming. By focusing communities directly on local impacts and innovative solutions, we are helping to move the needle."

The education of an architect is fertile territory to forge new ways of integrating practice-based experience to aid in developing long-term relationships with communities. Architecture students should be taught the tools, rather than the outputs, to deepen their understanding of project sites as part of complex urban-natural ecosystems. With such tools, the community-sensitive architect can garner skills to interject with good design and adapt programs that have relevant social, cultural, and environmental implications for the communities in which they work. In addition to working alongside community members and stakeholders, a studio, in particular the one being discussed here, could be a model that reimagines how an architectural office environment could counter the "conventional" with a more "collaborative" type of practice through the emphasis on the "processes," rather than the products it provides.

THE QUESTIONS

This paper examines new methods within architectural education which can influence future modes of practice that encourage strengthening strategic partnerships with a community. The concepts for such practice are viewed through the lens of a semester-long Masters of Architecture graduate studio at the University of Louisiana Lafayette School of Architecture and Design. The studio's primary objective was prompted by a desire expressed by the American Institute of Architects Blueprint for Better Campaign, "…the public isn't always aware of what architects do or how their work affects society. The truth is, in partnership with their clients and communities, architects plant the seeds that blossom into stronger communities." The studio strived to flip the script, meaning, to bring the emerging architects out of the studio and into the community in which they would directly impact. Generally, initial student site visits yield bland, superficial readings and miss out of the usually very nuanced community dynamics. Too often are educational opportunities separated from immediate and physical interaction through site, communities,

Figure 1. Bunk Johnson Mural at da Berry Fresh Market. Credit: Envision da Berry.

and / or clients that give access to fine-grain socio-cultural details of a place. Therefore, to question not only the roles but processes of practicing architects can directly impact the new skills learned within architectural education. This skill or tool-based learning requires the students to synthesize human interaction with the built environment and integrate their research and on-site experiences into their design proposals.

In order to successfully tackle problematic norms found in traditional architectural practices in the turn of the 21st century, the studio identified four traditional deliverables and offer proposed alternatives that could potentially achieve a more relevant architectural practice: 1) The static rigid masterplan product versus a framework for instituting actionable processes impacting the local built environment, 2) the formal community charette versus informal direct local action and engagement, 3) quick turnaround proposals versus building a timeline of institutional presence and acquired trust, and 4) the singular solution versus multi-scaler and transdisciplinary approaches that broaden the scope of inquiry while expanding the network of resources for the community.

The image in Figure 1 is the Bunk Johnston mural on the facade of Da Berry Fresh Market in New Iberia, Louisiana which sets the stage for this studio and testing of this kind of design practice. Quick and immediate renovations like the mural here gives new life and hope to a crumbling context. However, the mural alone can not solve systemic community problems with a single act. Communities like New Iberia's underserved West End District are where these questions posed by the studio began. Questions about the products that architects supply - the rigid, dust-collecting master plan, versus, a more active solution, through tangible public processes that strives to shift the inequality presented from the economically and politically degraded context. Further goals aim for architects to deploy tangible and more sustained design engagement in contrast to a one-time design charette, build strategic partnerships creating trust and long-term institutional presence, and foster transdisciplinary collaboration to further the reach of the work.

METHODOLOGIES

The studio approach relies on a definition of "collaborative practice" which alludes to a more engaged design process with focus on community, local economy, and urban actors. This collaborative practice is explored through a partnership with community not-for-profit organization "Envision da Berry" (EdB) which has worked in the small city of New Iberia, Louisiana (population 30,000) since 2011. Before entering the nuances of the partnership, a clearer picture of the specific site and why it may be called "under-served" shall be presented. The context and ecology of New Iberia's West End is crucial to understanding its socio-economic roots.

New Iberia is the parish seat of Iberia Parish, located along the coast of southern Louisiana. The city is identified as part of the Gulf of Mexico Coastal Region. This region is especially susceptible to impending climatic conditions such as coastal erosion, potential hurricane damage zones, and flooding. New Iberia's West End neighborhood, the once thriving commercial and cultural hub for the African-American community prior to desegregation, has witnessed more recent social, cultural, and economic decline. A look into the history and demographics of New Iberia reveals economic disjunction in architectural and master planning investment for communities like the West End. Demographics comparing the West End to other parts of the city reveal economic disparity in the past decade leading to a devastating deterioration of the neighborhood's urban fabric and loss of collective memory of the place. This once vibrant working-class area has been torn apart by crime, addiction, violence, and poverty. Comprising three census tracts, the West End is a predominantly African-American population and has roughly 9,000 residents, 30% of whom are living below the poverty line. For comparison, the 2017 US Census Small Area Income and Poverty Level Data shows the nation's poverty rate at 13.4%, the state of Louisiana at

Figure 2. 2011 West End Installations. Envision da Berry.

19.6%, and Iberia Parish's rate at 23.8%. The West End shows an alarming 30% rate.

The graduate studio adopted a site and adaptive reuse program defined as a SNAP-approved, for-profit food retail market, Da Berry Fresh Market, located in the heart of the West End Cultural and Historic District. The market is the culmination of EdB's consistent long-term community based visioning process. EdB seeks to upgrade and expand this existing endeavor. This begins a discussion of a shift from conventional practice to a practice that targets more immediate cultural need. Strategies of including transdisciplinary figures into the studio conversation allowed for the students to have more thorough perspectives about the community and questions at play.

Insights into the local community context was imperative to the success of the studio's relationship to the place. Phanat Xanamane, served as a co-instructor for the studio and as an intermediary between studio, community, and client. This beneficial partnership of the studio gave access to a local individual, who was a co-founder of EdB, as well as stakeholder and native resident of the West End community. His background and professional experience as an urban designer working with ecologists at the Millbrook Institute for Ecosystems Studies and environmentally-conscious public artist Mary Miss brought forward unique intersections of knowledge into the studio's pedagogical framework. In EdB's 8-year history, Xanamane established a series of community initiatives and stakeholder relationships. Those relationships fostered cross-disciplinary guests to visit, offering discussions that would aid students. A peer question from the 2020 AIA / ASCA Intersections Symposium where this paper's preliminary form was presented underscores Xanamane's significance: "How crucial was Phanat's role as co-instructor of the studio?" His life-long personal ties to the community allowed for an intimate understanding of the social, economic and cultural fabric of the site. His presence was the cornerstone to this studio's trustful relationship that ensured continuity and longevity within the West End. Other studios may cultivate this kind of trust through institutional presence or strategic partnerships with individuals with strong personal ties within the community.

RECALIBRATING THE TOOLS

Prior to the nonprofit EdB's founding, the city went through planning and the public charette process at least three different times. Rather than create yet another top-down masterplan, EdB sought to make strategic temporary public space installations to initiate a tactical urbanism that would catalyze further engagement. In 2011, after a 5-week tem-

Figure 3. Redefined Charette: 2019 West End Brown Sugar Festival. Ashlie Latiolais.

porary installation, consistent dialogue through public art, performance, and social media campaign helped re-shape narratives about the West End (Figure 2). The diagram presents an alternative to a formal masterplan and instead, outlines a set of performative pieces to build connections in the community in various development sectors. Building upon this precedent of change and interaction, the studio, here, recalibrated its own tools for impact.

Beyond the regular site visits for documentation and remote analysis tools achieved through the internet, students were

Figure 4. West End Weir System. Graduate Student Sean Siravo.

asked to engage and gather information in a very direct way with the community. This engagement served as a key strategy to understand the community on their own turf opposed to a formalized charette process organized by architects. One event that served as grounds for an informal engagement was when the students and instructors participated in the West End's "Brown Sugar Festival" (Figure 3). There, patrons and children were able to reveal the needs and wants of the community through informal conversation and activities while promoting mental health and well-being. Students observed as residents interacted with their own built environment: shopping, dancing, gathering, confabulating, eating, and living. The Festival served as a novel way to engage the community through an active local event, not created by us, but by *them*. The students took all of the experiences and verbal data back into the studio to synthesize the research and graphically convey the inequalities, fragmentation, and needs of the community, as well as the assets and idiosyncrasies (Figure 5). The studio instructors were keenly interested in the students' ideas and fostered them into mitigating essential architectural questions of today and tomorrow. The instructors supported students through this effort and the work that marked it. Interactions yielded beneficial positive experiences for residents and students and built a new trust that had not existed beforehand.

Interdisciplinary partners and stakeholders were also involved at several strategic points throughout the project. Investors, developers, council persons, psychologists, educators, non-profit directors, and scholars served as key influential resources. Carl Cooper Jr is the Market's current manager and is set to take full ownership of the market in the future after it grows out of its fledgling stages under the auspices of EdB. His input and vision for the space that serves this community was essential for students to understand the basic needs of the project's program. Beyond the immediate client's program needs other conversations with cross-disciplinary stakeholders in the market and the West End community were invited to inform the process. Investor David Levy and architect / developer Barry Broussard lended their perspectives offering their phased approach strategies toward investments. Dr. Caryn Winters, a former EdB board member and PhD in Mass Communication, prepared students for calling upon the expertise of the residents through culturally sensitive training and listening. Lorna Bourg and Denise Galatas with the not-for-profit organization, Southern Mutual Help Association that has accomplished work in the West End and other distressed communities for decades, spoke with students on the systemic racial and cultural issues embedded in the West End. The studio created anti-oppression toolkits where "call-in" versus "call-out" strategies utilized knowledge, assessment,

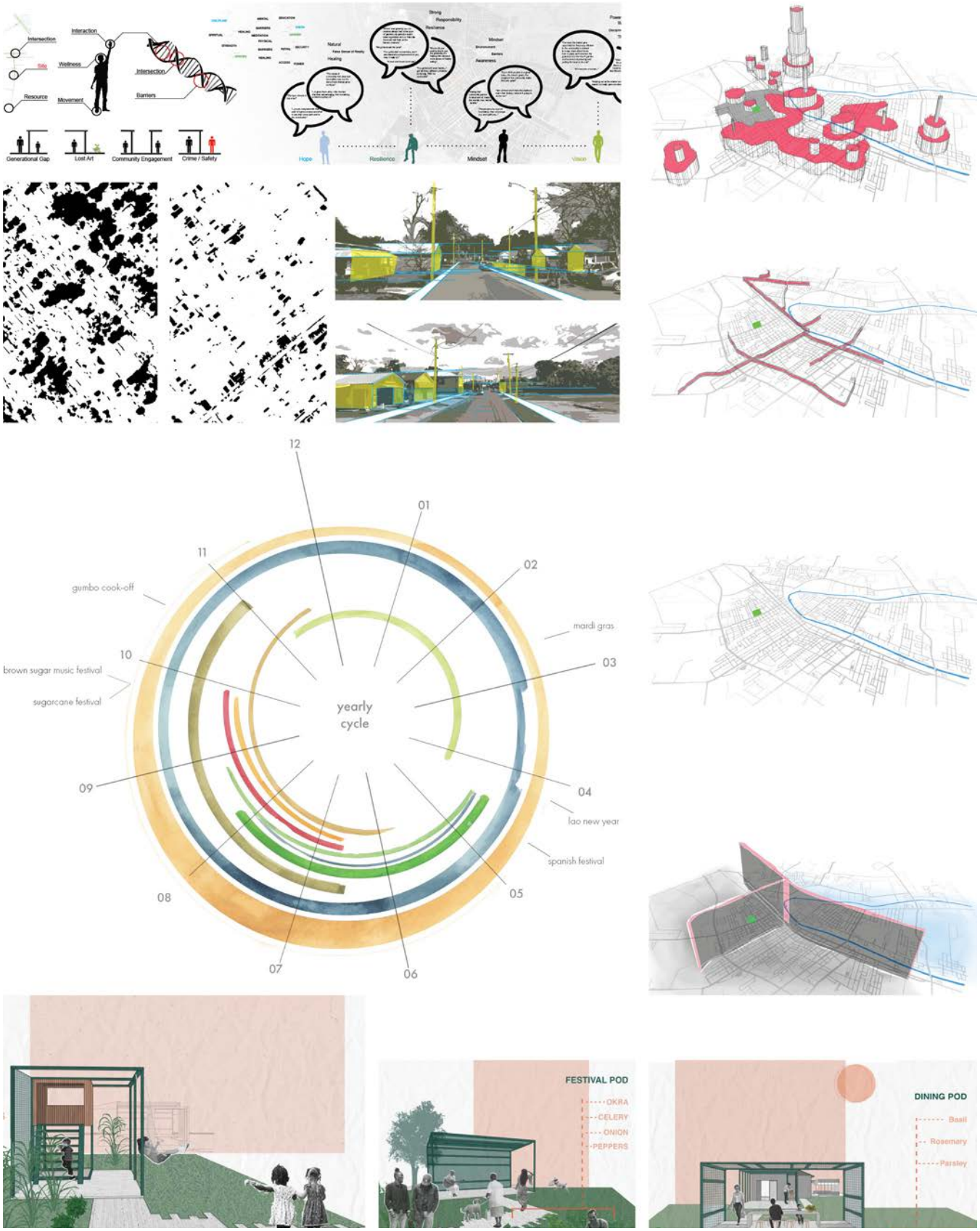

Figure 5. New Iberia, LA Cultural & Ecology Research. Graduate Students David Allen, Chloe Barton, John Bowman, Sean Siravo.

Figure 6. UL Lafayette Fletcher Hall Gallery. Ashlie Latiolais.

acceptance, and listening to reach compassionate communication within this community.

Four themes emerged from the student's research and engagement: Heath and Wellness, Agriculture, Social Concerns and issues of the Urban Fabric. All student proposals effectively encompassed one or more of the themes. The most successful students integrated all themes by not only demonstrating an understanding of the place culturally with sensitivity to its social needs, but also, environmentally. This student's proposal, pictured here, brought together rainwater harvesting and experiential weir systems into the site to harness the social and environmental interactions while being economically conscious of the agricultural program's demand for water irrigation. (Figure 4, above). The integration of these themes launched the trajectory of the studio's processes, and ultimately, established an open-source tool for furthering community interaction.

A NEW PROCESS

In addition to phased master planning drawings and details, the studio, most importantly, created a traveling exhibition device (Figure 6). The intention of this device is to be used extensively by the public as an interactive tool for conversation and community-based modeling. The first display was for final studio reviews where outside review critics could comment and discuss the very things discussed in this paper. As a way to start to frame an on-going conversation with a range of different audiences, a color-code system was devised using blue, pink, green, and gold representing the themes of the project foci. Blue denoted projects that addressed mental health and wellness, pink for larger social systemic issues, green, rightfully so, denoted agricultural focused projects, and gold for urban / infrastructural interventions. Students painted scaled-models of their proposed design accordingly. Then, the work was exhibited at the University of Louisiana's School of Architecture and Design Fletcher Hall Gallery.

When thinking about an open source tool, the accessibility of the information must maintain a level of inclusivity for the reader (that may not have training in design or architecture). Architects must be sensitive to the visualization of this information when presenting it to the public in which it directly affects. Visualizations also give the intentions of the project increased public credibility. Projects employing sensitive processes as related to planning efforts have later reported increased levels of clarity between stakeholders in terms of desired outcome and overall direction. Therefore, the studio began pairing the images with an active tactile tool, such as drawings plus physical models, for interaction to further convey scale, impact and materiality to the community and stakeholders. Although we have critiqued the traditional master plan, these drawings are still necessary to visualize the larger dream. However, once again, coupling these drawings with additional and alternate views (Figure 7, right) to describe the components is valuable to the public. It allows them to achieve small components over time rather than large scale, completed visions. These drawings intended to provide immediate information that balances the technical and the poetic.

POST-STUDIO ACTION

In the following Spring semester, after the studio concluded, Xanamane taught as a visiting artist at the Hilliard Art Museum on the UL Lafayette campus. The studio's traveling exhibition model became part of an interactive urban planning

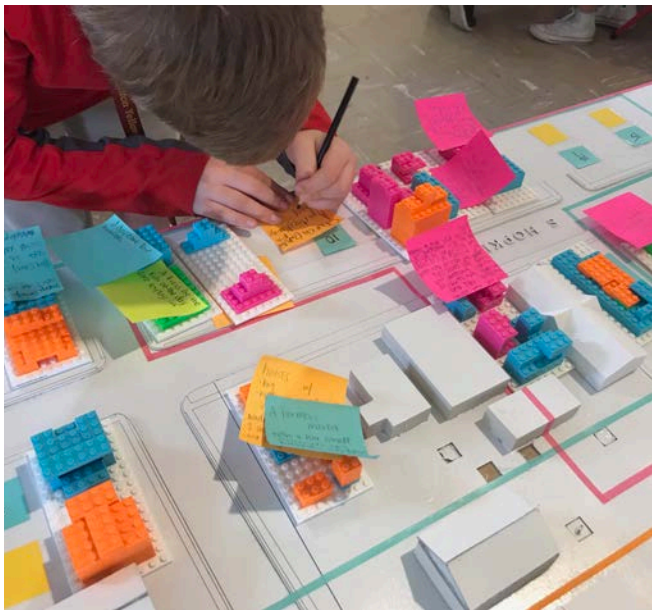

Figure 8. Open Source Exhibition Tool. Phanat Xanamane.

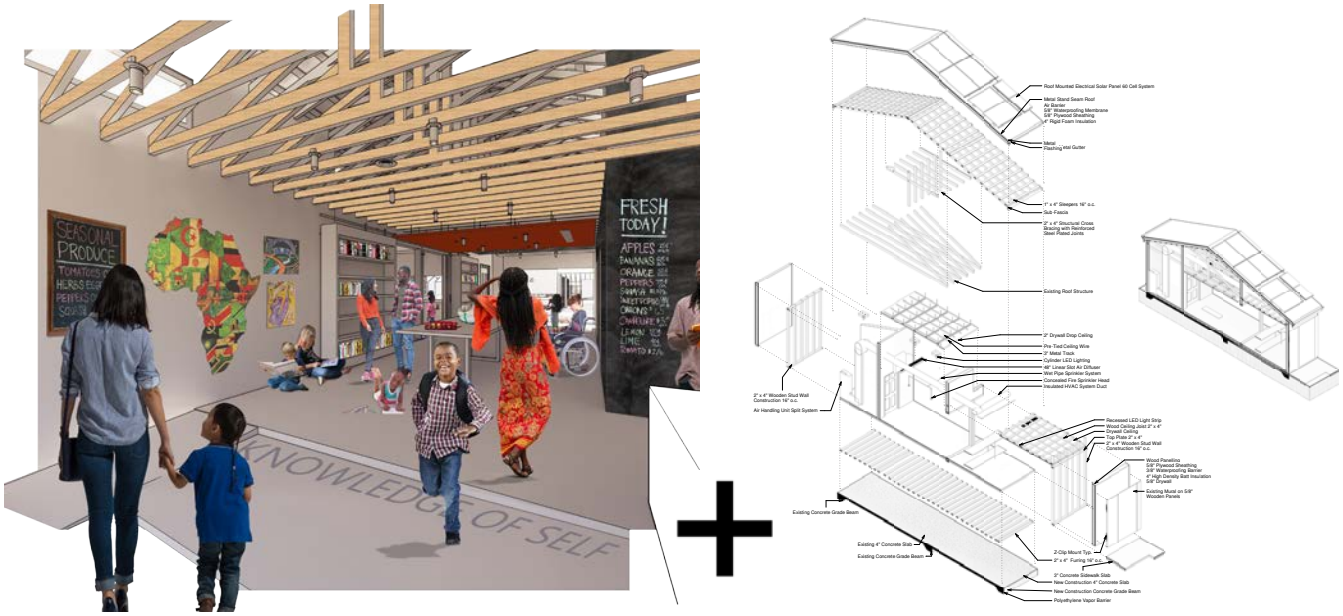

Figure 7. Pairing Visualizations. Graduate Student David Allen.

installation: "Box City" by sculptor Robert Tannen. Tannen's boxes and other durable sculptures at various scales were meant to be publicly interactive models for an imaginary "city." His installation was an inspiring tool for non-architecture students to understand scale, planning, defining and responding to a community's needs. Small workbooks were created to assist in teaching during tours of the installation which ended with students working with the Studio model.

Interactive lego tools were added to the site model (Figure 8, left). The four themes (as defined by the studio) correlated to sticky notes and lego tools. Persons of all ages could comment and interact with the tool in a very accessible, informal, unintimidating, and playful way. K-12 school programs within the community made field trips to the Hilliard Art Museum in Lafayette, La – the second location of the exhibit. Museum visitors created various built environment scenarios for the West End. This proved as a great test dry-run before the model would eventually go to the market in New Iberia in the late Spring 2020. Unfortunately, the COVID-19 pandemic hit the world. Plans to open the exhibit back to the community in which it originated – the West End are currently on hold. Eventually, this final exhibition model will serve as an open-source tool to invite the public to collaborate with the goal that residents and stakeholders join in the process. The participatory model could be a helpful tool for residents of the neighborhood to gain support and further buy-in. Creating more accessible and tangible design tools for the community should be a priority for all community driven studios.

IMPACT ASSESSMENT

Now, one year later, it's relevant to reflect on the sustained impacts on this community. As most studio projects terminate at the end of a quarter or semester, this work is a piece of EdB's larger ten year commitment strategy. The studio's active performative processes instigated a new hope for the West End. The four initial questions from the studio established a level of engagement that the community respected and achieved action and equated to real dollars funded for further projects within the West End. The tools helped inform the process and the process fueled the work. This reciprocal relationship solidified the role of architects (and architectural students) to be integral players consistently and effectively.

Interrogating the dated models of practice redefined and reshaped the architecture student, a break from the master builder or top-down approach. Direct engagement proved to be successful when integrated into existing community networks and events. Valuable services for the community were also gleaned, such as the ability to see consistent value in architects work to manifest community vision and create opportunities for self / community reflection.

This work contributes directly to the greater understanding of the role of professional architects for all key participants - the architecture students, project partners and stakeholders, and the community. Architects can perform a more important role by connecting cross-disciplinary views and community expertise attained through direct public engagement to inform their approach towards design in underserved communities. The resulting work from students demonstrated multi-scalar approaches to the microcosm of cultural climatic issues calls for a practice that discusses the climate action needed to address cultural inequalities.

Taking cue from the 2020 Intersections Symposium call for proposals, "How can architects help foster and realize community-based visions of equitable development and climate responsive design?" From product to process, from transactional to transformative, and we (as a studio) listened. Countering conventional practice became a clear choice when designing impactful interventions in the heart of the West End; an intentional re-alignment to a process that usually leaves communities lacking resources to take urgent action that will catalyze effective change.

