July 2020

Urban Inter-Space: Convergence of Human Interaction and Form

Clayton Beaudoin

URBAN INTER-SPACE:
CONVERGENCE OF HUMAN INTERACTION AND FORM

A Thesis Presented

by

CLAYTON J. BEAUDOIN

Submitted to the Graduate School of the
University of Massachusetts Amherst in the partial fulfillment
of the requirements for the degree of

MASTER OF ARCHITECTURE

May 2020

Architecture

URBAN INTER-SPACE:

CONVERGENCE OF HUMAN INTERACTION AND FORM

A Thesis Presented

by

CLAYTON J. BEAUDOIN

Approved as to style and content by:

_____

Joseph Krupczynski, Chair

_____

Stephen Schreiber, Department Chair

Department of Architecture

EPIGRAPH

"A space is dynamic when you have elements that are active in every axis."

-Joseph Krupczynski

ACKNOWLEDGEMENTS

First and foremost, I want to thank Joseph Krupczynski for working closely with me as my advisor throughout the process of this thesis. He has pushed me to work as hard as I can to finish this thesis and to make a final product that I can be proud of. His dedication and unwavering support have made this possible.

Thank you to the UMass Amherst Department of Architecture. Throughout my Undergraduate and Graduate studies at UMass, I have been able to work closely with the professors in this department and have gotten to know many of them very well.

I would also like to thank my parents, Beth and Randy, and their spouses Tim and Jen. They are the greatest group of parents I could have asked for, and they have been nothing but supportive throughout all of my education at UMass Amherst and they have pushed me to keep going and to be the best I can be.

Lastly, I want to thank my boyfriend Jason for sticking by my side for the past five years while I was in school, and for supporting me through many stressful moments.

ABSTRACT

CONVERGENCE OF HUMAN INTERACTION AND FORM

MAY 2020

CLAYTON J. BEAUDOIN,

B.F.A., UNIVERSITY OF MASSACHUSETTS AMHERST

M.ARCH., UNIVERSITY OF MASSACHUSETTS AMHERST

Directed by Professor Joseph Krupczynski

How can the convergence of human interaction and form activate underused spaces and catalyze future community developments?

Architecture is defined by human needs, such as that of shelter, comfort, and place. However, we as humans have other needs; the need to create, to make, to play, to thrive, to inhabit, and to interact. The interaction between humans and architecture can serve as fuel to answer the question of how these ideas converge. This thesis examines the dynamic between humans and architecture, and how this interaction can catalyze future change by creating space and place utilized within the underused areas of urban communities.

The debate of form versus function is not new, but this thesis continues to question this relationship. It questions what happens when we are allowed to change form – what happens to the function? If we are allowed to change the function, what happens to the form? What can we control through these changes, and what can we create? These questions can be answered through the development of a series of dynamic structures with the ability to expand and contract. Through the process of this

expansion and contraction, function becomes variable. Form becomes dynamic. These structures inhabit the leftover spaces of urban settings, using the limited space between buildings to the advantage of creating a dynamic, ever-changing space for community placemaking and architectural intervention, and allowing future community developments to thrive in these leftover spaces.

These modular, compact, built environments have the potential to blend the literal and metaphorical boundaries of surface, program, and human interaction. By allowing the individuals of an urban community to gather within an otherwise ignored space, and by giving them the ability to physically transform this space establishes a place to create, make, play, grow, perform, learn, relax, and socialize.

TABLE OF CONTENTS

Page

LIST OF FIGURES

CHAPTER 1
DICHOTOMY

In order to understand the dichotomous relationship between humans and architecture, we must question the importance of the delicate balance, or imbalance, between different schools of thought. We must examine the past, present, and potential future of the relationship between form and function and begin to come to an understanding of how humans impact architecture.

1.1 Form versus Function

The reoccurring debate in architecture that has been present through the ages— as Colin St. John Wilson puts it in his book *The Other Tradition of Modern Architecture*[1] — is whether architecture should be considered a Fine Art or a Practical Art. In other words, should architecture be considered art created with focus on aesthetics or a machine with the function of living? Aristotle's definition of these terms goes deeper, however, defining that Fine Art has an end only to serve itself, while Practical Art serves an end other than itself. Wilson chooses to re-word the debate of "form versus function" in Aristotle's own words because of the Greek method of "embodying in metaphor every nuance of the human psyche," and perhaps these metaphors may help further explain the argument. Although it is not heavily mentioned in Greek philosophy, there is an insistence that architecture is a Practical Art — that the art is derived from the intention of serving another end. This is investigated further during the Modernist

[1] St John Wilson, Colin. 1995. The Other Tradition Of Modern Architecture. The Uncompleted Project. London: Black Dog Publishing Ltd.

movement, the era of architectural thinking that challenged the relationship between two broad ideas: form and function.

Form versus function can be argued either way, that form takes precedence over function, or that function controls the form, but can one exist without the other? Should necessity limit creativity and creativity limit necessity? There should be a balance between these two theories to create a cohesive piece of architecture that performs as well as it looks. However, it can be argued that one's emotional response to architectural aesthetics is just as important as how they physically interact with the space. It is human nature to ask questions that have no true answers; therefore no one will ever stop asking.

Both Modern architecture and Ancient Greek architecture are periods of debate and contradictory approaches that have clear parallels between one another. For example, Le Corbusier's famous quote, "there is no work of art without system,"[2] can be considered a parallel to Aristotle's words, "the virtue of a thing is related to its proper function."[3] However, a direct contradiction to this philosophy is the Greek temple, particularly the Orders of architecture that were specifically invented to be represented at temples of worship. Temple architecture was created with one end goal in mind: gathering and worship. Therefore, it would fall under the umbrella of Aristotle's definition of Fine Art. Similar to the Greek Orders, Le Corbusier attempted to control

---

[2] Ibid.

[3] Ibid.

architecture's parameters by introducing a set of rules known as his Five Points. He is quoted by saying that "a house should be a machine for living," therefore his philosophy regarding the house as a machine is justified by the concept of defining architectural design parameters as if they are components of a machine that can only function based on those components. Collin St. John Wilson appreciates Le Corbusier's great mind, but more so recognizes that his Five Points, as well as his City of Four Functions, are failures of the Modern architecture movement and its original intentions.[4] Even if Modernism was founded on the general ideas of human movement and necessity to create space, as well as the desire to expose structural truths, creating boundaries and rules for people to follow limits the creativity and exploration that thrived during this time. Corbusier, like many others, attempted to answer a question that may never truly be answered.

By diluting the creative expressions and explorations of Modern Architecture and summing up the entire movement by calling it a "style," it negates all the original ideas of this era and represents it in the wrong light. Phillip Johnson and Henry-Russel Hitchcock created a set of rules called The International Style,[5] in which, on the same idea as Le Corbusier's Five Points, intended to set standards for what architecture should be at this time. However, it represented the Modern era incorrectly. Although their own interpretation for what architecture's physical manifestation should take, the

[4] Ibid.

[5] Ibid.

attempt at developing a rigorous standard for all architecture was a mistake. Wilson himself presents this attempt at summing up this creative era as vague and amateur.

Alvar Aalto wrote, "we cannot create new form where there is no new content."[6] Wilson responds to this by stating that "purposive form is generated from inside out." This is particularly true because the Modern era was about exploring new methods of living. This idea is not revolutionary, but the Modern era was an important turning point for this discourse in architecture because architects created new ideas based on old ones. Returning to Greek architecture, when the need arose for large congregations, a new type of architecture was explored in the form of buildings like Hagia Sophia, essentially the opposite to Classical Greek Temple architecture. This solidifies the point that there is no need for architectural guidelines like the *Five Points* or the *International Style*. Whenever a new need may arise, architectural restrictions are unnecessary and limit new explorations of form and function. In Wilson's words: "new content, another language."[7]

Wilson makes a clear case in *The Other Tradition* of his rejection of any attempt at defining architecture as a style, or as something that needs to be creatively regulated. He states, "The gratification of some living purpose must be the grounds of its necessity and the source of its inspiration. It must be open to any and every call from whatever

[6] Ibid.

[7] Ibid.

quarter it may come."[8] Architecture can be created on the grounds of necessity and visual inspiration without being contained within guidelines that a group of individuals believe architecture should be and is thus diluted even further by containing these standards within a style.

1.2 Procedural Architecture

A philosophy developed by artist-architects Madeline Gins and Shusaku Arakawa[9], "procedural architecture" is an experimental concept with a goal to heighten and stimulate the human senses within a mundane space. As stated by Gins and Arakawa, "[those] who inhabit these spaces are given possibilities to discover the full potential of the body and experience challenging environments."[10] The team's first residential project of procedural architecture,

Figure 1. Reversible Destiny Lofts Mitaka, 2005, Tokyo

[8] Ibid.

[9] Gins, Madeline, and Shusaku Arakawa. 2020. "Reversible Destiny Foundation". Reversibledestiny.Org. Accessed January 13. http://www.reversibledestiny.org/.

[10] Gins, Madeline, and Shusaku Arakawa. 2019. "Reversible Destiny Lofts — Mitaka - Reversible Destiny Foundation". Reversibledestiny.Org. Accessed October 6. http://www.reversibledestiny.org/architecture/reversible-destiny-lofts-mitaka?view=slider.

Figure 2. Bioscleave House, 2007, Easthampton, NY

Reversible Destiny Lofts (figure 1) in Tokyo, consists of stacked and intersecting shapes to create an interior space that requires the user to be fully alert and mindful of their surroundings. Once inside, one is required to interact with the built environment to move about the apartment. The floor is bumpy and uneven, and columns are placed strategically throughout the space to assist the inhabitants' movements. This way of thinking in conjunction with architecture adds more dimensions to the built environment that one is not typically accustomed to thinking about, such as the uneven floors, or a sphere-shaped room that challenges the functions capable within that space. Living in these spaces requires one to be hyper-aware of their surroundings.

Another example of procedural architecture by Gins and Arakawa is their first United States residential project, called *Bioscleave House – Lifespan Extending Villa* (figure 2). This house contains the same concepts as the *Reversible Destiny Lofts yet* is expanded to the size of a single-family home. The sunken kitchen is the hearth of the

home, which requires its inhabitants to make their way across the uneven surfaces and steep slopes of this space to complete everyday tasks. Arakawa and Gins determined *Biocleave House* as an "inter-active laboratory of everyday life" in which the usable environment is "realized in unexpected ways to keep a person 'tentative' so that they must actively negotiate even the simplest tasks." [11] The architects believe that this increased awareness and movement in which the body must "reconfigure itself" will strengthen the inhabitant's immune system and extend their lives.

Although these projects may not be feasible for "everyday" architecture, the philosophy of connecting the mind and body to the built environment serves as inspiration for this thesis.

Frank Lloyd Wright's *Imperial Hotel* can be considered a piece of procedural architecture, as the progression to enter the hotel subtly interacts with its users. The pathways leading up to the main entrance of the hotel are paved with rough lava stones, so that guests need to be aware of the uneven surfaces when approaching the hotel. As one moves towards the entrance, the lava stones become more polished, emulating a gradient of material roughness that subconsciously alters the user's experience. Once the user enters the lobby and reaches the front desk, the floor is

[11] "Bioscleave House (Lifespan Extending Villa) - Reversible Destiny Foundation". 2019. Reversibledestiny.Org. Accessed October 6. http://www.reversibledestiny.org/architecture/bioscleave-house-lifespan-extending-villa?view=slider#8.

polished and smooth. Whether the user is aware of it or not, they most likely feel a sense of relief as they move from a rough, uneven surface to a smooth one.[12]

1.3 A Human-Product Relationship

In his 2005 book, *What Things Do*,[13] Peter-Paul Verbeek writes of philosophical and ethical relations to technology and products. In chapter seven of this text, called *Artifacts in Design*, there is a constant reminder of the relationship between people and their products.

Verbeek offers strong explanations that are explained in detail, as his argument of the clear relationship between people and their products and how they shape the human experience is often repeated in a multitude of ways. For example, in the sections called *Toward a Material Aesthetics* and *Aesthetics and the Senses*, this argument is strengthened by his statement:

"The meaning of aesthetics in design then comes to include not just style and beauty, but also the relations between people and products, and the ways in which products coshape the relation between humans and world."[14]

[12] Goldhagen, Sarah Williams. 2017. Welcome To Your World. New York, NY: Harper, an imprint of HarperCollinsPublishers.

[13] Crease, Robert P, and Peter-Paul Verbeek. 2005. What Things Do. University Park, Pa: Pennsylvania State Univ. Press.

[14] Ibid.

This is a conclusive statement that pushes the boundary of what is typically meant as aesthetics. He opens the idea that, since this word comes from the Greek word *aesthesis* and translates to "sensory perception," an object's aesthetics should be linked to all sensory relations of human beings.

The theory of "visualism" is explained by mentioning that some products are made with the intention to fit into certain lifestyles, and that the consumers of those products buy them specifically to adhere to their own lifestyles, or the ones they *want to live*.[15] This explanation further contributes to his argument of a direct human-product relationship. Albert Borgmann criticizes the overemphasis of visualism in design and states that "[products] must function so well that their physical presence goes as unnoticed as possible."[16] Verbeek inserts this critical quote to make the argument that, just like the idea of visualism in which visual aesthetics are overemphasized, the opposite idea can also be overemphasized in the sense of focusing solely on how a product functions. Borgmann's ideology on hyper-functionalism denotes the relationship between humans and products, portraying that products must act as seamless artifacts that serve humans, rather than the preferred idea of human interaction with products becoming a mindful process in which one is aware of how a product works and what it is doing for them.

---

[15] Ibid.

[16] Ibid.

While Borgmann suggests that products need only functional qualities with no attention paid to aesthetics, Verbeek adheres to the argument that products need both functional and aesthetic qualities to work, but he also states that "[there should be] a redefinition of aesthetics in which not artworks but useful objects take center stage."[17] Therefore, it seems that Verbeek leans more towards defining products as functional objects whose aesthetics are derived from the function, but both qualities still must exist to create a product. This raises the question: why can't artworks become useful objects through the convergence of form, function, and human interaction?

In a literary review by Andrew Feenberg, a scholar from the University at Harbor Center in Vancouver, he mentions an opportunity he wishes Verbeek had addressed. Feenberg mentions that although Verbeek states that meaning is just as important as function in a product, he does not consider meaning as a main driver of why a product exists, and only mentions that meaning is complementary to function. He wishes that if Verbeek had "[analyzed] the transcendental conditions of meaning as well as function he would [have arrived] at something resembling a two level instrumentalization theory."[18] Feenberg says that this theory would essentially break down the idea that although the function of something may remain constant, the meaning behind it is more

[17] Ibid.

[18] Feenberg, Andrew. 2009. "Peter-Paul Verbeek: Review Of What Things Do". Human Studies 32 (2): 225-228. doi:10.1007/s10746-009-9115-3.

variable depending on the culture it is placed within and what lifestyles are being shaped as a result.

This thesis questions this relationship. A function can be variable rather than constant. The meaning behind a function can also become a constant rather than a variable. However, what happens when something is variable in both function and meaning? Both should be determined by where this "product" is sited and by those who interact with it. Context and users should determine a product's true function and true meaning, but who is to say that either can't change?

1.4 Firmatas, Utilitas, Venustas

Vitruvius was an ancient Roman architect known best for his treatise, *De Architectura (On Architecture)*, in which he stressed that compelling architecture consists of three principles: *Firmatas* (durability/strength), *Utilitas* (utility/function), and *Venustas* (beauty/delight).[19] A building must be robust and in good condition, it should function well for those using it, and it should spark delight in people. Many questions arise at the notion of "beauty" as a principle of good architecture because it is a subjective term decided by the individual, arguing that strength and function should take precedent. However,

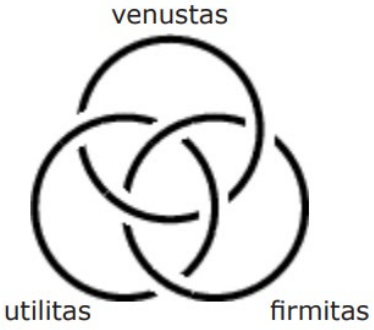


Figure 3. Vitruvius' Three Principles of Architecture

[19] Cartwright, Mark. 2019. "Vitruvius". Ancient History Encyclopedia. https://www.ancient.eu/Vitruvius/.

humans benefit from visual stimulation, as it is the first mode in which one experiences architecture. Therefore, why are form and aesthetics often pushed aside?

What sets these architectural principles apart from the inflexible thinking of Le Corbusier's *Five Points*, and Phillip Johnson and Henry Russel Hitchock's *International Style*, is the absence of a rigorous standard that invents a "style" for architecture. Architecture can claim to be the best functioning, yet the focus on aesthetics and style often dilutes original intentions. Vitruvius writes about these principles as broad themes in which architects must think about when designing buildings. Even when mentioning the ancient Greek Orders (Doric, Ionic, Corinthian), Vitruvius focuses on the social impact of the temple architecture rather than the style in which the temple manifests:

"If the sacred temples of the gods are to lie along public roads, they should be orientated so that passers-by can see them and make their salutations in front of them. (BK. 4, Ch. 5.2)" [20]

For Vitruvius, architecture is not about style, it is about experience. This is one of the primary philosophies that applies to this thesis.

[20] Ibid.

CHAPTER 2
DISSECTION

The research process of this thesis delved into topics of varied levels of specificity. Researching topics related to the convergence of human interaction and form led from investigating the philosophy of human motion to the science of human body measurements within a space. It studied the broader concepts of interactive architecture while exploring the operations that can transform architecture. The study of operations in architecture led to the exploration of implementation through structure and joinery.

2.1 Biotechnique

Architecture is undoubtedly a socially constructive factor in a human's daily activities. Friedrich Kiesler, an Austrian-American architect and sculptor, sought to designate the distinction between biotechnics and biotechnique, as well as determine a clear connection between humans and their environments in his essay *On Correalism & Biotechnique: A Definition and Test of a New Approach to Building Design.*[21] Kiesler states that humans have three environments: natural, human, and technological. The natural environment consists of the naturally occurring world, and the human environment is essentially describing the fact of human existence as animals. Humans inherit both the natural environment and the human environment from their predecessors. However, humans have developed a third environment called the

[21] On Correalism & Biotechnique: A Definition And Test Of A New Approach To Building Design. 2019. Ebook. Accessed October 6. https://apolonijasustersic.com/wp-content/uploads/2017/04/friedrich-kiesler-on-correalism-and-biotechnique-1.pdf.

technological, and an example of that is what we perceive as architecture. This environment is not produced by humans, but it is produced by human *needs*. It is a complex of relationships that responds directly to human needs, and thus is what Kiesler calls "correal" (figure 4).

"What we call 'forms,' whether they are natural or artificial, are only the visual trading posts of integrating and disintegrating forces mutating at low rates of speed. Reality consists of these two categories of forces which inter-act constantly in visible and invisible configurations. This exchange of inter-acting forces I call 'co-reality,' and the science of its relationships, 'correalism.'"

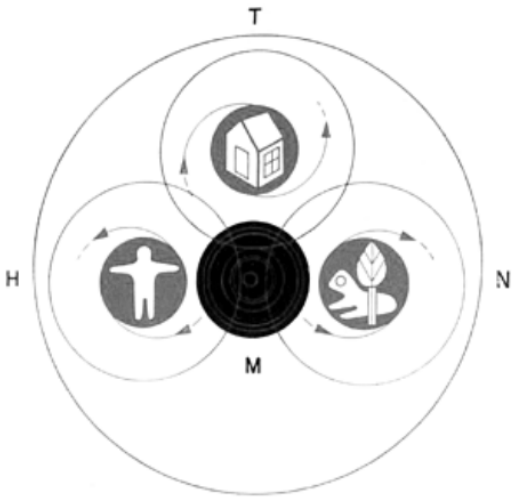


Figure 4. "Man=Heredity + Environment. This diagram expresses the continual interaction of both the total environment on man and the continual interaction of its constituent parts on one another." – Kiesler, On Correalism

The term correalism articulates the dynamics of interaction between humans and their natural and technological environments. The existence of the technological environment is conditioned by the convergence of the human struggle and their needs, contributing to a human's total environment (nature + human + technological). [22]

[22] Kiesler, Friedrich. 1939. On Correalism & Biotechnique: A Definition And Test Of A New Approach To Building Design.

2.2 Human Scale

The human scale is a significant factor to analyze when designing compact structures that are solely based on function through form manipulation. Not only must one design for the average human being and respect code-compliant intention, one

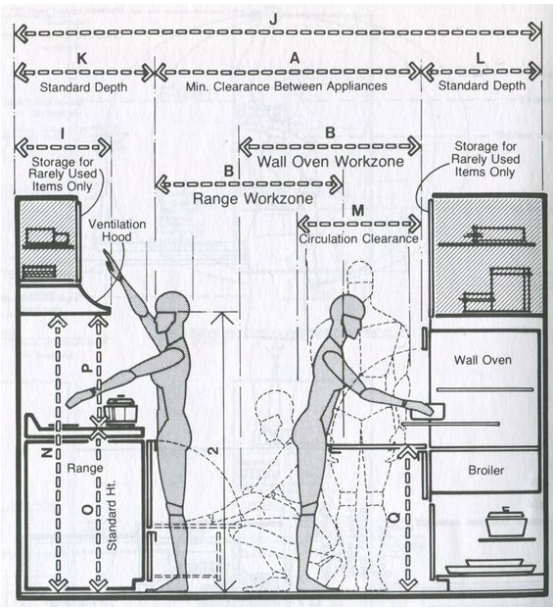


Figure 5. Average Human Anthropometrics

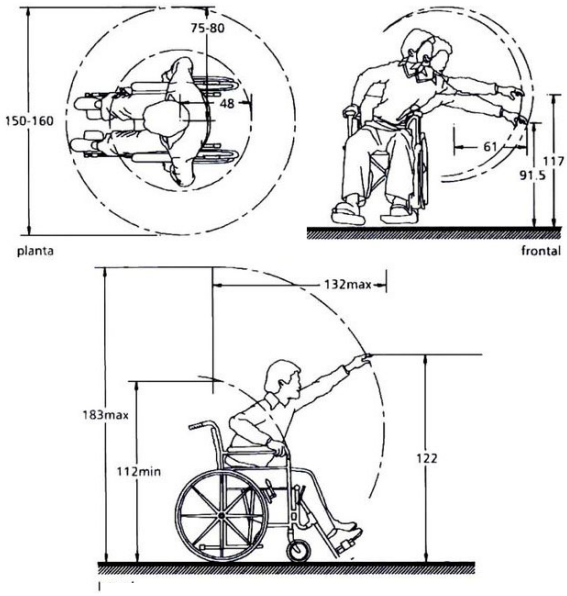


Figure 6. Wheelchair Accessibility Anthropometrics

must also consider varying age groups and disabilities that can play a role in these dynamic structures for community engagement. A solution to provide for the varied individuals who would engage with a collection of dynamic structures in a populated urban environment would be to design the structures to have more articulated surfaces for more intricate form manipulation, or to have surfaces and seating be variable in height.

To address varying human scale design, one must consider anthropometry and biomechanics of the human body in relation to objects in the environment they interact

with. For example, a person who is six feet tall can reach up to roughly two feet above them.[23] Those measurements can become guidelines for designing an architectural object based on operations. This includes surfaces such as chairs, desks, shelves, and other such furniture. This type of design is relevant to the actions performed by humans, such as when they are sitting versus when they are standing. Anthropometry not only informs basic requirements for small-scale design, but it also allows one to explore how to exemplify functions through form manipulation based on the human body and different circumstances.

2.3 Interactive Architecture

Interaction between humans and architecture is the primary motivation for this thesis. The ability to touch, see, feel, and experience the built environment provides

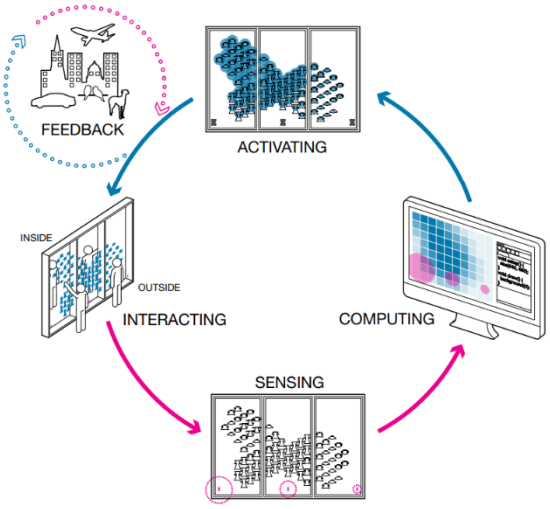


Figure 7. LIGHTSWARM.
Diagram of Interactive Feedback Loop

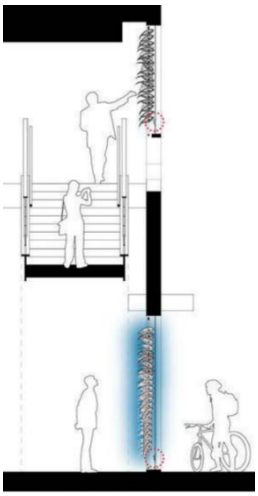


Figure 8. LIGHTSWARM.
Sectional diagram of human relationships

[23] "Anthropometry | Sustainable Ergonomics Systems". 2020. Sustainable Ergonomics Systems. https://ergoweb.com/anthropometry/.

opportunities for engagement with communities in urban settings. Architecture possesses the ability to encompass existing buildings and various spaces that are designed specifically to respond, change, adapt, and even come alive.

Much of contemporary interactive architecture keeps the digital world and its many capabilities close by, serving more artistic purposes meant to exhilarate and delight those who interact with it. Some projects include data sets and algorithms that allow the built environment to respond to human movement, sound, and touch. While this innovative use of technology combined with a range of materials creates an exciting, simulated interaction between humans and architectural environments, manual operations remain the most compelling form of a human-architecture relationship. The digital realm is an important tool that can push projects further and provide the resources to discover new capabilities of interactive architecture, yet tangible environments controlled by the user create more dynamic and personal experiences for those controlling the form and the function of their space.

The book *Interactive Architecture: Adaptive World*, a part of the *Architecture Briefs* series and edited by Michael Fox, documents a plethora of architectural environments that use innovative technology to generate interactive spaces. It also offers opinions and predictions for the future of interactive architecture, and the projects within the book are even referred to as "the future of interaction."[24]

[24] Fox, Michael. 2016. Interactive Architecture: Adaptive World. New York: Princeton Architectural Press.

The architectural profession has always been encompassed by the discourse of style; but present theories, similar to the Modern Era of architecture, are shifting towards function as experience. Architectural discourse is beginning to shy away from questions surrounding image and representation and is thus moving towards questions of processes and behaviors.[25] While this mainly refers to the technological processes and behaviors derived from projects that implement digital design and mechanical systems, physically changing an object's form through manual operation to change its function also falls under the umbrella of processes and behaviors.

Theorist Nikos Angelos Salingaros says, "our society tries to understand its own structures, and builds its physical extensions on the earth's surface, guided by the blank slate hypothesis."[26] Regarding the architectural and community intervention posed by this thesis, the Urban Void Condition is the blank slate, and the multi-layered objects that change function through its expansion and contraction of form are the physical extensions of the earth, guided by human interaction.

2.4 Folding

Lisa Iwamoto's book, *Digital Fabrications*,[27] details and praises the design ingenuity that has been made possible by contemporary advances in digital fabrication technology.

---

[25] Ibid.
[26] Ibid.
[27] Iwamoto, Lisa. Digital Fabrications: Architectural and Material Techniques. New York: Princeton Architectural Press, 2010.

"Architecture continually informs and is informed by its modes of representation and construction, perhaps never more so than now, when digital media and emerging technologies are rapidly expanding what we conceive to be formally, spatially, and materially possible." [28]

This book showcases both the finished projects that have used these techniques as well as the working drawings, models, and prototypes, allowing one to understand the processes and to learn along the way. The most relative and perhaps the most dynamic form of digital fabrication design detailed here is folding. At its most simple operation, folding transforms a flat, two-dimensional surface into a three-dimensional one. However, it also allows one to design a three-dimensional structure and transform it beyond its inhibited three-dimensional form to allow new functions to emerge in the process.

The most convincing effect from folding operations is the ability for new spaces to emerge with new territories to explore, without the loss of the native traits of the object being folded. A material that has been folded is still that same material, yet it is represented as a new form and has potential to introduce new functions, allowing its existing characteristics to be seen differently by those interacting with it. Iwamoto states that "folding offers the greatest potential for variety because it is inherently capable of manifesting a wide range of forms." [29]

---

[28] Ibid.

[29] Ibid.

To introduce architecture into the folding processes informed by digital fabrication creates a cohesive language that can be manifested by converging the spatial, physical, cultural, social, and programmatic conditions of the Urban Void Condition explored throughout this thesis (Chapter 6). Greg Lynn, a pioneer of folding and digital fabrication argues in favor of architectural folding: "If there is a single effect produced in the architecture of folding, it will be the ability to integrate unrelated elements within a new continuous mixture."[30]

While *Digital Fabrications* is informative about the power of folding operations combined with digital fabrication technology, most of the projects, although striking and representative of digital design, are repetitive and digitally based collections of folded objects. What makes folding a convincing form of architectural intervention is the potential for direct human interaction, and how users can physically manipulate a space to rearrange spatial and functional qualities. A successful folding architecture that is designed at the human scale is something that can be actively manipulated to showcase

Figure 9. Alastair Pryor, Pop-Up Compact Shelters

[30] Ibid.

the operation of folding. Something that is already folded and remains static achieves the opposite effect, one that only visually portrays folding operations. While projects that implement static folded planes can be striking and thoughtful, such as Chris Bosse's *Digital Origami* (figure 10)[31], dynamic folding planes represent active movement and spatial shifting that is highlighted in this thesis. An example of a project that uses physical manipulation to create space is Alastair Pryor's *Pop-Up Compact Shelters* (figure 9), in which a flat-packed stack of polypropylene sheets can unfold within minutes to create a tent-like emergency shelter.[32]

Folding can also be used as a method of creating space through surface, such as a threshold between interior and exterior, and can become a transitional factor as an

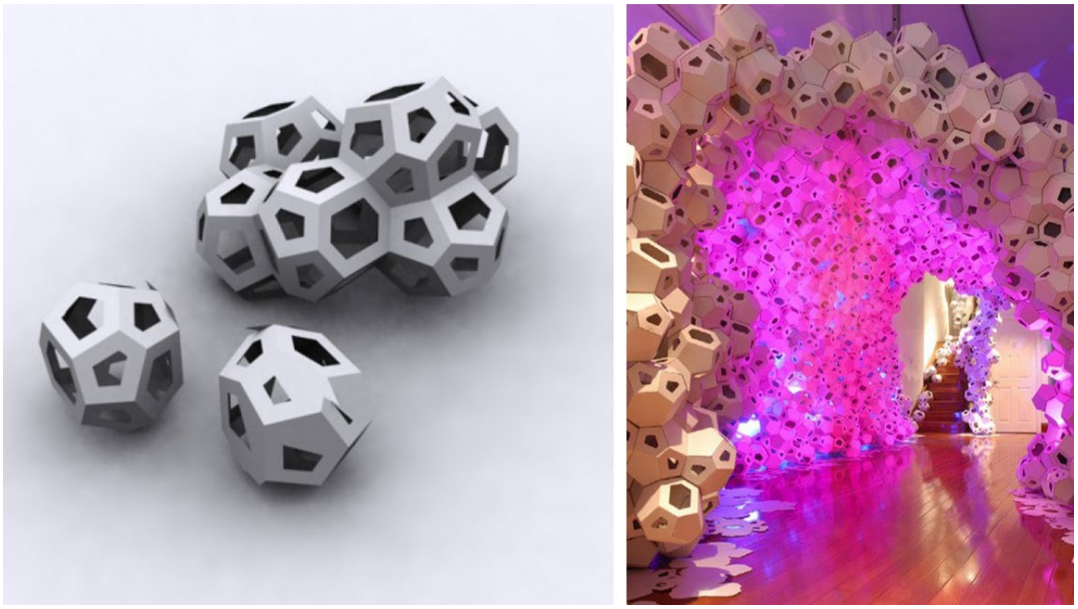


Figure 10. Chris Bosse, Digital Origami, 2007. A static, folded architectural space

[31] Ibid.

[32] "Flat-Pack Disaster Housing That Goes Up — And Down — In Less Than 2 Minutes". 2020. MNN - Mother Nature Network. Accessed January 15. https://www.mnn.com/your-home/at-home/blogs/flat-pack-disaster-housing-that-goes-up-and-down-in-less-than-2-minutes.

architectural object is manipulated to change function. Discussing the variables between interior and exterior, Antoine Picon challenges the traditional mode of architectural presence and explains that surfaces do not define space by enclosing it, but that they "generate [space] as layers following their various inflections."[33] In this situation, folded surfaces are the layers, and through various inflections by human interaction, space is generated. Picon questions architecture that appears to have folding surface operations, as they are only an image of the folded surface. Their folded surfaces may give the impression of a dynamic series of surfaces and its representation of digital design operations, yet it remains static and unmoving. Generating a surface that can be actively folded and transformed to create spaces is a more successful approach for blending the boundaries between varying programs, material responsiveness, and human interaction.

2.5 Deployable Structures

In the book *Deployable Structures: Form and Technique*, the author Esther Rivas Adrover defines deployable structures as having the ability to expand and contract based on their geometrical, material, and mechanical properties. The primary interest in deployable structures for the research of this thesis stems from their potential to create transforming and dynamic experiences and environments. Although the science behind deployable structures are typically applied to mechanical structures that "are capable of

[33] Picon, Antoine. Digital Culture in Architecture: An Introduction for the Design Professions. Basel: Birkhäuser, 2010.

large configuration changes in an autonomous way,"[34] this same way of thinking can be applied to smaller, human-scale structures that are designed to create architectural space through their expansion and contraction.

The section of this book that focuses on "Rigid-Foldable Thick Origami" is closely related to the fabrication of the architectural product proposed in this thesis. What digital model space teaches us, is that nothing in existence truly has zero-thickness qualities. The conceptual paper folding models presented in Chapter 5 are able to imitate folded products void of thickness. While those exercises were useful in exploring the properties of folding and how folding operations influence form, real material and thicknesses must be considered for the continued development of a modular structure that expands and contracts.

[34] Adrover, Esther Rivas. Deployable Structures. 2015.

Origami scientist Tomohiro Tachi proposes two methods of folding to emulate the ideal kinetic behavior of zero-thickness origami when applied to rigid-thickness origami (figure 11).

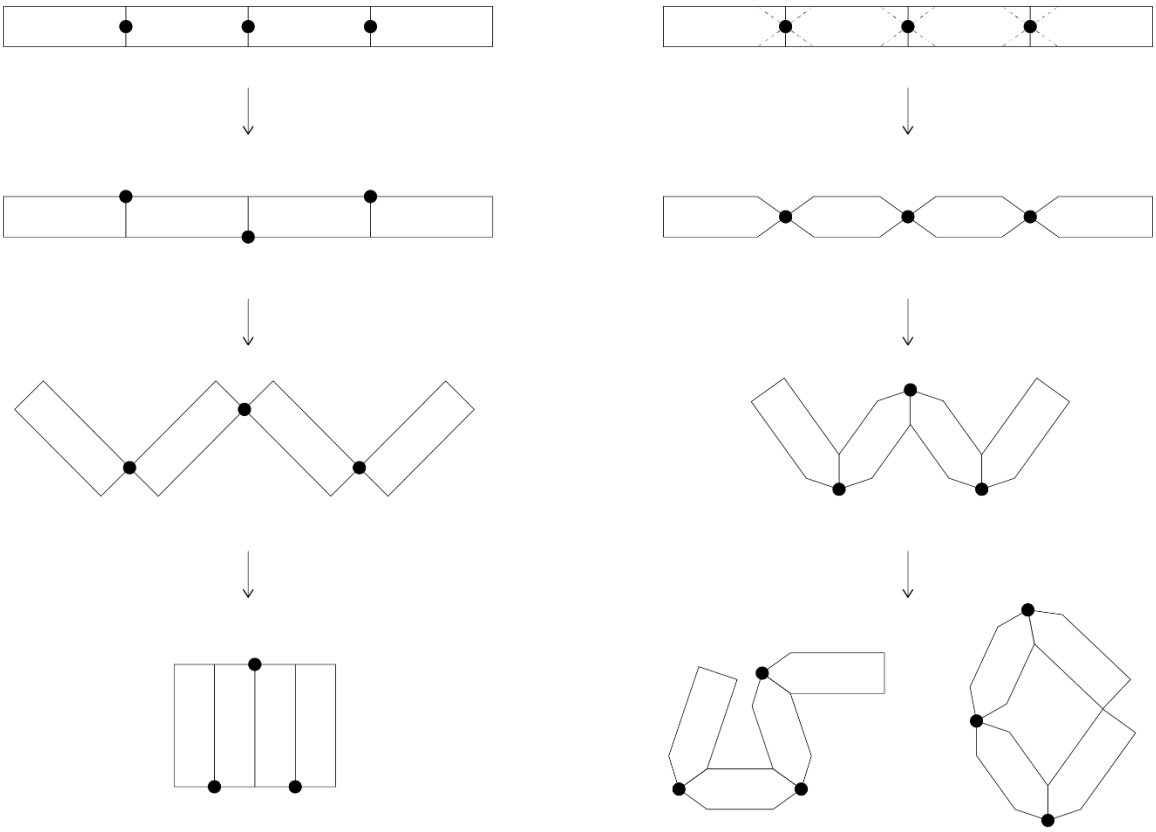


Figure 11. Rigid-Foldable Thick Origami. Constant Thickness Panels (left), Tapered Panels (right)

One method is utilizing “constant thickness panels” in which joints are placed at the vertices of the intended direction of folding. The other method utilizes “tapered panels” in which joints remain at the center points between panels, but material is removed from the adjacent planes to allow for the panels to fold in both directions. Although these methods are functional, each has its own limitations. In the constant thickness method, the panels are able to completely collapse, but can only be folded in one

Figure 12. Tomohiro Tachi, Rigid-Foldable Thick Origami

direction, determined by the placement of the joint or link. With the tapered panels method, the panels are able to fold in both directions, but are limited to how far they can fold set by the parameters of the tapered material, and thus cannot be fully collapsed.

2.6 Joinery

The operation of folding generates different forms, but also creates new structures with changing geometry. Therefore, more questions arise, such as structural support and joinery that allows such changing geometry to become realized and

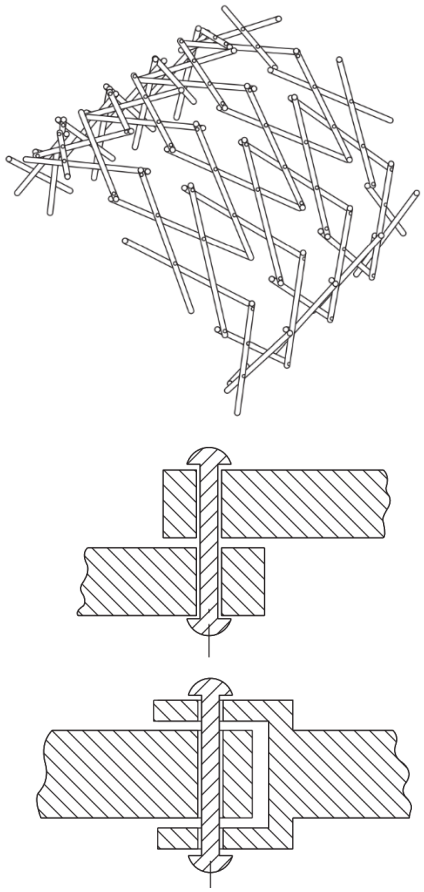


Figure 13. Bennett Links joined (above) and alternative joints connecting two links (below)

tangible. Esther Rivas Adrover's *Deployable Structures*[35] details some methods of joinery, applying to folding operations and collapsible structures. Developed by Yan Chen and Zhong You, one method of linking between components uses Bennett linkages, which consists of links connected by four revolving joints (figure 13).[36] Although these links are typically used by connecting all the links into a patterned surface with the ability to take on organic shapes that can deploy and collapse, rotational joints can be considered useful for folding surfaces and rotating planes on small structures. In a detail provided by the team, alternative joints are considered for joining the links together, a helpful drawing for

[35] Adrover, Esther Rivas. Deployable Structures. 2015.

[36] Chen, Yan, and Zhong You. 2020. "Connectivity Of Bennett Linkages | Structures, Structural Dynamics, And Materials And Co-Located Conferences". Arc.Aiaa.Org. Accessed January 15. https://arc.aiaa.org/doi/abs/10.2514/6.2002-1500.

designing links between components.[37]

Hinges are perhaps the most practical method of joining two planes to give them the ability to fold. However, the design of these small structures, in order to provide

Figure 14. Baoz Mendel, Loop Chair, 2010

Figure 15. Hinges. One-Way (left), Double-Action (middle), Wrap-around (right)

[37] Adrover, Esther Rivas. Deployable Structures. 2015.

higher levels of operative flexibility, require the planes to fold in both directions, and in some moments, they may become static for structural stability. This raises the question of combining many types of hinges (figure 15), such as one-way hinges, double action hinges, or wrap-around hinges with methods of changeable links that lock folded elements into place. A 2010 project known ask *Loop Chair* by Boaz Mendel[38] features a simple solution to this, in which they created an object with looped folding planes, joined by double action hinges, that lock into place via a series of metal connectors. *Loop Chair* (figure 14) has the ability to be transformed into a variety of combinations, such as chairs, stools, tables, and more. The wood boards used for the folding planes have perforated edges that allow the U-shapes metal connectors to lock the object into place in whatever combination the user chooses. In a statement close to the philosophy of this thesis, the creators claim:

"Every folding position has a defined function and it is possible in a moment to go from a television chair to a barstool; from a ladder to a chaise-longue; from a bookshelf to a coffee table – all with great ease and according to one's personal whims and needs."[39]

[38] "Loop Chair - Boaz Mendel". 2010. Sites.Google.Com. https://sites.google.com/site/mendelboazdesign/home/loop-chair.

[39] Ibid.

CHAPTER 3
EMERGENCE

3.1 Between Worlds

Susannah Hagan introduces a variety of philosophical ideas surrounding the digital impact on architectural theory in her book *Digitalia*.[40] In order to introduce the concept of the "digital," Hagan mentions broad historical philosophy through such figures as Plato and Aristotle as a method of comparison between certain historical impacts that have changed the human way of thinking. This is an increasingly relevant theory today, as technology and the digital world is constantly influencing and even changing the way in which people think, especially about architecture and design. There is the idea of two different worlds, such as heaven and earth, that can be compared to the digital world's impact, the digital being "heaven" and the material world being "earth." This analogy creates a cohesive comparison between new and old ideas to reinforce a singular concept.

Hagan continues to compare history with the present and uses many historical references such as Gottfried Leibniz and his theory of "Monism" from the seventeenth century, which is defined as "the possibility of integrating the material and the spiritual."[41]

[40] Hagan, Susannah. 2008. Digitalia. London: Routledge.

[41] Ibid.

"Monism means that everything is made of the same substance, that dualities of mind and body, spirit and matter don't in fact exist, being instead different places on the same continuum." [42]

That is perhaps true about the connections between the digital and physical worlds today—there is a constant system that now exists in which two or more worlds are always "etherealizing" between one another. This is also true about a human's understanding of material and their senses in which materials on the atomic level are made of the same atoms and elements, yet they are perceived by those who interact with it as different (touch, sight, taste, hearing, smell). There is an ethereal connection between the human mind and their bodies, and its physical interaction with objects at the scale in which humans live.

Hagan mentions that historically, opposites have been celebrated and respected, such as "yin and yang," from the Chinese philosophies of Taoism and Confucianism[43], and Christianity, in which heaven and earth were often represented as two separate worlds but overlapped considerably. According to Hagan, opposites are now about "domination and subordination," meaning that one world is meant to be viewed as superior over another. The argument of integration between the digital world and the physical world and the inclusivity and complementation between the two worlds is vital

---

[42] Ibid.

[43] Encyclopedia.com. (2019). *Yin And Yang | Encyclopedia.com*. [online] Available at: https://www.encyclopedia.com/literature-and-arts/classical-literature-mythology-and-folklore/folklore-and-mythology/yin-and-yang [Accessed 5 Oct. 2019].

to how the world can be "reconfigured in more environmentally and socially viable ways."[44] As this argument was written in the late twentieth century, where the digital world was introduced to design, the bond between the digital and physical worlds have become more transparent. Designers can often become stuck in the digital world, void of scale and context, hindering one's creativity and interaction with the physical world if one is letting a computer make design decisions. The digital world is a tool and can be used to generate marvelous things. However, interaction with the physical world and the product of the collaboration between the digital and physical worlds shows that these two worlds can become monistic.

The connections between *Digitalia* and *What Things Do* (Chapter 1, section 1.3) is the idea that two or more worlds can be brought together to create a cohesive concept. In *What Things Do* those worlds are "meaning" and "function" in which both are present in products that impact human conditions. In *Digitalia,* those worlds are the "digital" and the "material" in which there is a continuous flow between the two, which also impacts human conditions through the generative connection of interaction, which can become ever-present in the world of architectural design. Although the comparison between worlds present in *Digitalia* is more relevant with alternating between digital and material worlds in design, the correlation between meaning and functionality can be a more applicable approach when exploring interactive architecture.

[44] Hagan, Susannah. 2008. Digitalia. London: Routledge.

3.2 Blending the Boundaries of Surface

Antoine Picon, author of *Digital Culture in Architecture: An Introduction for the Design Professions*,[45] explains that there are various ways to account for the trend of treating a surface with digital design. One method may be more literal, such as using screens for advertisements that seem to shroud all language of architecture that sits behind it. Although he talks about these "hypersurfaces" which refer to the melding between cyberspace and the physical world, Picon does not seem to believe that this is the proper way to treat surfaces through the medium of digital design. Rather than using larger screens as advertisements, they can be used to display works of art to visually alter a façade at varying scales. However, these moments are not architectural. Although architecture is a host for these surfaces, all language of the building it shrouds is hidden and remains a mystery.

Picon's chapter titled *The Crisis of Scale and Tectonic* focuses on the challenges of digital culture in architecture and how tectonic qualities of architectural design can be lost through the iterative process of digital tools. Although these types of products challenge the idea of traditional fundamentals in architecture, which seems to have been the goal of many architects throughout the 20th century and continues to be a goal now, what is

Figure 16. Frank Gehry, Walt Disney Concert Hall, 2003

[45] Picon, Antoine. Digital Culture in Architecture: An Introduction for the Design Professions. Basel: Birkhäuser, 2010.

often lost is the expression of structure as a guideline for design. Picon mentions that Frank Gehry often rejects the structural constraints most seem to abide by, which is a common thread present in Deconstructivist architecture (figure 16). This thesis aims to celebrate structure and use it as a factor throughout the design process in order for the user to understand the full dynamic and multi-functional qualities of a human-architecture relationship.

When viewed in a digital model space, it is easy to see the unique quality and daring expressions of a digitally produced object by simply rotating or panning around an object that is weightless and void of scale or structural information. However, in actualization, a building is seen from the perspective of its users and cannot be easily manipulated to gain the full effect. It can only be truly seen through site and interaction. This may be a desirable effect, to intend for an audience to experience a design in a new perspective, but it is impossible to experience the end-product in reality the same way it is viewed digitally.