In conclusion, the studio was dedicated to the students' professional development of social and environmental responsibility using a transdisciplinary and collaborative approach to: work in the public interest; understand the relationships between people, place, and context; improve the quality of life of the client and community; and design resilient proposals for the management and modification of the natural and built environment. Most importantly, the students' creative acts initiated dialogues in an under-served community and amplified the voices of community stakeholders through the collaboration with Envision da Berry and Da Berry Fresh Market. It's our hope to inspire a more profound impact, at a series of scales, within a community and re-think their methods to be more active performers within the built environment. This certainly holds true when considering futures of architectural practice focused upon community work. Every project, no matter the scale, should give voice and agency back to the communities in which they're cited. Architecture is a political act, architects must strive for a more inclusive process and deliverables that fosters more relevant and sensitive solutions.

ENDNOTES

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Transforming Single-Family Neighborhoods: A Climate Action and Social Equity Mandate

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Keywords: single-family zoning, climate action, social equity, racial exclusion, design advocacy

In many fast-growing cities around the country, up to three-quarters of the land zoned for residential use is reserved for detached, single-family dwellings at suburban densities. This is both a climate justice and racial justice issue as it has the doubly negative impact of artificially constraining housing supply and driving up costs, forcing many lower and middle income families farther away from job centers and imposing on them long, costly, and carbon-intensive commutes. Single-family zoning was also used as an explicit tool to segregate the U.S. by race starting in the 1920s and, in the process, denied countless people of color access to home-ownership, the most powerful wealth-building tool available to U.S. families. This is a significant factor in the stark racial disparities in household wealth that we see today.

This paper outlines the findings of a nationally cited report on single-family zoning released by the Seattle Planning Commission, which advises the City Council and Mayor on land use and housing policy and of which the author is a member. It also reviews a collaboration between the commission and a graduate research-based architectural design studio and seminar co-taught by the author. This collaboration re-envisions urban, single-family neighborhoods to be more equitable, sustainable and livable while engaging students in a national policy dialogue in the process. The results of the studio will advance the commission's efforts to advise Seattle's elected officials in revising public policy to be more aligned with the city's climate and racial justice goals.

INTRODUCTION

Single-family zoning is among the most controversial social equity and sustainability challenges in the U.S. as, for many, the detached single-family home embodies the American Dream. This paper will review the origins of single-family zoning and its environmental and social equity impacts in Seattle and other fast growing U.S. cities. It relies in part on research conducted by the Seattle Planning Commission, of which I am a member, although I speak only myself on these pages. It will note how the inequities of single family zoning have been amplified and exacerbated by the current pandemic and will conclude with a discussion of student work from a graduate architecture research design studio and seminar I taught in winter quarter, 2020 at the University of Washington in collaboration with the Seattle Planning Commission.

Nowhere is growth and change met with more resistance than in single-family neighborhoods throughout the U.S. Expressed concerns of single-family homeowners include the potential loss of existing tree canopy, the reduction of available on-street parking and the unleashing of a wave of speculative development that could lead to displacement and the loss of so-called livability [1]. What these positions fail to acknowledge, however, is that single-family zoning artificially constrains the supply of housing within cities. While new development can and often does physically displace people from their homes through demolition, far more are displaced economically as their rents rise beyond what they can afford due largely to housing demand not being adequately met by housing supply.[2] This condition pushes households further away from employment, education, health care and other services while forcing long commutes to auto dependent locations with lower rents but higher transportation costs due to the increased reliance on car ownership. In the process, this dramatically increases per capita vehicle miles travelled and resulting carbon emissions while a greater loss of tree canopy is incurred as new suburban green field development replaces what could have been urban infill development that leverages existing municipal infrastructure.

Despite being the northernmost major city in the continental U.S., Seattle has a temperate maritime climate which reduces the heating and cooling load on buildings relative to many other U.S. cities.[3] Since the early 20th century, Seattle has relied almost exclusively on hydroelectric power which, while raising other environmental concerns, has virtually no direct carbon emissions in contrast to coal or natural gas fired power plants. However, the city also has among the highest per-capita rates of car ownership in the U.S.[4] As a result, automobiles account for roughly half of Seattle's direct carbon emissions and much of this can be attributed to the city's single-family zoning policies which thwart the development of compact, walkable communities with robust access to transit.[5]

"NEIGHBORHOODS FOR ALL" REPORT

While single family zoning's contribution to carbon emissions and climate change is troubling, the social inequities that single-family zoning engenders are more disconcerting still. In response, the Seattle Planning Commission began to examine Seattle's single-family zoning policy through a social equity lens in 2017. The commission consists of sixteen volunteer members who live in neighborhoods throughout the city and provide experience and expertise ranging from architecture and urban planning to mobility, affordable housing development, public health policy and the social equity dimensions of climate change.[6] Commissioners are appointed by the city council and mayor to advise them on issues related to land use, housing and transportation. While the commission's primary charge is to evaluate and comment on policy proposals from various city departments, it also conducts independent, policy-based research projects that elected officials and city staff may be unable or unwilling to pursue. The commission's examination of Seattle's single-family zoning is an example of this.

In late 2018, the commission released a report titled "Neighborhoods for All – Expanding Opportunity in Seattle's Single Family Zones" of which I am a co-author.[7] The report outlines the history of single-family zoning in Seattle and includes a series of observations and recommended strategies to address the social inequities of single-family zoning. The report outlines Seattle's meteoric rise in housing costs and notes that the principal reason for this rise is that, while more housing has been built over the past decade in Seattle than in most comparably sized cities, it has failed to keep pace with the unprecedented job growth that has increased Seattle's population by nearly 30% during that time. [8]

This misalignment between job growth and housing production has existed since the mid-1980's when Seattle emerged from a fifteen year period of economic and population decline due to the so-called Boeing Bust.[9] Boeing, the world's largest manufacturer of commercial and military aircraft and the region's largest employer, saw a steep decline in aircraft demand due the energy crisis and cuts in military spending in 1970 leading to massive layoffs and a loss of roughly 15% of Seattle's population. In 1985 Microsoft, headquartered just east of Seattle, launched Seattle's tech economy with its Windows operating system which, combined with a national interest in Seattle's grunge music scene, coffee culture and striking natural setting, encouraged population growth. Due to zoning constraints and the relatively low cost of housing at the time, however, the housing market was slow to respond to this rebound. The more recent resurgence of Boeing and the growth of Microsoft and other tech companies, most notably Amazon, has fueled an escalation in job and population growth. However, between 2016 and today less than half the amount of housing needed to accommodate this growth has been constructed.[10]

The Planning Commission's report also reviews Seattle's zoning history, which mirrors those of cities around the country. Seattle's original zoning ordinance was enacted in 1923 and it differed from the building codes that preceded it by focusing on building use, as opposed to building safety. The 1923 code also introduced the widespread mandate for detached, single-family homes by designating roughly half of the city's developable land exclusively for this building type.[11] From the 1950's to the early 1980's, Seattle gradually expanded single-family zoning throughout the city by downzoning areas that had previously allowed duplexes and triplexes to exclusively single-family use.[12]

In response to the 1990 adoption of the Washington State Growth Management Act, which is designed to contain sprawl by mandating increased development capacity in existing cities and towns, Seattle introduced two significant zoning changes in 1994. First, the city allowed accessory dwelling units, or ADU's, within or attached to single-family dwellings. Second, the city established the urban village growth strategy which locates growth close to existing transit in urban villages at three scales – the most dense being Urban Centers followed by Hub Urban Villages and the least dense, Residential Urban Villages located within neighborhood commercial districts.[13] By locating growth close to frequent transit, urban villages have had the positive impact of making Seattle one of the few U.S. cities with increasing per capita transit ridership. However, the urban village growth strategy was also used as a negotiating tool by single-family homeowners in the early 1990's to ensure that their neighborhoods would not be impacted by future growth. This perceived agreement continues to beleaguer the city's discussions related to single-family zoning reform today.

As with virtually every U.S. city, Seattle's growth has been shaped by a history of systematic, government-led racial segregation that denied people of color access to home ownership, the most powerful wealth building tool available to U.S. households.[14] Racially exclusionary zoning and restrictive covenants prevented households of color from living in most Seattle neighborhoods forcing them instead into less desirable areas adjacent to or within industrial zones and in neighborhoods lacking schools, parks, commercial services and quality housing stock. While Black people bore the brunt, Asian, Jewish, Hispanic and Indigenous households were sometimes excluded as well. To mitigate the impacts of the Great Depression the Federal Government created the Home Owners' Loan Corporation (HOLC) in 1933 to refinance home mortgages that were then in default to prevent foreclosure.[15] HOLC loans made home ownership more accessible as they were amortized loans with lower interest rates than the previously existing interest-only loans in which the principal was due in full at the end of loan.

However, HOLC is generally cited as institutionalizing the segregationist practice of redlining, which entails color coding

neighborhoods by level of investment risk.[16] Lending regulators produced maps of Seattle, and virtually every city in the country, where red denoted "hazardous", yellow "definitely declining", blue "still desirable" and green "best". The "hazardous" areas were the same neighborhoods, such as Seattle's Central District, where households of color were forced to reside through racially exclusionary zoning and restrictive covenants. Households in these neighborhoods consequently found it difficult if not impossible to gain access to mortgage financing and the wealth-building capacity of home ownership. This limited their financial ability to move from the neighborhood even after racially exclusionary zoning and restrictive covenants were lifted.

Single-family zoning itself played a role in Seattle's segregationist strategy. While the city was drafting its 1923 zoning ordinance it hired Harlan Bartholomew, considered by some to be the father of U.S. comprehensive planning, as its consultant. When planned segregation through racially restrictive zoning was deemed illegal by the Supreme Court in 1917, Bartholomew proposed using single-family zoning itself to achieve the same ends. While drafting the original St. Louis zoning code in 1919 as that city's first planning engineer he stated that a goal of the ordinance was to "preserv[e] the more desirable residential neighborhoods" and to block movement into "finer residential districts… by colored people."[17] Bartholomew would later consult with cities around the country regarding their zoning codes and would advance the same goal through single-family zoning. The principle was simple. By making housing artificially expensive through single family zoning's mandate of minimum lot sizes and detached structures, it would segregate cities by class and race.

Today, a staggering 75% of Seattle's residentially zoned land is reserved for detached, single family homes at suburban densities while a mere 25% of its residentially zoned land allows for multi-family structures.[18] This is a condition found in fast growing cities throughout the U.S. While only 15% of residential zones in New York's five boroughs are zoned single-family the numbers are 70% in Minneapolis, 75% in Los Angeles, 77% in Portland, OR, 84% in Charlotte, N.C. and 94% in San Jose, CA.[19] As mentioned above, this has the doubly negative impact of artificially constraining housing supply and driving up costs, forcing families farther away from job centers and imposing on them long, costly and carbon-intensive commutes.

Not coincidentally, the zoning maps in these cities closely approximate the HOLC redlining maps with previously "red" areas now zoned for multi-family and "blue" and "green" areas zoned single-family. Because these cities have directed nearly all their recent growth to those "red" and "yellow" areas while putting single-family zones off-limits, many households of color have been displaced from their communities to locations outside the city and many more are at risk. [20] A legacy of these polices in Seattle is that most publically funded amenities such as parks, schools, playgrounds and community centers are located within single-family zones while most subsidized affordable housing, which could most benefit from these amenities, is located further away in multi-family zones.[21]

Today, many Seattle single-family homeowners fear that changes to so-called neighborhood character will result from changes to land use legislation to address these inequities. However, single-family neighborhoods in Seattle and around the country are already changing as modest existing homes are demolished and replaced with new single-family structures three to four times the size.[22] At the same time, many Seattle single-family neighborhoods have actually lost population despite the city's dramatic growth.[23] This is mostly due to changes in household demographics, but, the current trajectory in Seattle, and cities around the country, is fewer people living in more floor area which has a devastatingly negative impact on both housing affordability and sustainability.

An outcome of the proliferation of single-family zoning in Seattle is that 95% of the city's growth in the last decade has been constrained to the 25% of its residentially zoned land that allows multi-family structures. A mere 5% of the city's growth has occurred in the 75% of the city's residentially zoned land reserved for detached single family homes.[24] This is simply not an equitable distribution of the burdens of growth. More importantly, this has yielded a dichotomy of housing types in which 43% of the city's housing stock consists of detached single-family dwellings and nearly 40% consists of small apartments in large multifamily buildings with very little in between.[25] This dichotomy has yielded an inequitable condidition in which those wealthy enough to afford a detached house with porches and private yards also have the best access to publicly funded parks, schools and playgrounds while most others live in large apartment buildings on arterial streets with elevators, double loaded corridors and little if any access to open space. This inequity is problematic under any circumstances but especially so during a stay-at-home pandemic such as the one we are now experiencing.

What is lacking are so-called missing middle housing types including duplexes, triplexes, courtyard housing and small apartment buildings, the very building types that Seattle zoned nearly out of existence with its 1923 zoning code and the steady expansion of single-family zoning that followed.[26] These ground related or nearly ground related housing types offer much needed housing quantity and variety for a diversity of households while providing access to private and/or shared on-site open space. They would also offer the same access to publicly funded amenities that single-family homeowners currently enjoy and would expand opportunities for affordable homeownership and the wealth-building capacity it provides.

"NEIGHBORHOODS FOR ALL" RESEARCH DESIGN STUDIO AND SEMINAR

In 2017 the University of Washington launched a substantially revised Master of Architecture curriculum for the first time in nearly three decades. This removed the requirement that every student complete a thesis and offered two research studios and companion seminars in the final two quarters of the program as an alternative.

In winter quarter, 2020 I taught, with Seattle architect and colleague Brad Khouri, the inaugural version of the architecture research studio and seminar. Entitled "Neighborhoods for All" the coursework was taught in collaboration with the Seattle Planning Commission focused on expanding and evolving the commission's work as outlined in its report of the same title.

The seminar informed the studio work by delving into the racist history of Seattle's single family zoning policy, its inherent inequities and the ways in which it thwarts the creation of compact, walkable and sustainable communities. It explored strategies being employed in other cities including Minneapolis and Portland to address single-family zoning policies in those cities. Community land trusts and limited equity cooperatives were presented as alternative financing strategies that could address displacement concerns and expand opportunities for affordable home ownership.

A goal of the seminar was to engage students in a national conversation regarding the paradox of single-family zoning's racist legacy yet the strong support it receives from homeowners in cities such as Seattle that claim to be politically progressive. Several guests joined the seminar both in person and via Zoom (before the platform became the new normal in response to the pandemic). Guests included, among others, housing analyst and advocate Michael Andersen of the Sightline Institute and Eli Spevak, a community developer and single-family code hacker both based in Portland and Lisa Bender, President of the Minneapolis City Council, who led the effort to eliminate single family zoning in that city .

The studio intentions were to leverage student proposals to both visualize an increase in the quantity and variety of housing opportunities in single-family zones and to suggest potential land use strategies to bring this to fruition. Together with the commission's report, the goal was to influence single-family zoning policy in the next major update to Seattle's comprehensive plan.

The studio asked students to consider the following key questions:

1. What is most valued in Seattle's single-family neighborhoods?

2. How does this vary between neighborhoods?

3. How can this value be retained or even enhanced while increasing housing quantity and variety?

4. How can displacement be minimized, especially in lower income communities and communities of color?

5. How can opportunities for home ownership be expanded, especially in lower income communities and communities of color?

The studio of 19 students worked in teams of three or four to develop strategies for infill development in six Seattle single-family neighborhoods as an alternative to the current "one-size-fits-all" mandate of single family zoning. Neighborhoods were selected to provide a diversity of contexts with respect to population demographics, topography, vegetation and tree canopy, lot size, age of neighborhood and housing stock, walkability and access to transit, open space and commercial amenities. Student teams prepared an in-depth analysis of each neighborhood's history, demographics and conditions that have impacted the community in the past or may do so in the future. While the constraints of the ten week quarter limited the engagement with residents of each neighborhood, students had access to a substantial city data

Figure 1. Seminar guests joined remotely including (from left to right): Michael Andersen, Sightline Institute; Eli Spevak, Orange Splot Development; Lisa Bender, Minneapolis City Council. Image credit.UW Neighborhoods for All Studio/Seminar

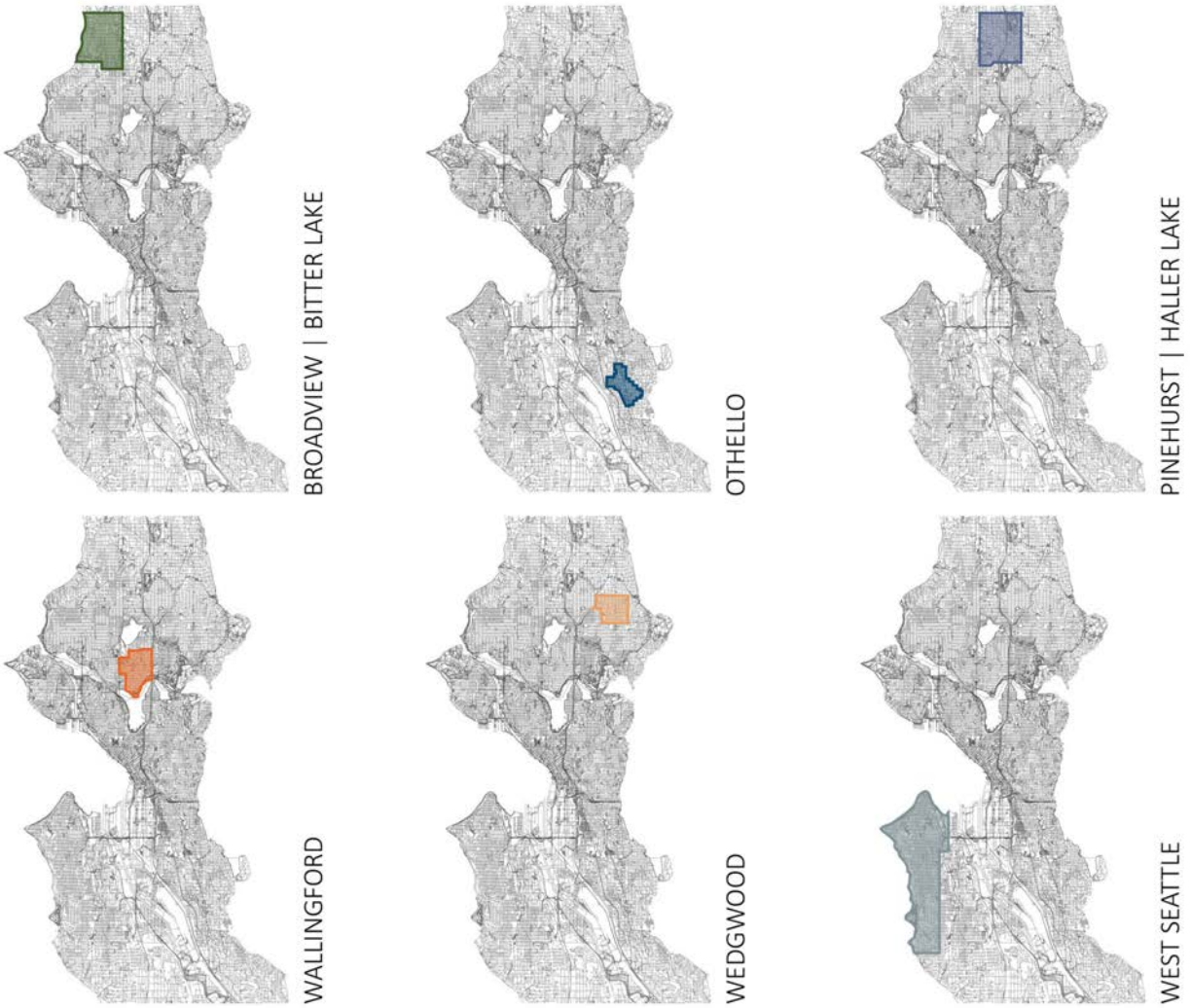

Figure 2. Six Seattle neighborhoods were studied representing a range of topography, demographics, walkability, transit access and other factors. Image credit. UW Neighborhoods for All Studio/Seminar

base of neighborhood information and community plans. Each team was also assigned a neighborhood "ambassador" who, while providing only one person's insight, were selected for their deep knowledge of and involvement in the community.

Students were provided with a hypothetical land use code matrix employing a floor area ratio (FAR) incentive system to encourage a larger number of smaller dwelling units in contrast to the large single-family homes being built today. The matrix would establish a given level of development capacity, or FAR, depending upon the number of housing units proposed on a given lot type. For example, a proposal with six dwelling units on a corner lot would be allowed more FAR than a mid-block lot of the same size with only three units. Particular emphasis was placed on expanding opportunities for affordable home ownership, especially in lower income neighborhoods and communities of color.