When digital design is used with intended and achievable scale in mind, in coordination with experiments in the material world, it becomes immediately more convincing and influential. However complex or simple, the idea of creating something digitally with so much thought and effort into the design and how it functions as a result from those experiments is an important quality to explore. The scale of these final operations should be related to the human scale to experience the full effect of the intended design. This can be achieved through interactive architecture that functions

with the synonymous act of human operation. For example, an interior space may only be accessible by a series of physical manipulations designed through digital design, more tightly integrating the user with the tectonic functionality of architecture.

3.3 Touch, Sight

Materials are one of the most important parts of not only architectural design, but any physical space. Human-scale interaction primarily involves the human senses of touch and sight, and the surfaces that the user sees and touches define the experience for the user. Is the surface smooth and reflective, or rough and cold? Can the surface move or does it remain static? The materials seen daily, yet rarely thought about, is the primary subject of Mark Miodownik's *Stuff Matters.* Miodownik takes these materials such as steel, glass, and concrete—that some may perceive as boring and simple—and evaluates in attentive detail the science behind why they exist, why they are important, and how they shape human beings' everyday lives. Miodownik is examining his own experiences with materials and telling the story of where they come from and how they shape the human experience, and how the human experience has shaped them.[46]

[46] Miodownik, Mark. Stuff Matters: Exploring the Marvelous Materials That Shape Our Man-made World. Boston: Mariner Books, 2015.

Materials, while made up of naturally occurring substances, are all the product of human interaction. The discovery of stainless steel is an example of this. In 1913, scientist Harry Brearley discovered that an experimental steel alloy he had produced did not rust, but rather shone brightly when exposed to light. This new material formed a protective coating of chromium oxide, a transparent material that sticks to every surface of steel when exposed to oxygen. This is a theme that Miodownik mentions a great deal; that many of the properties and new discoveries of materials were uncovered on accident or by trial and error. These accidental materials help shape how we use and how the world perceives materials, and often leads to continued innovation that improves our lives in many ways.


Figure 17. Anish Kapoor, Cloud Gate, 2006

For instance, stainless steel is often used in art and architecture because it appears "uncorrodable" and clean, such as Anish Kapoor's *Cloud Gate* sculpture in Chicago (figure 17), which is an example of how humans had "conquered grime, and the dirt and messiness of life."[47] Every material can have a story and a strong concept behind it, whether man-made or natural. An unnaturally smooth and shiny surface can be perceived as clean, while a naturally rusting piece of steel can be seen as rough and dirty. Human interaction is what changes one's perception of material. Only through

[47] Ibid.

visual and physical interaction can one perceive how something feels and how it can be manipulated.

3.4 Conceptualization

How can the convergence of human interaction and form activate underused spaces and catalyze future community developments?

To answer this question, topics were broken down into various subtopics. These topics were explored throughout the research process (chapter 2) and informed processes for design and community intervention. From this process, a series of concepts emerged that related to the design exploration of small structures that question the relationship between form and function. These concepts were created by exploring the possible characteristics of designing dynamic compact structures and with the intention of interweaving community placemaking to create a changing built environment within a common urban condition.

Each conceptual diagram began with asking three questions. The concepts are intended to encapsulate the broad requirements of a human-architecture relationship, through the design of small structures.

3.4.1 Adapt. How can architecture change form to introduce to functions?

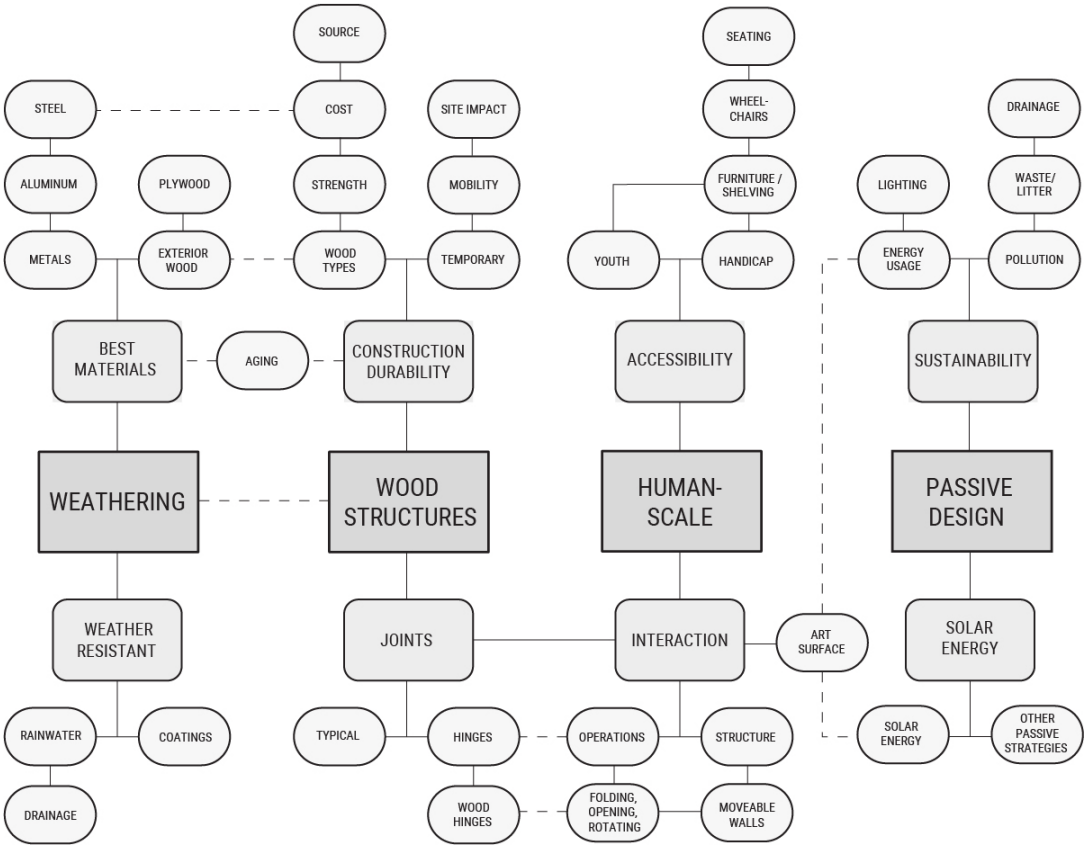


Figure 18. Taking four topics and breaking them down for more specific research topics about adaptation.

There are opportunities for there to be strong relationships between humans and architectural objects. Based on this relationship, the physical environment can be altered to adjust to varying functions through manual operations. The study of human biotechnique and dimensions of body space in conjunction with folding surfaces and procedural architecture allows for a thoughtful approach that challenges the function of objects and the humans who use them. Structural and mechanical implications coincide with a space that can morph, fold, or deform from one thing to another, changing the function of the space as it is altered. The basis of human interaction and physical control over objects and structures primarily inspires form.

3.4.2 Protect. How can shelter and temporary spaces serve urban communities?

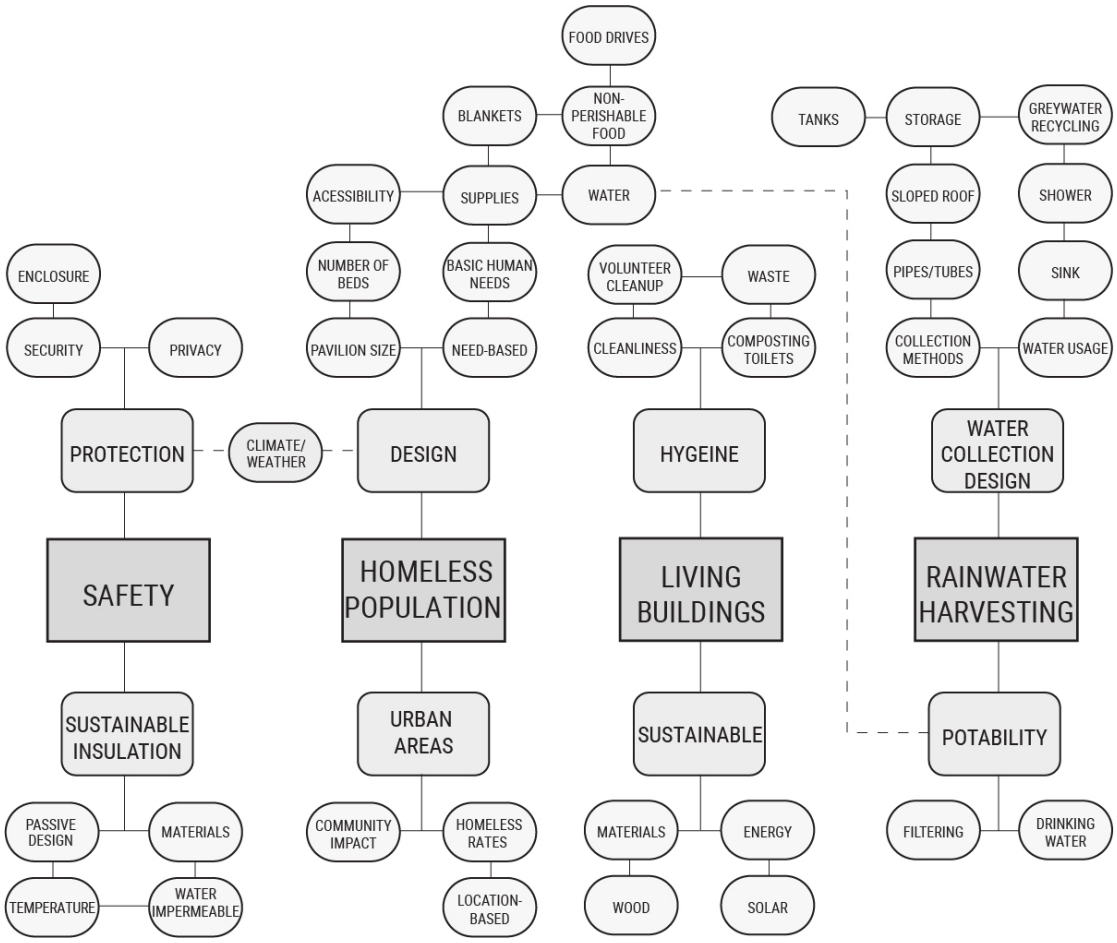


Figure 19. Taking four topics and breaking them down for more specific research topics about protection.

Safety and enclosure can serve an important function when designing dynamic compact structures. This concept leads one to address a variety of topics, such as climate, water, shelter, environmental impacts, and sustainable design. Engagement with the community invites people to interact with the built environment, creating opportunities to serve human needs, such as shelter, shading, and storage. The research behind this topic would also include the implications of dynamic structural design with the ability to conform to a series of manual operations performed by the users.

3.4.3 Contain. How can limited space create and inspire architectural intervention?

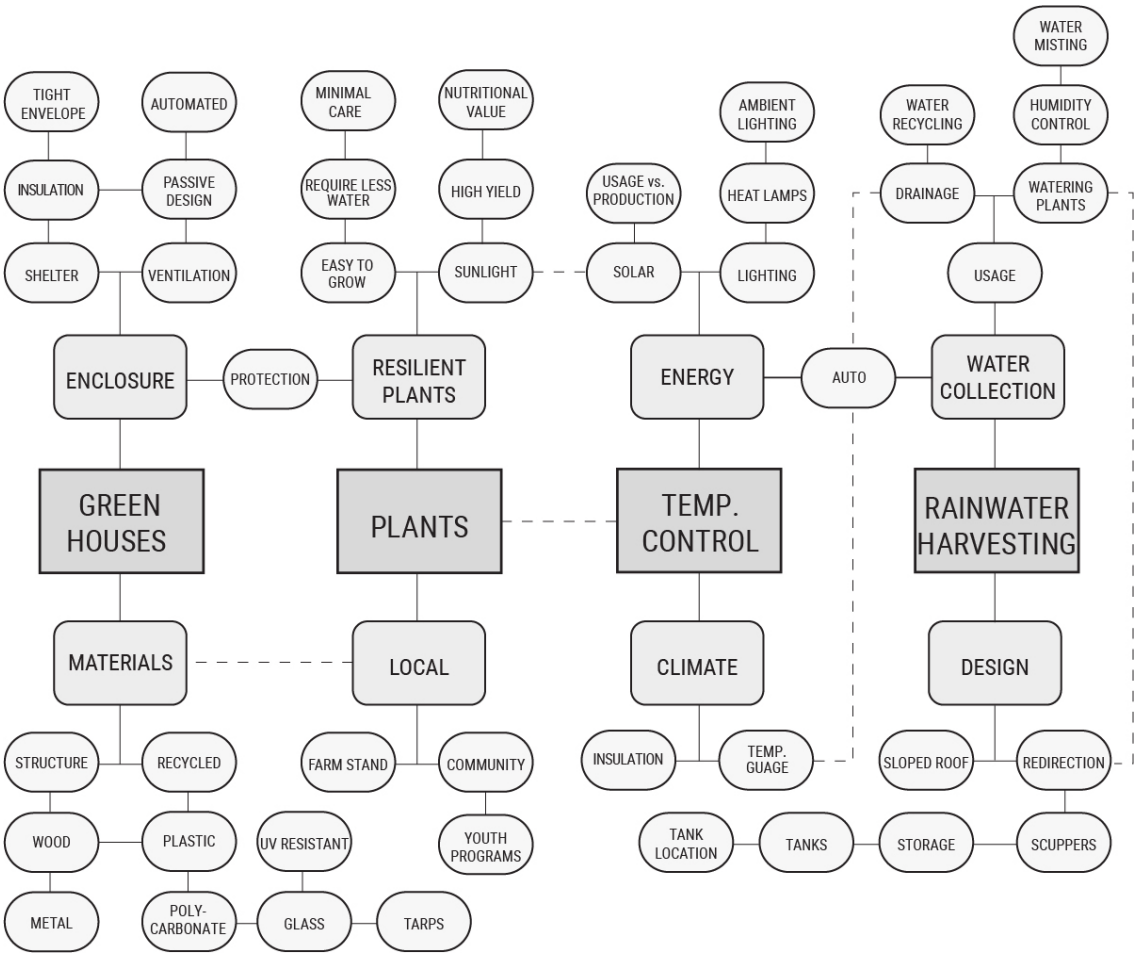


Figure 20. Taking four topics and breaking them down for more specific research topics about containment.

Designing within a limited environment is a challenge in itself. Containment can address a variety of topics, such as how to develop an architectural space that holds many functions or capabilities within a single enclosed environment. If these functions are expanded or contracted further, new opportunities and conditions arise. Introducing program into this concept, such as urban gardening or an architectural space that may require temperature, air, and light control can allow for the development of a dynamic, multi-functional space within a limited environment.

CHAPTER 4
INTERPRETATION

4.1 Correlation – The Engagement Lenses

When three concepts converge in community placemaking and architectural design, what can be created? When comparing the three concepts (Adapt, Protect, and Contain), three essential similarities can be observed that have developed a framework for this thesis. Each concept poses questions about the transformation between one or more environments, each concept generates responses based on the transformations triggered by manual operations, and each concept requires interaction between an individual and the architectural object being manipulated. This comparative process when applied to design, could inform how an object transforms, how physical operations and people respond to that transformation, and how a community interacts with it. By examining these relationships, we can view these concepts through each of these comparative lenses.

4.2 Transform

These concepts deal with the **transformation** between one or more environments.

- *Adapt:* Manipulating form to introduce more functions.
- *Protect:* Changing an architectural space to serve individual needs.
- *Contain:* Using parameters of limited space to control an architectural environment.

Through various human engagements with physical form, one can alter the use and feel of a space through shifts in the spatial characteristics of an architectural environment. These spatial shifts can affect the structure, program, function, and

aesthetics through the expansion and contraction of architecture. By allowing an architectural object to blend the boundaries of surface, program, and function, the Transformative Lens focuses on the broad idea of shifting one an environment to another through iterative human interaction.

4.3 Respond

These concepts generate **responses** based on spatial transformation.

- *Adapt:* The tectonic responses of a form generated by human operation.
- *Protect:* How an object is built and what needs to happen for it to transform.
- *Contain:* Using limited space to generate movement and design.

The transformation of an architectural environment through specific operations (pivot, fold, slide, push, pull, rotate, etc.) generates a response for each object within that environment. The physical and perhaps mechanical responses of the elements that make up an object has effects that must be examined through the research of operable structures and joinery conditions. Responses are also generated by environmental conditions such as climate, the limitation of site and space, and how people use it. The exploration of these functional conditions creates the potential for varied use and program.

4.4 Interact

These concepts create moments of **interaction** between humans and architecture.

- *Adapt:* Changing function and experience from spatial manipulation.
- *Protect:* Manipulating a space to serve human and community needs.
- *Contain:* Addressing the capability of function within a limited space.

The manual operations determined by the user can change their experience within a space. It is only by human interaction that an object can transform to serve their needs, and only through that transformation can an object's elements respond and create new experiences for the individual. Maintenance of a shifting space and the designated function that has the potential to change regularly is determined by the user.

CHAPTER 5
MANIFESTATION

5.1 Merging Concepts

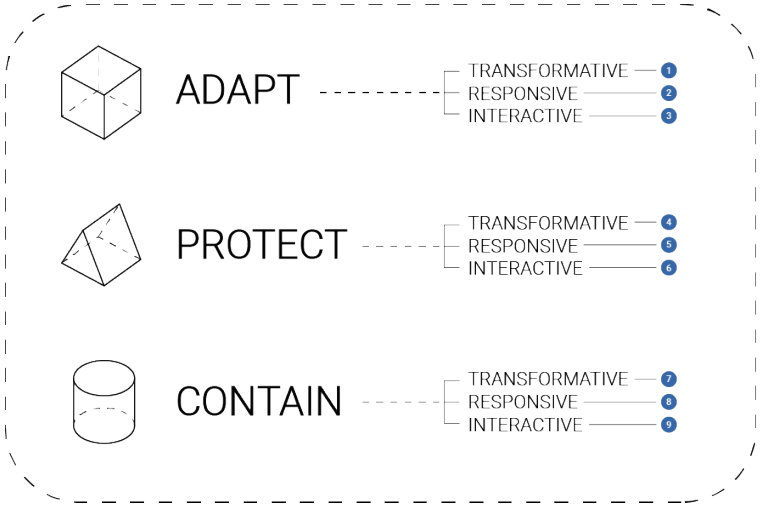


Figure 21. Generative Diagram for Model Series 1

Two series of paper folding models allowed the three concepts of this thesis, Adapt, Protect, and Contain (Chapter 3), to be personified as physical objects, primarily focused on form over function. Both series of models were designed in digital space, laser cut, and folded by hand. In the first series, each concept is represented as its own three-dimensional shape (adapt=cube, protect=triangular prism, contain=cylinder). Each shape is then unfolded and reorganized to fold along different creases, motivated by the three Lenses: Transformative, Responsive, and Interactive (Chapter 4). They are then refolded to create different objects, with a total of nine models in the series. This is a

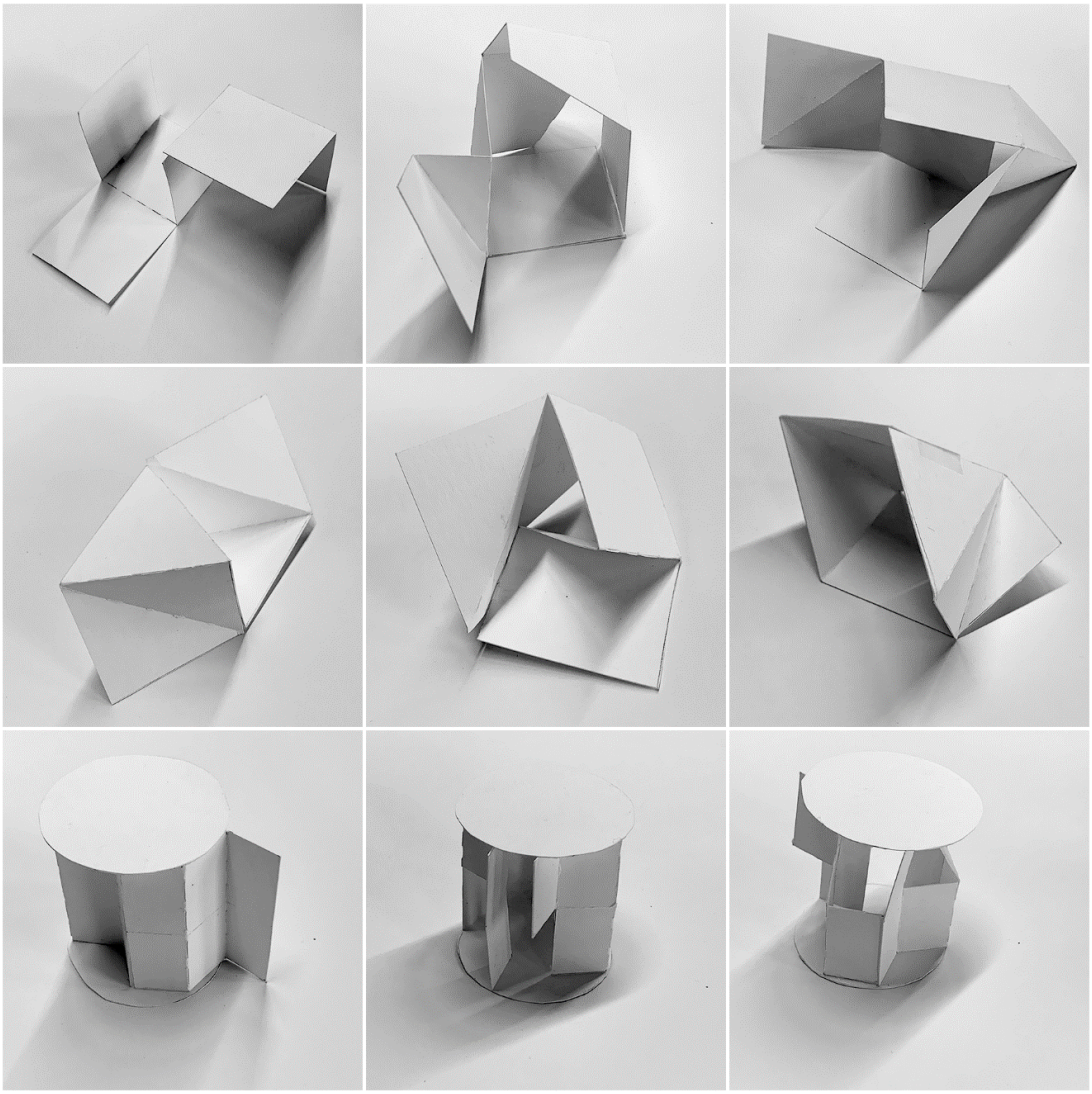


Figure 22. Model Series 1

study predominantly exploring folded form and the consequences and opportunities that arose in the process. The models resulted in varying shapes with some moveable and some static elements that altered spatial conditions, light conditions, and overall form.

In the second series of models, a single three-dimensional cube was used to represent each of the three Lenses, and the three initial concepts were used as inspiration for their resulting physical forms. This next series of nine models achieved a similar goal to the first series. However, each unfolded cube grew in complexity with further divided folds, as well as reduced surface area with added openings. This resulted in a varied series of re-folded objects that created more inspiration and ideas for how an object's functions may arise through more complex operations. Like the first series, new spatial and light conditions resulted from this experimentation of form.

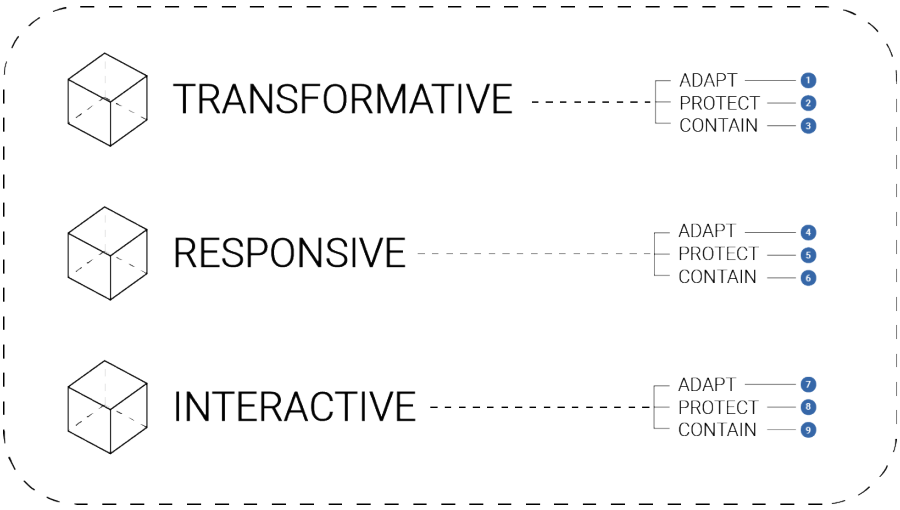


Figure 23. Generative Diagram for Model Series 2

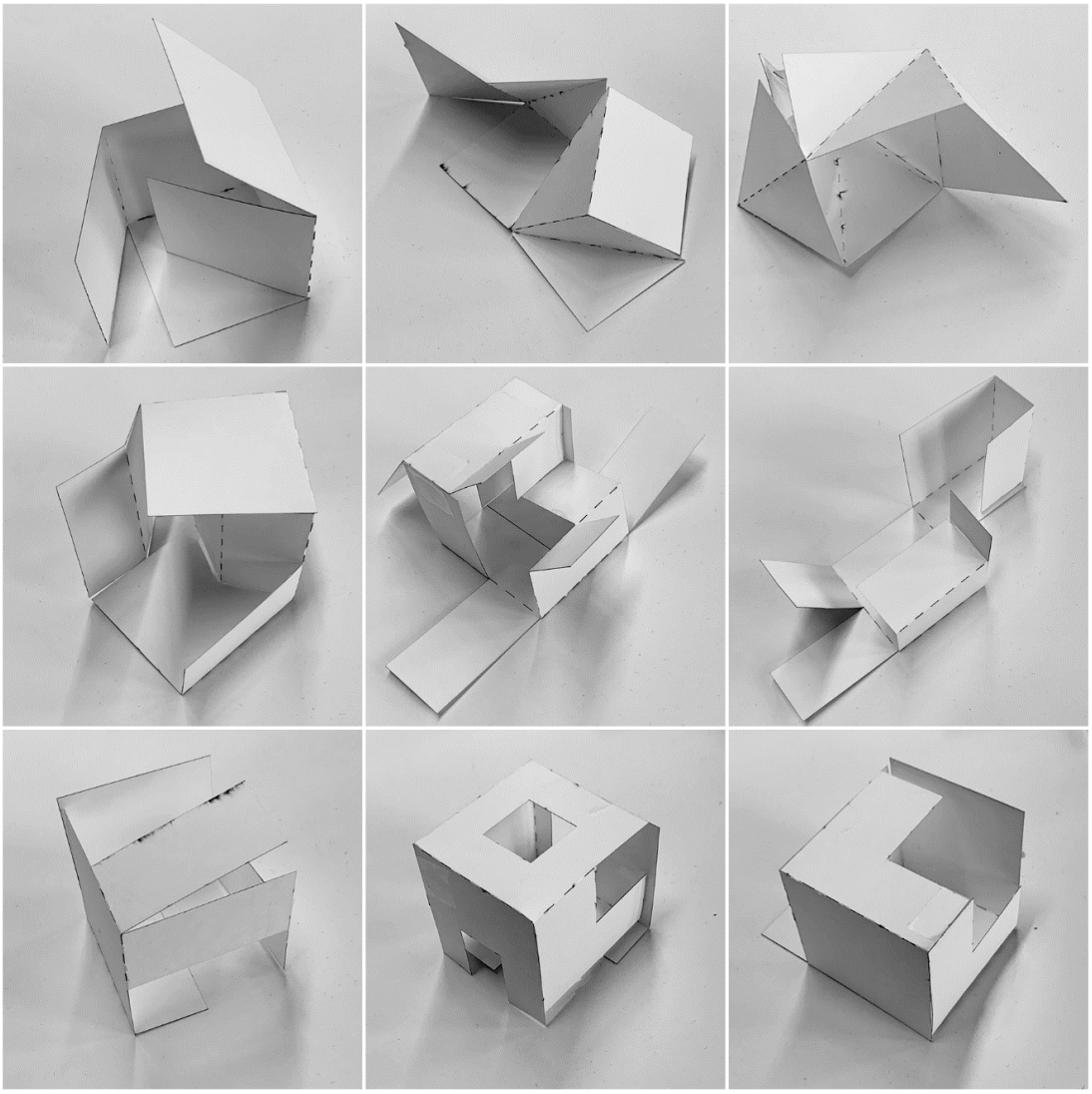


Figure 24. Model Series 2

5.2 Reflection

The making of these series of models have helped inform new and more specific topics of research, such as the edge conditions based on the material thickness of each folding plane or the joinery conditions needed to allow an unfolded object to collapse, shift, rotate, or lock into place. There are also many limitations that come with this type

of model making, such as the combination of digital fabrication and hand-folding the laser cut product.

These series of models purely express form and folded planes, and their lack of materiality and scale led to the decision to create a series of models based on the human scale.

5.3 Modular Unfolding Model – The Maker's Module

Figure 25. Modular Unfolding Model – The Maker's Module

By introducing program into the process of paper folding, form-finding and the early foundations of design can influence steps toward creating an operative architectural object. This series of modular folding models allows one to visualize human interaction with folded planes, and the multitude of shapes and configurations that could take place. These configurations have influence on the function of the object, which changes with virtually every operation. There is the possibility of horizontal and

vertical planes becoming usable surfaces and containers for making, playing, sitting, eating, storage, structural design, etc. The idea behind this folding model is modularity, in which a series of closed objects with set dimensions expands its surfaces to unfold into something new. These modules could be used as makerspaces, marketplaces, urban gardens, farmer's markets, performance spaces, and other similar programs that can become catalysts for future community developments and begin to weave new program

Figure 26. The Maker's Module – Spatial Organization

and life into an existing urban fabric littered with unused spaces.

The program applied to these modular designs is a makerspace, because of the variety of creative and hands-on processes that a makerspace can provide. Makerspaces also offer multiple types of creative processes, such as painting, woodworking, fabric crafts, digital media, and many more.

This unfolding model differs from the first two series of models because while digital space was initially used to design and laser cut the basic shape, many planes were hand-cut and repositioned to different edges to allow for more flexibility when refolding them. The planes are allowed to fold in both directions, offering variability of form and function, the potential for unique join conditions, and begins asking the question of surface materiality. This series of modular models additionally includes scale figures to better appropriate the scale of the design and how the unfolding surfaces could be used.

CHAPTER 6
CONDITIONS

Conditions define decisions. There are no sites without conditions, just as there are no conditions without parameters and existing contexts that inform design. Conditions occur at varying scales, at varying densities; yet they lead back to an initial distinguishing factor that makes it a reoccurring condition.

Conditional Design by Anthony Di Mari[48] builds from a series of operative verbs meant to spark architectural inquiry and volumetric design and introduces scale and spatial qualities that develop conditions and methods of design.

"Spatially, the conditional is the result of the operative. As one manipulates volumes with operative verbs, different spatial conditions start to emerge."[49]

While this book discusses what could happen through volumetric manipulation, what if the volume being manipulated was a void? What if the operative was a result of the conditional? Can the same operative verbs be applied to a condition that already exists? Can an existing condition inform what operative verbs are used to change this condition? What happens when social and programmatic conditions converge with this existing condition, and what operative verbs can be derived from this intervention? Can direct human interaction and manipulation of objects transform this existing condition into a dynamic public space?

[48] Di Mari, Anthony. 2018. Conditional Design. 6th ed. BIS Publishers.

[49] Ibid.

6.1 The Urban Void Condition

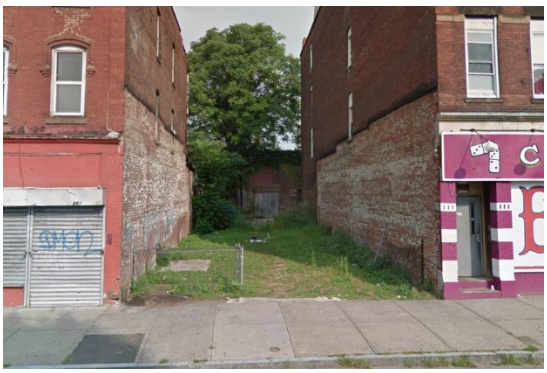


Figure 27. Dormant Urban Void

Figure 28.Extreme Urban Void

This project is not sited to one location – rather a common urban condition is explored as a public space that can be used as an opportunity for community engagement and design intervention. The specific condition explored in this thesis is the urban void, the result of a demolished building within a dense built environment. In an article published by the Karlsruhe Institute of Technology,[50] it is stated that "urban voids are all areas in a city, whose functions and designs have not yet been decided upon conclusively. These areas do not fulfill any concrete function in the urban system." The leftover, vacant lot is not a new urban condition, yet it is informative of physical and socioeconomic conditions and remains common within urban contexts. The condition itself is not unique; however, the discarded space creates opportunities to encourage an exploration of limited space

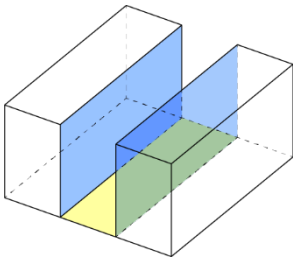


Figure 29. The Urban Void Condition (above), Abstracted Diagram (below)

[50] "Urban Voids—Recoding Functionless Areas In A City". 2015. *Phys.Org*. https://phys.org/news/2015-11-urban-voidsrecoding-functionless-areas-city.html.

through processes such as community engagement. The Urban Void Condition exists at varying scales and intensities; occurring as an indiscriminate and dormant void, as an extreme reoccurring condition that leaves holes in dense neighborhoods, or somewhere in between (figures 27-28).

At its most abstract, the Urban Void Condition is a horizontal plane abutted by mirrored vertical planes (figure 29). This condition gains complexity with its individual traits. With each condition comes characteristics and demographics that are unique to their physical locations. The Urban Void Condition thus becomes a passive public space. It remains present in the urban environment, yet empty of meaning, function, or place. Urban Rock Design, an urban art and architecture design firm, states this type of conditions as: "The public spaces of urban neighborhoods [that] are stripped bare. The blankness makes them public, the margin to be inscribed."[51]

The Urban Void is a residual condition. It is a leftover space that is no longer used as it was originally intended. These spaces contain remaining indications of what used to be there, such as the phenomenon known as "ghost architecture"[52] in which a pattern is left on the side of a building showing evidence of the building that used to be there. These ghost patterns typically depict the past locations of doors, stairs, windows, walls, structure, etc.

---

[51] "Finding Public Space In The Margins | Urbanrock Design". 2014. Urbanrockdesign.Com. https://urbanrockdesign.com/finding-public-space-in-the-margins/finding-public-space-in-the-margins-concepts/#main.

[52] Kohlstedt, Kurt. 2020. "Urban Ghosts: Remnant Stories Of Building Demolition & Graffiti Removal - 99% Invisible". 99% Invisible. Accessed January 15. https://99percentinvisible.org/article/urban-ghosts-remnant-stories-building-demolition-graffiti-removal/.

Each urban condition contains characteristics that further define physical, social, and programmatic conditions that inform new program and potential community engagement.

6.2 Physical Conditions

The physical conditions of the Urban Void Condition include an array of existing and leftover elements that can begin to inform new modes of design and spatial organization. For buildings such as row houses or other densely built urban environments, lots range in size. However, the typical sizes of these urban lots were historically planned to be a minimum of 20ft in width by 90ft to 100ft in length.[53] In New York City, urban lots are generally 25ft by 100ft.[54] Existing buildings within this condition can range from roughly 20ft to 60ft in height. This narrow lot presents its own challenges for architectural design, but as time passes, some buildings may be demolished and leave an empty, unoccupied space. This space, although limited, creates interesting opportunities for engagement that can utilize spatial context and physical characteristics to inform design.

Most buildings in cities that are a part of the Urban Void Condition are made of brick, and the remaining facades within the empty space typically have remaining

---

[53] "Row Houses". 1964. American Planning Association. https://www.planning.org/pas/reports/report164.htm.

[54] Howe, Richard. 2012. "Notes On 19Th Century Lot Sizes — The Gotham Center For New York City History". The Gotham Center For New York City History. https://www.gothamcenter.org/blog/notes-on-19th-century-lot-sizes.

evidence of what used to exist there. “Ghost Architecture” is an architectural phenomenon in which patterns of a demolished building remain on the face of a building it used to be adjoined to. These remnants can include structure, stairs, doorways, floor plates, etc. If there were to be an architectural intervention in this leftover space that utilizes this leftover surface, it is possible that this Ghost Architecture can inspire new design. Volumes or structures intended to attach to these faces may use these imprints as volumetric design inspiration or for placement opportunities. Some have even used the building remnants as canvasses in which to inscribe playful artwork

Figure 30. Ghost Architecture

featuring typical home furnishings.

Other physical conditions that could impact design within this empty space include geographical location and site orientation. Whether the site receives natural daylighting or is completely in shadow, one could respond to these conditions through architectural design. Climate should be taken into consideration as any construction that goes into these places must account for the varying weather and temperature patterns that exist throughout the year. Vegetation, while a result of time, is also a result of climate and solar orientation, which can inform what type of program can be implemented into the Urban Void.

The density at with the Urban Void Condition occurs, in concurrence with the greater context of these urban environments, is informative to what program and who will be interacting with the site. The varied reoccurrence of this condition is also informative of economic conditions, social environments, and levels of decay.

6.3 Social Conditions

Social conditions are conditions that involve people, the most important factor when designing for community engagement within a built environment. Population density matters, as well as how often the streets that the Urban Void Condition exists on is utilized by pedestrian traffic. City demographics are informative of age groups: children, young adults, adults, or elders, and what areas are most used by which group. The differences between quieter residential streets and busy commercial blocks can be addressed by implementing varying levels of engagement and programmatic decisions that work best with the social and physical context.[55]

6.4 Programmatic Conditions

Immediate built context, such as homes, stores, restaurants, gas stations, or other businesses can be helpful in determining what site is best to use and what it could be used for. There are programmatic conditions within urban settings. A location with an empty space between buildings may be near a park or playground, therefore this

---

[55] " A Public Surface: Finding Space in the Margins | Mark Robbins; Kim Shkapich; Jeanine Centuori; Norman Millar". 2003. Hollywood, CA : Center for Community Research and Design at Woodbury University.

leftover space could serve as an extension for this greenspace and bring more activity into the underused areas. If the condition exists near where food trucks often park along streets, the space could become a place to gather with others to eat and sell food. Social activity can directly inform program and offers how best to implement semi-permanent community engagement projects into a public realm.

When thinking about programmatic conditions in urban environments, one must think about what new program could be defined based on these existing conditions? What could these leftover spaces be used for, and what could they become or inform in the future? Can they be claimed for conversation, play, lounging, making, performing, or gardening? How can the community be engaged within this empty space, and what can they create?

6.5 Urban Site Activation

Figure 31. AAA, Urban Agriculture, 2009 (left) • Stephen Holl, Storefront for Art and Architecture, 1993 (middle) • Atelier Bow-Wow, BMW Guggenheim Lab, 2011 (right)

The Urban Void site condition has enormous potential for community engagement and activation. There are many key case studies to explore and develop strategies for urban site activation. The case studies shown in Figure 31 are places that reactivate leftover spaces for catalytic community development, using temporary

installations to inspire future projects and community engagement. These places attract members of the community to participate in events and activities, they reclaim underutilized spaces for creative pursuits and education, as well as support local businesses.[56]

6.6 Converge

Therefore, the idea of the Maker's Module, when combined with the Urban Void Condition, can be developed into an Activated Urban Makerspace within the limited space of this conditional site.

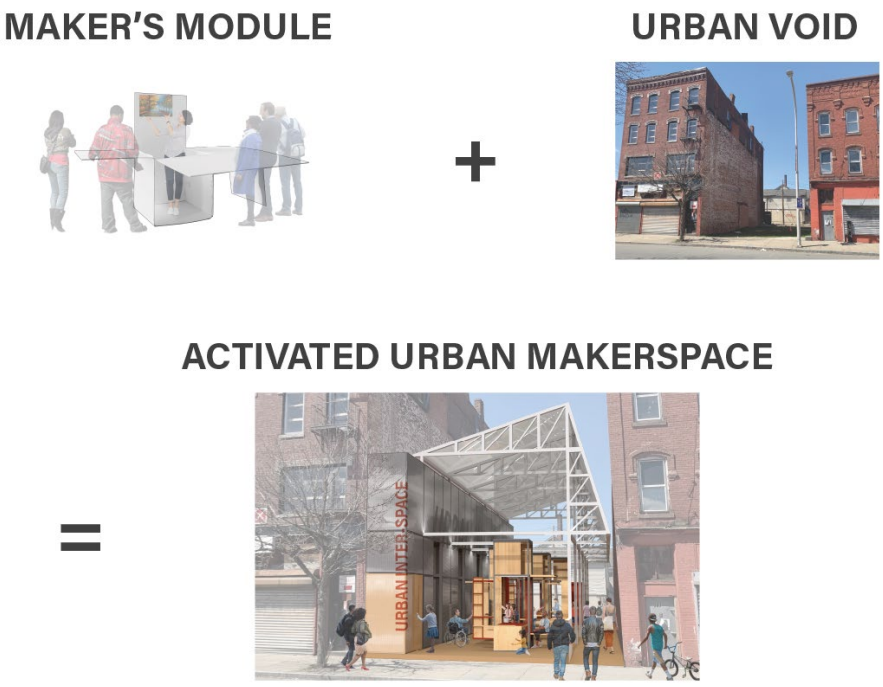


Figure 32. Convergence Equation

[56] AAA. 2020. "R-URBAN". Accessed April 23. http://r-urban.net/en/press/.

CHAPTER 7
CONVERGENCE

When the three concepts (Adapt, Protect, Contain), and the three engagement lenses (Transformative, Responsive, Interactive), converge in coalition with the idea of the Maker's Module and with the Urban Void Condition, the result is an Activated Urban Makerspace. It is within this activated space in which form and function become challenging factors between the interaction of humans and architecture, and the interaction of social and physical context, to create a place that engages the people of urban communities and become a catalyst for future community developments.

The Urban Void Condition, with its many physical, social, and programmatic factors to consider, can become a place in which small, modular structures are created to respond to all of these conditions of design. These catalyzing spaces will focus on the interaction between the user and the object through physical shifts in the built environment that allow the users to alter the function in response to their individual needs.

7.1 Specifically Generic

Convergence by Kiel Moe is about what happens in design when three major principles—materials, energy systems, and amortization—converge. When these factors converge in architectural design, the resulting building is a complex and high-performing system that treats the mechanical workings of a building with the same respect as the program. This is the main subject of the third chapter in the book, titled: *Specifically Generic Architecture: Convergence as a New Program for Architecture.*

The chapter describes designing architecture that is thoughtful enough to be "specific," while remaining "generic" to allow for future uses of architecture to evolve with a minimal impact on the environment and a maximal impact on next-use functionality. However, the specifically generic ideology can also be directly applied to current-use functionality and can begin to question how it can operate as changing function and program while remaining generic in the sense of modular design.

It can be argued that the Urban Void Condition is a specifically generic condition, as its reoccurrence in urban contexts and its simple parameters are generic, while the specifics rely on other physical and social conditions that occur more circumstantially based on location.

Moe states, "A specifically generic program for [architecture] anticipates possible next-uses while designing current uses."[57] This philosophy pushes preservation further by creating a basis for the program of a design to shift over time and allow changing functions to adapt to the same conditions. The Urban Void is an existing condition that can influence the generation of current and next-use functionalities.

Mónica Ponce de León's lecture at UMass Amherst in the Spring of 2019 included an insightful segment about next-use architecture. She talked about the design of a single-family home called the Lover's Lane Residence,[58] which explores the

---

[57] Moe, Kiel. Convergence: An Architectural Agenda for Energy. London: Routledge Taylor & Francis Group, 2013.

[58] Ponce de León, Mónica. 2020. "Lover's Lane Residence — Mpdl Studio". Monicaponcedeleon.Com. Accessed January 6. https://monicaponcedeleon.com/Lover-s-Lane-Residence.

relationship between the long life of structures and their inevitable changing of function. Simultaneously within the framework of a three-bedroom, single-family home design, is the thoughtful potential for how it can transform over time. Ponce de León chose to design the plan of this house so that in the future it could be split into apartment units to rent to tenants. Each bedroom has access to the outside, ample daylighting and a walk-in closet that is designed to be the exact size of a small kitchenette, allowing for the future use of this space to be predetermined. This is a good example of specifically generic architecture, by using the present to plan for the future.

Moe explains the idea that the constants and variables in architectural design are bound to invert in productive ways. Continuing to use Mónica Ponce de León's Lover's Lane Residence as an example, the closets can be considered both a constant and a variable, in which the function of the closet remains constant until a new use is determined, to where it temporarily becomes variable for its conversion into a kitchenette, and then returns as a constant with its new function.

The Maker's Module is both a constant and a variable. They close up as modular, static objects, and become constants within their default conditional environment. They become variables as they are activated and transformed into new, productive objects for pure human interaction and function. They are variable because they can be organized in a variety of ways, and these varying layouts change how the space can be perceived and how the space can be used. Each module contributes to this variable space, until they return as constants.

In reference to how these constants and variables can invert in productive ways, constants can become variables and reiterated, but can only be returned in a singular way. The Maker's Module starts and ends the same: closed up. They begin as constants, transform into variables, and return back as constants. However, the transition phase between constant and variable is what makes the difference. The module does not have to be fully opened to be activated, it only needs to be opened to where it fits the intended function. Therefore, any step in which the module is transforming, its state as constant and variable is continually shifting. If a function of the module is determined simply by performing one operation, it in itself is variable, but in its useful state that is serving that function, it remains constant.

Throughout the chapter, Moe wanted to make it clear that specifically generic (or "precisely vague" as he also puts it) does not mean architecture should be designed with too much simplicity or lack of imagination, nor does it have to be bland or boring. On the contrary, Moe believes that architects need to be as thoughtful about the future program as much as they are thoughtful about the current program. Moe often states that contemporary architecture is over-programmed, and that this limits design ambition and is in the long run, very unsustainable since this makes for the adaptation of inevitable future uses harder and more negatively impactful. However, by granting architecture the ability to serve many functions as a variable network, this problem could be solved. He says that contemporary architecture follows too much in the footsteps of Modern architecture, in which "new uses and new technologies were

viewed as enablers and determinants of new forms and architectures."[59] This brings up the term "form follows function," a recurring and necessary theme explored in this thesis. Although it is said to be the fundamental basis of Modern architecture, this term is vague and misinterpreted. Louis Sullivan, an American architect of the 19th century, coined the term "form ever follows function," further explaining that "where function does not change, form does not change."[60] It is determined that it is not just the shape of a building or object that needs to adhere to the functional qualities it is designed for, but that architectural form must be capable of evolution when function inevitably changes. He explains that "form follows function" seems to portray that form should follow a singular function, but reminds readers that for architecture to be successful (through specifically generic design) form must follow *many* functions and not adhere to a single use, which results in wasted energy, money, and less opportunities for reuse.