REPRESENTATIVE NEIGHBORHOODS AND PROJECTS

Bitter Lake in northwest Seattle is a diverse and relatively affordable neighborhood consisting of relatively large lots with modest houses on long blocks with alleys and relatively level terrain. The combination of long blocks, limited sidewalks and a lack of neighborhood commercial destinations hampers neighborhood walkability. In response, the student team proposed a strategy of "extend, activate and connect" to extend commercial destinations into the neighborhood, activate the alleys with new housing types and connect streets through the long blocks with pedestrian through block connections. To advance housing affordability, existing housing stock is retained and back yard infill development is incentivized with the exception of new block end development

With a team developed neighborhood and block strategy in place, students worked individually in advancing proposals

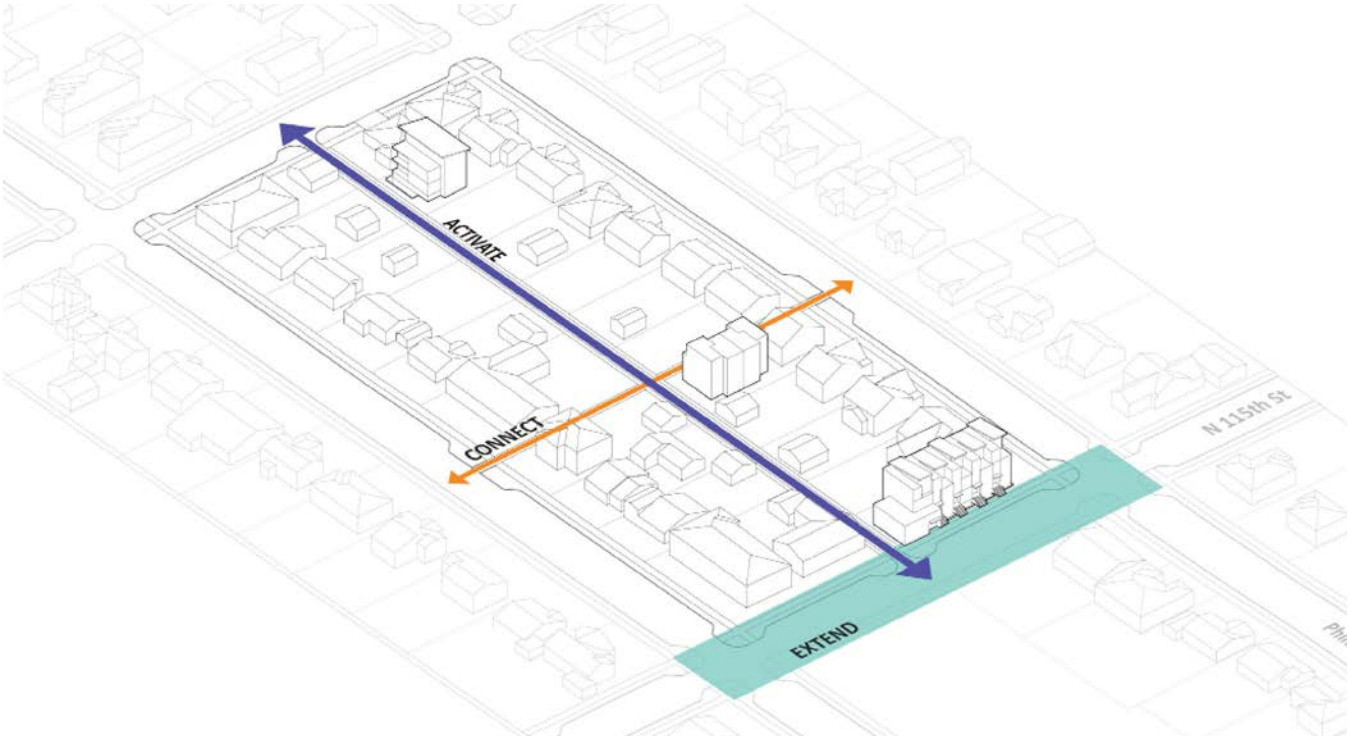

Figure 3. In Bitter Lake block end development extends the nearby commercial street into the community, the alley is activated with new housing and the long blocks are connected with mid-block connections lined with new housing. Image credit.Paige Collins, Nolan Nolan Higa, Benny Yeo

Figure 4. Block end development includes row houses.with ADU's below and a cafe that connects the street with the activated alley Image credit. Paige Collins

Figure 5. Stacked two-bedroom flats with balconies activate the alley. Image credit.Benny Yeo

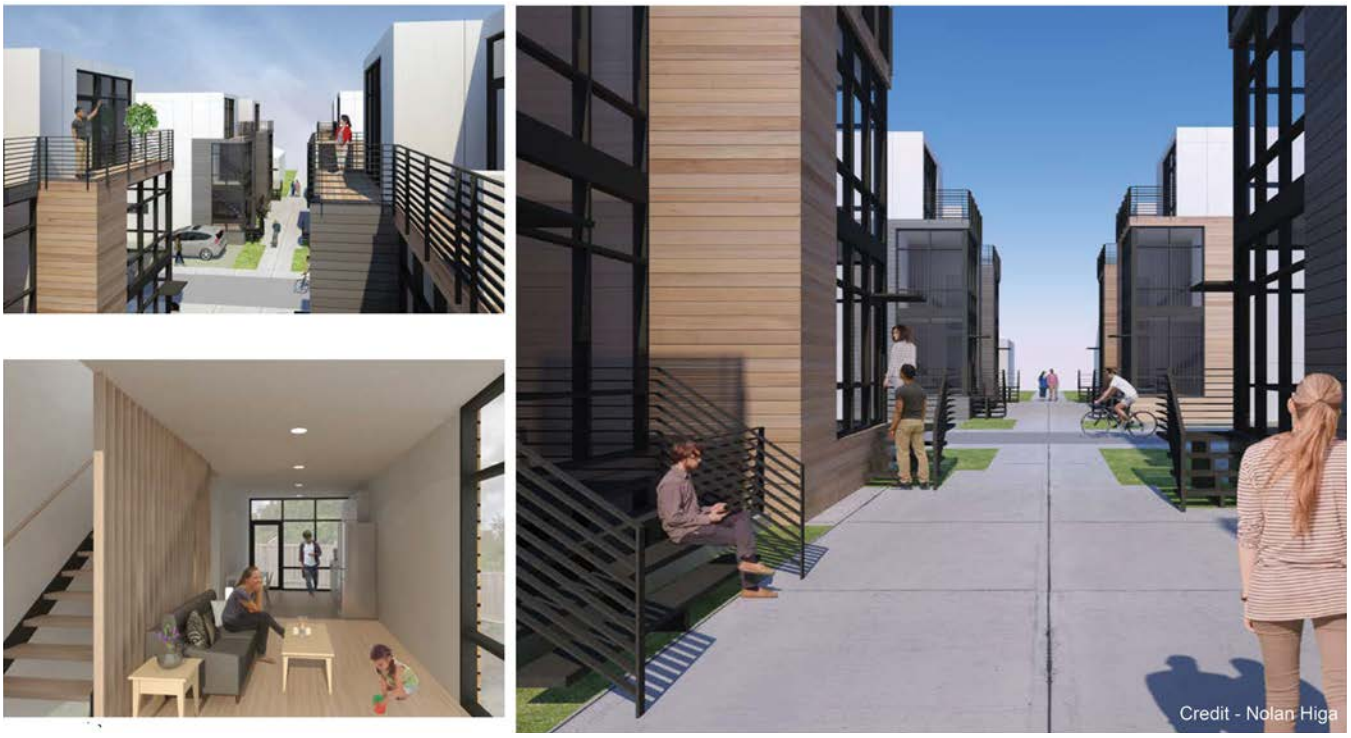

Figure 6. A new through-block pedestrian connection, or mews, is lined with small row houses with roof decks. Image credit.Nolan Higa

on specific parcels with a focus on prototypical development strategies. The block end development includes row houses with small roof gardens, stoops and lower level accessory dwelling units. A corner commercial space enhances walkability, creates a neighborhood destination and turns the corner to engage the newly activated alley. Alley activation strategies include a prototype small footprint infill building in rear yards with four stacked two bedroom flats each with its own open space enfronting the pedestrian friendly shared space of the alley. The pedestrian through block connection, or mews, enhances neighborhood walkability while quintupling the opportunities for home ownership through small row houses each with its own roof deck and modest rear yard.

Several miles east of Bitter Lake, the Wedgwood neighborhood also consists of relatively large lots on blocks with limited sidewalk infrastructure. In contrast to Bitter Lake, Wedgwood contains few alleys and, instead, a mature, coniferous tree canopy occupies the heart of most blocks. Displacement risk is low as residents are more affluent and there is very little diversity of households or housing types. To preserve tree canopy and introduce housing and income diversity, one proposal replaces an existing single-family dwelling with a co-living development of slightly larger scale providing a home for more than 20 unrelated adults with shared amenities and front and rear gardens. Structured as a limited equity cooperative, the project would provide housing stability and access to the housing market for younger adults as a step toward longer term home ownership.

In southeast Seattle, the traditionally affordable Othello neighborhood is among the most racially diverse in the U.S. Well within the walkshed of a light rail transit stop, the neighborhood has experienced displacement pressures for more than a decade. As in Bitter Lake, this concern is addressed through the retention of existing housing stock and the development of a variety of housing types along its alleys. In one proposal affordability is advanced through the deployment of a prefabricated system of flexible modular units in rear yards to create new alley oriented garden communities with roof decks, balconies and shared open spaces. Pre-fabrication also provides increased predictability of developments costs allowing existing low and moderate income homeowners to retain their property and develop it themselves.

OBSERVATIONS AND IMPACT

There are several ways in which to measure the success and impact of the coursework outlined above. The research studio and companion seminar are key components of the newly implemented master of architecture curriculum. As such, the individual and collaborative student learning experience within them was critical. Based upon the level of engagement, quality of student work and anonymous student evaluation of both courses, they were generally a success. The most common critique was that the complexity of issues being addressed coupled with the demands of research and design were unreasonable to accommodate within the constraints of a ten week quarter and that two quarters would have been more appropriate. This is currently not an option within the curriculum but is something that should be considered as it evolves.

The studio and seminar worked in collaboration with the Seattle Planning Commission to advance the strategies outlined in its “Neighborhoods for All” report. Roughly half of the commission, including the Executive Director and Chair, directly engaged with the coursework through design reviews and seminar presentations. These consisted primarily of commissioners with architecture and planning expertise who were able to decipher design drawings and diagrams. The intention was for the entire commission to be engaged with a major event at quarter’s end but, as outlined below, this proved to be impossible.

A very tangible goal is to influence Seattle’s single-family zoning policy in the next major update to its comprehensive plan in 2024. This is a politically contentious issue and, as such, the strategic introduction and socialization of approaches that challenge the status quo is essential. To this end, the term was to conclude with a major public presentation, panel discussion and reception/review with an anticipated 150-200 attendees including elected officials, city staff, planning commissioners, housing advocates and the public at large from Seattle, Portland and Minneapolis both live and remote via Zoom. However, Seattle was host to the first U.S. Coronavirus outbreak on January 21, 2020, and the event was postponed due to a state mandated stay-at-home order at the end of the term. It will be conducted as an online event during the 2020-21 academic year although this will not replace the direct engagement students, policy-makers and the public would have experienced at an in-person event.

The coursework introduced students to the messy fray of public policy debate by engaging them in a national dialogue concerning a challenging and contentious social equity and environmental issue. By providing them with knowledge, data and communications tools they can enter this discourse as effective advocates for change. The studio/seminar also serves as a template for future curricula within the department and beyond in which research and design at the neighborhood, block and building scales are leveraged as tools to foster racial and climate justice at the city scale through public policy change.

Figure 7. In Wedgwood a co-living project provides entry-level access to home-ownership for more than 20 unrelated adults. Image credit.Steven Moehring

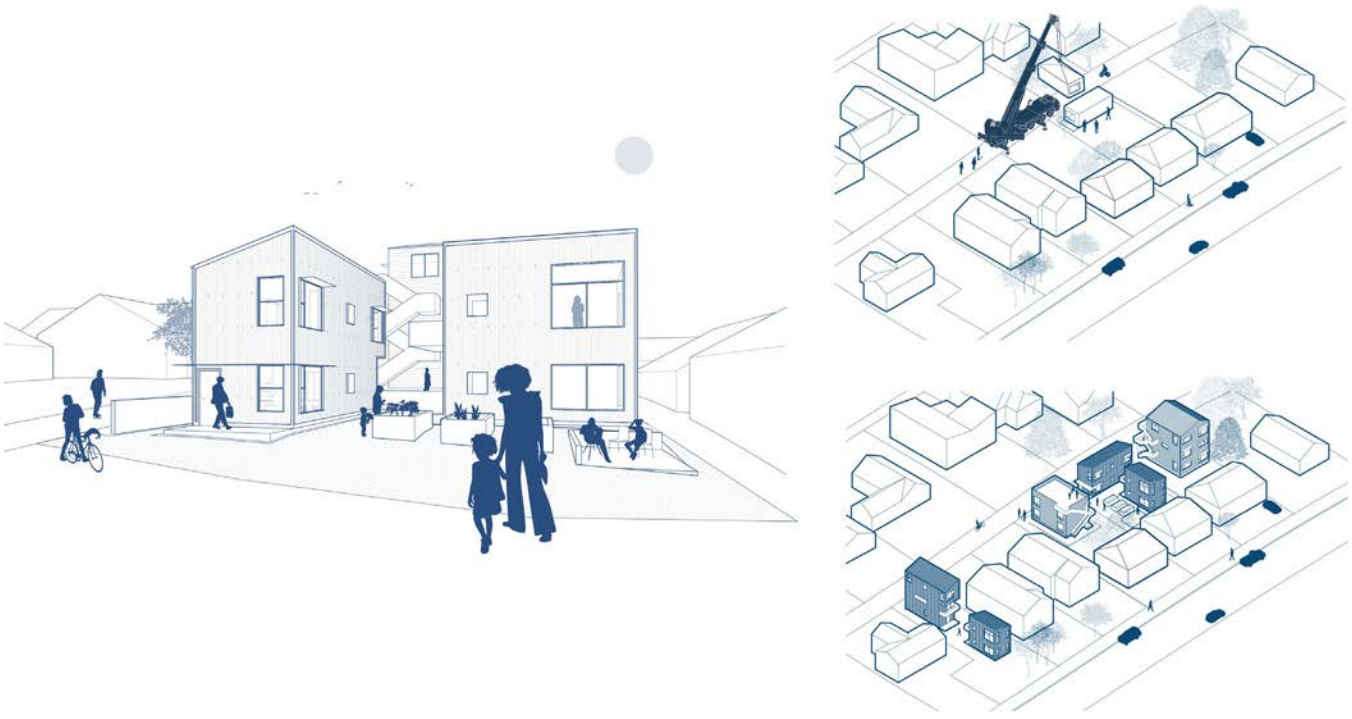

Figure 8. In Othello housing adfordability is advanced by retaining existing housing stock and creating new alley communities from pre-fabricated modular units . Image credit.Jesse Davis

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Designing for Degrowth: Architecture Against Climate Apartheid

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Keywords: degrowth, social justice, environmental justice, gentrification, green-washing

This paper challenges architects to consider a political economy that allows for social and ecological sustainability in the practice of architecture. At a time that bears witness to scores of radical proposals for re-shaping the field, we have the opportunity to reconsider the foundations of the field, and to pinpoint systemic injustices in which the building industries are complicit. In engaging a conversation about alternatives to a market-driven design field, this paper opens up a conversation about the ethics of sustainable design as it's been practiced under the prevailing growth-driven economic model, in comparison with how it might fortify the longevity of a community under an alternative framework. The paper will point to examples of existing practices that apply principles of degrowth in furthering sustainable building and living practices in the context of their community. Using the framework of degrowth, this paper expands the notion of sustainable design to include the social dimension (ie, whether a project sustains a community or displaces it); provides an analysis of "green growth" and "green-washing," and equips architects with an understanding of ecology that considers the biosphere and the community where the project is sited as being inextricable from one another.

WHY GROWTH?

The past few years have brought about a wave of radical proposals in the field of architecture. The proposals—be they written manifestoes, prototypes for a new era of architecture education, or design projects — emerge from a generation of designers, educators, and students who recognize that we are overdue for a reckoning with the inequalities perpetuated within and by the practice of architecture. This moment of reflection gives us the opportunity to reconsider the foundations of the field, and to pinpoint systemic injustices in which the building industries are complicit.

Challenging architecture's allegiance to economic growth must be at the center of any project to make the field more just. Under a growth-driven economy, architecture has blindly served to better the lives of the already wealthy, while giving form to the forces that immiserate marginalized communities the world over. Despite ecological and social boundaries to growth becoming more vivid as wildfires rage, ice sheets melt, and the US stares down an eviction crisis, the field of architecture has yet to question the political economy that has come to define architectural design as an integral part of the growth machine. Meanwhile, this growth-centered political economy has only limited our imaginations and our potential as designers. Most importantly, a growth economy has weaponized the majority of architectural activity performed today, against immigrant, low-income, and BIPOC (Black, Indigenous, and people of color) communities.

> " I am not proposing a return to the Stone Age. My intent is not reactionary, nor even conservative, but simply subversive. It seems that the utopian imagination is trapped, like capitalism and industrialism and the human population, in a one-way future consisting only of growth. All I'm trying to do is figure out how to put a pig on the tracks."
>
> —Ursula K. Le Guin, **A Non-Euclidean View of California as a Cold Place to Be**

THE TROUBLE WITH SUSTAINABILITY

Before we can consider how architecture can challenge the growth-driven framework within which it currently operates, we need to consider how we define ecology. Ecology, or ecological thinking, is pivotal to this discussion because it can be used to foster an understanding of the ways that the social and environmental impacts of a growth economy are intertwined. Ecological thinking takes a holistic approach to conceptualizing the causes, effects, and ways to address our social and environmental problems. If we do away with the notions that nature is "over there," distinct from us; and that individual choices can mount a challenge to environmental and social destruction; it's not hard to see that the way we've conceived of sustainability—that is, growth *but green*—is woefully inadequate to addressing inequality.

The term "sustainable development" emerged in the 1980s in response to a rising concern among progressive economic theorists about the ecological impact of economic growth and its material effects on lives of people world-wide. At this point, it was becoming clear that the dominant mode of development was further disenfranchising already-marginalized

communities and destroying ecologies around the globe. These concerns were documented in the *Limits to Growth* report in 1972[1], which argued that the prevailing economic logic—expansion through resource extraction— would become increasingly destructive, and eventually, impossible, on a planet with finite resources.

Unfortunately, the proponents that came to champion and define sustainable development were interested in techno-managerial fixes rather than the systemic, political, or economic overhauls suggested in *Limits to Growth*. Speakers at the 1992 Earth Summit[2] put the final nail in the coffin, promoting a notion of sustainability that completely disentangled the environment from economic growth and depoliticized the issue of environmental collapse.

A central pitfall of this apolitical, technologically-oriented sustainability policy-making is what's been called "Jevons paradox." In 1865, English economist William Stanley Jevons observed the contradictory results of efficiency-oriented solutions.[3] He observed that under capitalism, the more efficiently a resource can be used, the more of it will be used. At the same time, these efficiencies may present themselves as a decreased strain on resources to an individual, while only driving more consumption in the economy as a whole, and more negative impacts on poor communities. Increasing the efficiency of, for example, an HVAC system in a private residence may lower the homeowner's utility bills, but they will use the money they saved to buy new electronics or a flight to a far-away destination. In other words, sustainability logic neglects to address structural issues. By individualizing systemic problems, and offering technical, rather than structural solutions, sustainability only serves to keep current rates of consumption intact.

Sustainable development laid the groundwork for what would be a decades-long cooptation of environmentalism by capitalism. Because of this inherent bias in favor of growth, sustainable design fails to address the widespread social inequality necessitated by a growth-driven system. This approach is quickly becoming ubiquitous in the field of architecture. LEED ratings have climbed to the top of an architect's agenda when executing a project, and environmental sustainability is widely taught in design programs. When architects talk about ecology in relation to their work, they discuss passive energy, graywater systems, and window decals that prevent birds from flying into glass curtainwalls. However, the field has made little progress towards normalizing a concern for social sustainability— the longevity and well-being of marginalized communities. This pattern reflects the pitfalls of sustainability thinking within a growth-oriented framework, and demonstrates that any solutions to environmental problems that maintain growth at their center, are not conceived using ecological thinking. Under green growth, social issues go unchecked. The Global North benefits as the Global South bears the brunt of resource extraction and exploitative labour conditions. Foreign investors, wealthy property owners, and tourists claim more and more space in so-called 'global cities,' at the expense of working-class communities, who are displaced from their neighborhoods to make room for the luxury developments that cater to a global elite. A political economy premised on perpetual economic growth has given us this market-driven approach to urban planning and design, which has deliberately widened the gap between the rich and the poor. Frontline communities — Indigenous groups and the urban working class — have long recognized the need for a complete overhaul in the way that we structure our political economy. But under the current system, even proposals that are considered radical, like the Green New Deal, are limited to technical solutions—leaving the prevailing political economic order intact.

In conversations amongst community organizers, tenants unions, and advocates for the unhoused, the risk of climate apartheid poses a very real and immanent threat. Climate apartheid is a scenario in which those who can afford it, move to climate-proof fortresses, while the rest of the world's population suffers increasing wildfires, deepening droughts, an an entropic degradation of air and water quality. This is already happening, with BIPOC communities showing higher rates of climate crisis-induced health conditions; displacement; food insecurity, and less access to green space and fresh air when compared to predominantly white middle and upper-class neighborhoods. These conditions cannot be undone under a growth-centered, capitalist economy. Capitalism relies on the creation and subjugation of a class of people that shoulder the cost of the betterment of life for the rich.

Greenwashing, which follows the eco-modernist logic that technology can solve problems that technology creates; is a favorite tactic of developers looking to capitalize on land in gentrifying neighborhoods. Greenwashing is a wolf in sheep's clothing: developments and renovations that check many of the boxes of what is widely accepted to be environmentally-responsible design, but meet none of the needs of the community that is already there and has typically suffered from decades of disinvestment. The end product is LEED-certified luxury condos that replace rent-controlled apartments, high-end espresso bars in working-class neighbourhoods boasting reclaimed wood and recycled furniture, and zero-waste grocery stores moving in next to mom-'n'-pop green grocers, whose landlords opportunistically raise rent, forcing them to close. This is the built environment under a growth-centered economy. An architecture of displacement, no matter its LEED rating, is fundamentally unsustainable.

Growth is to blame. The issue is not that "we" (*who?*) are choosing to live beyond our means, but that the capitalist machine is producing and consuming beyond what's needed, and in disregard of what's moral. While we're told that what's hurtling us towards climate collapse is the sum of individualized problems:

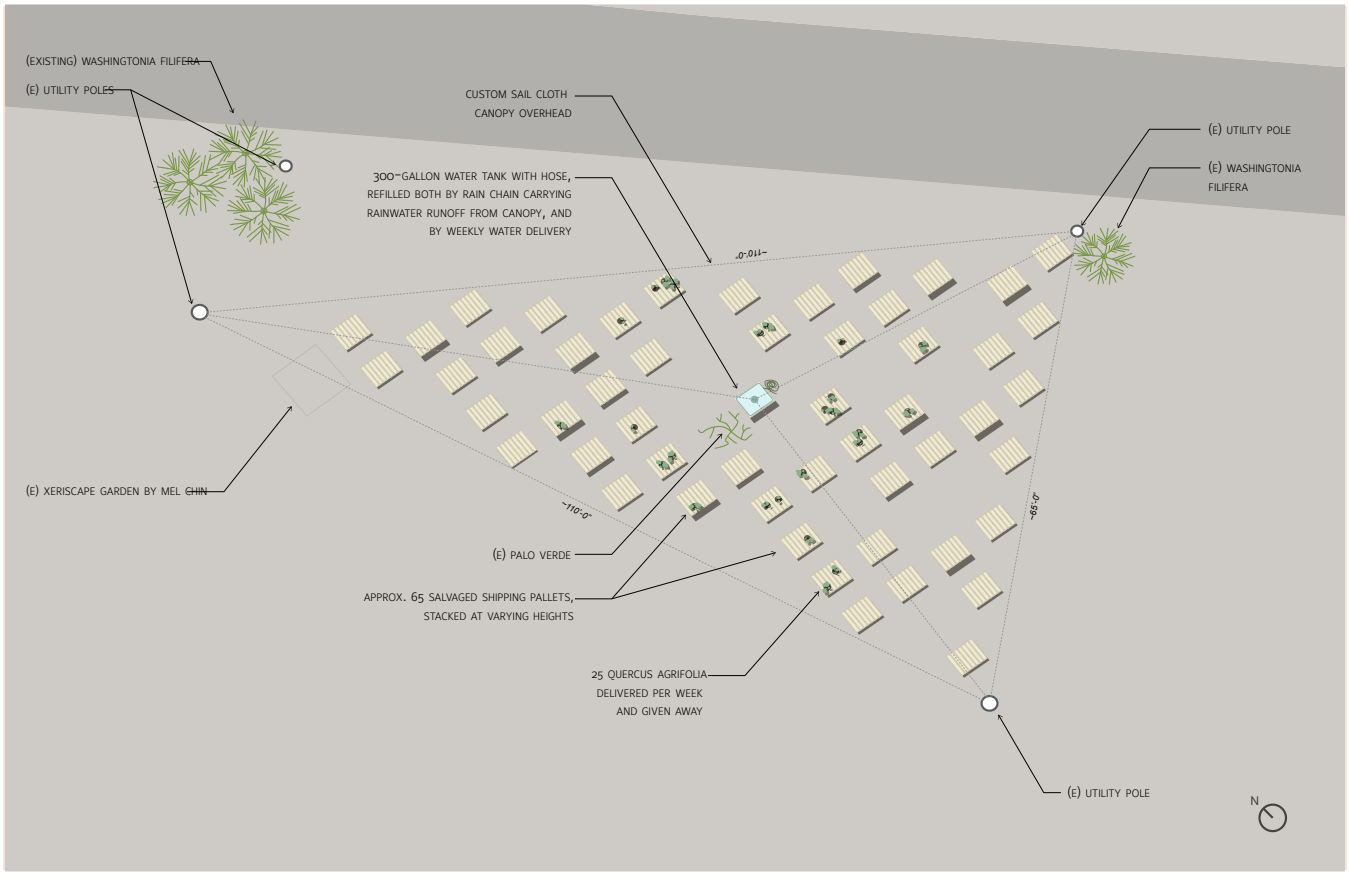

Figure 1. Quercus Supply Unlimited (QSU): plan for a pirate nursery for Northeast LA by OOLA. Image by author.

plastic waste, rainforest destruction, and carbon emissions; growth underlies all of those assaults on the biosphere, while destroying communities and proliferating exploitative labour practices.