Moe's use of explaining the philosophies and ideas of a variety of people is a great method to introduce and/or reiterate the main themes of his writing through the

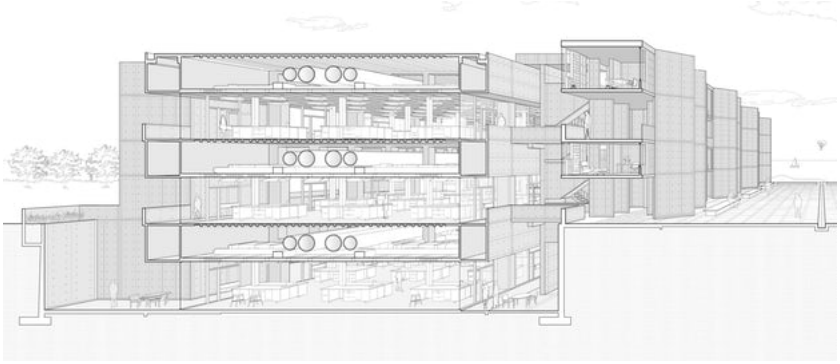


Figure 33. Louis Kahn, Salk Institute, La Jolla, CA 1965. from Manual of Section, 2016

[59] Moe, Kiel. Convergence: An Architectural Agenda for Energy. London: Routledge Taylor & Francis Group, 2013.
[60] Sullivan, Louis H. 1896. The Tall Office Building Artistically Considered.

perspectives of others. The whole chapter is essentially an architectural discourse about the current function versus the future function of architecture and whether it should be designed to adapt to the future or to adhere to the present, and the answer is both.

Moe believes that Kahn's Salk Institute for Biological Studies (figure 33) is the epitome of specifically generic architecture. The most compelling reason is Kahn's interpretation of architectural program. He treats both the required program and mechanical functions of the building with the same priority, insisting that the serviced parts of the building are of the same importance as what the building was designed for (biological research). He calls these different yet similar spaces a "laboratory for experiments" and a "laboratory of pipes." Kahn further explains,

"The separation of served and servant spaces is beautifully expressed at Salk, in that you have a laboratory for experiments and a laboratory of pipes which you can see downwards or upwards. This space is just as tall as the space where experiments are made. These rooms have large pipes that feed upwards or downwards. You walk into service these areas. They are just as important as the biological laboratories."

Since the served and servant spaces are treated with the same amount of care through design, the successful characteristic that makes the Salk Institute specifically generic is the uninterrupted laboratory work and uninterrupted maintenance work as a result. That is, both systems can work simultaneously without interruption by one or the other. This building was considered by Dr. Salk a "mesenchyme space," in which mesenchyme cells are the portion of an embryo that contains non-specific cells that

develop into other tissue and organ systems. This description is the perfect comparison of specifically generic architecture and the ultimate link between biological science and thoughtful architectural design.

However simple or complex, this way of architectural and philosophical thinking reinforces the primary goal of this thesis. Although dissimilar in scale to Kiel Moe's many examples, converging the thoughtfulness of specifically generic design with compact, dynamic architecture can become a catalyst for community development and adaptive reuse.

There are many factors in design that must be treated with an equal amount of respect. Form must be treated with the same respect as function.

CHAPTER 8
CASE STUDIES

The case study research for this thesis was an important and informative process. These case studies can be sorted into three subtopics that adhere closely to the engagement lenses mentioned earlier: Transform, Respond, and Interact.

8.1 Transform

This section of case studies is focused around projects about unfolding and refolding forms to inform new geometries, which involves the deconstruction and reconstruction of architectural objects.

8.1.1 "The Man Who Would Be Architecture"

Allan Wexler's works are a key inspiration for this thesis, as his projects explore human activity and the built environment. To accomplish his abstractions of reality, he creates small, human-scale objects that exist as useful objects while simultaneously questioning function and routine. Having worked in the fields of art and architecture for almost fifty years, he often aims to abstract reality and questions the line between the form and function of everyday objects, furniture, and buildings. His works tend to separate daily rituals that involve human functions and pose them as theatrical and experimental, while keeping his products close to the human body. For example,

Wexler's *Screen Chair*,1991 (figure 34)[61] exploits different parts of the human body by isolating the head, hands, and feet within separate boxes of a chair that is enclosed by transparent insect screens. In his own words: "flat rectangular planes clothe the body and isolate the various parts of the human anatomy."[62] It is representative of a front porch combined with the idea of a cocoon; *Screen Chair* can be transported, allowing the user to be placed within nature. Similar to this thesis' intentions, the chair is the architectural object, and nature is the condition.

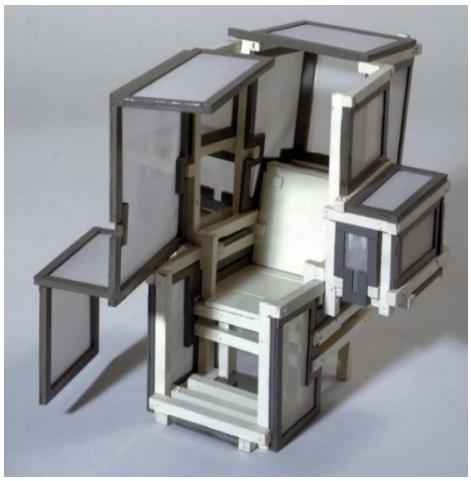


Figure 34. Allan Wexler, Screen Chair, 1991

In many of the projects described in this thesis, Wexler uses basic shapes that he expands beyond their inherent functionality. His philosophy of blending the boundaries between humans and interaction, practicality and abstraction, and architecture and theatrical performance, is perhaps what allows new ideas and innovation to thrive.

"He pulls apart the structures of our everyday life, plays with the materials out of which we construct our surroundings and our implements, and opens up new spaces within a world we thought we had defined." [63]

[61] Wexler, Allan. 1991. "Screen Chair". Allanwexlerstudio.Com. http://www.allanwexlerstudio.com/projects/screen-chair.
[62] Ibid.
[63] Wexler, Allan. 2020. "Biography". Allanwexlerstudio.Com. Accessed January 10. http://www.allanwexlerstudio.com/biography.

8.1.2 Chairs

Investigating the line between form and function, *Chairs*, 1998 (figure 35)[64] takes a generic form and questions its structure, shape, and size. Although the chair is a familiar object with a single function, abstracting its basic elements and re-working its

Figure 35. Allan Wexler, Chairs, 1998

makeup alters perception of how one sees and thinks about it, creating opportunities for new functions. In this series, Wexler's technique for taking a chair and reconfiguring its structural qualities allow it to unfold into its abstracted elements, and then re-fold into its original shape. This project explores the transitional phase from concrete to abstract, and how it goes back from abstract to concrete through unconventional methods.[65]

[64] Wexler, Allan. 1998. "Chairs". Allanwexlerstudio.Com. http://www.allanwexlerstudio.com/projects/chairs.
[65] Ibid.

8.1.3 Folded Houses

A product of experimentation and simple planes, like many of Wexler's other projects, *Folded Houses*, 1998 (figure 36)[66] explores shape and abstracted form to spark new ideas. In one of the many series of *Folded Houses*, he uses color to seemingly alter the perception of each plane that makes up the unfolded house. He represents the same unfolded shape ninety-nine times, but all with different color schemes, potentially meant to portray each unfolded piece with varying significance, or positive and negative

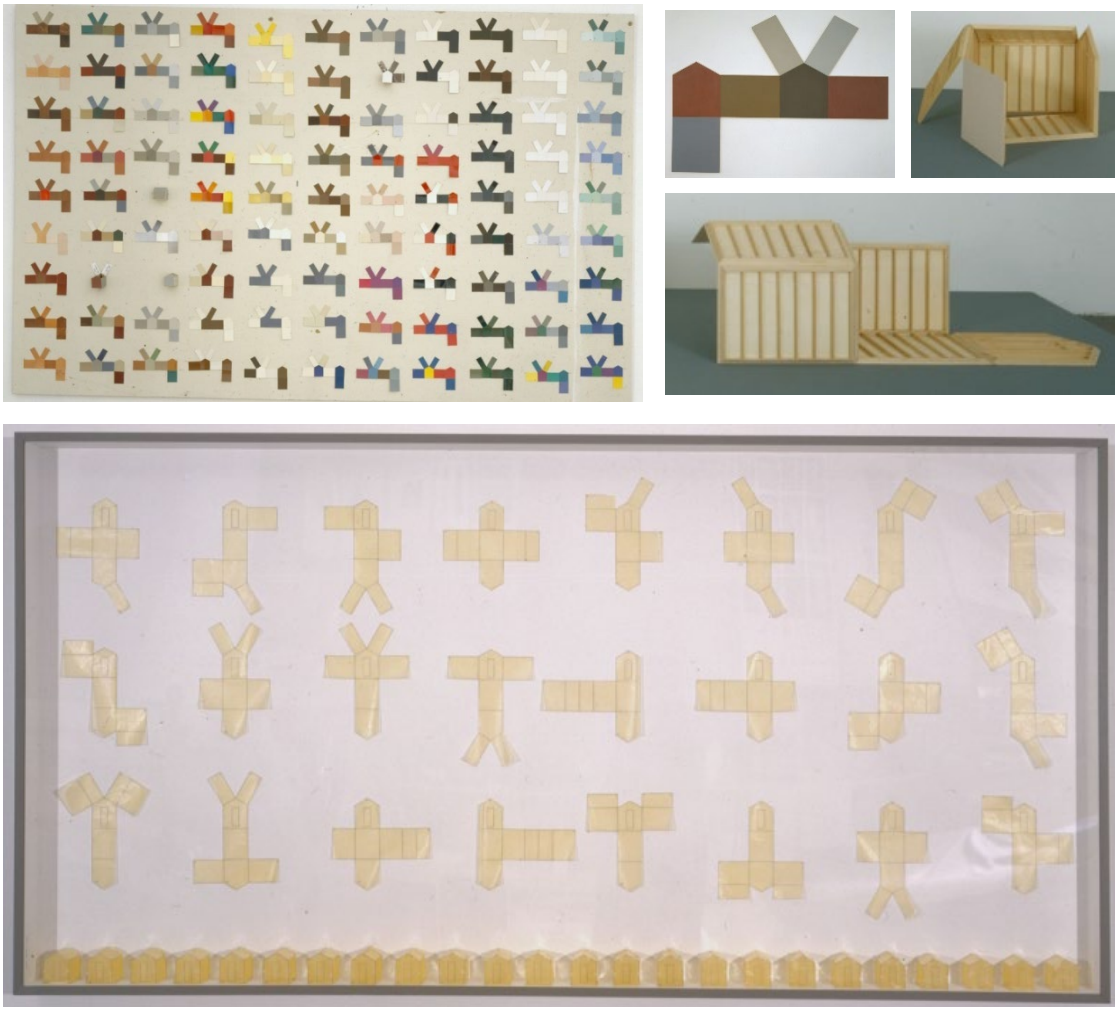


Figure 36. Allan Wexler, Folded Houses, 1998

[66] Wexler, Allan. 1998. "Folded Houses". Allanwexlerstudio.Com. http://www.allanwexlerstudio.com/projects/folded-houses.

space. In the most iterative part of this series, Wexler uses the most basic shape of a "house," and unfolds the three-dimensional shape's planes and re-folds them in different ways to generate varying spatial qualities. After unfolding, he re-situates the planes and attaches them to different edges, allowing the shape to be refolded into something new.

8.2 Respond

Case studies categorized has responsive are projects that explore compact functional spaces and introducing function to the form primarily explored in the previous section about transformation.

8.2.1 Little Office Building #2

Allan Wexler's *Little Office Building #2,* 1987,[67] retains its existing function as a small, modular object when in its closed state, but when opened, introduces a new

Figure 37. Allan Wexler, Little Office Building #2, 1987

[67] Wexler, Allan. 2020. Allanwexlerstudio.Com. Accessed January 14. http://www.allanwexlerstudio.com/projects/little-office-building-2.

function compacted within. Wexler's projects are known for being literal despite his tendency to abstract reality and question functional spaces. This project contains the components of a small office space within a tiny building. *Little Office Building #2* is a simple pitched roof structure when in its closed state and is roughly 3ft by 3ft wide and 6ft tall. It accommodates its limited functions in this state as a modular storage unit. In its expanded state, this project addresses new programs and a complexity of functions as a dynamic office space. The building is made up of four quadrants, each with a different function, and when combined creates a single shed-like form. A chair fits into its own compartment, a writing surface slides open, there are small cubby holes for office supplies, as well as hooks for hanging items. Wexler mentions that each of the four quadrants were built individually from each other without detailed measuring and were then fastened together with hinges and white slats of wood to combine it into a single unit.[68]

8.2.2 Crate House

Similar to *Little Office Building #2, Crate House*[69] is a project in which Allan Wexler compresses the necessary amenities of an entire house into an 8ft cube. *Crate House* combines four functions: a kitchen, bathroom, living room, and bedroom into a single dynamic unit that changes function when the user sees fit. The white cube, or the core, acts as the single living space for the inhabitant. The four crates that extend from

[68] Ibid.
[69] Wexler, Allan. 2020. Allanwexlerstudio.Com. Accessed January 14. http://www.allanwexlerstudio.com/projects/crate-house.

the core are isolated functions and are described by Wexler as "dioramas in an anthological museum."[70] When the function of one of the four crates is needed, that crate is rolled into the core, transforming the function of the core into whatever crate occupies the space. "At night the entire house becomes a bedroom and when the

Figure 38. Allan Wexler, Crate House, 1990

[70] Ibid.

occupant is hungry the entire house becomes a kitchen. The basic activities are pared down to essential artifacts needed and desired. Isolated they are sculpture; their use becomes theater."[71] This project exemplifies the theme of using physical operations to alter the form of a space and in turn alter its function.

8.3 Converging Themes

While the Allan Wexler projects are excellent examples of architectural objects that create a variety of functions through dynamic and compact design, the goal of this thesis is to explore what happens when this philosophy converges with community engagement in urban conditions. *Outpost*, *Storypod*, the *BMW Guggenheim Lab*, and *Finding Public Space in the Margins* discussed in the next sections, are examples of dynamic projects made for community engagement, in which these communities' benefit from their form-driven functions. Many of Wexler's projects are experimental and artistic, while the aforementioned community projects make use of experimental approaches and execute them into the public realm. What *Little Office Building #2* and *Crate House* both lack as case studies for this thesis is the connection to a site or condition in which people and communities interact with them. By introducing a condition to help inform the object's operability, function and form can change through human interaction. The Urban Void Condition explored in this thesis can inspire form, function, and the interaction required to create a dynamic public space. Through this

[71] Ibid.

interaction based on place and community, meaning can be established and therefore these projects can become catalysts for future community developments.

8.4 Interact

These case studies focus on the previous explorations of form and function and look at projects that engage the community with temporary installations and spaces that are intended to activate urban communities.

8.4.1 Finding Public Space in the Margins

Urban Rock Design, an art and architecture design studio based in Los Angeles, California, serves communities by celebrating the subtlety of urban conditions and

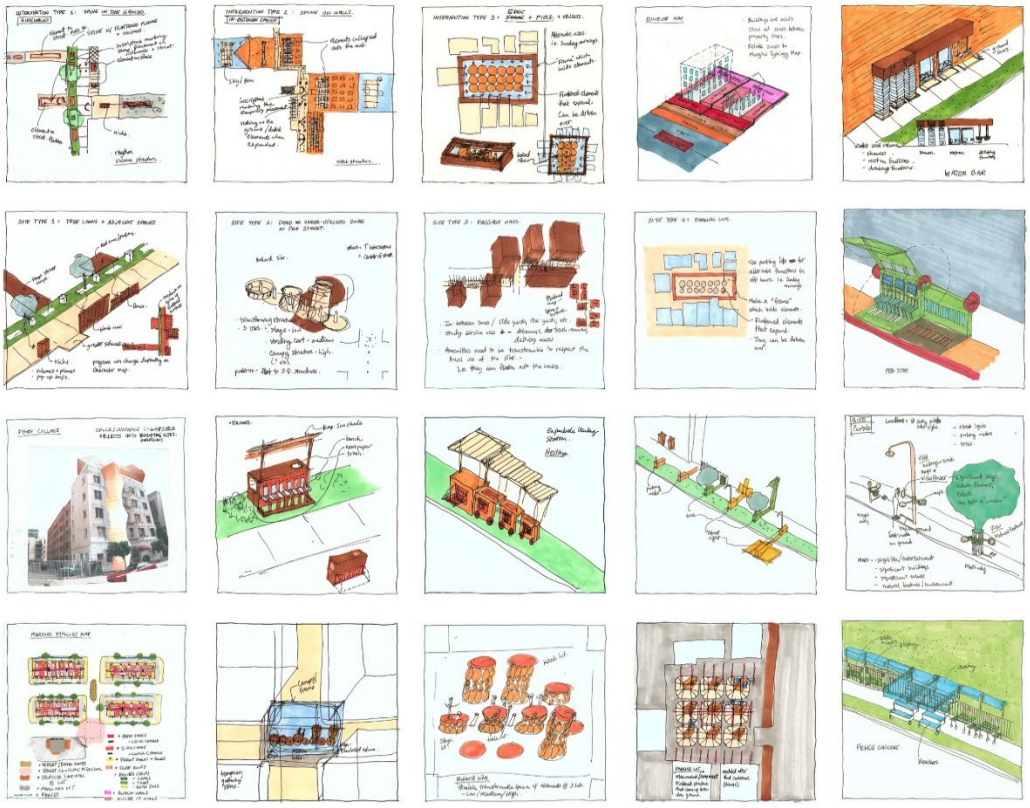


Figure 39. Urban Rock Design, Finding Public Spaces in the Margins. Sketches, 2003

creating connections of space. This thesis seeks inspiration from this design firm as their projects often "seek to transform the ordinary into moments of delight through transformation, appropriation, and reframing."[72] One project in particular hits all of these key points and is titled *Finding Public Space in the Margins.*

This project uses a framework of utilizing marginal spaces as sites (or conditions) as places for amenities and communities in order to form a collective public realm. Through the team's strategy of defining, refining, and redefining, the horizontal and vertical surfaces of an urban environment are extracted to document the opportunities for public intervention. Through this analysis of surface compilation, it was noticed that the bareness present in the vertical and horizontal orientations, such as surfaces and voids, became place. The firm sees these marginal urban edges and surfaces as catalysts for design proposals, and canvasses on which to incorporate into a new public realm. This project focuses on marginal spaces, which compares heavily to the Urban Void Condition discussed throughout this thesis as opportunities for inclusion into an existing urban fabric through art, design, and community placemaking.

The team for this project analyzed an existing vernacular for the urban environment they were working with, and began to juxtapose varying layers of public utilization, pedestrian activity, and the times of use of these marginal spaces. This cross-

[72] "About | Urbanrock Design". 2020. Urbanrockdesign.Com. Accessed January 10. https://urbanrockdesign.com/about/.

analyzation of data allowed the firm's exploration of hybrid programs, as well as the incorporation of expanded versus essential/individual needs posed by the community. [73]

As a result, a collection of features achieves variability and multiple functions through the expansion and the contraction of their proposed amenities. One can see the team's conceptual exploration of expanding and contracting amenities in Figure 39. Projects are often placed on building surfaces, small unused spaces, and street fronts that allow pedestrians to easily interact with them. This collection of objects were proposed to be placed within the marginal spaces of this urban community, and they serve many functions. A few of the following proposed projects for this urban planning project stand as firm examples of small structures built for the purpose of community

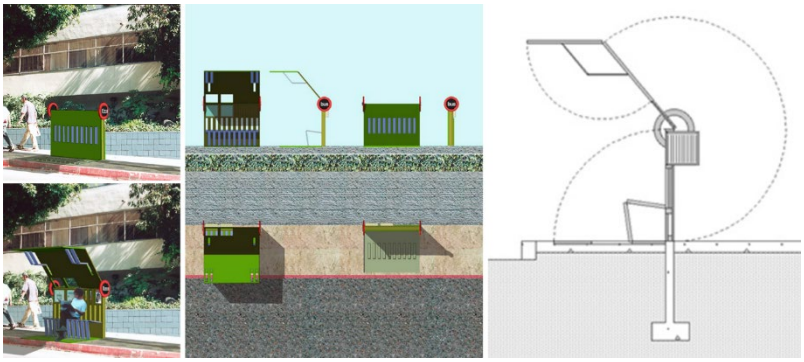


Figure 40. UrbanRock, Ped Stop (proposal), 2003
engagement and physical manipulation to change spatial qualities and functions.

Ped Stop[74] is mean to expand the notion of the bus stop and is situated on the small grass space between the street and the sidewalk. When unfolded, it becomes a

[73] "Finding Public Space In The Margins | Urbanrock Design". 2003. Urbanrockdesign.Com. https://urbanrockdesign.com/finding-public-space-in-the-margins/finding-public-space-in-the-margins-concepts/#main.

[74] "Ped Stop | Urbanrock Design". 2003. Urbanrockdesign.Com. https://urbanrockdesign.com/ped-stop/.

canopy and bench during the day. At night, it is closed into a thin object that has self-service kiosk functions. It contains interchangeable modules such as a pay telephone, newspapers, bus route maps, and community event announcements. When referring to the folded and unfolded phases of *Ped Stop*, the designers label the folded state as "closed," while they call the unfolded state "open and activated." By using this language, UrbanRock intends to portray that the object is not only unfolding into something new, but that it is also activating the street by allowing people to use it.

Another proposal in this project is called *Slim Stores.*[75] It is meant to address the unbounded areas of parking lots. A series of vertically oriented panels are situated here,

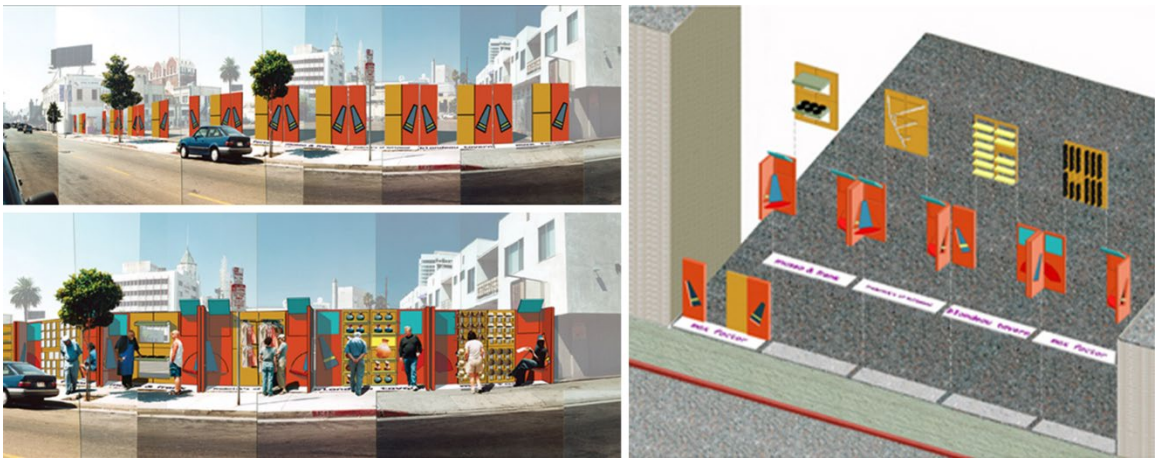


Figure 41. UrbanRock, Slim Stores (proposal), 2003

and when they unfold, they turn into "active business incubators."[76] These essentially become places for community members or local businesses to sell products and create an activated street front marketplace. The unfolded objects create seating and vending

[75] "Slim Stores | Urbanrock Design". 2003. Urbanrockdesign.Com. https://urbanrockdesign.com/slim-stores/.