DEGROWTH OFFERS AN ALTERNATIVE

An emerging economic theory offers an alternative to the "grow or die" ultimatum posed by a growth economy. Technological fixes alone will not solve the climate crisis. The environmental crisis is not a crisis of method—of efficiency and technology— but one of social and ecological limits. The solution will lie in developed nations recognizing existing limits and volunteering new bounds to their own production and consumption: *degrowth*. Degrowth offers a vocabulary that gravitates around the concepts of limits, care, and democracy, rather than offering a blueprint like many conventional economic theories do.[4] Its name is a provocation: *Why do we think of growth as inherently good? How does likening an economic process to a natural one neutralize its impacts, and naturalize its political agenda?* Degrowth scholars intend to ignite local and global conversations about the redistribution of resources, and about the possibility of developed economies intentionally scaling back to give ecological space for marginalized communities to thrive.

The environmental crisis cannot begin to be addressed without an anticapitalist analysis of its causes and effects. Environmental justice is contingent on the redistribution proposed by many degrowth advocates. Degrowth suggests that a carefully programmed decline in production and consumption would correlate with an incline in quality of life[5], starting with those for whom living conditions are the worst now. Capitalism tells us to worry that resources are running out, while neoliberalism moralizes that we (again, *who?*) are each consuming too much. While elements of both arguments are true, they lack an analysis of power. With an internationalist lens, degrowth recognizes the necessarily uneven development of the world under capitalism and suggests a framework by which the most impacted communities could determine their own growth.

A degrowth program starts with local and global reforms. Globally, developed countries would engage in a co-ordinated effort to strictly cap their own carbon emissions and provide aid to the Global South. Locally, there would be changes to financial institutions, a moratorium on luxury development; reduced working hours, and universal basic income paired with an increased social safety net. In the meantime, there would be investment in community-controlled institutions: co-ops, eco-villages, community farms, and retrofits to vacant buildings to provide low-income or public housing. Today,

prefigurations of a world without economic growth are all around us, within the cracks of the growth-driven system, in communal kitchens, urban farms, and childcare cooperatives.

ARCHITECTURE WITHOUT GROWTH

An economy propelled by extractivism has diminished the role of architecture to a luxury service— a tool with which to raise land values, or a weapon of real estate waged by the wealthy against the poor. Gentrification is destroying cities, but architects have an opportunity to counter this process, and to prioritize community resilience in their work instead. In what Samuel Stein has called "the real estate state"[6] in US cities, the right to the city has been seized by Big Real Estate. In a sustainable world, this right—the right to safe, stable and affordable housing; the right to an enduring community; and the right to true participation in municipal governance and budgeting— would belong to low-income communities and communities of colour, not real estate corporations. As a result of growth-centered architecture, American cities are in a crisis of tenancy (what many mistakenly call a crisis of "housing"), an eviction epidemic that dates much further back than the COVID-19-induced crisis, and an assault on the longevity of communities, all triggered by the dogma of growth. This is gentrification, as defined by the Los Angeles Tenants Union: the displacement and replacement of the poor for profit.[7]

For architects to practice environmental justice, the transition that we promote must be a just transition for all. To truly consider the problems caused by our growth-centered approach ecologically would require considering the relations and mutual impacts between architectural activity, an existing community, and the biosphere. A healthy design ecology is a situation in which an act of design ensures the longevity of the existing community.

Reconnecting the ecological and the social, degrowth repoliticizes environmentalism. As similar efforts to re-engage political debates emerge within the field of architecture, architects cannot let the political economy go unchallenged. *What might an architecture of living within our means look like? What is an architecture that does away with 'grow or die'? How does architecture practice sufficiency, rather than efficiency?* Challenging the economic foundations of the field will impact the practice of architecture at all levels.

Figure 2. QSU: Kids get a lesson about their local ecology from a park ranger under the shade canopy. Image by author.

Figure 3. QSU: A tenant takes home a liveoak to plant in their backyard. Image by author.

> "Unlike failed radical projects of the past, degrowth does not offer only a new way of realizing humanity's dreams; it changes the dreams themselves."
>
> —Giorgos Kallis, *In defense of degrowth*

For architecture, the task is not only to change the dreams themselves, but to change which dreams get to become reality. An architecture divorced from the growth machine could center the cultures and needs of poor communities by building power from the grassroots and situating conversations around the future of a neighbourhood amongst its residents. Rather than expansion, the economic engine of communities would be social reproduction: their ability to go on, and to thrive.

A commitment to empowering communities to not only have a say, but control over the future of their nieghborhood, is uncommon in architecture. However, some notable examples from recent years illustrate the potential of practicing degrowth through design today. Chicago's Sweet Water Foundation hosts the Thought Barn, a community-built commons within a community farm that was installed on an empty lot. Sweet Water Foundation's 'by the community, for the community' ethic democratizes design and draws on the existing knowledge about community needs from the community itself. In Portland, City Repair Project empowers community members to shape their own built environment through community permaculture and street painting projects. In both examples, community build days create powerful experiences of cooperation amongst neighbors as they work together to effect material improvements to their neighborhoods, often quite literally putting down roots.

In Detroit, A(n) Office transformed a foreclosed home into a community arts venue. Their project, *House Opera | Opera House*, not only provided a space for the community to gather, but, by operating outside of the speculative real estate market, gave the designers space to explore a rich conceptual project that engages the relationship between form and performance. As this project demonstrates, a degrowth economy would make architecture a more creative practice. With a turn

away from the drive for productivity and service provision, the work of architects could be more contemplative, thoughtful, and slow. Theaster Gates' *Dorchester Projects* are another example of this approach: creating community spaces in a series of foreclosed homes, the project shifts the subject of architecture from the abstract buyer of a house built on speculation, to the collective subject—the community— that lives alongside the built environment of their neighborhood.

My collective, OOLA, completed a proposal in 2019 that demonstrates an active attempt to slow growth in today's economy. We took as our subject the coast live oak, or Quercus agrifolia as it's known in Latin. The project, *Quercus Supply, Ultd.* (*QSU*) is inspired by Ordinance 177404 of the Los Angeles Municipal Code, which protects the live oak in the face of real estate development, prohibiting the tree's removal once established. The ordinance was introduced in 1980 to ensure that several California native tree species can continue to thrive in their native habitat even as urban land is increasingly commodified and subject to real estate speculation. *QSU* is a proposal for a pirate nursery for 100 live oaks in the rapidly gentrifying working class neighborhoods of Northeast Los Angeles. Members of the community would be invited to visit the site and take home a tree. As the trees mature, the community gains protections against a system that profits off of their displacement. The trees symbolize the community's fight for public housing, universal rent control, stronger tenant protections, and a right to the city.

While an architecture practice that promotes ecological and social longevity is incompatible with today's political economy, ushering in an alternative future and an alternative economy is crucial to practicing truly sustainable design.

Figure 4. QSU: The site plan of the pirate nursery reveals an ecological occupation of the gentrifying neighborhood around the project's site. Image by author.

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CHAPTER TWO

DESIGNING ACROSS SCALES FOR CLIMATE ACTION

Architects and designers impact the built environment across a range of scales, from innovative materials and technologies to buildings, landscapes, infrastructure and larger systems. We are inspired by the following projects that demonstrate how architects, designers, scientists, students, clients, and communities can creatively address these issues and generate new discoveries that can embolden and energize architectural practice and our shared future.

In her paper, **Pulp: Research in Temporary, Biodegradable Structure**, Stephanie Davidson examined a series of architecture studios that used recycled cellulose-based materials to cast temporary, biodegradable, thin-shell monocoque structures. The project asked designers to both see materials as responsive and constantly transforming, and to take responsibility for where materials come from and where they end up. Ariane Lourie Harrison's paper **Architecture and Analogous Habitats** sought a larger role for architecture in environmental activism and focused on biodiversity conservation and materials exploration. Her Pollinator Pavilion used artificial intelligence and automated scientific monitoring strategies to create and analyze habitat systems and increase building awareness. **Salty Urbanism: Toward an Adaptive Coastal Design Framework to Address Rising Seas and Climate Change** featured projects in Ft. Lauderdale, Florida and Venice, California. These projects used a coastal-hazard adaptation design approach and urban place-building framework to protect economic, engineering, environmental, and quality of life issues from the impacts of sea-level rise, storm surge, rainfall, and runoff within coastal zones. Zaneta Hong demonstrated how our food systems and changes in agricultural practices could address growing global populations and impact climate change. Her paper, **Ecologies of Consumption: Food, Materials & Climate** also defining new roles for architects and designers in transforming future landscapes and material systems.

Pulp: Research in Temporary, Biodegradable Structures

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Keywords: cast paper, pulp, recycled paper, monocoque, thin shell structures, biodegradable structures, ephemeral structures

This paper documents in-progress design research in temporary, biodegradable structures. The experimental, thin-shell monocoque structures have been cast using a variety of cellulose-based materials, and represent a sampling of the outcome of a studio taught at three different architecture schools to-date.

The work and the process of making the work serves as an example of how designers can take responsibility for both where the materials that they choose come from, and also, where they end up. Made of exclusively recycled paper, self-harvested fibers or fabric pulp, the structures have the capacity to biodegrade completely. The idea for the experimental structures came from witnessing the dumpsters overflowing with models and scrap material at the end of each semester. The conviction underlying the work is that mindful handling of resources should begin in architectural education if it is going to successfully make its way further into the discipline, profession and construction industry.

The design task shows students how materials are responsive and constantly changing; they are not static, fixed objects. Paper is a particularly ephemeral material, highly vulnerable to moisture. Designing something with an intentionally short lifespan, and witnessing how it can break-down and decay, introduces students to the transformative nature of materials, and shows how degradation and eventual decay could be a design strength.

Formally, the design research has, to-date, developed a range of small-scale studies and full-scale forms that defy straightforward typological classification. The geometries are imprecise and unpredictable and because they change as they disintegrate, the geometries are not describable as fixed things. The formal results can't be anticipated with a high degree of accuracy before they're actually constructed. In keeping with the low-waste ethos of the approach, formwork for each cast study is also kept to a minimum. This paper documents three sample full-scale outcomes of the research that employ different approaches to formwork.

INTRODUCTION

Longevity and resilience against the elements have become among the most prized characteristics in building materials. Materials and assemblies that require little maintenance, and that don't react to moisture or time, have become the standard in the building industry. Cellulose-based materials like wood – typically highly reactive to moisture when untreated – are given surface treatments or clad in layers to decrease their permeability or exposure to the elements. This research sees the vulnerability of cellulose-based materials to moisture as a potential, and aims to develop structures of eventual decay.

More specifically, this documentation describes approaches to using a variety of cellulose-based materials, both found/recycled and self-harvested, to cast thin-shell or monocoque structures. The work is experimental and has very little precedent. It embraces the vulnerability of cellulose material to moisture and the elements, and views the inevitable disintegration and decay of the cast paper shells as a strength. The work asks designers to see materials as responsive and constantly transforming, and to take responsibility for where materials come from and where they end up. The work is formally provocative because of the informal and irregular nature of the thin-shell paper structures, and because of the process of disintegration which brings its own constantly changing formal expression.

This paper will describe a variety of approaches taken to-date in: sourcing materials for the cast paper shells,studying the composition and physical structure of the materials, making pulp, casting paper swatches, scaling-up to cast three foot spans, and finally, scaling-up to cast a room-size monocoque shell enclosure.

Three examples of room-size shells will demonstrate different ways of working with the constraint of minimal formwork; in the spirit of the research, formwork, which often adds unnecessary waste in a construction process, had to be handled with the spirit of material economy and biodegradability.

To-date, the research studio has been taught four times at three different architecture schools: the Peter Behrens

Figure 1. Photograph showing a student gathering grass clippings from a local park, to dry and use as pulp. Image credit: Georg Rafailidis

School of Arts (Germany), Daniels Faculty of Architecture at the University of Toronto (Canada) and SUNY Buffalo (US). Research has been undertaken in collaboration with Georg Rafailidis, Associate Professor of architecture at SUNY Buffalo, and is on-going.

SOURCING MATERIALS

In the research, the idea is that the material options should be broad. Any cellulose-based material that can be obtained in large quantities at either little or no cost is a candidate for the casting process. The first thing that students do, in the research studio, is gather potential materials, that fit the three criteria, for evaluation. Materials that have been sourced and gathered include twigs, wood shavings, grass, cat tail flower, flax fibers and seeds, hemp, denim, corn husks, paper from recycling bins, cardboard boxes, kraft paper (from paper bags) newspaper, cellulose insulation, toilet paper and paper towel, tissue paper and potatoes, among others. There is a scavenging aspect to the material sourcing phase of this research; materials should be common and found around us, not bought. In this respect, the process allies itself with material sourcing for another type of ephemeral architecture – bird's nests, wasp nests and other animal habitats which are self-made using materials readily available, light, and able be digested into a composite structure which lasts one season.

After examining the broad palette of potential materials that were gathered, two additional criteria were added: materials should be available throughout all seasons and materials should be easily transformed into pulp. These two additional criteria meant that materials like corn husks, available within a very limited time window in mid-fall in WNY, were not pursued. Twigs and wood shavings, likewise, were not pursued as they do not have a fibrous composition and cannot be easily transformed into a pulp mixture for casting using low-tech means.

In addition to the materials sourced by the students, the design research has benefitted from a bale of cotton linters donated by Georgia Pacific in Atlanta, GA. The bale consists of several compressed sheets of linters, which are commonly used in paper making. This particular type of linter was commonly used in making paper money. The large quantity of cotton fibers provided a base for many hybrid fiber mixtures that students have tried since the design research work started in 2016.

STUDYING THE MATERIALS

In all four research studios to-date, a period of research into the materials has preceded any hands-on work. The idea is that we should never immerse ourselves physically in materials that we don't understand. Gathering insight into the chemical composition of materials, their fabrication and their microstructures also provides a baseline physical understanding about the materials that helps when beginning hands-on work.

Students undertook "What exactly is…?" research studies, sharing the findings with the entire class in order to built-up collective knowledge. The presentations aimed to explain key terminology related to paper and fibers. Students learned more about cellulose, where it's found and in what concentrations. They also discovered the two basic categories of paper products: cotton-based and wood-based.

One aim, during this phase, was to connect abstract information about source materials, harvesting and manufacturing processes, and the chemistry of materials, to the physical samples themselves. In that way, empirical

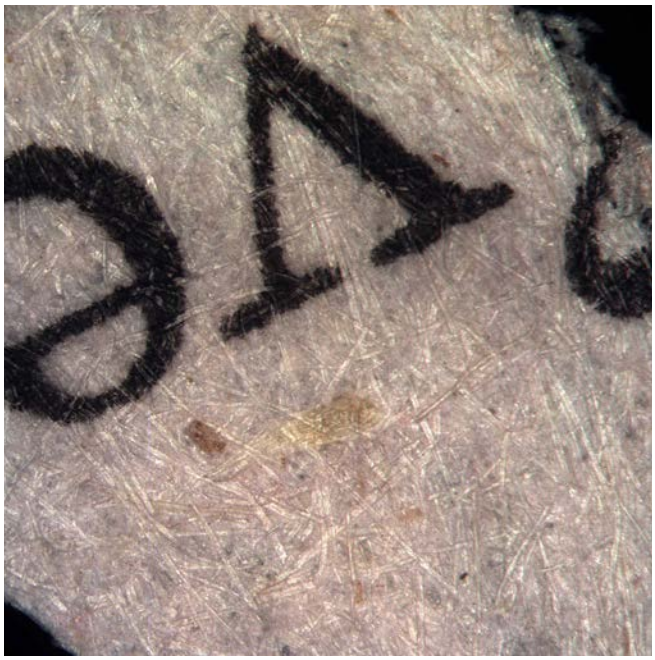

Figure 2. Stereomicroscopic image of newspaper taken at the Special Instruments Center, SUNY Buffalo for PULP graduate research studio, 2019.

observations could be knit together with more abstract facts about different materials. For instance, the physical weakness of toilet paper was knit together with the discovery that it's made with low-grade, recycled wood-pulp. Wood pulp fibers are shorter and weaker than cotton pulp fibers. The ephemeral nature of toilet paper made sense in light of these discoveries.

Further insight into the materials was gained through microscopy. Students used both the scanning electron microscope and a stereomicroscope at SUNY Buffalo to take images of the microstructures of their materials at different levels of magnification. Images were taken with the scanning electron microscope at between 100 and 300x, while the magnification used with the stereomicroscope was around 50x. Both sets of images enabled us to see and better understand key physical attributes that characterize paper such as the mechanical interlocking of the fibers.

MAKING PULP

Materials worked with to-date can be placed in two categories: recycled paper products and self-harvested fibers.

The recycled paper products include materials such as printer paper salvaged from garbage or recycling bins, paper towel, toilet paper, cardboard boxes, kraft paper, newspaper, cellulose insulation and tissue paper. These materials were generally easy to transform into pulp, which is a thick, slurry mixture made of a suspension of the paper fibers in water. Paper was either shredded or ripped-up manually before soaking in pails of water. After soaking, the paper was further broken-up using a universal mixing paddle drill attachment.

Self-harvested fibers, like grass and cat tail flowers, were considerably more labor-intensive to transform into pulp. In traditional paper making, a caustic basic solution, or chemical bath, is used to break-down plant fibers. In working with the cat tail flower, boiling was used as an alternative to the chemical process. Large pots of the cat tail flower were boiled for several hours and blended in small batches with a kitchen blender in order to achieve a pulp-like suspension.

A third category of materials used in the research studios to-date includes woven fabrics. Cotton jersey and denim were both used in projects and required the most labor to break-down into pulp compared to the recycled paper and self-harvested fibers. The denim, for example, was cut into 1x1 cm pieces before being boiled for several hours and pulled-apart by hand. Sheets and forms cast with the denim pulp retained the soft, fabric-like quality, but due to the thick and long character of the fibers, were also heavier than cast

Figure 3. Buckets of cattail pulp prepared for casting. Image credit: Grace Shih-En Chang, Hoda Farahani, Jeremy Keyzer

paper. Because fabric waste (known as "shoddy") is a known problem, research into digesting this waste into thin-shell cast forms is on-going.

CASTING PAPER SWATCHES

After looking into the backstory of their cellulose materials – what they're made out of, where the ingredients come from

Figure 4. Swatches fabricated by one student group (students: Lemma Al-Ghanem, Ashwini Karve) examining different fibers, fiber mixtures, connecting more than one cast sheet, three dimensional deformation of swatches. Image credit: Lemma Al-Ghanem, Ashwini Karve.

and how they're processed – students were introduced to basic papermaking. This part of the process – making swatches – provided the backbone to the research course. The swatches were the tests that enabled us all to see and examine how different fibers performed when cast as sheets. The swatches, made using a traditional mold and deckle and approximately 8 x 11 inches each, were also a manageable scale in which to experiment with different thicknesses of cast paper, different methods of joining separate swatches, combining fibers, and beginning to deform the cast planes three dimensionally. Material and formal tests in the swatches prepared students as we strategized about how to scale-up toward a full-scale cast paper shell. Swatches were also used to look at ways to decrease the hydrophilic nature of paper, by either applying or combining different greasy substances into the pulp mixture.

SCALING UP TO THREE-FOOT SPANS

The scaling-up process was done incrementally. From the swatch size, students looked for structural logics that made sense with the thin, cast paper. As the spirit of the studio was to create as little waste as possible, the conventional approach to constructing formwork was out of the question. The entire idea of formwork had to be re-thought and this was handled differently from group to group. Different techniques manipulated the cast paper in moist and dry conditions.

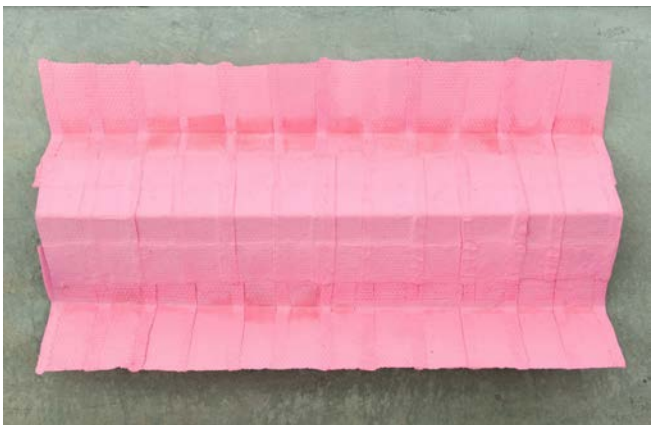

Figure 5. Example of a three foot span made using an additive approach of laminating individually cast sheets together while still moist. This particular span was cast using "found formwork" - geometries found in the studio interior that would lend structural properties to the cast spans. Students: Nashid Chowdhury, Vicky Pilles. Image credit: Georg Rafailidis.