[76] " A Public Surface: Finding Space in the Margins | Kim Shkapich; Jeanine Centuori; Norman Millar". 2003. Hollywood, CA : Center for Community Research and Design at Woodbury University.

areas for food, clothing, and artwork. While closed, the *Slim Stores* still define the boundary of the parking lot.

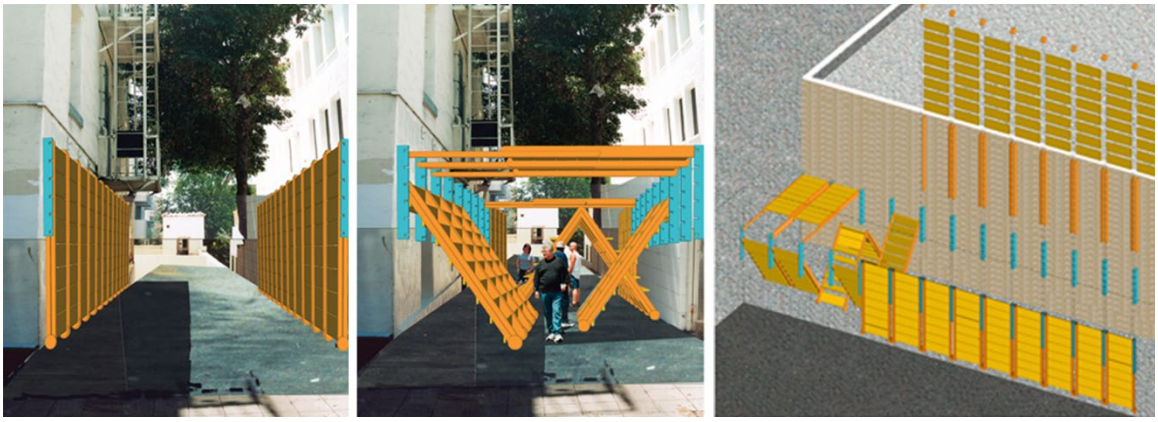


Figure 42. UrbanRock, Lean-To (proposal), 2003

Lean-To,[77] is a project in which structures are installed against the corridor of exterior walls between two buildings. There are pivoting rails attached to the building to allow for the structures to slide down and out and become support for planes that can be positioned as shelves, hanging panels, or seating. The site used in this project is very similar to the Urban Void Condition. It is an exploration of the limited space between buildings, and how the addition of changeable structures encourages community engagement in public areas, even if people are just passing through. There is a dynamic between the open and closed states of this project. When closed and tucked away, the elements add new color and texture to the existing building walls and reverts the space to its original function: a service alleyway between buildings. When open and activated, the potential for changing space and function emerges, creating art galleries, marketplaces, seating, and more. "In their closed or compact state, they accommodate their limited existing functions; in their expanded mode, they address new programs." [78]

8.4.2 Outpost

The Studio for Urban Projects is a design collaborative that combines urbanism, architecture, art, and social activism into their work. They aim to provoke change by altering the perceptions of the city and the design of urban landscapes, and how community engagement encourages dialogue of urban conditions.[79]

Their project *Outpost,* 2015, is intended to explore new ways of inhabiting urban environments through the combination of prefabricated architecture and public programming. This temporary street pavilion is meant to be installed and iterated to take on various structures and forms. In doing so, the pavilion's function can be changed to encourage new acts of interaction and community engagement. Rotating walls, changing structure, and gathering spaces create place for community events such as radio broadcasts, planting workshops, entertainment, book-sharing, and more.

Figure 43. Studio for Urban Projects, Outpost, 2015

Outpost can also be dismantled and rebuilt, either as a pre-existing form or a new one. While this project is functional because of its iterative structure, it also gives

[77] "Lean-To | Urbanrock Design". 2003. Urbanrockdesign.Com. https://urbanrockdesign.com/lean-to/.
[78] "Finding Public Space In The Margins | Urbanrock Design". 2003. Urbanrockdesign.Com. https://urbanrockdesign.com/finding-public-space-in-the-margins/finding-public-space-in-the-margins-concepts/#main.
[79] "The Studio For Urban Projects » About Us" . Studioforurbanprojects.Org. http://www.studioforurbanprojects.org/about/about-us/.

the public opportunities to participate in processes through interaction and feedback that will help shape the future of the street. “It provides the public an experience of these changes in advance of their longer-term adoption and becomes a critical step in learning what works and what does not.”[80]

The Studio for Urban Projects has created Outpost as a system that engages communities and allows them to explore the broad questions that affect cities and the possible solutions to urban issues. Solutions based on iterative form and function can be implemented into conditions such as the Urban Void Condition, in which the leftover space between buildings becomes a place for creativity, learning, and making, establishing place and meaning for future communities to engage with and create new, dynamic environments within the urban fabric of underserved neighborhoods.

[80] Ibid.

8.4.3 Storypod

Figure 44. AKB, Storypod, 2015

Atelier Kastelic Buffey, or AKB,[81] is an architecture firm based in Toronto with a quest to capture the poetic qualities of space through the prioritization of detail, vision, and conceptual intent. Many of their projects are meant to merge building and landscape into a harmonious experience, "transforming the ephemeral into the tactile."[82] Their collaborative and community-based project, *Storypod*,[83] accomplishes these ambitions as a striking architectural object that roams around urban areas for people to engage with. Similar to Urban Rock's philosophy for *Finding Public Space in the Margins, Storypod* accommodates its limited functions in its closed state, and addresses new program in its expanded state.

[81] "Akb — Studio". 2020. Akb. Accessed January 14. https://akb.ca/studio/.
[82] Ibid.
[83] "Akb — Story Pod". 2015. Akb. https://akb.ca/projects/story-pod/.

Storypod is a community-supported lending library with the intention of engaging the community of Newmarket, Ontario. It acts as a hub, sited in the heart of the town's historic district, offering a contemporary vision to the community through public interaction. The 8ft by 8ft dark object expands from compact state to reveal a warm, wood-clad interior. Two out of four walls slide open to provide seating and showcase bookshelves for the public to share. Ample daylighting is provided by its open structure and transparent enclosure. *Storypod* creates opportunities for learning, socialization, quiet contemplation, and shelter. At night, the pod reverts to its compact state; yet concealed lights powered by solar panels on the roof allow the pod to glow and offset its dark-colored exterior. The resulting glow creates ambient light for night markets or other community events, or simply as an engaging piece of public art.[84]

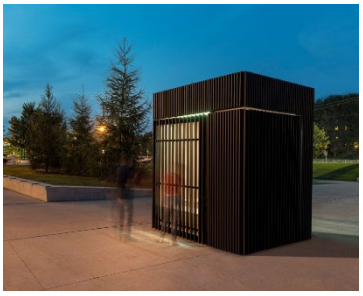
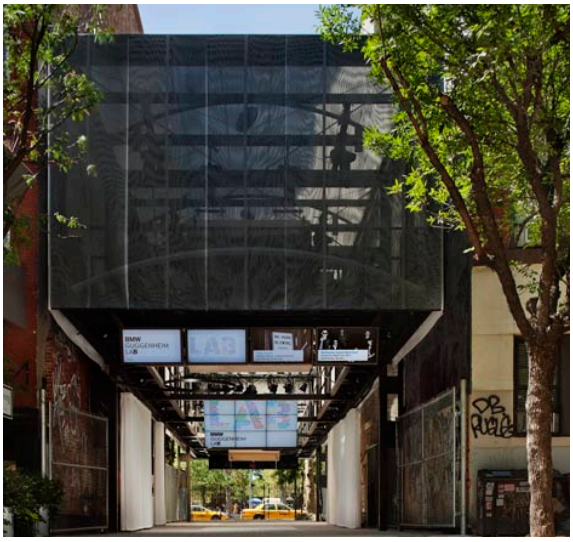


Figure 45. Storypod at night

8.4.4 BMW Guggenheim Lab

Atelier Bow-Wow is a Japanese architecture firm that is known for micro-architecture, cultural projects, and the exploration of urban conditions and ad-hoc

[84] Ibid.



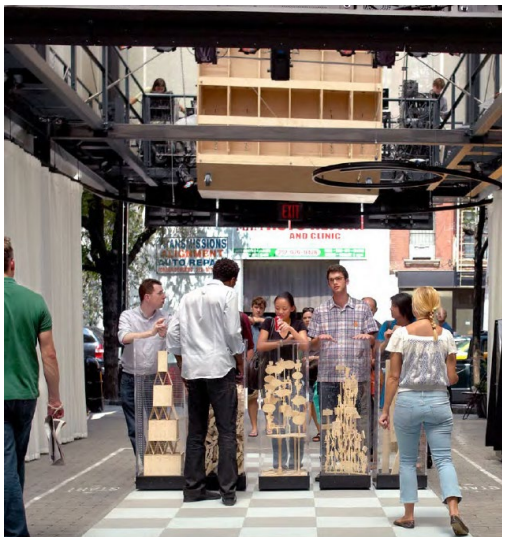


Figure 46. BMW Guggenheim Lab, 2011

architecture.[85] The *BMW Guggenheim Lab*[86] is a lightweight structure that was first built on a site similar to the Urban Void Condition, between two buildings in a limited space. The elevated structural framework is simultaneously heavy with its dark color floating over a variable workspace, and light with its semitransparent screen cladding. It shelters a space between two buildings, open on either short end of the site. The structural framework is rigged with mechanical, electrical, and lighting equipment to provide for a multitude of creative activities that happen on the ground level.

An interesting fact about the BMW Guggenheim Lab is its temporality. While originally situated between two buildings, its light structure is built to be deconstructed and reconstructed in other parts of the world. It was part of a six-year tour, where it was

[85] "Atelier Bow-Wow | Designboom.Com". 2020. Designboom | Architecture & Design Magazine. https://www.designboom.com/tag/atelier-bow-wow/.

[86] Frearson, Amy. 2020. "BMW Guggenheim Lab By Atelier Bow-Wow | Dezeen". Dezeen. https://www.dezeen.com/2011/08/04/bmw-guggenheim-lab-by-atelier-bow-wow/.

transported to places like Berlin and Mumbai. These places become mobile studios for talks, exhibitions, screenings, workshops, games, and more. During its travels around the world, different themes are applied as cycles, each with their own design of mobile structure. Each structure was moved to different locations that tackled local communities to raise awareness of issues, generate ideas for each urban situation, and engage with sustainable and innovative designs in order to yield lasting benefits for the cities it travels to.[87] In other words, it became a catalyst for future community developments by engaging urban spaces.

[87] Ibid.

CHAPTER 9
URBAN INTER-SPACE: CONVERGENCE OF HUMAN INTERACTION & FORM

9.1 The Maker's Module

Figure 47. The Maker's Module - First Paper Folding Experiments

The Maker's Module is a result of the paper folding experiments discussed in Chapter 5, in which the three concepts (Adapt, Protect, Contain), the three Engagement Lenses (Transform, Respond, Interact), and the program of a makerspace combine as a solution for how the convergence of human interaction and form can activate underused spaces and catalyze future community developments. It is an adaptive object that responds to human interaction through form manipulation. The Module's earliest design began at a 3'x3'x6' scale, meant to cater to the size of an average human body. It primarily uses the exterior surfaces to unfold, pivot, rotate, and slide to generate new function through these standard operations. While it can be used as a singular workspace, it can transform into many dynamic workable surfaces that when placed in the context of an urban neighborhood, can become a makerspace for members of the community to pursue the creation of art and other projects.

9.2 Designing the Module

The early paper folding models were translated as digital models in the next step of design. The focus of this development was to experiment with the pattern of the unfolding surfaces and how people could interact with the resulting forms.

Figure 48. Digital Progression of Module

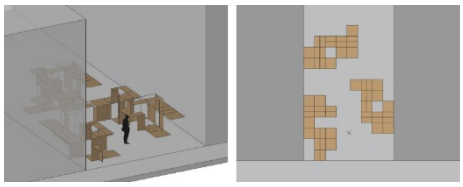


Figure 49. Spatial Organization

The unfolded modules were then brought into the Urban Void site to experiment with spatial organization. The scale of the module was changed to 4’x4’x12’, which is a better scale for more comfortable human use. The structure of the module is divided into an 8’ tall usable space, and a 4’ tall space above that is intended to increase height and visual interest. The horizontal structure at the 8’ height is the highest point of usable space, as an average 6’ tall person can reach up to 2’. The implementation of more specific program allowed for more detailed digital models, in which three types of makerspace program were applied: sewing, woodworking, and painting (figure 51). These iterative models used operations to shift the exterior panels such as pivoting, folding, hinging, and sliding.

Figure 50. Module Final Scale: 4'x4'x12'

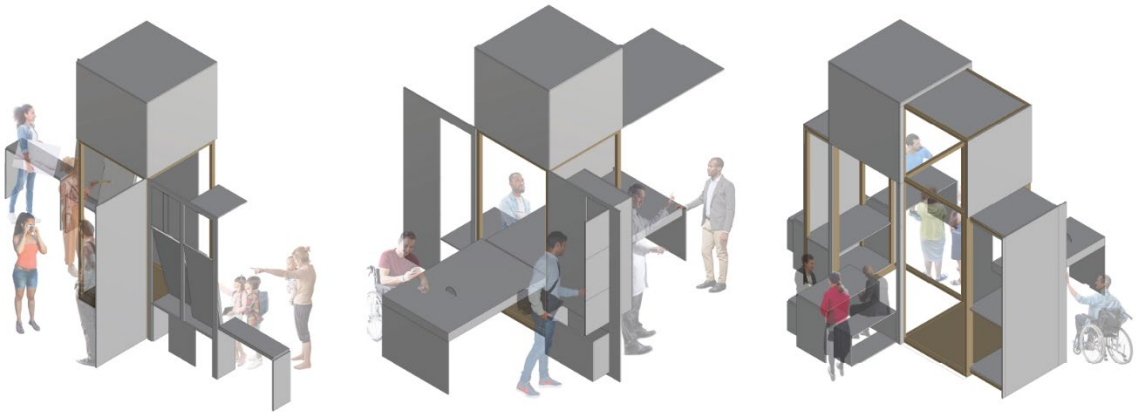


Figure 51. Iterative Modules with Applied Program

Figure 52. Early Working Model

In order to begin understanding the restraints and construction of operations within the module, a working model was built to contribute to the design process (figure 52). This model proved the importance of building by hand for this type of design, even at a scale smaller to its intended size. This method of hands-on problem-solving informed the constraints of designing a small, foldable object, and led to a more developed design.

9.3 Developing the Module

Figure 53. Developed Working Model

By taking into consideration the physical characteristics and surfaces that are needed for the different types of program explored throughout the iterative design process, a single module can be developed to adapt to a variety of functions. This combines the more specific program requirements to create a more generic module that has the ability to transform and adapt to a variety of program. Figure 53 shows a more developed working model that used key operations to simplify the operations of unfolding panels to generate horizontal and vertical surfaces that can be applied to multiple functions. The key operations used in this design are the horizontal pivot and the vertical pivot (figure 54). These operations can create panels that rotate along horizontal and vertical axes that are not tied to the edge of the material. These simple operations allow for the design of horizontal panels that can be used as work surfaces at varying heights chosen by the placement of the pivot axis, as well as vertical pivoting panels that generate a dynamic design through simple operation.

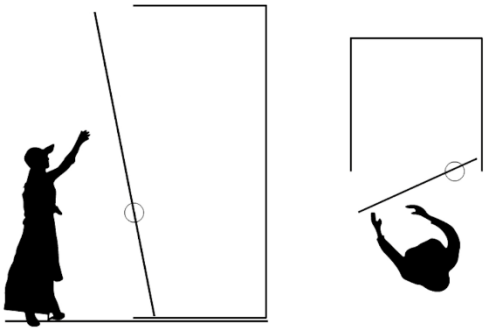


Figure 54. The Horizontal Pivot (left) and the Vertical Pivot (right)

9.4 Flexible Operability

An important part of designing the module was to take into consideration the variable human interaction that could take place. In an effort to experiment with the developed Maker's Module design, exploring how the module could adapt to different functions was a significant step. These iterative renderings include four types of makerspace program that could be applied (figure 55).

Figure 55. Flexible Operability Renderings. Sewing (top left), Woodworking (top right), Artist Studio (bottom left), Digital Media (bottom right)

The programs applied to the modules to represent flexible operability are sewing, which can become a place for people to repair and sell clothing, an artist's studio and gallery space for public exhibitions and to promote the sale of local art,

woodworking to build functional objects and make crafts, and a digital media and fabrication lab that explores 3D printing, coding, or virtual reality.

9.5 Maintaining the Engagement Lenses

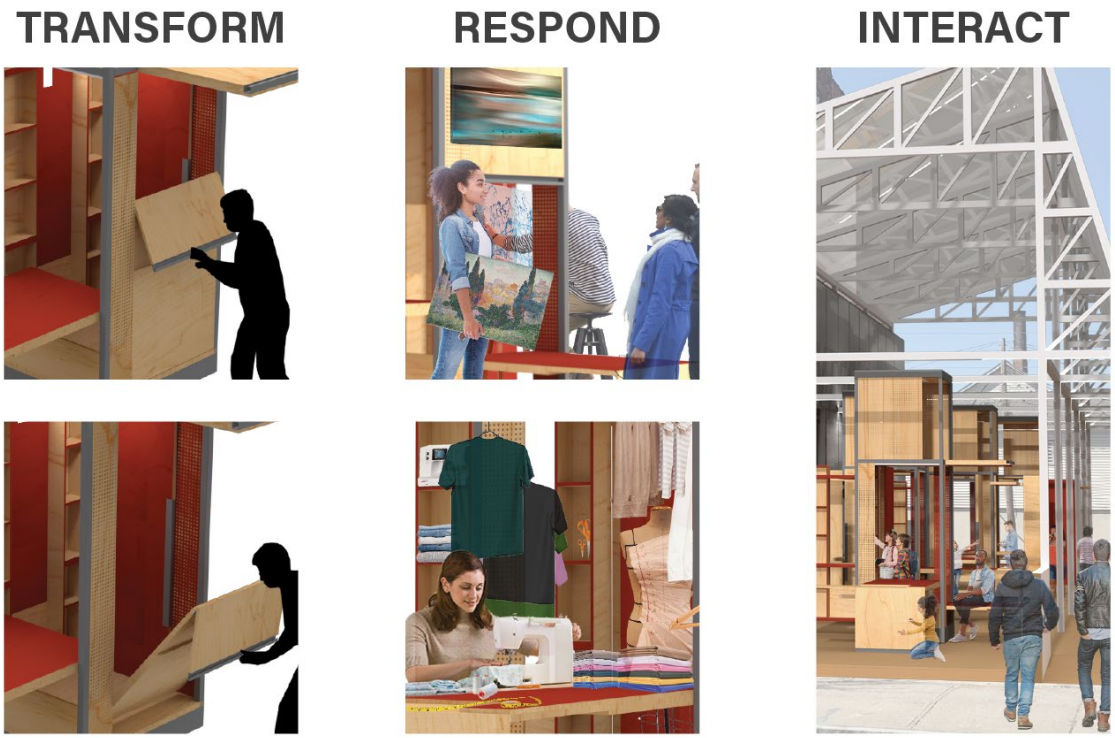


Figure 56. The Engagement Lenses

To maintain the conceptual framework developed earlier in this thesis, it is important to relate back to the three Engagement Lenses, which are important characteristics to consider when designing interactive architecture in urban contexts. In order for the module to exemplify the convergence of human interaction and form and activate underused spaces in urban communities, the design should be able to transform from one form to another through human operation, people should be able to respond to the transformations with a flexibility of uses, and it should invite the community to interact with this space to become a catalyst for future community developments.

9.6 The Urban Inter-Space Module

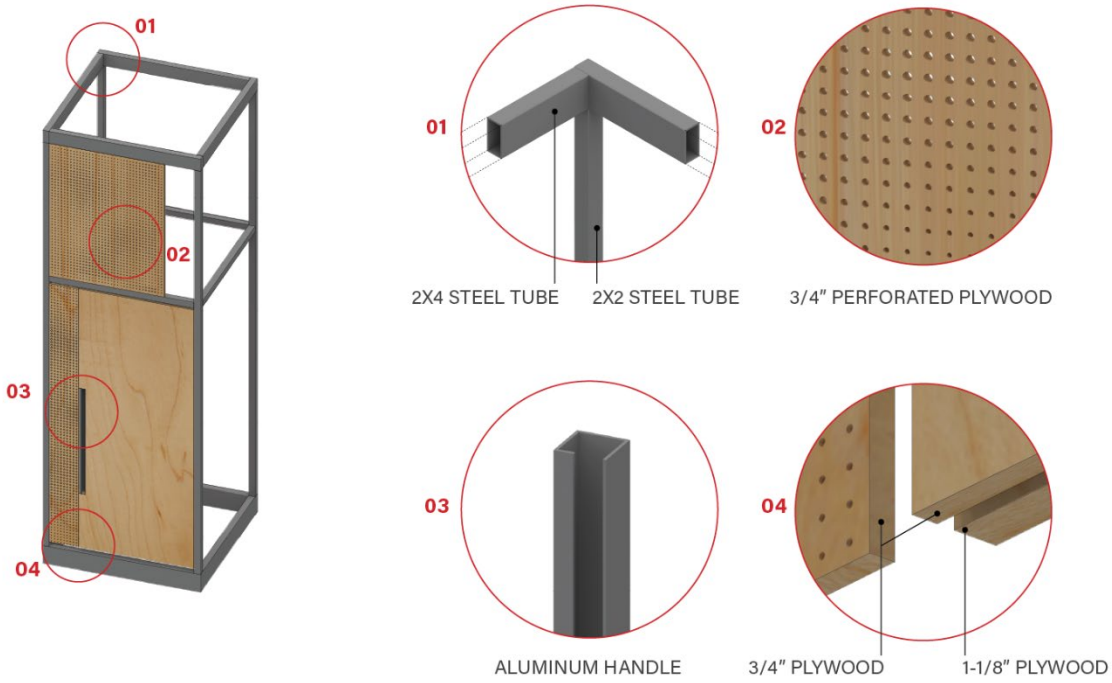


Figure 17. The Urban Inter-Space Module Design Components

The Urban Inter-Space Module is a four-by-four-by-twelve-foot module containing both static and operable panels that when manipulated, introduce new function as it is opened. It is constructed of 2x2 and 2x4 steel tubes, and the panels are made of plywood. The operable panels are roughly 2 inches thick, layered with one 3/4-inch sheet and one 1-1/8th-inch sheet. The static panels are 3/4-inch sheets that are perforated to help express the difference between the operable and static panels, but also to create interesting light effects and

Figure 58. The Urban Inter-Space Module, closed

sometimes act as a peg wall to hang items. The final design in its closed state (figure 58) features a hierarchy of material and exposed structure that is representative of its series