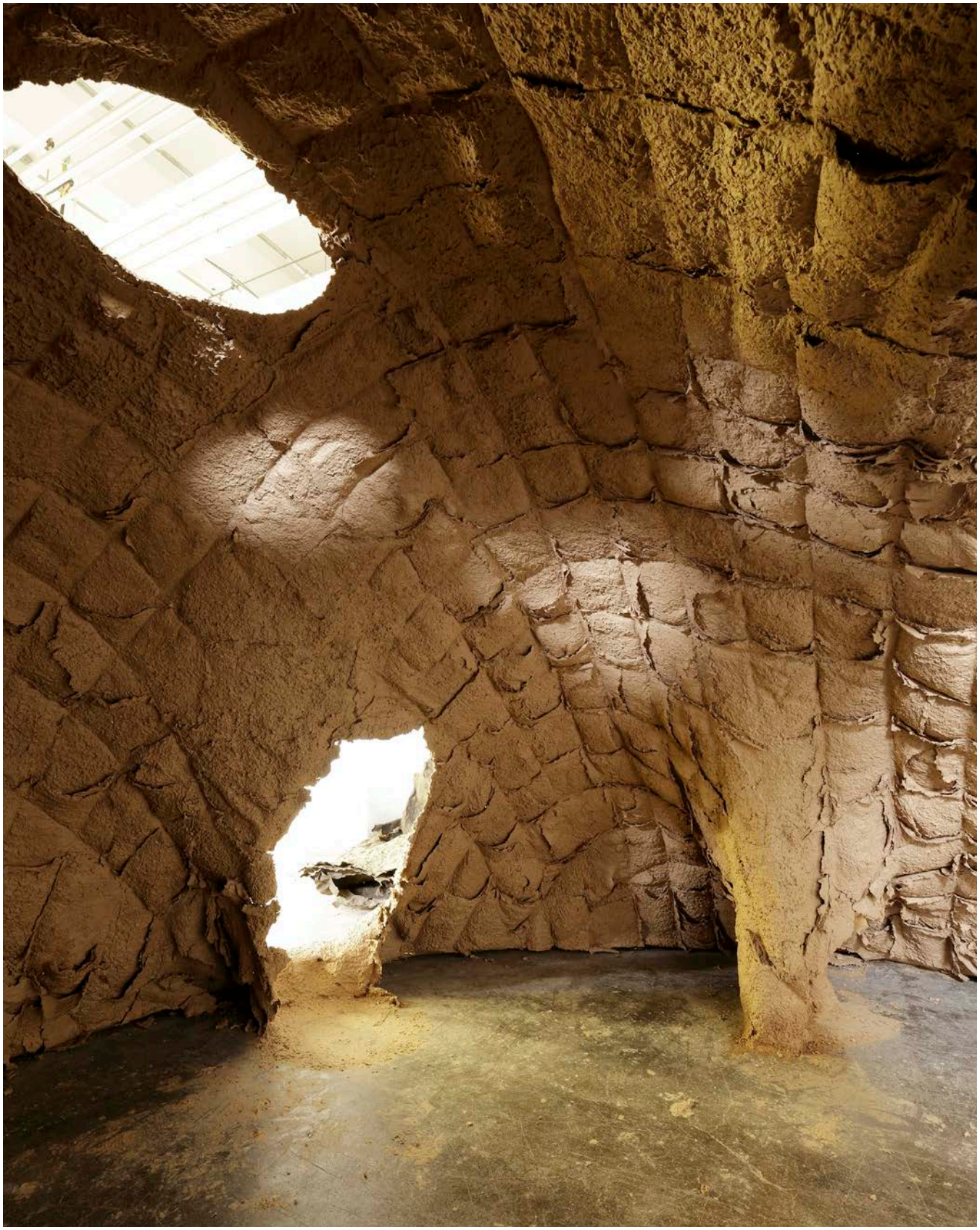

Figure 6. Photograph showing the interior of the cast cardboard shell after the formword had been “eaten” out. Image credit: Georg Rafailidis.

In one project, spots around the building were used as "found formwork" to create three dimensionally stable cast paper shells; paper was cast onto corners, stairs and furniture so that the structural geometries of those spatial situations were imparted to the sheet material. Corrugated and curved surfaces, in particular, contributed rigidity to the cast paper forms. Other groups used a combination of found formwork and the naturally occurring ripples in the hanging fabric that became structural when dry; large sheets were slumped, for instance, over tables or pails.

Large sheets of cast paper were also manipulated dry using folding patterns to achieve three dimensional forms.

The idea in this intermediary scale was to find ways that were material specific and light on formwork to scale-up and create a three-foot span. What became clear during this phase was that each material, though cellulose-based, had very particular behaviors when cast into sheet form. Students needed to use their structural intuition and work in a trial-and-error way to see what behaviors and potentials they could exploit in their specific material. For example, the high degree of shrinkage in the large scale cast grass sheets resulted in considerable surface deformity that, though irregular, gave the sheets more rigidity than flat sheets.

Another example of material-specific behavior was bagasse, which is sugar cane residue. This material, with granulated sugar as an additive, needed to be formed at a very specific time as it was drying in order to achieve a rigid, draped form. In scaling-up, other student groups opted to try ephemeral formwork like a balloon. Unlike other processes, using this type of formwork, depending on how it was handled, could result in more predetermined, controlled three dimensional forms.

ROOM-SIZED CAST PAPER MONOCOQUE ENCLOSURES

From the range of techniques tested to make a three-foot span, various approaches have been taken to scale-up to fabricate full-scale cast paper shells. These approaches are characterized by their structural typology, approach to formwork and, of course, material composition. Here, I'll share three large-scale cast paper shells that each used a very different set of variables.

EXAMPLE PROJECT 1: CANNIBALISTIC CARDBOARD FORMWORK/SHELLENCLOSURES

Students: Eric Chandler, Elias Kotzambasis, Cody Wilson

The first large-scale cast paper shell is notable for its cannibalistic approach to formwork. This project worked with pulp made from used corrugated cardboard boxes. The form for the shell was generated using Rhino Vault, a plugin for Rhino, which gives catenary geometries in digital model form. The templates for the ribs were projected onto the wall to scale them up, traced onto the cardboard and cut-out by hand. The dimension of the grid used in the formwork was determined by the deckle – the traditional papermaking frame and screen used to cast single sheets of paper. The formwork grid was slightly smaller than the mold and deckle used by this group, so that individual sheets of cast paper would create an overlap and bond as they were laid, one by one, atop the formwork. This particular project is notable because of its strategic use of both cast paper sheets and sprayed pulp. Whereas many projects switched to the use of a texture sprayer for the full-scale paper shell fabrication, this approach used a layer of tiled paper sheets as a base. The sheets were made rapidly using a self-made machine consisting of a shop-vac attached to a mold and deckle. The process of layering the individual tiles atop the ribs was time sensitive since we knew, from swatch tests, that moist cast paper doesn't bond with dry paper. On top of the tiled sheet layer, an additional, thin layers of cardboard pulp was applied using a texture sprayer. The unexpected twist in this project was that the additional pulp for the several sprayed layers was made using the cardboard formwork, which was torn out bit by bit until the vault was hollowed-out and substantially thickened from the cast layers.

EXAMPLE PROJECT 2: WIND-FORMED CATTAIL SHELLS

Students: Grace Shih-En Chang, Hoda Farahani, Jeremy Keyzer

The second of three projects that I'll share contrasts from the cardboard project in its material selection and more unpredetermined formal outcome. Pulp was made, in this project, from the cattail flower. As with most natural fibers harvested from their source, the material had to be boiled for several hours in order to break-down into a slurry consistency that could be manipulated further as cast sheet material.

The material was strained and blended repeatedly. Compared to paper pulp, the cattail pulp was finer and didn't accumulate into a sheet using the mold and deckle used in traditional paper

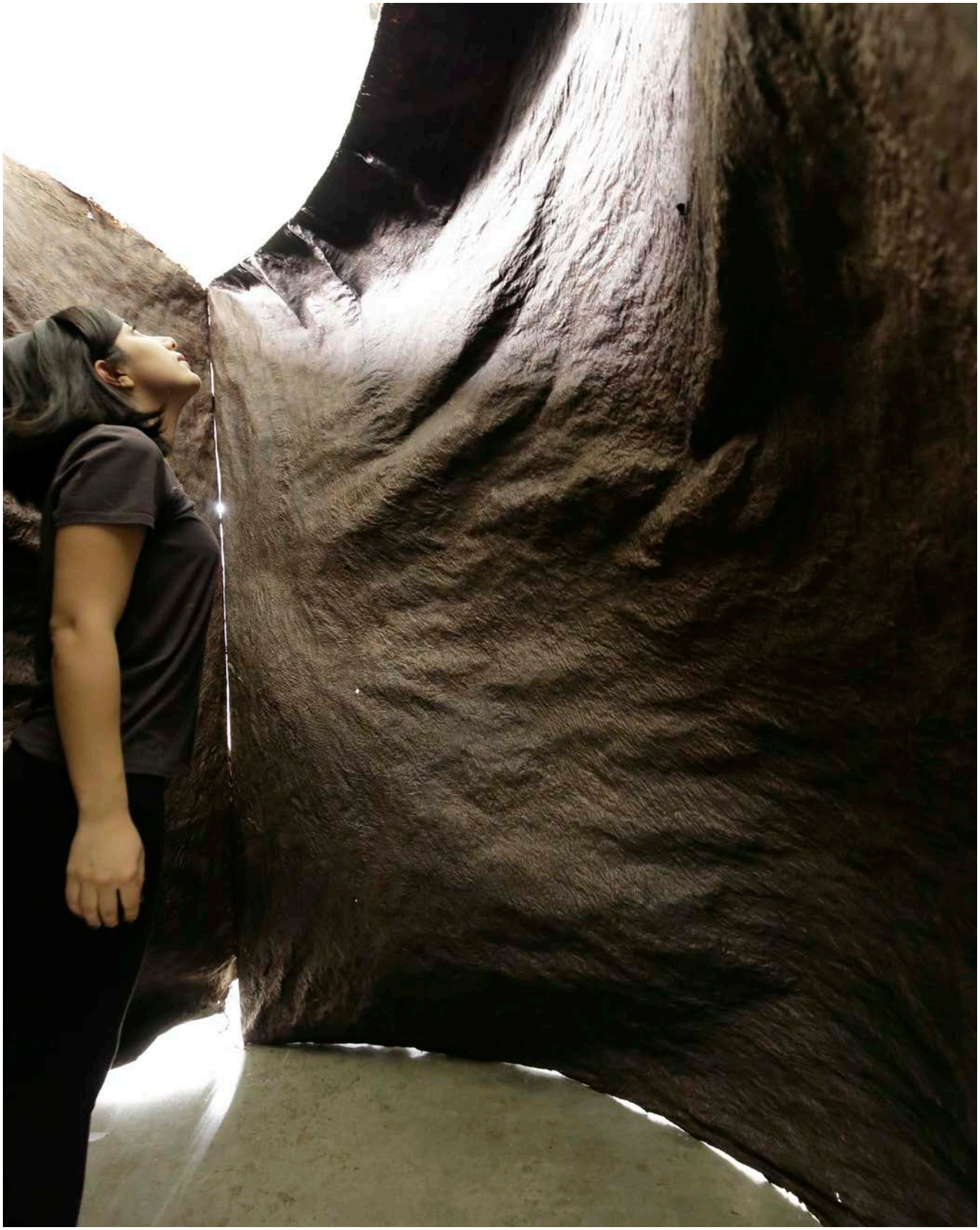

Figure 7. Photograph showing the cattail shell enclosure.Image credit: Jeremy Keyzer.

making. Cheesecloth was used as a substrate to compensate for the lack of mechanical interlocking in the cast, fine cattail fibers. Students used a combination of painting the pulp onto the cheesecloth with fans constantly running in order to help the sheets dry and to aid in air circulation in general, since studio environments for this type of work were consistently very humid. In order to achieve a degree of rigidity that allowed the panels or sails to sit self-supported on the ground, pulp was applied daily for around 10 days. Ultimately the fans required to help in drying and air circulation had an impact on the three dimensional deformation of the cast planes. The structural typology, though hanging, could best be described as a wind-formed shell, since the three dimensionality of each plane was largely determined by the orientation and force of the wind driven by the fan or fans used for each sail.

EXAMPLE PROJECT 3: CELLULOSE INSULATION CATENARY ARCHES

Students: Craig Brozowski, Mike Hoover, Morgan Mansfield, Abigail Peters

The final project I'd like to share is the one, in the last three years of research, that was able to achieve the largest scale. The vaults produced in this project, reaching 9' in height, represent the furthest limits we've been able to push thin shell paper structures. The project was executed in the fall 2019 semester and the degree of refinement shown in the process is thanks, in part, to the knowledge accumulated in prior years of teaching this studio. The material used in the project is cellulose insulation. Cellulose insulation is newspaper treated with boric acid as a fire retardant. To make the formwork for the large catenary arches, the group used catenary lines derived from hanging string, and traced the lines onto plywood segments which were laser cut into arches. Cotton muslin fabric was then slung between the hung catenary frames which were suspended from the ceiling of the workspace. The fabric was bought by the 24' long bolt for this project. Tubular foam was mounted on top of the wooden frames and the fabric was secured to the underside of the frames with bulldog clips. The same texture sprayer that was used in the cardboard project was used here. The newsprint blended easily into pulp and didn't clog the texture sprayer, as the cardboard and cotton linters tended to do. As with other projects, the ambient moisture in the workspace became a problem. At the time that this project was being executed in mid-fall, the heating system wasn't yet on. Fans helped with air circulation and a dehumidifier was set-up to help control the ambient moisture. Moist, cool air prevented the cast paper from drying and we did witness some instances of mold beginning to form. In the specific workshop conditions that we had, one vault was taking approximately one week to fabricate. Several layers of sprayed paper pulp were needed in order to achieve rigidity. The vaults were released from the ceiling and flipped over carefully. It took four people to carry one vault into another space for presentation – not because of weight but because of the form and the need to tip and twist through doorways. One of the considerations in designing the widths of the vaults was the need to transport through conventional-width doorways in the building. Nine catenary vaults were cast in total, in three different sizes, to allow the vaults to nest into one another and create a continuous enclosure.

CONCLUSION

This research and the outcome to-date is meant to shift our attitude toward decay-prone materials, and consider ways in which to harness this weakness to make temporary structures that are able and meant to disappear, and even add aeration and nutrients to the soil where they end up. More broadly, the research encourages a view of materials and assemblies as things that are constantly transforming instead of looking at materials as object that are fixed in a certain geometry or spatial composition. This research has been focused on demonstrating that it is possible to create large-scale monocoque structures using different methods that are each light on formwork and create little or no waste. The formal outcome of the research done so far shows that large-scale cast paper shells can be cast using a wide variety of source material and techniques, following different structural logics that best exploit or respect the capabilities of the material. Next steps of the research will look at the eventual decay of the structures as well as concrete use scenarios.

Figure 8. Photograph showing the interior of the series of cellulose insulation catenary arches. Image credit: Georg Rafailidis.

Architecture and Analogous Habitats

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Keywords: architcture for nonhumans, machine learning, climate-crisis, species extinction

Harrison Atelier proposes architecture for multiple species in projects that range from pavilion-scale agricultural infrastructure to speculations for new urban ecologies. Such built work represents the application of principles from architectural theories of the posthuman, namely a focus that seeks to integrate habitats for non-humans into architectural design concerns. The Pollinators Pavilion by architect Ariane Harrison, seeks a larger role for architecture in environmental activism and focuses on biodiversity conservation and materials exploration. Harrison Atelier uses artificial intelligence and automated scientific monitoring strategies to create and analyze habitat systems and increase building awareness.

ANALOGOUS HABITATS

The current sixth mass extinction of species demands new ways of building in support for biodiversity. Species are being extinguished to a large degree because of habitat loss. If, according to the oft-cited statistic that by 2050, 68% of the human population will be living in cities, then we can project further depletion of habitats for non-humans. With urbanization comes a now familiar set of degraded environments: increasing temperatures caused by urban heat island effects, flooding caused by loss of pervious surfaces and poor air quality due to carbon emissions. Urbanization exerts a significant pressure on the non-urban and effectively claims as zones of production (industrialized agricultural and extraction) for the human species those territories which might have supported multiple species. Habitat loss thus continues to drive species loss and increasing tempos of extinction rates.

The impact of human activity on the planet marks a new geological period, the Anthropocene and prompts us to ask whether, on a disciplinary basis, architecture needs to address building for multiple species. Harrison Atelier's position is clear from a programmatic approach: why would we restrict architecture to the design of habitation of one species? We understand that we share the planet with 1.7 million identified species and potentially millions of others that slip unnoticed into extinction due to the anthrocentric environments we produce and reproduce? On a formal level, our work engages affects marking the presence of non-humans. Elsewhere, I have described this as a feral aesthetic: the dual connotations of the term "feral," refering to both mourning and wildness, inscribes non-human presence within a context of threat and loss.

Can architects build alternatives? Analogous habitats refer to man-made artificial ecosystems that can support native biodiversity, in part due to material, structural or functional resemblance to natural ecosystems. Urban and industrial ecosystems can integrate man-made habitats that could function as analogues to natural ecosystems and point to a role for design in reconciliation ecology, defined as "the science of inventing, establishing and maintaining new habitats to conserve species diversity in places where people live, work and play."

Designing habitation for non-humans brings architecture to consider surprising dimensions: native pollinators, for example, inhabit holes and burrows of one centimeter in diameter and ten centimeters in depth. This modest scale points to building cladding as a site for accommodating other species: for example, a façade panel of 1 meter by 1 meter by .01 meters in thickness could contain several hundreds of native pollinator habitats. This tiny scale nests comfortably into the exteriors of our edifices, if we recall how Gothic ornamentation creates perches for bird fauna.

Harrison Atelier addresses the question of building for multiple species from theoretical and practical approaches, grounded in theories of the posthuman articulated since the 1980s in performance, literature and ecology. As I descovered in looking for case studies of architecture for non-humans, once one excluded zoos and industrialized animal farms for their anthrocentric bias, building for species co-existence has few models. Harrison Atelier seeks a larger role for architecture in environmental activism; we offer that architecture, from a materials and design approach, can create habitats for multiple species as a concrete action towards biodiversity conservation.

Figure 1.Feral Rooftops, Harrison Atelier, 2020.

FERAL ROOFTOPS

COVID-19 exposed the urgent need for distributed and multi-scale networks of urban green spaces, for humans' physical and mental health. A partial solution preceeded the pandemic with changes to the building code through the Climate Mobilizaton Act (CMA): NYC's Local Laws 92 /94 of 2019, mandated "that all new buildings and alterations of existing buildings where the entire existing roof deck or roof assembly is being replaced must provide a sustainable roofing zone covering 100% of the roof." Between the lines of Local Law 92/94 lies a radically vision for urban rooftops as analogous habitats. This law designates rooftops as not only a new layer of programmed urban space, but potentially a restorative space for multiple species and a secure harbor for biodiversity.

Local Law 92 /94 prompts us to view the greened rooftop as a new zone of ecological richness and biodiversity. In the urban imaginary, marginal spaces foster diversity. From Piranesi's ruins outside of Rome that equally sheltered animals, goatherds, pickpockets and beggars, to DC Comics' city of Gotham with its batwinged guardian perched high above, there is a feral logic: the less accessible, less visible or "waste" spaces are inhabitted by outsiders to mainstrean society. Our Anthropocene cityscapes indicate that most species that lie outside of immediate human interaction (either domesticated or food animals) are marginalized and rarely considered as architectural subjects. Yet the margin are repositories for diversity and difference, as discussed by the landscape designer and theorist Gilles Clement as a "Third Landscape," a patchwork of transitional, inaccessible and neglected spaces that, by these same virtues, secure space for biodiversity, becoming, in his terms, a "genetic reservoir for the planet."

In distinction from monocultural roofscapes, Harrison Atelier's project, Feral Rooftops, envisages green roofs as open air reserves of native plants and pollinators, with constellations of field stations that, while monitoring each biodiverse surface, assemble and relay air quality and storm-water sequestration data. Integrating monitoring technology into analogous habitats allows for the constant and patient acquisition of data on biodiversity by machines. A deployment of ecological machine surveillance in this sense could create a more nuanced and scientifically complete understanding of our urban ecosystems, allowing us to understand the striated quality of the urban section. Biodiverse green roofs at New York City's Javits Center function as a new ecological territory, different from the urban park in important ways due to its remove from the traffic of the ground. Javits' roof hosts a rich array of plants and attract hundreds of species of migratory birds, pollinating insects, moths and bats, harboring an impressive biodiversity up high above any of NYC's parks. It is both pragmatic and utopian to ask how dense cities could effectively contribute to what Clement describes as the "planetary garden."

Figure 2. Pollinators Pavilion, Old Mud Creek Farm, Hudson NY, Harrison Atelier, 2019.

POLLINATORS AND THE PLANETARY GARDEN

The decline of native and non-native pollinators today poses a major threat to the global agriculture food supply: over 70% of world crops are pollinated by honey bees, which have collapsed globally due to multiple factors tied to intensive agricultural practices. Global climate change has amplified pollinator population decline, threatening ecosystem resilience and food security at all scales, leading the New York Times to announce in a 2018 feature that "The Insect Apocalypse is Here."

Less widely known is that that familiar and media-friendly honeybee is poor representative for the diversity of pollinating bees. Ninety percent of the planet's 25,000 bee species are native bees, responsible for 75% of non-agricultural pollination globally. These bees are diverse in size, coloration and foraging preferences and represent the native diversity of each continent: from this perspective, the honeybee is an invasive species imported to North America from Europe. One type of native bee, the mason bee, does the pollinating work of 100 honeybees, yet produces neither hive nor honey. Native bees sustain the majority of non-agricultural plantlife, but have the potential to contribute significantly to agricultural pollination as well: carrying more pollen, transferring fruit pollen at a higher rate, and foraging in more inclement weather than do honeybees. The majority of native are considered "solitary," that is, they do not form hives and social structures. Rather they inhabit singular dwellings, nesting in burrows and tunnels underground. Cavity-dwelling solitary bees make discreet and opportunistic nests in patches of eath, abandoned burrows, holes and reeds; these varied habitats make many solitary bee nesting habitats hard to identify but easy to eradicate.

Despite this critical role, our understanding of some basic aspects of solitary bee biology, including species level distributional and inhabitation patterns, remains incomplete. While Europe has the best described bee fauna globally (2,000 species), even this data is surprisingly poor for solitary bee species (of which 60% were deemed "data-deficient"). The US native bee fauna is far less well described. And adding to the challenges of identification, solitary bees are identified typically in a process called destructive sampling involving trapping, capture and killing the bee subject. Because the elusive nature of solitary bee nesting sites makes monitoring a time-consuming and expensive prospect, and destructive sampling further reduces solitary bee populations, it becomes important that any analogous habitat include an embedded monitoring system, such as a no-kill method for studying solitary bees.

Analogous habitat for solitary bees departs from formats such as "bee hotels," in embedding scientific observation as a program. The architectural dimension highlights the overlooked if not strange presence of non-humans, with the thesis that greater visibility via an architectural format may bring these non-humans into our ethical regard.

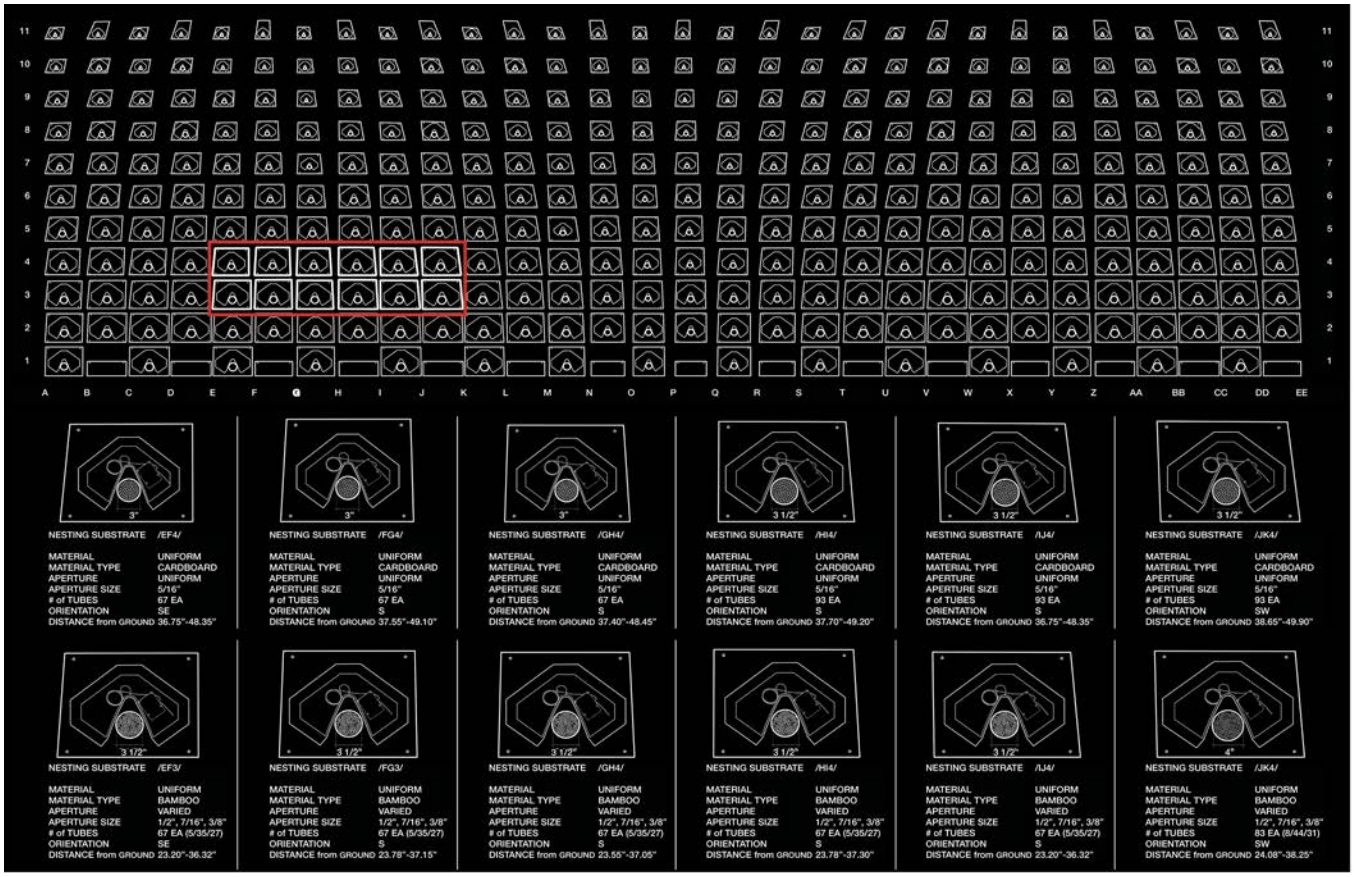

Figure 3. Grid of nesting substrates in Pollinators Pavilion, Harrison Atelier, 2018.

POLLINATORS PAVILION

Given on the one hand the underappreciated status of these native pollinators, and on the other their increasing importance to food security and agricultural production in the wake of honeybee colony collapse, Harrison Atelier developed the Pollinators Pavilion, a visitors center /analogous habitat for native cavity-dwelling pollinating bees for Old Mud Creek Farm, in Hudson NY. The large organic farm works with Hudson Carbon, an open-source research collaborative that quantifies the effects of regenerative agriculture on soil carbon sequestration. It is estimated that there are about 120 species of native bees likely to congregate in our research zone; half of these are cavity nesting bees, that is to say, potential inhabitants. This particuar context and client led us to ask how an architectural idea - an analogous habitat for native bees- can serve as a new type of agricultural infrastructure by contributing to regenerative farming? Biodiversity contributes to improved management of agricultural land, known as regenerative farming, and has the potential to both reduce net greenhouse gas emissions and to act as a direct carbon sink, with soil contains about 2.5 times more organic carbon than the vegetation.

Recalling the ovoid bristling form of solitary bees' compound eyes, the Pollinators Pavilion is a ribbed-wood structure with 320 handcast UHPC Ductal ® panels. The final versons of the panel contains a hole for 30-50 nesting tubes and a cavity housing all the monitoring technology. We placed 152mm long nesting tubes (which can accomodate three to six native bee egg cells) of diameters from 3-9mm in cardboard, bamboo, glass, wood and other substrates into the panels. Undergoing many tests at 1:1 scale thanks to a uniquely dedicated team, the resulting Pollinators Pavilion's curved surface can be considered a test-bed that reveals nesting preferences. A gridded diagram of the interior evelation demonstrates how panels test a variety of nesting tube substrates nesting tube aperture sizes, orientations to the sun, and nesting heights from the ground level.

Initially inspired by applying rain protection over the nesting tubes, the pointed canopies (or "thorns") evolved in our work to house solar-panel powered monitoring equipment: motion sensors, when triggered by insect movement, prompt an endoscopic camera to photograph the insect. Camera, sensors and microprocessors equip each panel: powered to operate 6 hours a day, we started field studies in September 2020, collecting 1,000 images per day per camera (3 pictures/min, 6hr per day). This set of field studies will be extended to the full nesting season in 2020-21, during the four-month nesting season.

Figure 4. Ductal panel with cardboard nesting tubes and endoscopic camera, Pollinators Pavilion, Harrison Atelier, 2020..

Insect identification lies well outside of the purview of architecture. With the goal of establishing a means of monitoring and eventually identifying pollinating insects, we are indebted to the guidance, advising and collection-access from Dr. Jerome Rozen (American Museum of Natural History), Dr. Kevin Matteson (University of Miami of Ohio) and Dr. Christina Grozinger (Pollinator's Garden, Arboretum, Pennsylvania State University). We assembled thousands of images of Mechachile mendica, Megachile pugnata, Megachile cenruncularis, Megachile campanulae, Hylaeus annulatis, Heriade leavitti and Osmia pumila in Dr. Rozen's Apoid collection at the American Museum of Natural History to create the foundations for an AI model able to identify insect family.

The images harvested by each panel produce a database of photographs to train a machine-learning system to identify native pollinating species without trapping and killing them. Bringing the database into a machine-learning platform, we seek to automate pollinator identification, thereby helping to address biodiversity conservation and fill important gaps in current scientific knowledge of solitary bees and records images of the everyday rhythms of native pollinators. This research has earned support from Microsoft's and National Geographic's AI for Earth programs; models presented at the Microsoft AI for Earth Summit (June 29, 2020) will be shared with the public as open source datasets to contribute to native pollinator identification. Embedding a scientific program of biodiversity conservation within an architecture for multiple species is one way that we see architecture addressing climate crisis.

ARCHITECTURE AFTER THE ANTHROPOCENE?

The Pollinators Pavilion occupies a prominent role at the entrances of Old Mud Creek Farm and Hudson Carbon at 67 Pinewood Road, Hudson NY. It is visible from the busy Route 9 and draws visitors from the farming, cultural and educational communities in the Hudson Valley. It functions as a field station and analogous habitat for solitary bees, but also as a solstice-watching space, an outdoor classroom, a dance venue, and a way-station on nature tours. This diversity of programs, each with varied connections to our planetary garden, points to inclusivitity—of inhabitats both human and non-human and of multiple functions. Inclusivity equally refers to the cross-disciplinary work required to reach across the anthropocentric divide: one potential for architecture is to offer frameworks to hold biological and computer sciences, machine-learning and hand-casting, digital fabrication and food production together in redefining analogous habitats for the post-Anthropocene.

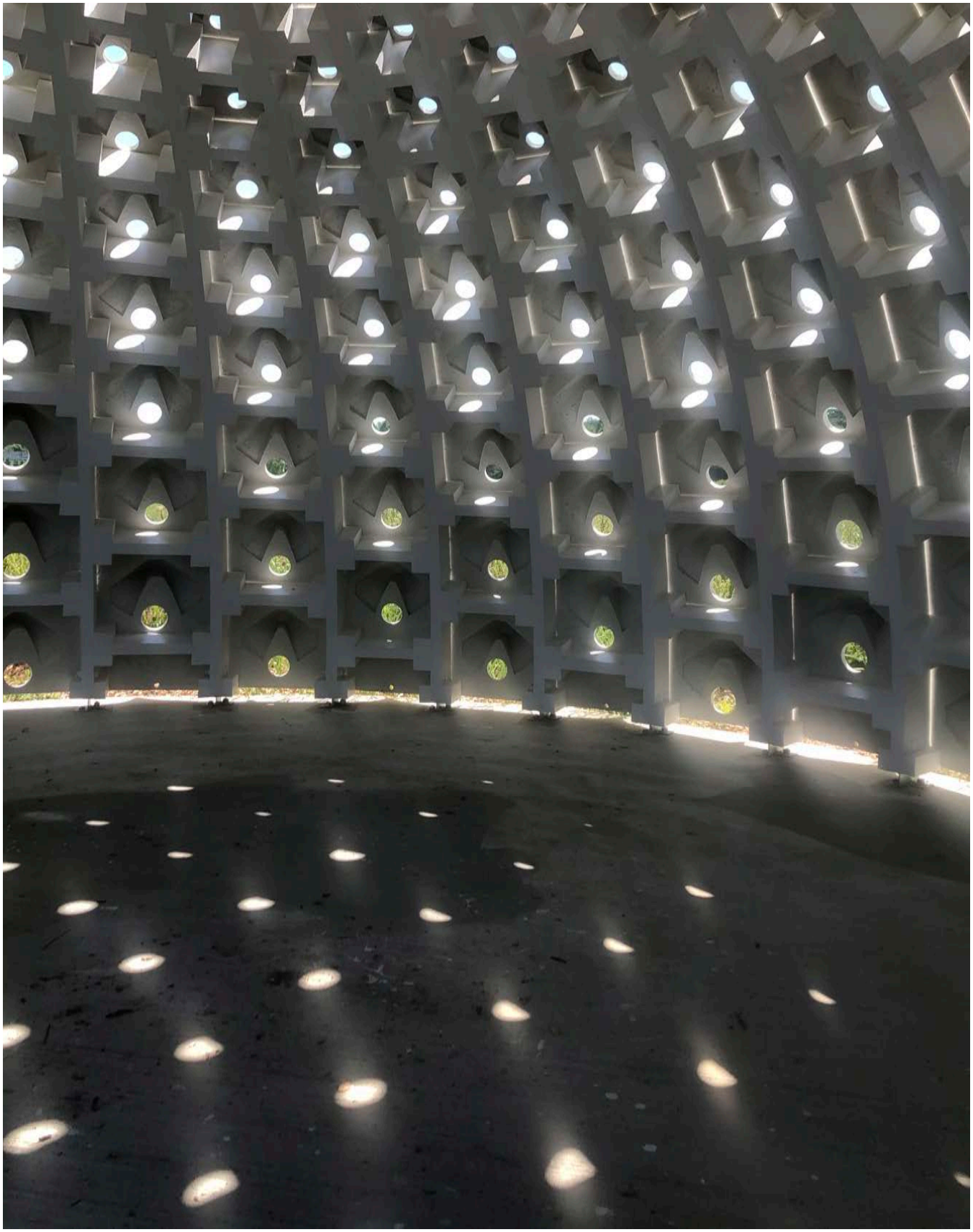

Figure 5. Interior of Pollinators Pavilion prior to nesting tube installation, Harrison Atelier, 2019.

Figure 6. Interior view of nesting tubes and microprocessor, Pollinators Pavilion, Harrison Atelier, 2020.

Figure 7. Exterior view of panel indicating nesting tubes occupied by pollinating bees, Pollinators Pavilion, Harrison Atelier, 2020.

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8. Bryan Danforth, Robert Minckley and John Neff, ***The Solitary Bees: Biology, Evolution, Concervation*** (Princeton: Princeton University Press, 2019).
9. The Ductal UHPC Workshop at the Brookklyn Navy Yards, and members of Lafarge-Holcim company Andrew Pinneke, Kelly Henry, and Danny Regad have generously sponsored the material for these panels, as well as their insights and expertise in the production process of 320 hand-cast panels.
10. Harrison Atelier is founded by Ariane Lourie Harrison and Seth Harrison; the Pollinators Pavilion project has been led by Yuxiang Chen, a Pratt MS Architecture (2018) graduate along with Pratt GAUD graduates Eileen Xu, Nai-Hua Chen, Zongguan Wang, Spring Wu, Brad Li, Daniel Longoria and Yale SoA graduates Victoria Ereskina and Matthew Bohne.
11. We are indebted to Dr. Jerome Rozen and Lance Jones at the American Museum of Natural History, New York, for the hours of discussion and time to photograph the Apoidea collection. Our network of scientific advisors includes Dr. Jerome Rozen (Curator Emeritus, Apoidea Collection at the American Museum of Natural History); Dr. Kevin Matteson (Dir. Graduate Programs for Social and Ecological Change, Miami University, Ohio), Christina M. Grozinger (Distinguished Professor of Entomology and Director, Center for Pollinator Research at the Huck Institutes of the Life Sciences, Pennsylvania State University); Natalie Boyle (Center for Pollinator Research at the Huck Institutes of the Life Sciences, Pennsylvania State University) and Sam Droege (USGS Patuxent Wildlife Research Center)
12. This innovative panel system was awarded third place at the New York City Media Lab Tech Expo of 2018; Pratt faculty research grants, Pratt research Open House awards in 2019 and 2020, as well as Microsoft and National Geographic AI for Earth grants.

Salty Urbanism: Toward an Adaptive Coastal Design Framework to Address Rising Seas and Climate Change

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Keywords: Salty Urbanism, Resilient Redesign, Adaptation Design, Sea-level Rise, Climate Disruption

Over the next 100 years, nothing will radically change the coastal built environment more than climate change and sea-level rise. The coastal zone is home to some of our country's most valuable ecological and socio-economic assets. Many of these locations are being demonstrably transformed due to large-scale human and biophysical processes. The result is a potential loss of myriad ecosystem services such as storm protection, wildlife habitat, recreation and aesthetics, among others. Policy and design solutions are not truly considering the necessary transformation that will be required to live and work within a saturated coastal environment. The old paradigm of flood management and control will need to change from prevention to acceptance and population will decline as businesses and individuals decide the costs are too high. The need for developing a long-term urban design and planning framework that adapts to these effects is critical. More specifically, there is a need for a "systems" approach that utilizes urban design and takes into consideration infrastructure impacts, future investments, and insurability of risk as long-term objectives to address potential impacts from both coastal flooding and rising sea levels, while at the same time guiding communities' future land use and investment plans.

Considering the Brookings Institute's statistic that 50% of the built environment projected to exist by 2050 currently does not exist, there is an enormous opportunity to create an innovative coastal-hazard adaptation design approach and urban place-building framework to protect economic, engineering, environmental, and quality of life issues from potential impacts of sea-level rise, storm surge, rainfall and runoff within coastal zones. Urban design thinking brings problems involving community-scaled systems related to energy, food production, water, waste, and transit. Only urban design gives the architectural and planning professions a holistic framework through which these systems can be engaged, even though urbanism is often the missing piece in discussions on resilience and smart growth planning.

Utilizing Fort Lauderdale, Florida, and Venice, California as case studies, Salty Urbanism establishes an interdisciplinary team to develop a coupled research methodology and pedagogical approach that envisions and quantifies the experiential and ecological outcomes of alternative ways forward for these cities in response to climate instability, disruption and rising sea levels. These outcomes consider an inevitable future of saturated landscapes and, as a result, integrate research models that accommodate a variety of low impact development (LID), flood-adaptive architectural design and other alternative concepts to be implemented over time. In order to change the prevailing land-development models to favor integration of ecosystem functioning in urban development, this project proposes a multi-scale approach within the embedded scales of the building, lot, public rights-of-way (streets, easements, parks, etc.), and neighborhood, to generate feedback between bottom-up design thinking and top-down policy and planning production. Best management practices alone may address issues of urban stormwater management; however, they will not lessen flood potential as environmental engineering and urban planning disciplines are practiced as separate fields. Salty Urbanism provides a new tool and design methodology that helps connect segregated disciplines to meet the complex challenges.

DESIGN FOR THE ANTHROPOCENE

Social scientists and ecologists both agree that new policies which reshape design thinking to transgress global threats of climate disruption by approaches or even overstepping current policies are required to avoid the inevitable risks to communities and the built environment. These threats are global, long-lasting, uncertain, and interconnected, therefore solutions must be hyper localized to minimize conflicts and take advantage of potential synergies. Establishment of policies and design frameworks that are effective at a local level requires strategic analyses of the underlying conditions and understanding of scientific, livability, engineering, and legal approaches, as well as take local politics into account.

BRIDGING ECOSYSTEM AND URBAN SERVICES

Just as these environmental pressures have synergistic causes, there exists a great potential for synergistic solutions. In the 1960s, Ian McHarg's *Design with Nature* provided a model for rethinking and bridging ecological and urban design. However policy still fell short, academics and urban designers have

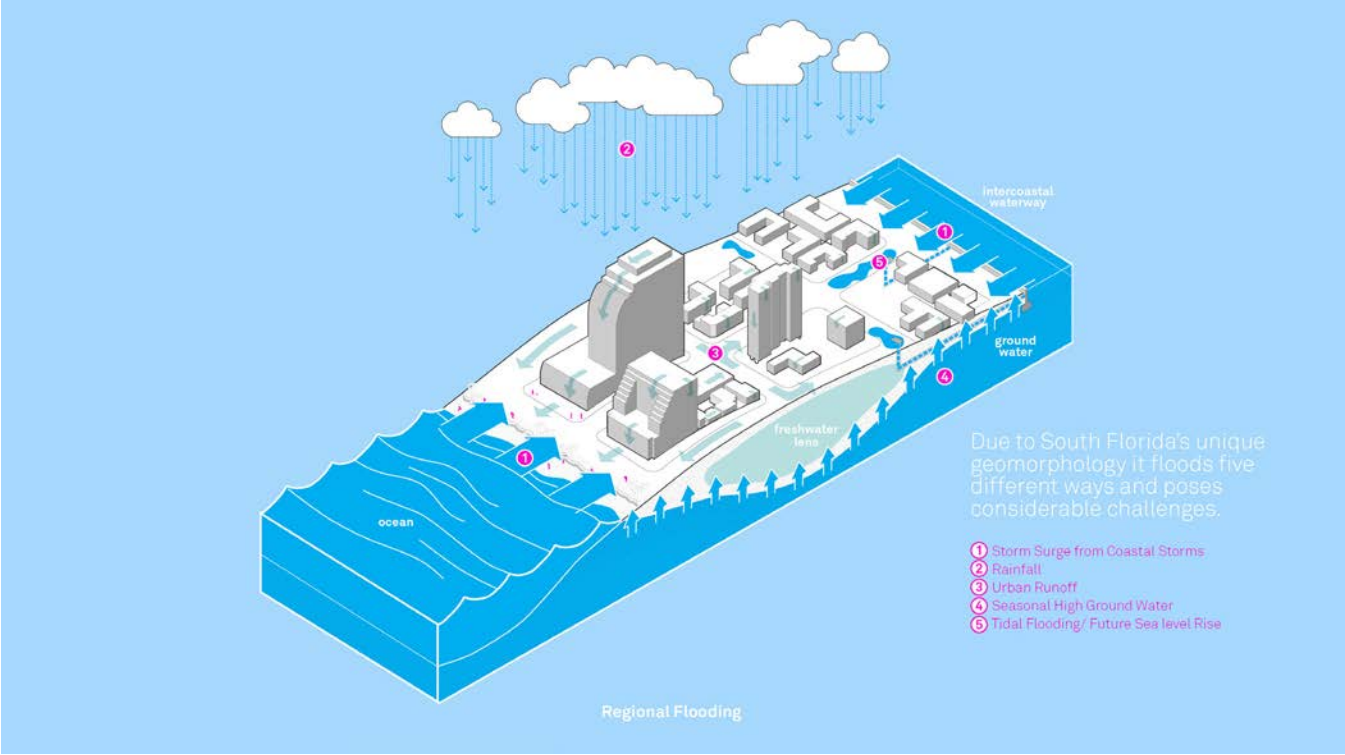

Figure 1. Five forms of regional flooding. Huber, *Salty Urbanism.*

given increasing attention again in recent years to "green infrastructure" and "nature-based features" as potential solutions to infrastructural problems normally relegated to purely engineering-based frameworks within the built environment. The reasoning for this revised perspective is largely due to the biological nature of the compounding environmental problems at hand. Functioning ecological systems produce a host of services essential to healthy societies, free of cost, and within a potentially indefinite scope of renewability. In south Florida, specifically, healthy coastal ecosystems (mangrove forests, seagrass beds, coral reefs, oyster reefs, etc.) provide a multitude of provisioning, regulating, and cultural ecosystem services, which not only support the economy (tourism, fisheries, aquaculture, etc.) but also the well-being and way of life for the millions of South Florida residents who live here year-round. The huge loss of these ecosystems along the southeast coast has had a resultant loss in ecosystem services, which has serious economic implications since tourism is a central source of income for industries in the area. Considering the benefits to water quality, storm protection, and urban livability, restoring the living components of shorelines in a urbanized setting stands to produce a host of synergistic benefits.