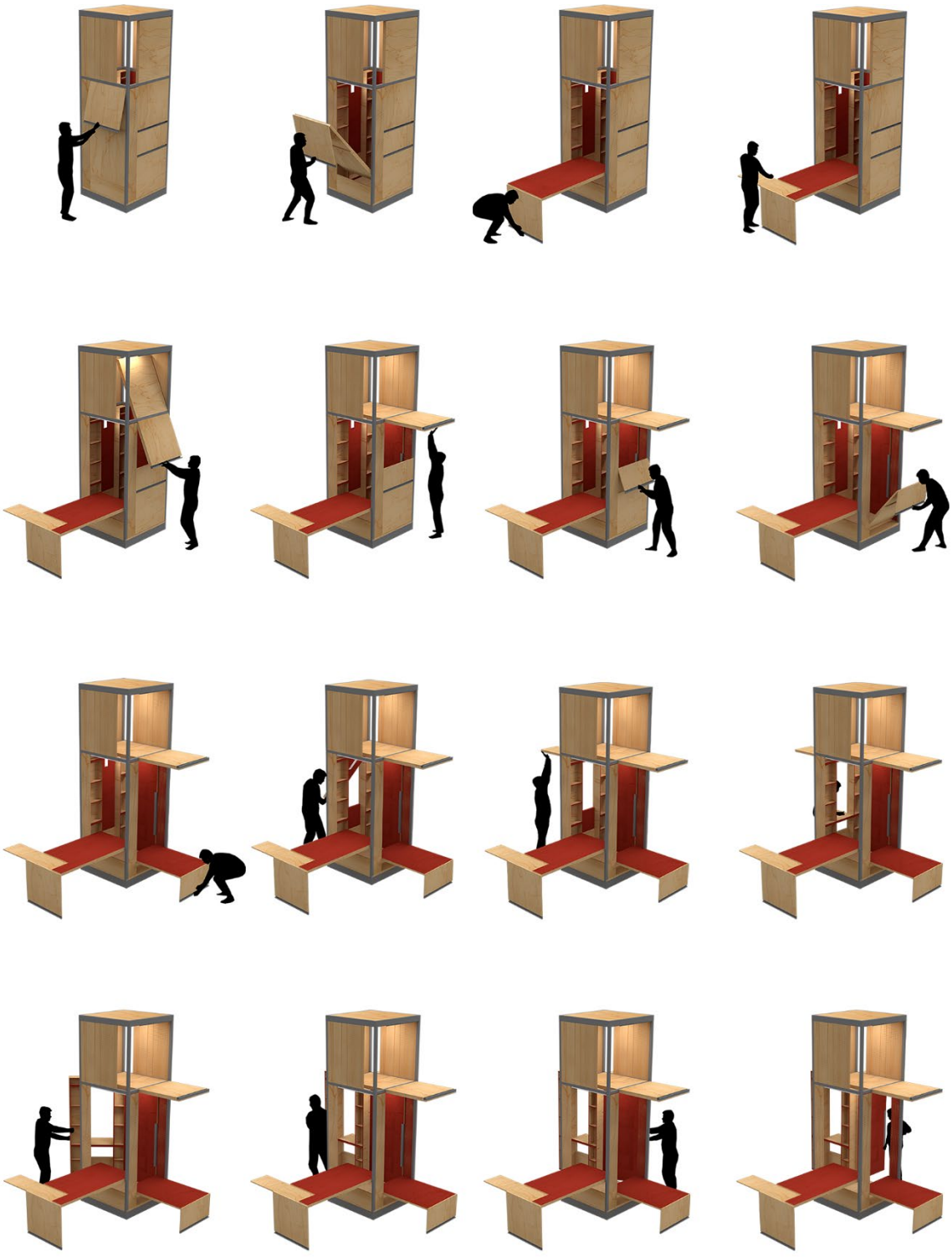


Figure 59. The Urban Inter-Space Module Transitioning from Closed to Open

of operations. It transforms from a closed state to an open state, to which it can be used for a variety of functions. The interior surfaces are painted a vibrant red in order to create visual diversity as it goes through its transitional phases between closed and open. As the module opens, horizontal panels pivot at varying heights and can be used as work surfaces, including a small panel that rotates to expand the workspace. The lower surface can be used for seating, a work surface for children, or a place to display items. There is also a panel that pivots to become a canopy, reciprocating the lower work surfaces. The horizontal surfaces have hinged vertical support panels that are pulled by the user with an attached steel handle. Two faces of the module pivot along vertical axes. One is a thicker wall with shelving that can be used for storage or displaying items, and also contains a small pivoting desk and an overhead canopy. This wall can be used as a workspace or a retail space. The other vertical pivoting panel can be opened to access the interior of the module when other panels are closed. Additionally, each panel can be operated individually, allowing the user to decide which panels are needed for their intended function of the space.

Figure 60. The Urban Inter-Space Module, opened

Figure 61. The Urban Inter-Space Module (other side)

Figure 62. The Urban Inter-Space Module from Other Angles

PLANS

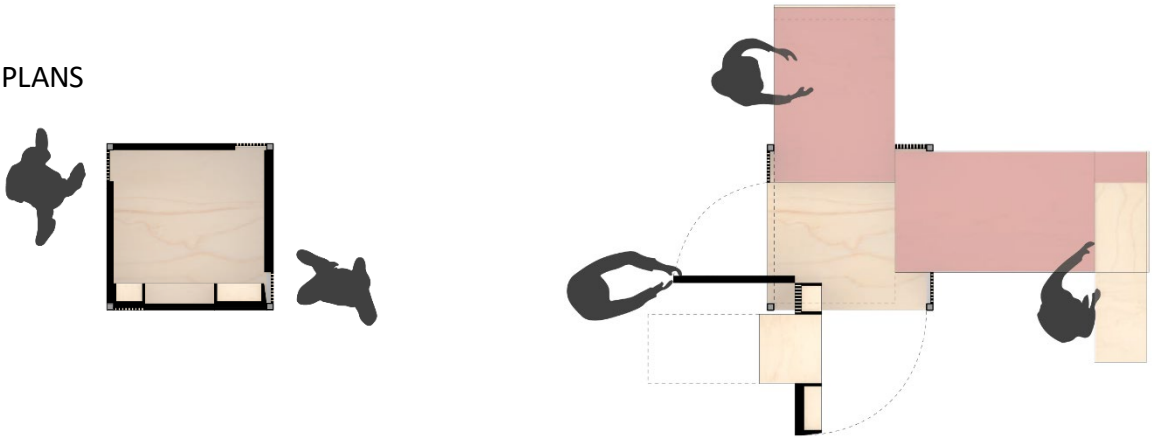


Figure 63. Module in Plan, closed (left), open (right)

ELEVATIONS

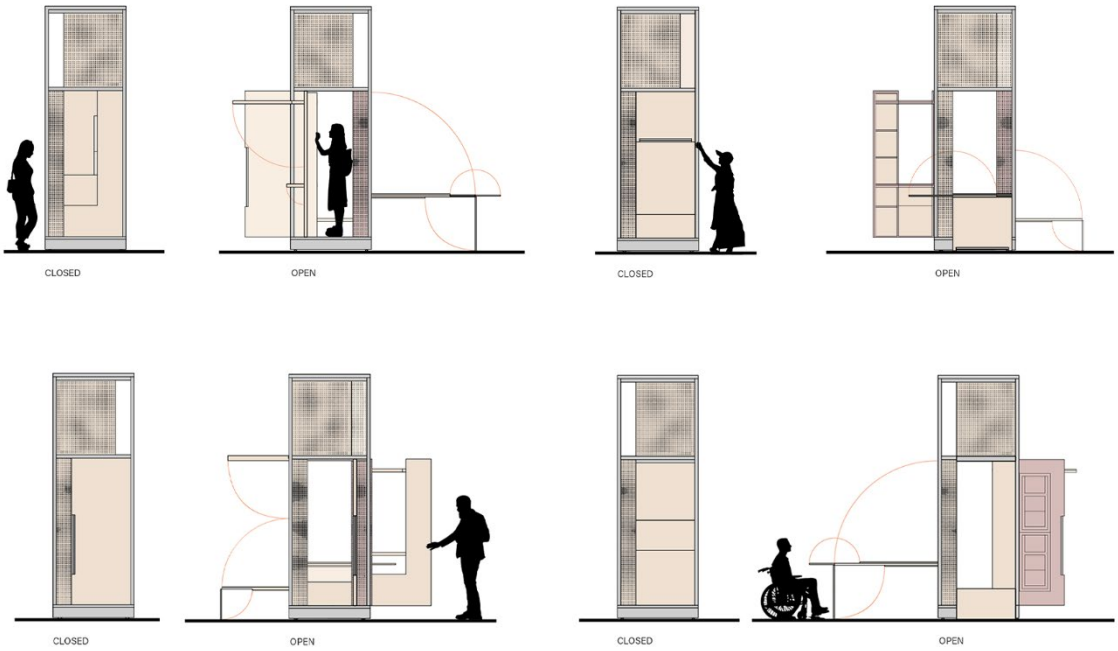


Figure 64. Module Elevations, open and closed

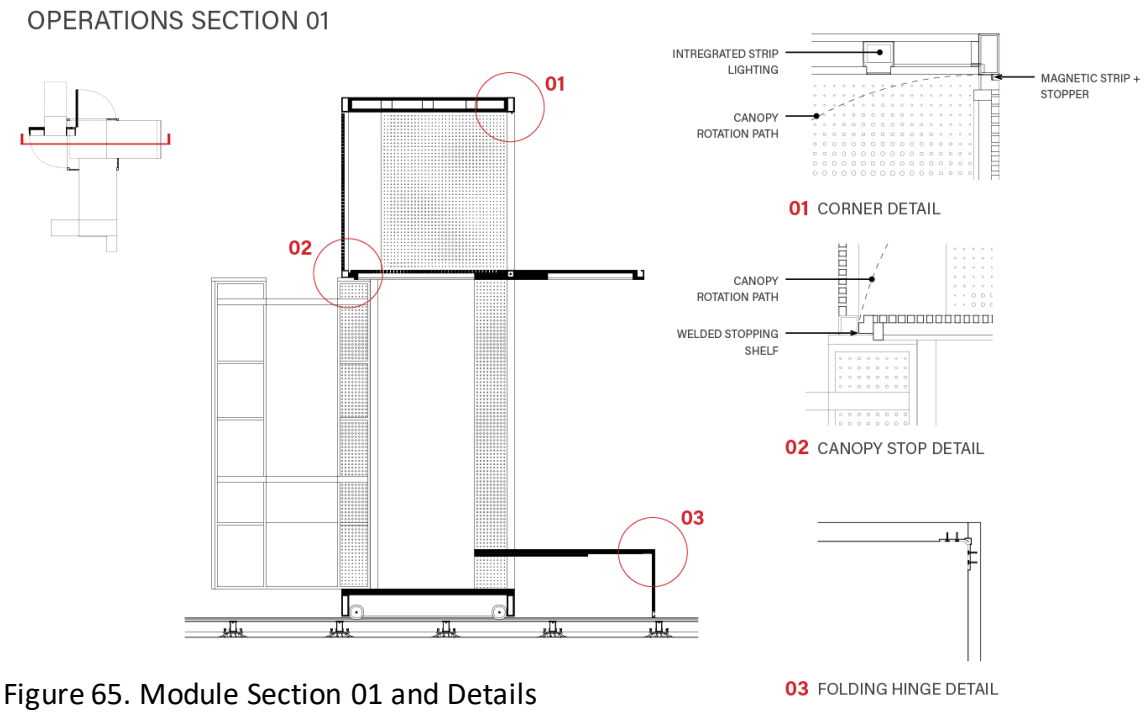


Figure 65. Module Section 01 and Details

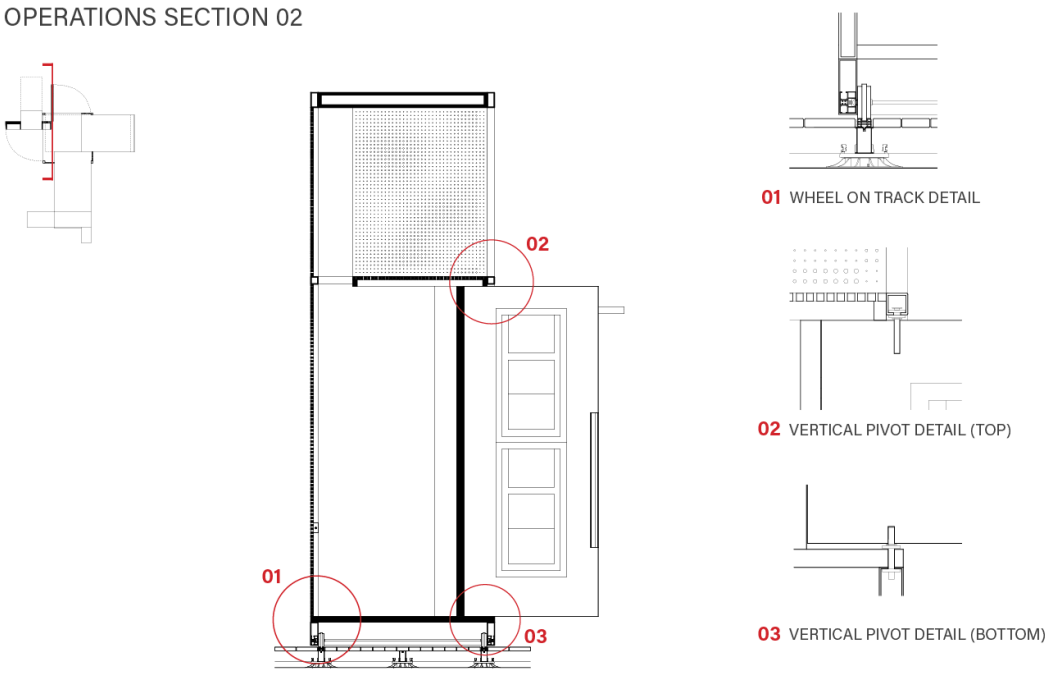


Figure 66. Module Section 02 and Details

To ensure the workability of the operable panels, details that explained how they pivoted, rotated, hinged, and locked in place were a necessary part of the final design.

9.7 Module Unit

The module is housed within a prefabricated aluminum unit that is twenty feet tall and twelve feet wide and plays an important role in the modules' placement and relationship to the site. Perforated aluminum panels are attached to each of the units, and when placed adjacently, spell out "URBAN INTER-SPACE" and depict a dynamic pattern. The mobility of the module was a key element of its operability, and the resolution is an integrated track system that allows the module to slide along the width of the Urban Void Site perpendicular to the module unit.

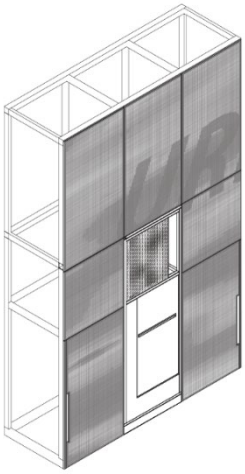


Figure 67. Module Unit Axonometric

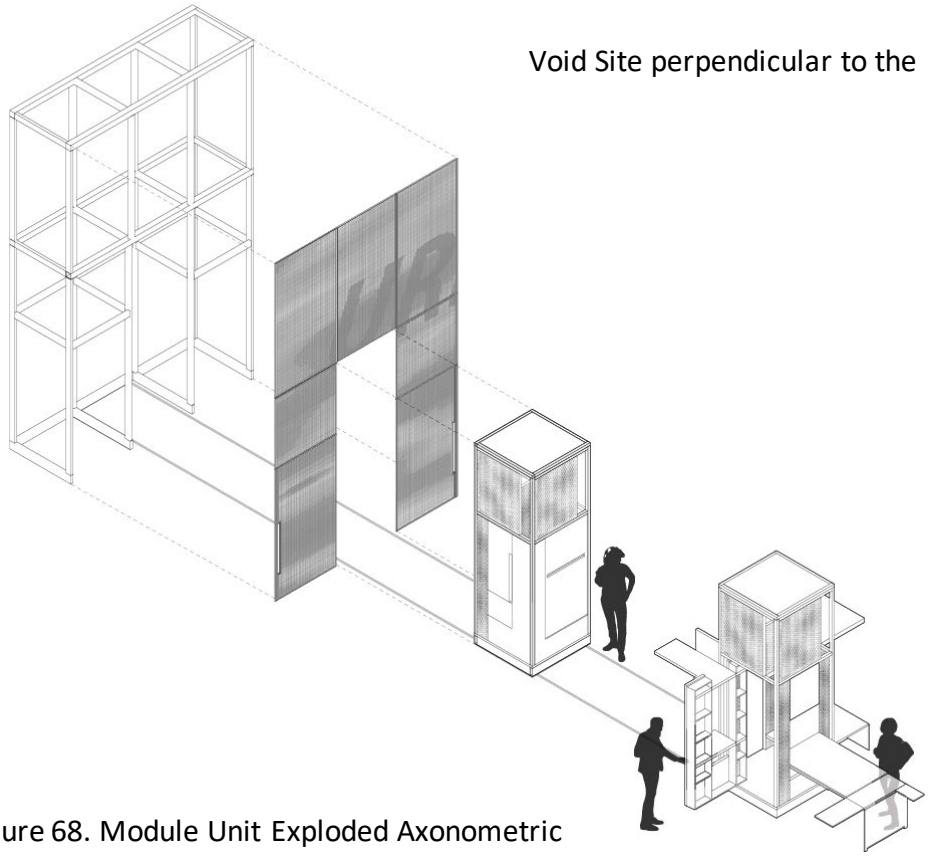


Figure 68. Module Unit Exploded Axonometric

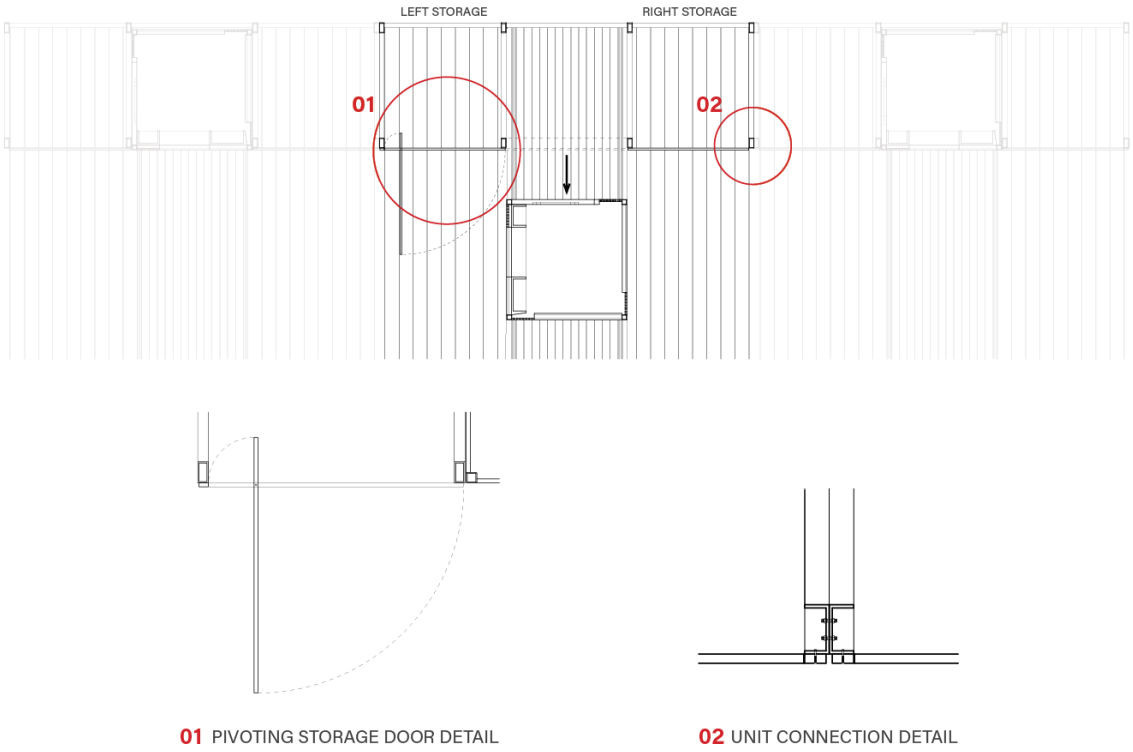


Figure 69 • Module Unit Plan and Details

The units are situated along one of the existing building's facades in a row of five, sitting twelve feet on center and allowing a maximum of eight feet of expandable space between each of the parallel faces of the modules. This allows for neighboring modules to fully expand and create a continuous workspace that can combine multiple modules. Each of the units have three bays; the center bay is where the module is placed, and the bays on either side of the module can be used as storage spaces pertaining to the program of the module within the unit, which are accessed by a pivoting door (figure 69). The units are built of welded 2x2 and 2x4 aluminum tubes and channels and are bolted together when placed adjacent on the site.

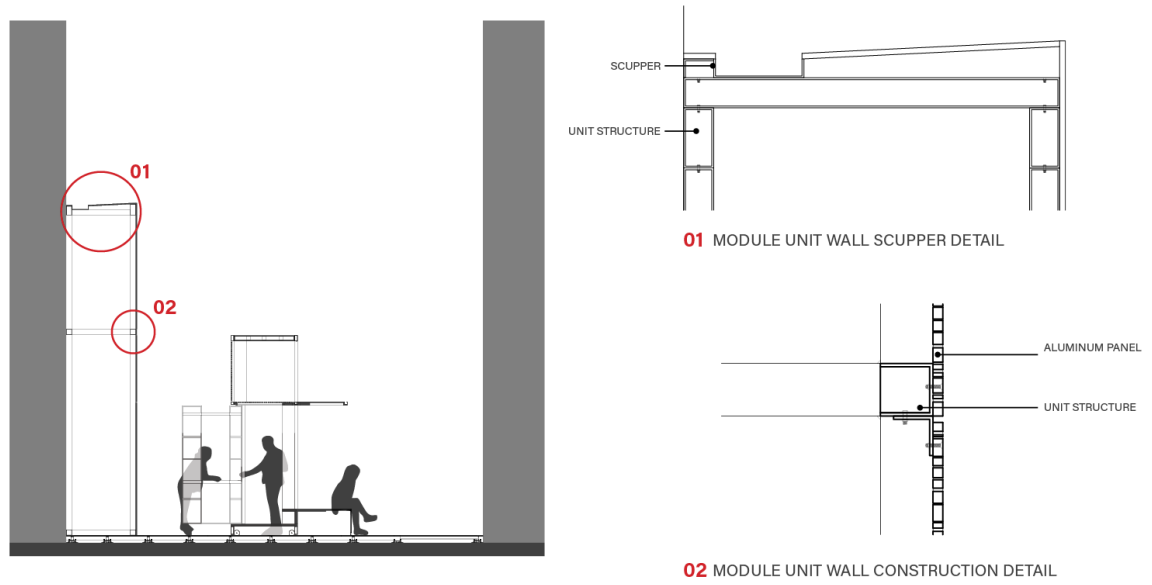


Figure 70. Site Integration Section of Unit Wall and Details

Figure 71. Full Elevation of Module Unit Wall Showing Perforation Design and Modules

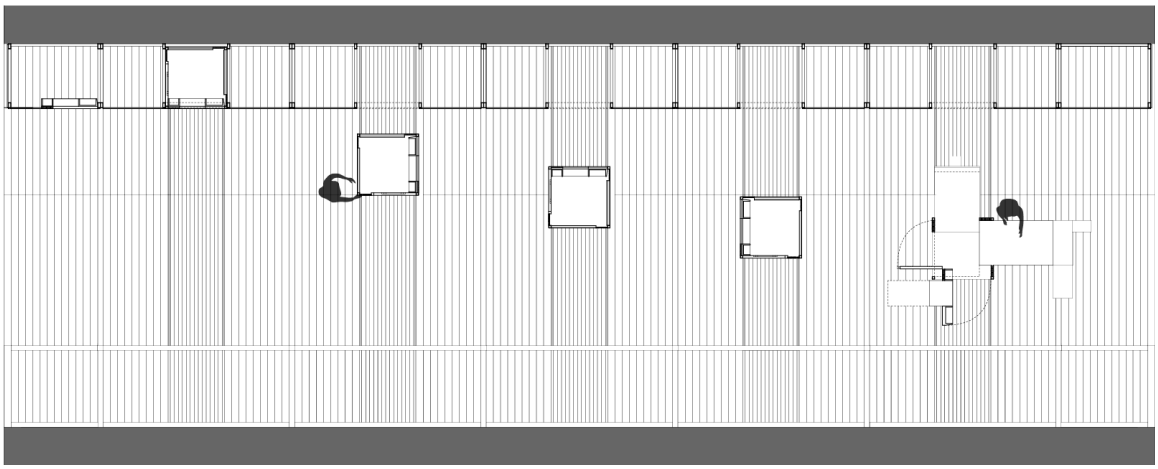


Figure 72. Floor Plan of Integrated Site Showing Modules' Removal from Unit Wall

The Module Unit Wall sits on top of a raised floor structure that is meant to conform to any type of ground level condition within the Urban Void site (figure 73). A series of self-leveling pedestals are placed in a grid on the site, where aluminum joists rest on top. The decking is a composite wood system that lasts longer when faced with rain and snow. Integrated tracks in the decking create allow the modules to slide across the width of the site to be positioned anywhere perpendicular to the wall. The entire floor system is raised five-and-a-half inches above grade, with an accessible ramp on the side opposite the Module Unit Wall. With this simple method of construction and slightly raised floor level, the floor structure can be deconstructed and moved to another Urban Void location. The raised floor also leaves room for integrated floor outlets, where the electrical can run underneath the decking.