SALTY URBANISM AS A FRAMEWORK FOR ADAPTATION DESIGN AND PLANNING IN THE COASTAL ZONE

Coastal areas face a gamut of environmental threats that span across spatial and temporal scales and involve collaboration among many disciplines. Participants range from practicing architects and planners negotiating site, infrastructure and architectural issues, to researchers involved in modeling climate, sea-level rise and urban development patterns along coastal corridors. The complexity of environmental issues, as well as the diversity of disciplines and methodologies involved, present substantial barriers to establishing integrated solutions that might be possible within a more collaborative and comprehensive framework. Parallel to this, coupling ecosystem services with urban development is at obvious odds with current planning policies and zoning regulations. The situation summons creative approaches on how to retrofit architecture and planning to address paradigm-shifting threats of storm surge, sea-level rise, and fluctuating rainfall and runoff patterns. Defending against water encroachment from all directions is a particularly unique challenge of South Florida (Fig. 1), making it a good candidate for development of an adaptation framework that can be appropriated by coastal communities.

From an urban development/urban design perspective, the real challenge for developing resilient communities is ensuring ecosystem integrity within urban contexts since developers, nor municipal and county governments have mainstreamed green infrastructure within regulatory practices or design standards. Urban waterfronts have developed according to local social context—economics, recreation, and land use needs, which often denude coastal areas of native landscapes.

Figure 2. Image of King Tide flooding in Fort Lauderdale. Huber.

A much-needed place-building model that illustrates waterfront design standards while engaging socio-environmental development challenges will collectively yield a new ecology of the city necessary to address ecological design within human-dominated ecosystems. Only urbanism—urban design and the allied fields that engage in it—gives the architectural and planning professions a holistic framework through which these systems can be engaged, even though urban design is usually the missing piece in discussions on adaptation and resiliency. More than the impacts from alternative energy sources and supply-side green technologies (photovoltaics, fuel cells, rain water harvesting, etc.), our land development/stewardship patterns are by far the most comprehensive venues for tackling climate change, energy conservation, and social equity. Municipalities and private development have yet to mainstream green infrastructure practices. The challenge is how to retrofit traditional planning and urban design to include addressing storm surge, sea-level rise, and changing rainfall and runoff patterns on the heavily-developed coastal zone.

Perhaps even more challenging is expanding ***Salty Urbanism*** to support new and creative urban development capable of solving the complex and multi-faceted issues of urban placemaking—approaches to the design, planning, and management of public space, while planning for likely retreat and urban decommissioning (unplanning/rewilding) of parts of the existing shoreline. This framing will surely spark debate on the extent to which the governmental agencies must reconcile with the environment and quality of life concerns.

Best Management Practices (BMPs) alone may address issues of urban stormwater quality, however, they will not necessarily lessen flood potential, because the environmental engineering and urban planning disciplines—each with their own optimization practices—are often practiced as separate fields. The project's multi-scale approach (shoreline, lot, public rights-of-way, and neighborhood) provides a link between the large-scale policy-driven approach and bottom-up design thinking with scientific modeling to provide niche adaptation solutions. This is why the framework is structured around the concept of ecosystem services as sources of capital for producing resilient flood protection and urban place-building in coastal areas. The research addresses climate and environmental threats, while at the same time considering the social fabric of the neighborhood relative to economic, recreational and cultural factors. The research goes beyond simple stormwater management infrastructure engineering and design to create a unique comprehensive strategy that links isolated research into a meta-disciplinary framework—one that leverages engineering, ecology, social sciences, mapping, and urban design and planning to reward greater resilient planning while enhancing livability.

DESIGN APPROACHES AND DEVELOPMENT OF A NEW MODEL FOR INTEGRATIVE THINKING

Salty Urbanism develops an integrated research and pedagogical approach that envisions and quantifies the experiential and ecological outcomes of alternative development pathways in response to flooding events that are a result of rising sea levels (projected to be eight feet now by 2100 according to the Southeast Regional Climate Change Compact).

The framework scenarios consider an inevitable future of saturated landscapes and integrate research models that accommodate a variety of best management practices, green infrastructure tools (Fig. 3), and alternative urban design and architectural concepts to be implemented over time. An inter-scalar approach that fosters urban solutions at the scales of individual lots, public rights-of-way, and neighborhood proved an appropriate point of departure to manage the potentially awkward intersections of knowledge and to more effectively cross-reference the multiple interdependencies and challenges of urban and natural systems. The integration of design practice, speculative studio environments and interdisciplinary research was leveraged to develop a framework for designing adaptive coastal communities in the wake of rising sea levels, while at the same time preparing emerging professionals for the inevitable future challenges facing their disciplines.

Four design studios at three schools of architecture across the nation collaborated to envision future adaptation scenarios. Utilizing alternative planning scenarios, with results from asset modeling and a matrix of soft and hard engineering technologies, scenarios were explored through design visioning for North Beach Village, a small barrier-island neighborhood

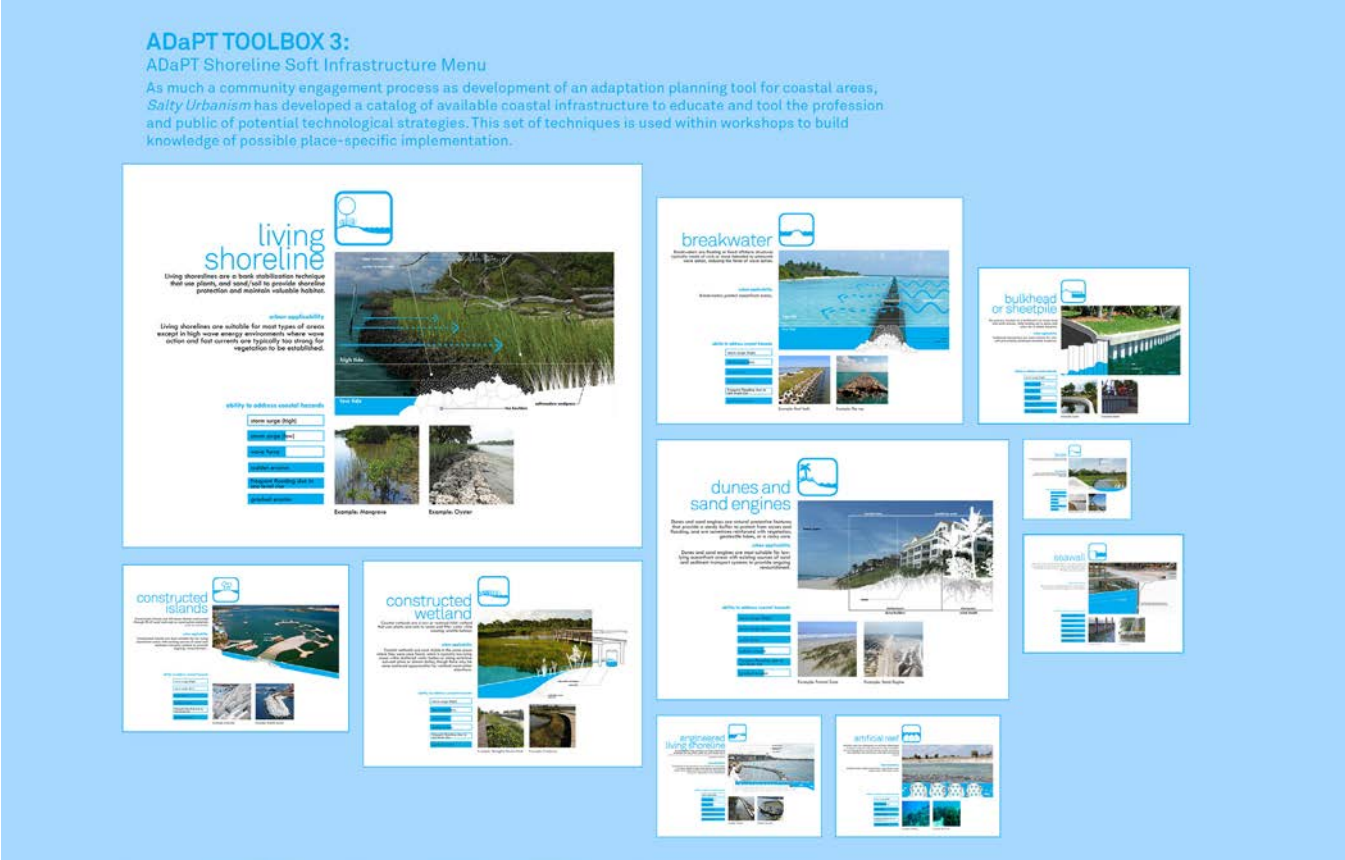

Figure 3. Shoreline Green Infrastructure Technologies. Huber, *Salty Urbanism.*

enclave in Fort Lauderdale. A robust set of strategies emerged that link ecological and urban design thinking. Similar to Fort Lauderdale the studios also applied the approach to Venice, California. The proposals re-think preconceptions about conventional infrastructure, since most students are unaware or have never designed for these complexities. Although some radical proposals were produced, they were plausibly comprehended by stakeholders – an indication of the severity of risk facing coastal areas, a threat increasingly recognized by experts and laypersons alike. The following is a general assessment and description of design outcomes within each scenario thinking.

Focusing on the North Beach Village scenario planning utilizing the *Salty Urbanism* design framework the four scenarios include a Business-as-Usual (if nothing was implemented and showing the projected permanent flooding by 2100) (Fig. 4), 1) Soft Defense, 2) Strategic Retreat, and 3) Land Adjust. The following explains the synthesized studio proposals.

"Soft Defense Scenario" (Fig. 5) combined strategies of both hard and soft engineering to mitigate impacts of rising seas and non-point source pollution from urban runoff allowing current development to remain largely unaltered. Installation of living shorelines, as well as bioswales and rain gardens in the street rights-of-way created high-tide gardens with salt-tolerant, halophytic landscapes and pervious paving systems. These saltwater landscapes become "biopumps" with phreatophytic vegetation—long-rooted trees that transpire significant amounts of water for hydraulic control, thereby reducing the time streets are flooded. Architectural strategies include allowing first floor levels to be designed to flood – a strategy already finding its way into building codes and architectural typologies in coastal areas.

"Strategic Retreat Scenario" (Fig. 6) accepts a lateral shift in urban footprint and develops a gradual removal of urban development through relocation to higher ground on the coastal ridge. Thus, a retreat enables naturalizing low-lying areas and intensifying urban development on higher ground through Transfer of Development Rights. This includes soft-engineered solutions that can be implemented over time as "rewilding" in both public and private properties. Through these scenarios, students participated in policy and regulation discussions as they pertain to the built environment and lifestyles of residents, thereby promoting awareness to the numerous politically sensitive issues that will factor in many adaptation strategies in coming decades. Policy and recommendations included a "Department of Unplanning" that can

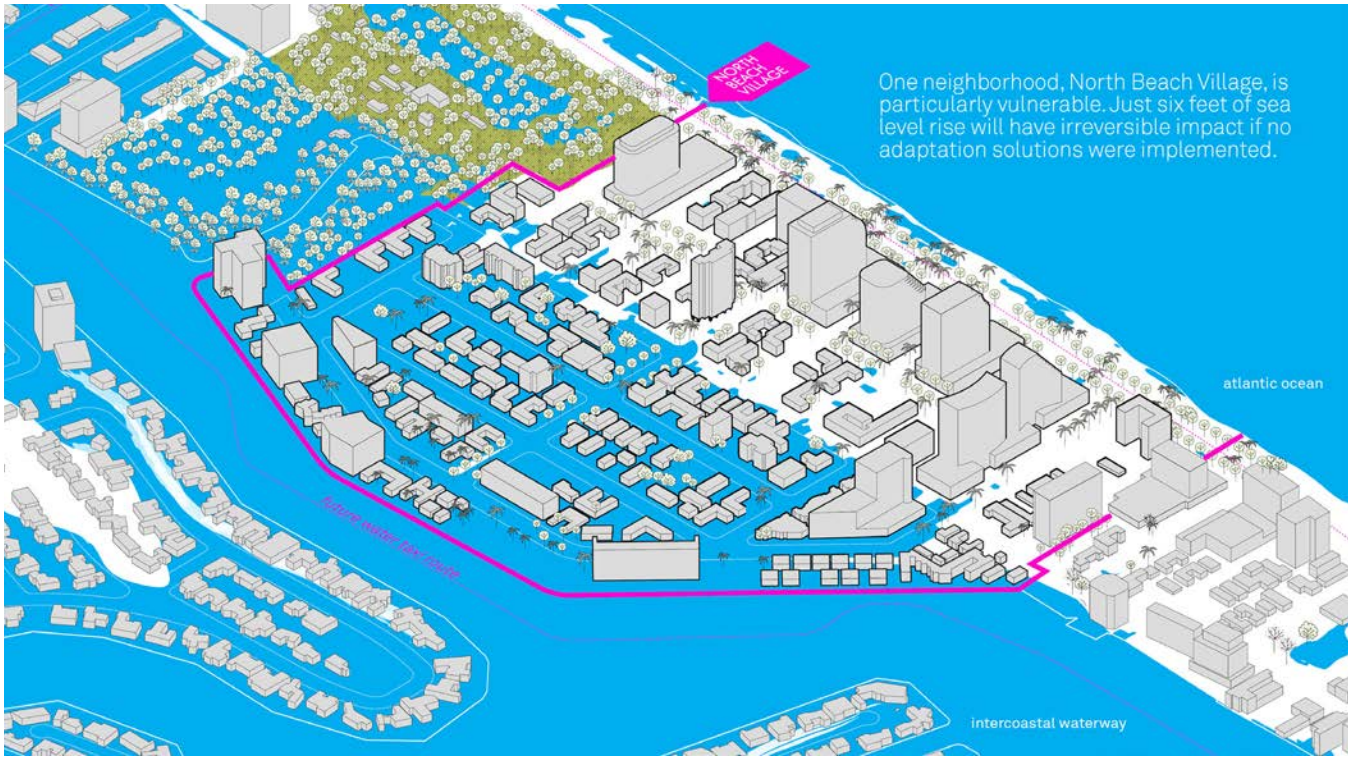

Figure 4.Business-as-Usual Scenario. Huber, *Salty Urbanism.*

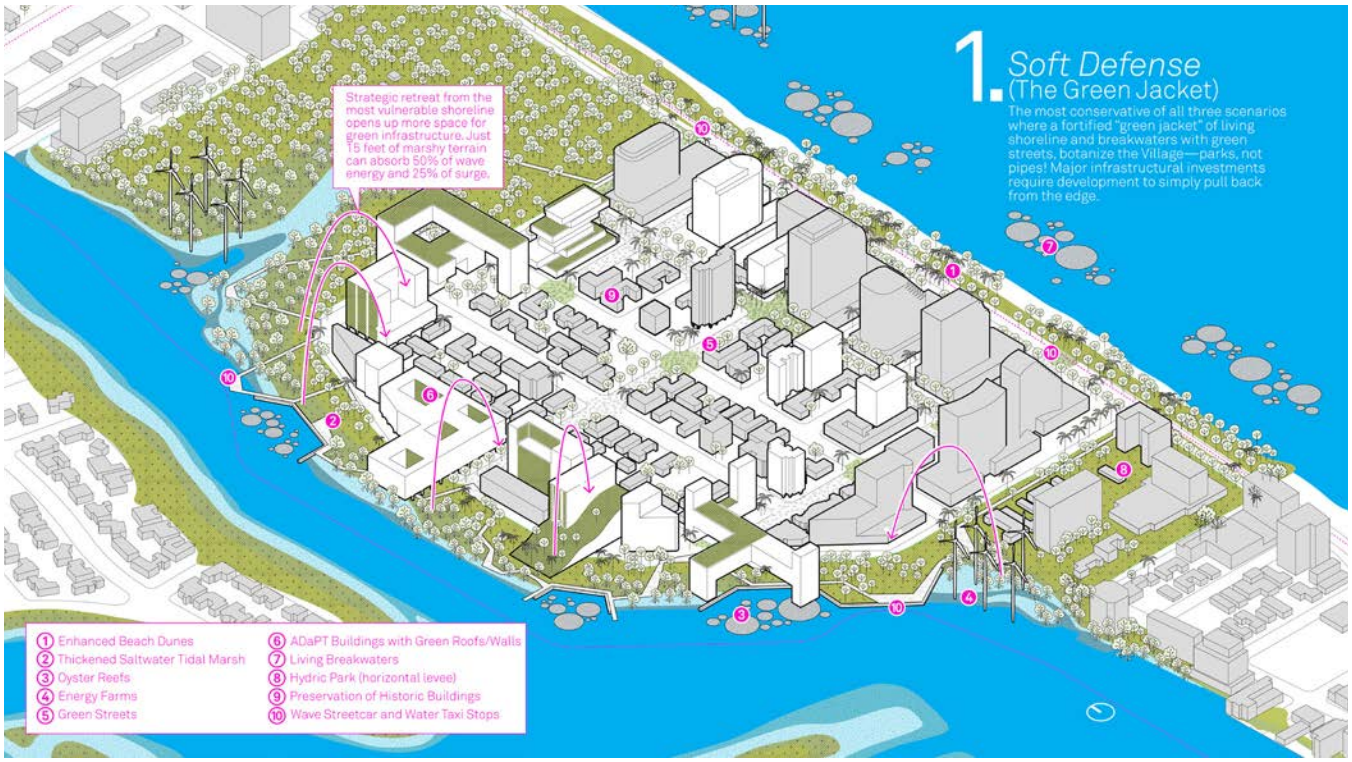

Figure 5. Soft Defense Scenario. Huber, *Salty Urbanism.*

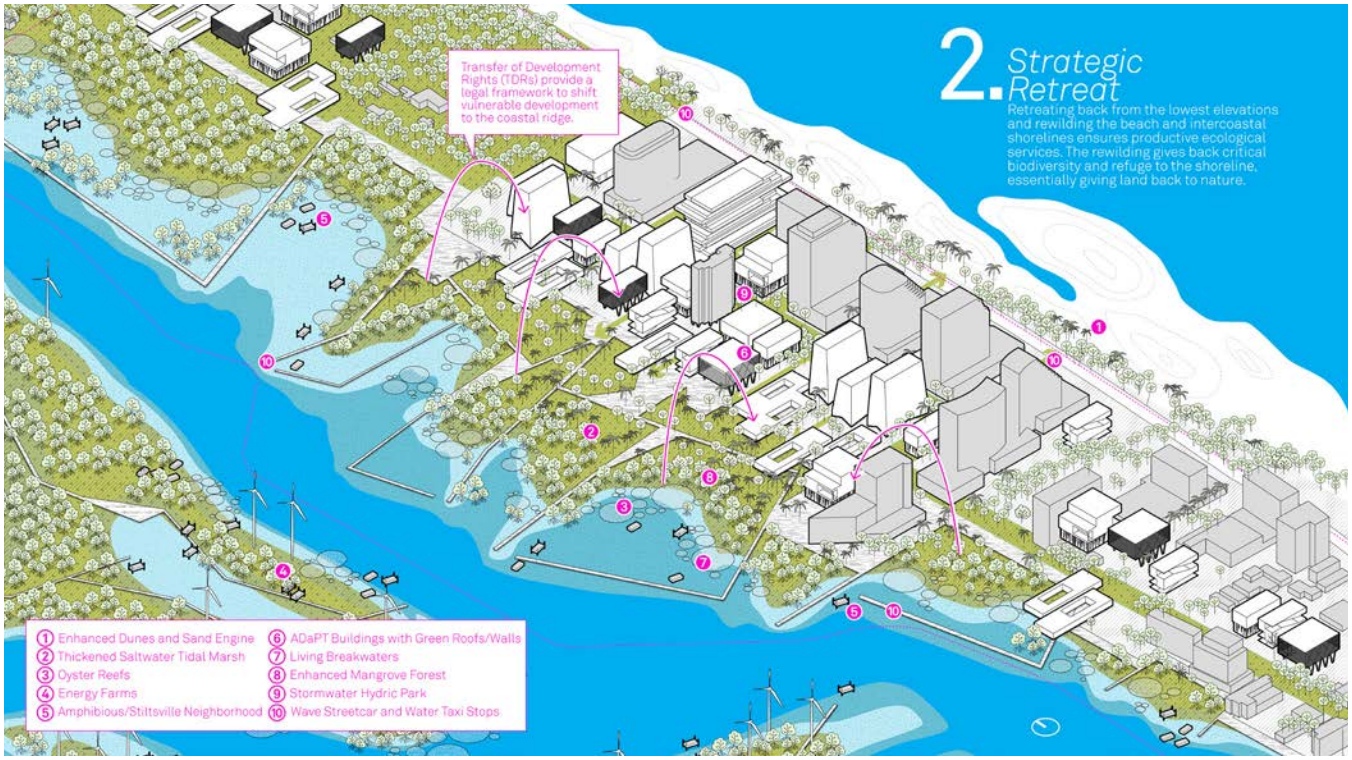

Figure 6. Strategic Retreat Scenario. Huber, *Salty Urbanism.*

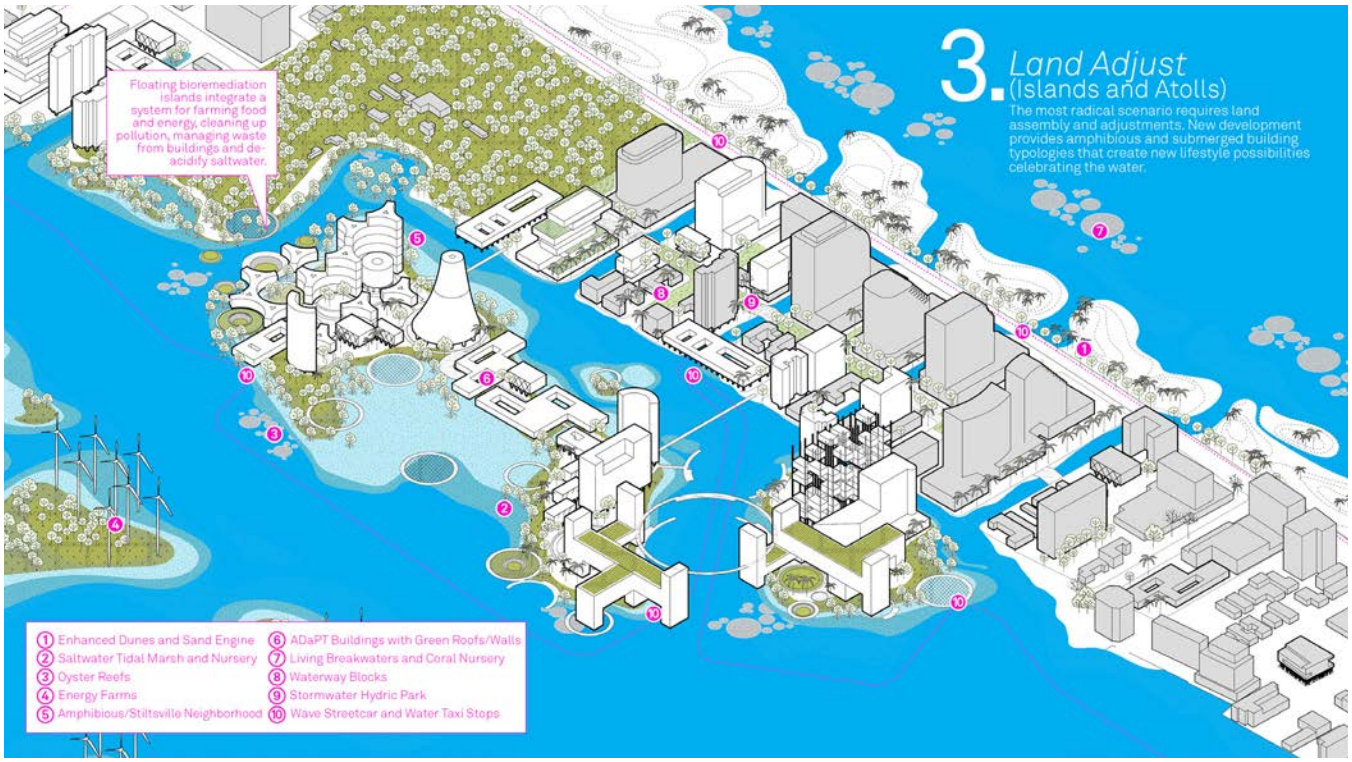

Figure 7. Land Adjust Scenario. Huber, *Salty Urbanism.*

manage urban decommissioning. Additionally, amphibious and floating structures would be proposed within rewilded areas.

"Land Adjustment Scenario" (Fig. 7) reformats buildings, blocks, and streets into an idealized urban and ecological morphology approach. Unconventional building types that showcase raised platforms for habitation, floating structures, and submerged living units with a transition to more water-based transportation systems were explored. (Fig. 8) Micro-grid distributed power-generation plants and neighborhood-scaled utility systems would be implemented in order to create resilient and redundant infrastructure as neighborhoods become more disconnected from mainland services.

CONCLUSION

The development of integrated place-building models, like *Salty Urbanism*, engage socio-environmental development and collectively yield a new ecology of the city necessary to address the greatest ongoing challenge to planning and design: ecological design within human-dominated ecosystems. By adopting ecological terms, architecture and planning can achieve greater resilience and retool themselves with the ability to adapt to changing conditions. It is at this juncture that *reconciliation ecology* and urban design, provides a framework for innovation. Beyond composition, ecological thinking requires logics of assembly where timing, interactivity, sequencing, componentization, and recombination constitute another aesthetic and utilitarian intelligence. Urban design projects bring problems involving community-scaled systems that work in tandem to ecological and social resiliency. *Salty Urbanism* provokes a policy platform to change prevailing development codes which have diminished both urban and ecosystem services. *Salty Urbanism* forms a path toward permittable structures and infrastructure, albeit in a simplified form. Likewise, urban design and the architectural profession might serve as leaders to navigate substantial barriers and establish a more collaborative framework. Integration of research, practice and education—coupled with community partners and public interest design—may be the norm, rather than the exception, as urban areas face increased uncertainty resulting from environmental and social challenges.

Salty Urbanism repositions how we live, adapt and transition urban development, especially when we must leave or adapt to the land that is no longer high and dry. Therefore, just as governmental agencies have planning departments, so to, should they consider the establishment of a Department of Unplanning coupled with new bottom-up design frameworks and policies. Ultimately decisions will need to be made on which neighborhoods are abandoned and which will be modified and adapted beyond the scope of the presented scenarios. Furthermore, population decline will occur as businesses and individuals decide the costs are too high to maintain regional assets and decommissioning (unplanning) of the built environment will come into more clarity as a pressing challenge.

Figure 8. Rendered view of the Land Adjust Scenario. Huber, *Salty Urbanism.*

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Ecologies of Consumption: Food, Materials & Climate

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Keywords: climate change, sustainability, traceability.

Our ways of living are endangered and on the verge of catastrophic change. Though we may experience the effects of climate change at a macro level, changes are rhizomatic, cascading through scales and networks interconnected by materials and energies, biologies and chemistries, economies and cultures; each of these connections affecting the very ingredients of our everyday life in diverse and unpredictable ways. No other system of matter and exchange offers such a thorough lens through which to examine these effects as does our contemporary food systems. This lecture presents a perspective on how degrees of interconnectivity and the precarity of decision-making for food, materials and construction can impact the future of built environments.

INTRODUCTION

When one takes a sip of coffee, tea, beer or wine, one is consuming something that is grounded in a particular geography, an artifact of a specific time and place. The natural ingredients, which are highly sensitive to their environmental conditions, co-mingle to craft these edible pleasures, and create a complex, yet delicate balance of chemicals that yield distinct aromas, flavors and textures. With a basic understanding of these relationships, we can ask: What does a place taste like? What does a season or year taste like?

Whether we consider staples such as vegetables, meats and grains or indulgences like alcohol, coffee and confection, food transects cultural, regional and physiological differences. It provides us with nourishment, and it also structures our routines and social practices – from cultivating, gathering and purchasing to preparing, consuming and discarding. Whether considering food as a domestic ritual, a commercial endeavor, or as an object of desire, it reveals our human evolution of place and memory, where fields and gardens, kitchens and dining rooms, bars and cafes are the cultural landscapes that represent our unique identities and material traditions. In effect, food defines who we are as individuals, as communities, and as citizens of this planet.

What is evident in contemporary food systems today is that they are in a state of flux. Food operates concurrently at the biological and ecological scales. And from shifting seasons, variable precipitation levels, increased global temperatures and greenhouse gas emissions, multiple crops have suffered lower and/or erratic yields, increased diseases, accelerated ripening or reduced flowering. The quality, as much as the quantity, of year-to-year variations for crops (including grains, vegetables, fruits, etc.) have significantly been altered; and with a projected 1.6 degree Celsius (or 2.9 degree Fahrenheit) rise in global temperature, our carrots could lose their texture, kale could become bitter, eggplants could become deformed, and canola oil could lose a quarter of its nutritional value. With climate change – linked with soil erosion, deforestation, pollinator extinction, invasive pests and diseases – the future of our food landscapes is transforming; and the effect on all biotic matter become irrevocably imminent and comprehensive. And so, one could say that every minute changes a plant's life. Through the basic interactions of soil, sub-soil, weather, microclimate and terrain, a flower, a grapevine or a barley seed can forever be changed.

THE CLIMATE OF DESIGN

The agricultural industry, along with the food and beverage industry, are the second and the third-largest sectors most dependent on nature – that is after the building and construction industry. Food security and nature loss are dire not just for our precious ecosystems and the species that are supported by them, but for the economic development of human populations. These communities are often directly and heavily dependent on these ecosystems; and not just as their source of food, but in addition to their income, shelter, fuel, health and way of life.

In a similar vein, these consequences will also have a disproportionate impact on women (and children) – as women play a vital role in these biological resources, providing for the essentials: food, fuel and water. Increased gender and racial equality are a driver of economic growth, but the adverse impacts of nature loss will have wider implications for social and economic development, and specifically for women and populations of color.

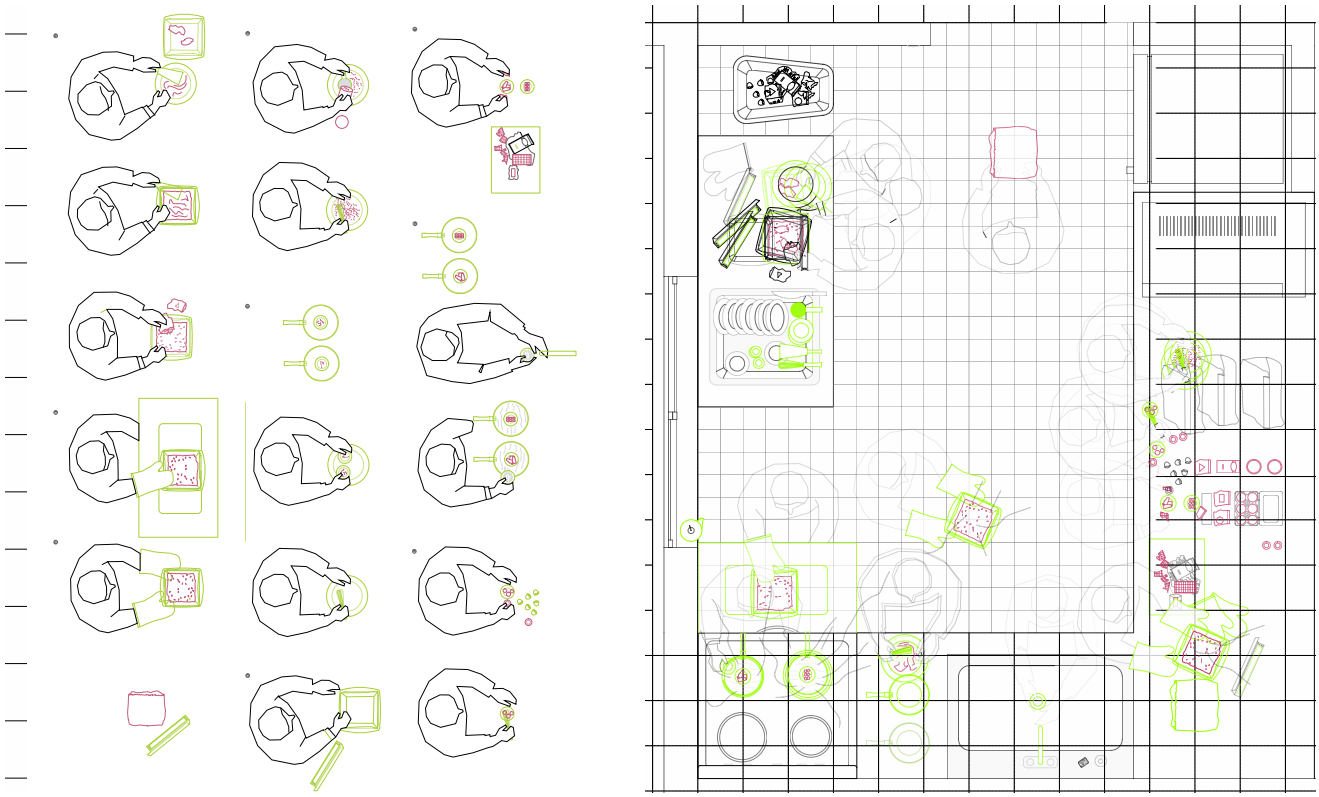

Figure 1. Human factors and operations related to cooking. Image credit: Hangxing Liu.

> "Humanity is on a collision course with nature. Already 72 percent of the global ice-free land surface is dedicated to supporting our species, and between a quarter and a third of the entire 'net primary production' of the planet is consumed by humans"—Mark Lynas, *Six Degrees: Our Future on a Hotter Planet.*

We must invest in nature, in order to fight climate change – this is the greatest challenge of our time. Just as generations of designers entering the profession amid the energy crises of the 1970's were fundamentally marked by their environmental-political context, undoubtedly so too will the architects and designers of today be fundamentally influenced by the increasingly existential threat of the climate crisis.

THE SCALES OF DESIGN

Food and materials are a litmus to change. They are both indicators and indexes of the global and local transformations and trends induced by human and non-human activities. As byproducts involved in production and consumption, both food and material ecologies are affected by a myriad of indeterminacies and injustices. This has led practitioners from anthropology and the natural sciences to design and social activism to a reexamination on how our consumption – if not our overconsumption – of natural resources can provide a lens through which to engage the complexities of architecture, and in consequence the interconnectedness of our society and surroundings. As designers, we need to be increasingly aware that the material realities of our practice, including knowing how manufacturing and construction is interconnected at multiple scales, influenced by multiple species, and operated across multiple locations around the world is relevant.

Traceability is a term originating from the food industry. And as a point of comparison for materials, a food traceability system allows one to follow the movement of food products in order to document the food supply chain at each and every stage of the food handling process from production and processing to distribution. By tracking food products from their source of origin, manufacturers can better achieve food quality, hygiene, and safety; and as consumers, we can have a greater stake in influencing recommendations on safety guidelines and compliance. As a result, we achieve a sense of security and awareness of where and how our food arrives to our kitchens and dining tables. But what proves to be of question when applying traceability to materials and in architecture, is that it moves beyond distance, and the space between products and their locations. The notion of tracing a path in physical space becomes misleading. What might seem very distant in physical reality, might actually be closer than what we imagine. When

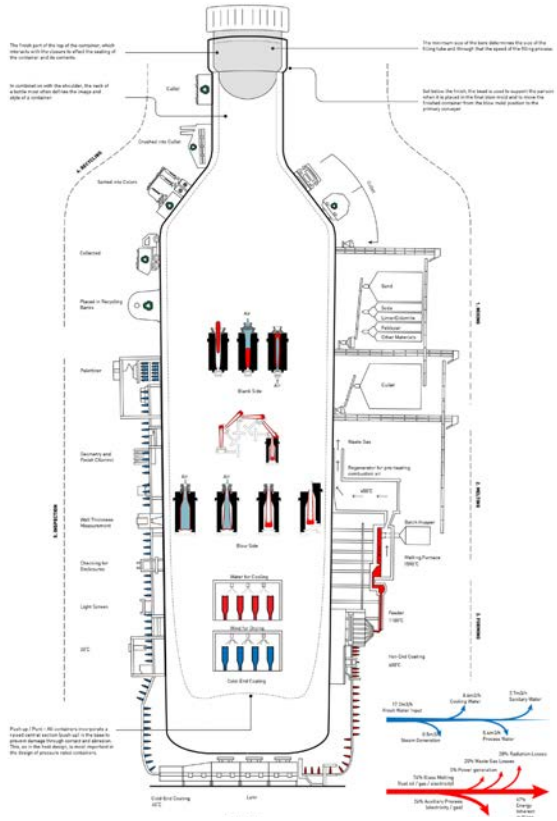

Figure 2. The material ecology of glass production. Image credit: Xitong He & Jingwei Jiang.

considering socioeconomic spaces, the gap between individuals' wealth, education, ethnicity, religion – these metrics or values provide a very different approach to understanding the traceability of constructed environments and their material assemblages.

Rather than emphasizing issues related to cost, convenience and/or appearance alone, one could deliberate upon other values that affect the realm of our designed objects and systems – all of these matters that undeniably impact our ecological and global footprint. In fore fronting particular issues, such as material depletion, environmental degradation, social inequities, these dilemmas might seem localized to individual communities and townships, but they are actually party to a global stage…. A much closer degree of interconnectivity – one that presents what imminently affects our collective future and humanity.

As architects and designers actively participate in this expansive reorganization of Earth's matter, energy and form; and with the output of these spatial interventions tending to manifest as isolated interventions; their formation is generated from an entanglement of complex ecologies and technologies. And so, whether we consider the products of these exchanges as biotic or abiotic in nature, simple or complex in computation, the conditions of their material and performative qualities are not bounded to any fixed or finite territory – their environmental impact influences an ecosystem of oceans, forests and quarries and an economy of commodification, consumption, as well as depletion.

THE IMPACTS OF DESIGN

By taking a closer look at the design and construction process, we can reveal decisions that ultimately impact the intimate, yet expansive degrees of interconnectivity of our food and material culture. And further said, it simply through the act of material specification that architects and designers can transform distant and remote landscapes as decisively as their own immediate surroundings.

Food and material ecologies rarely ever serve a singular purpose or identity; for example, a place to sit and relax, a barrier to enclose or divide, a means for accessibility and/or movement. Instead ecologies have come to address the many environmental and socioeconomic agendas in which we are challenged with today – not withstanding issues related to urbanization and building performance.

Contemporary practices of architecture and design require the embedding of specific sets of information to produce meaningful design expressions. Granted this requirement has been a part of all design disciplines and all designed productions – and it often happens subconsciously, informally or even intuitively. But increasingly so, it has become a much more explicit and rigorous aspect of practice – one that establishes a common ground on which to base both grounded research, as much as design speculation.

It has been widely forecasted that by the year 2050, the world's population will exceed nine billion people. It is a future of overpopulation, mass developments, forced migration, increased energy usage – humanity will be tested, as ecologies will have to endure a score of new and existing environmental issues. In order to support global supply and demand, productive agricultural and industrial lands will need to expand; and at the very expense of rainforests, wetlands and other protected ecosystems. An evolution in land and labor practices including regenerative technologies is a start for better design futures; however, designing at the scales of ecosystems can be incredibly complex. A systems-wide transformation of our current supply chain will require more than better policy and land management strategies. A re-examination of our approach to design, in particular our ways of design thinking, design making and design knowing is essential. And to broaden the scope of our shared cultural and environmental concerns, while bridging and synthesizing diverse expertise from architecture, landscape, material science, cultural anthropology, and even food science and nutrition will be necessary.

Figure 3. Cultural artifacts depicting the ecology of corn. Image credit: Alex Kiehl.

As designers, we are often, if not always confronted with these incongruent pressures – a collection of requirements, circumstance, and methodology all vying for saliency and influence within our design process. How we create coherence from these disparate factors, within our modes of exploration, whether in practice, academia or research will always be challenged to generate design synthesis. Designing for and with food and material ecologies – and by extension, designing for built spaces – begins with a set of metrics that determines a program for use; physical properties and human experience; and performance and sustainability. I would add, the acquisition of an environmental ethos that values ecologies and people first would be at the core of design.

Today, our co-habitation with nature has evolved in unprecedented ways; and the exchange of materials, energy and forces have influenced the biological, cultural, political, economic, and even the imaginary. The countless ways in which systems are interconnected, transcend well beyond a singular material, a singular ecology, an isolated moment in time. When we discuss issues of sustainability, we require an understanding of the architectural scale in simultaneity with the planetary scale. Our design disciplines require this facility and self-motivation to generate more responsible and more effective designed interventions – ones that are responsive to their timely needs. In order to establish a framework – or a collective conscious – for these critical discussions on the agency of architecture and design in the milieu of global re-formation and information transparency should become the foundation for research and design. Fore fronting these issues will reveal a design empathy, one that is not just oriented towards our built environments, but more so to an understanding of diversity – or rather biodiversity – of our cultural and ecological circumstance. As architects, designers and planners, we do carry the responsibility to create self-reliant, sustainable, and resilient places. And in sharing new streams of information including the processes of how we make design decisions and how we translate design ideas, it can significantly impact the planning and construction of these constructed environments, from distant regions to local commons.

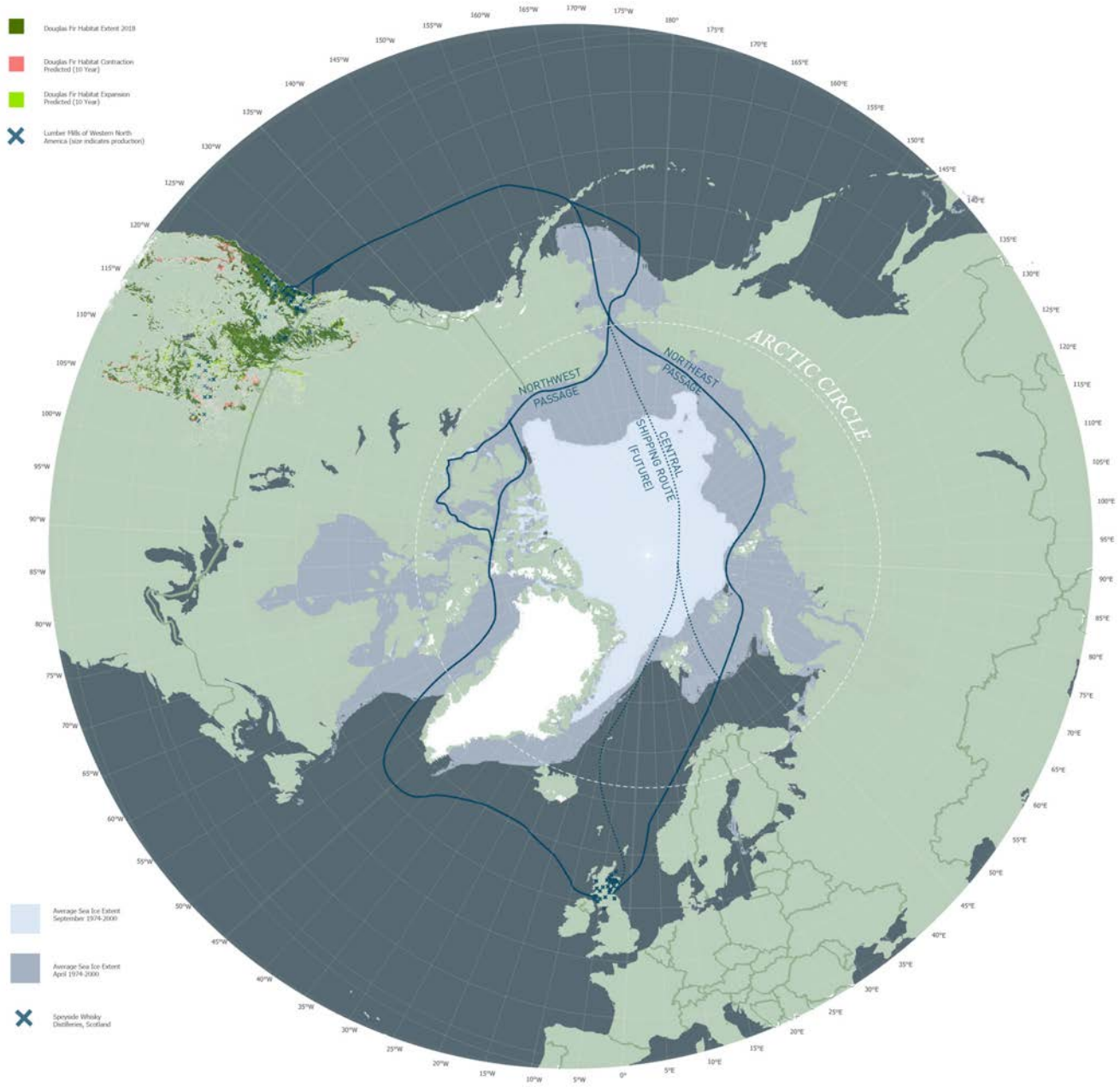

Figure 4. Traceability mapping for the ecology of Douglas fir. Image credit: Taryn Wiens.

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