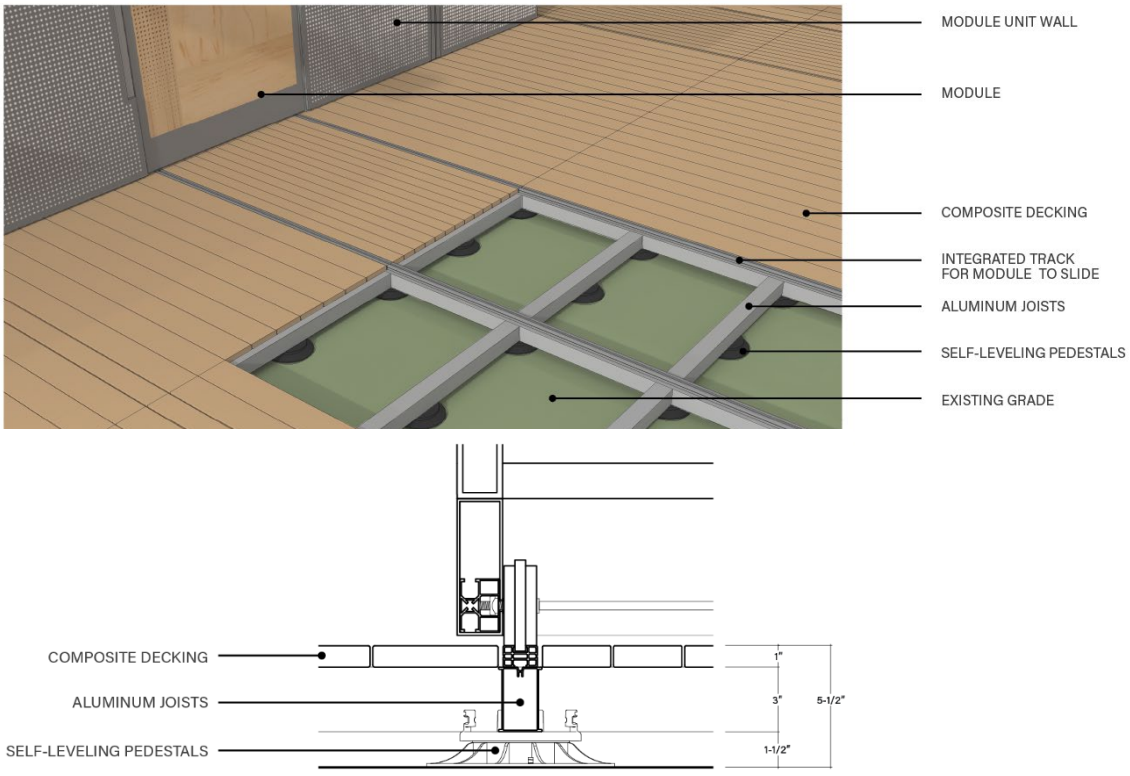


Figure 73. Floor Structure Components and Detail

9.8 Urban Void Site Integration

Figure 74. A Case Study for the Urban Void Site Integration

A site in Holyoke, Massachusetts was chosen as a case study for the Urban Void. Figures 75-76 show the sequence of how the Urban Inter-Space is integrated into the Urban Void site condition.

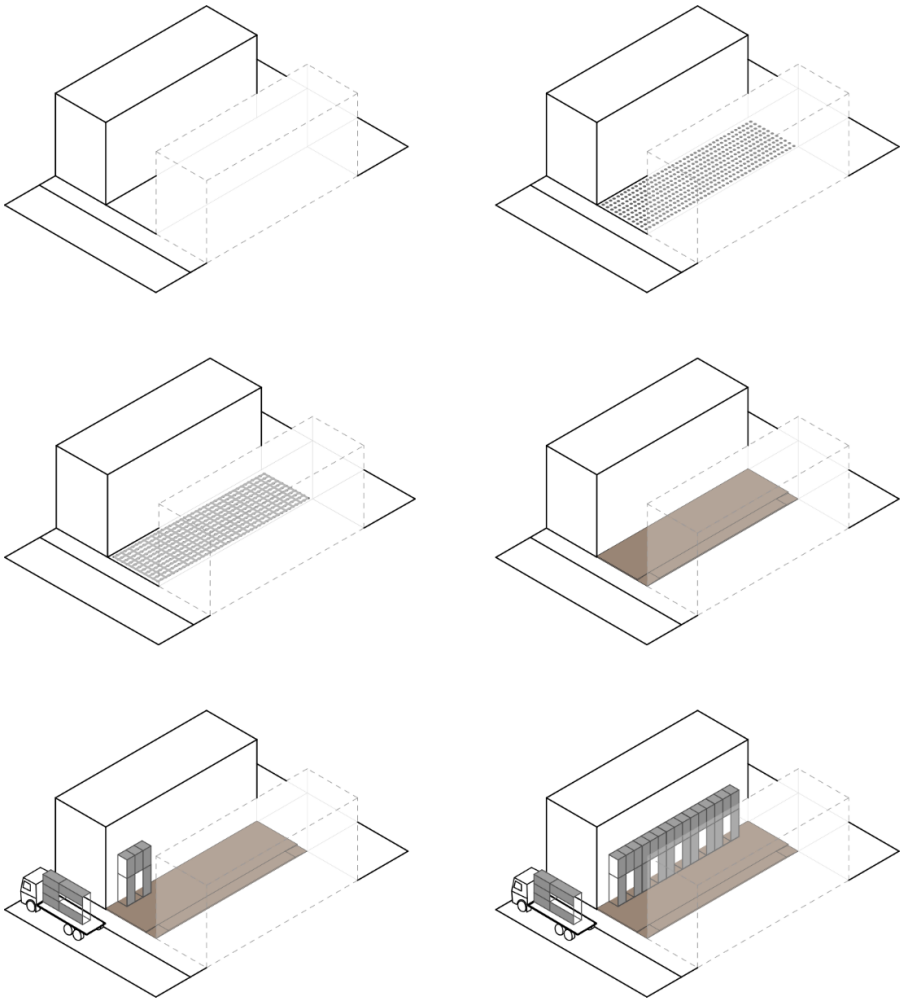


Figure 75. Sequence of the Urban Inter-Space Project Construction 01

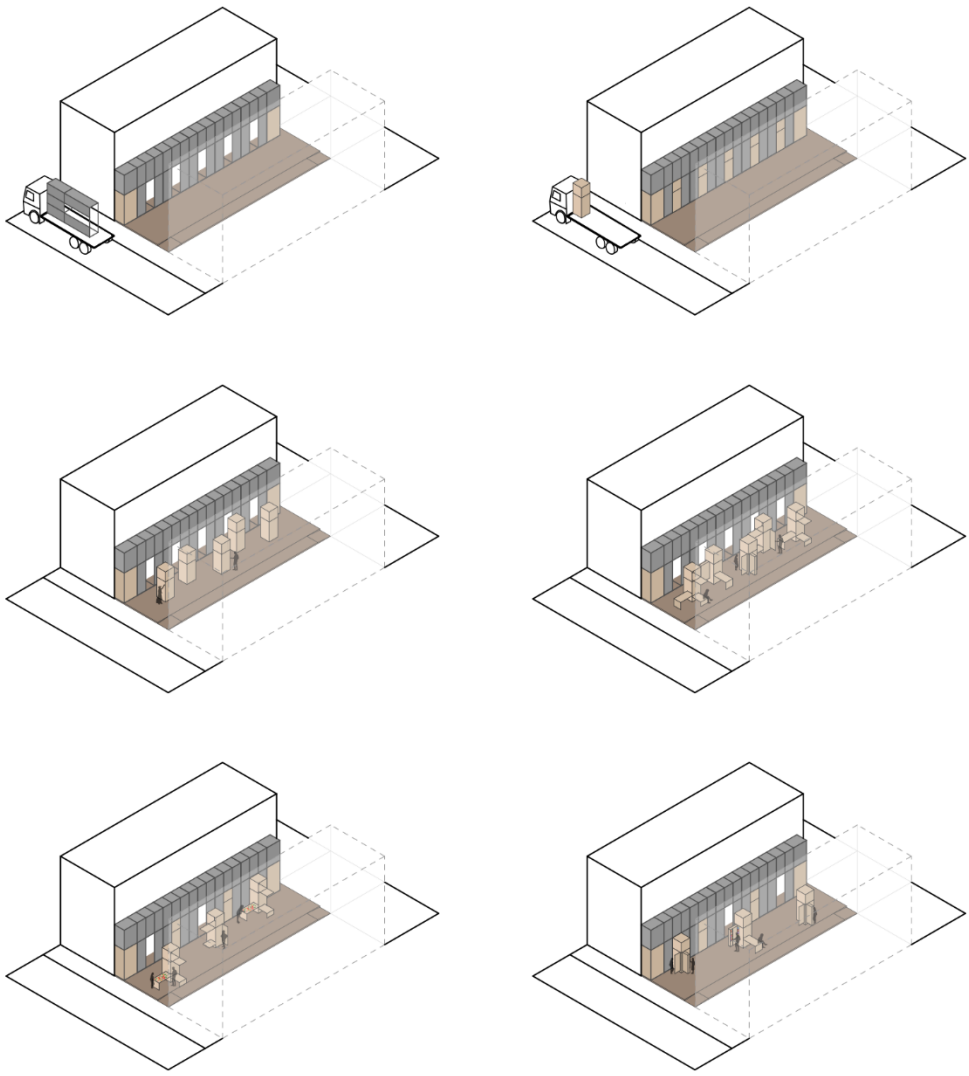


Figure 76. Sequence of the Urban Inter-Space Project Construction 02

Once the raised floor structure is built on the site, the Module Units can be delivered as prefabricated units by truck and placed on the site in a row of five. Two endcaps are built on either end of the units as usable storage spaces that also continue the perforation design around the corners as street-front displays for the Urban Inter-Space. The Modules are also delivered by truck and placed within their respective units, to where they can be removed along their tracks and opened to create a dynamic makerspace. The last two images of the sequence in Figure 68 show two of the other

programs that could be applied to the Urban Inter-space: a farmer's market that prioritizes the horizontal surfaces for displaying produce, and a book share/temporary library that uses the vertical storage panels as bookshelves.

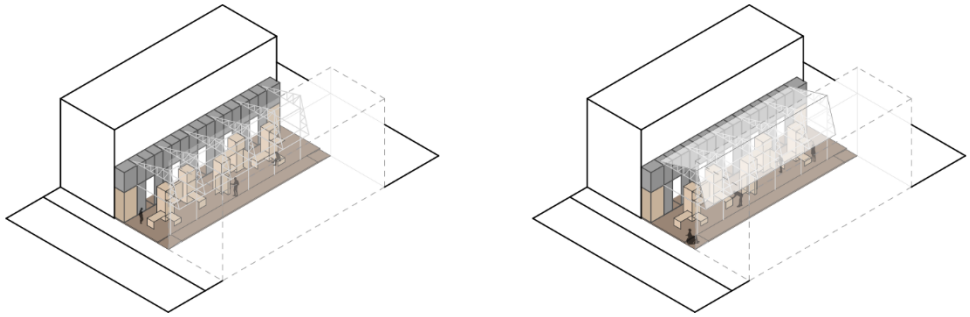


Figure 77. Prefabricated Aluminum and Stretched Fabric Canopy Integration

Figure 77 shows the integration of a prefabricated aluminum canopy system, covered by semi-transparent fabric. While the components of the Urban Inter-Space are meant to be weatherproofed for protection from rain, there is an option to build a canopy on the site that can be easily integrated into the existing Urban Inter-Space. Figures 78-80 show how this canopy, built of prefabricated aluminum trusses, can be integrated into the site. The Module Unit Wall structure is designed so that when each of the units are attached, a small space is left within the structure and in between the perforated panels. The canopy's supporting beam has an extended flange that can be slid into this small gap and bolted to the structure. The supporting columns of the canopy are slid into removable spaces in the decking to rest on self-leveling pedestals, placed twelve feet on center. The beams and columns are placed in between each of the modules to ensure there is no contact between the canopy structure and the modules as they are pulled onto the site and opened.

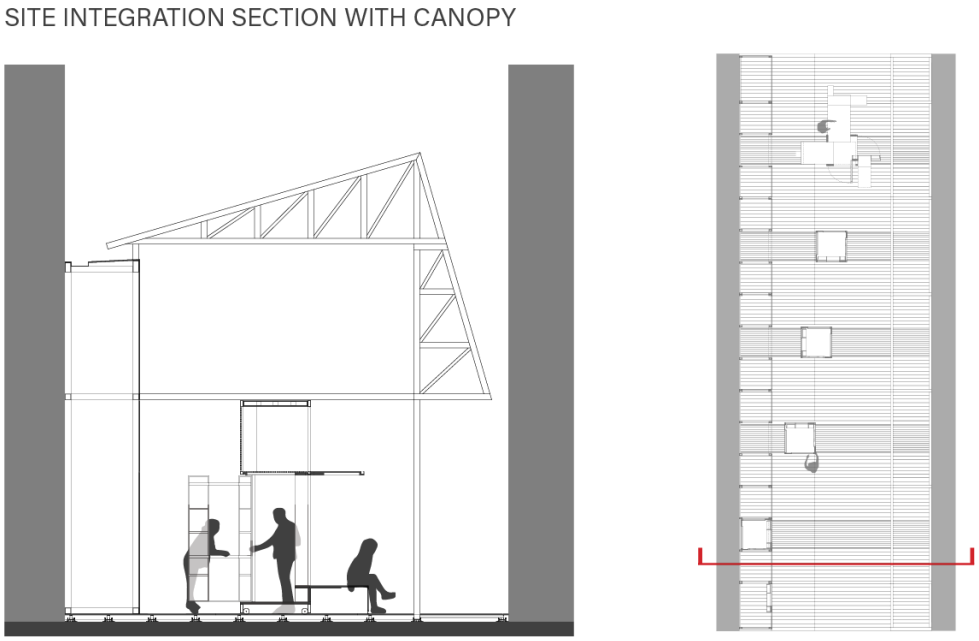


Figure 78. Site Integration Section with Canopy

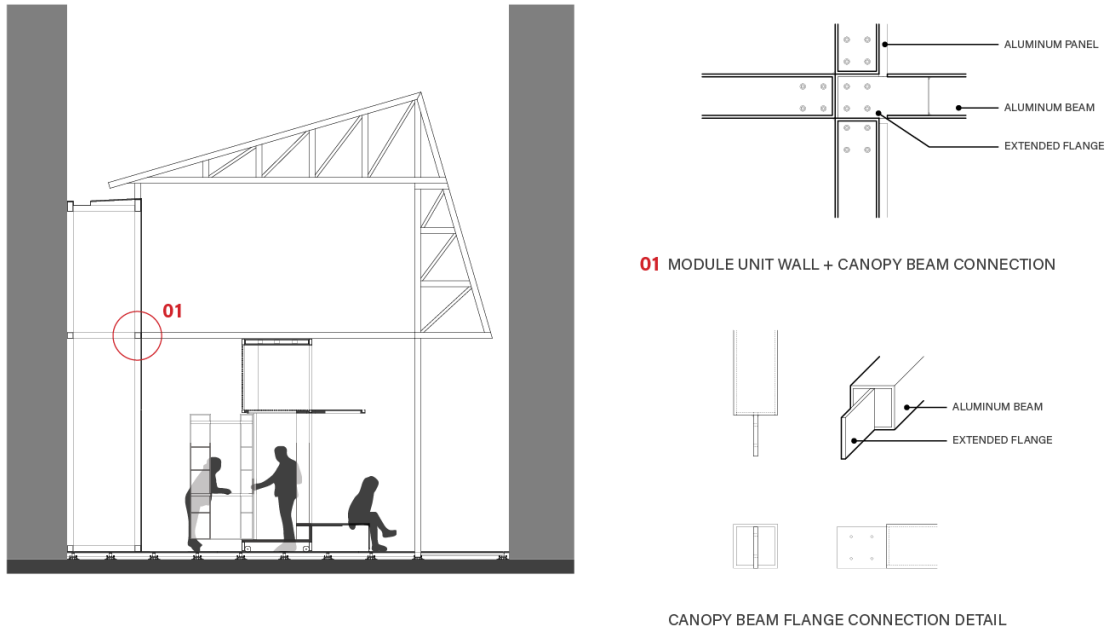


Figure 79. Canopy Structure and Module Wall Structure Integration

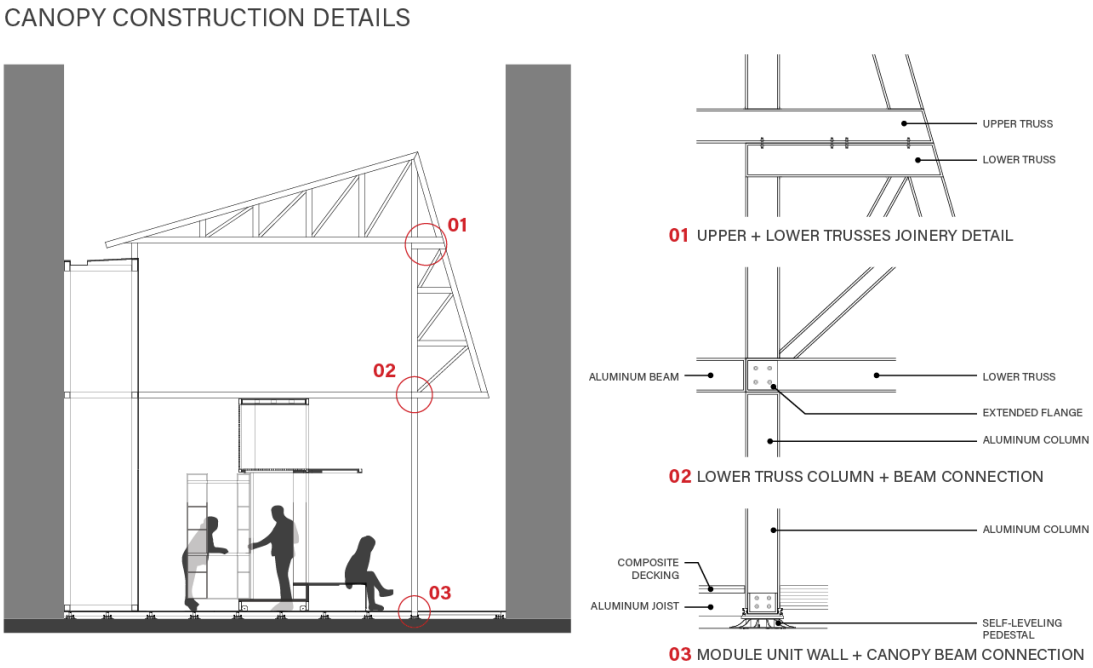


Figure 80. Canopy Truss Connection Details

9.9 Activating the Inter-Space / Conclusion

Figure 81. Rendering of the Activated Urban Inter-Space 01

The Urban Inter-Space can become a catalyst for urban communities. By integrating the convergence of human interaction and form into a leftover gap in a

Figure 82. Rendering of the Activated Urban Inter-Space 02

neighborhood, an activated urban makerspace can be created that engages communities and become a place that can inspire future projects.

This project activates these unused Urban Voids by reclaiming them as spaces for creativity and learning. It attracts members of the community to participate in events and activities, and it uses these temporary installations to inspire future projects and support local businesses.

Figure 83. Rendering of the Activated Urban Inter-Space 03

How can the convergence of human interaction and form activate underused spaces and catalyze future community developments?

Architecture is not only defined by the need for shelter and comfort. It can also be defined with response to the need to create, to make, to play, to thrive, to inhabit, and to interact. The interaction between humans and architecture serves as fuel to answer the question of how these ideas converge. This thesis has examined the dynamic

connection between humans and architecture, as well as how this interaction can catalyze future change by creating space and place utilized within the underused areas of urban communities.

The convergence of human interaction and form can activate underused spaces and become a catalyst for future community developments through the integration of dynamic, adaptive, expandable modules within an urban context.

Figure 84. Rendering of the Activated Urban Inter-Space 04

REFERENCES

- AAA. 2020. "R-URBAN". Accessed April 23. http://r-urban.net/en/press/.
- "About | Urbanrock Design". 2020. Urbanrockdesign.Com. Accessed January 10. https://urbanrockdesign.com/about/.
- Adrover, Esther Rivas. Deployable Structures. 2015.
- Agkathidis, Asterios. Generative Design: Form-finding Techniques in Architecture. London: Laurence King Publishing, 2016.
- "Akb — Story Pod". 2015. Akb. https://akb.ca/projects/story-pod/.
- "Akb — Studio". 2020. Akb. Accessed January 14. https://akb.ca/studio/.
- "Anthropometry | Sustainable Ergonomics Systems". 2020. Sustainable Ergonomics Systems. https://ergoweb.com/anthropometry/.
- "Atelier Bow-Wow | Designboom.Com". 2020. Designboom | Architecture & Design Magazine. https://www.designboom.com/tag/atelier-bow-wow/.
- Bassler, Bruce, and Keith E Hedges. 2017. Architectural Graphic Standards, Student Edition. Somerset: John Wiley & Sons, Incorporated.
- DENISON, EDWARD GLANCEY JONATHAN. 30-SECOND ARCHITECTURE: The 50 Most Significant Principles and Styles in Architecture, Each Explained in Half a Minute. S.l.: IVY PRESS, 2018.
- Encyclopedia.com. (2019). Yin And Yang | Encyclopedia.com. [online] Available at: https://www.encyclopedia.com/literature-and-arts/classical-literature-mythology-and-folklore/folklore-and-mythology/yin-and-yang [Accessed 5 Oct. 2019].
- "Finding Public Space In The Margins | Urbanrock Design". 2014. Urbanrockdesign.Com. https://urbanrockdesign.com/finding-public-space-in-the-margins/finding-public-space-in-the-margins-concepts/#main.
- Fox, Michael. Interactive Architecture Adaptive World. New York: Princeton Architectural Press, 2016.
- Frearson, Amy. 2020. "BMW Guggenheim Lab By Atelier Bow-Wow | Dezeen". Dezeen. https://www.dezeen.com/2011/08/04/bmw-guggenheim-lab-by-atelier-bow-wow/.
- Gins, Madeline, and Shusaku Arakawa. 2019. "Reversible Destiny Lofts — Mitaka - Reversible Destiny Foundation". Reversibledestiny.Org. Accessed October 6. http://www.reversibledestiny.org/architecture/reversible-destiny-lofts-mitaka?view=slider.
- Goldhagen, Sarah Williams. 2017. Welcome To Your World. New York, NY: Harper, an imprint of HarperCollinsPublishers.

- Gordon, J. E. Structures, Or Why Things Don't Fall down. Cambridge, MA: Da Capo Press, 2003.
- Hagan, Susannah. 2008. Digitalia. London: Routledge.
- Iwamoto, Lisa. Digital Fabrications: Architectural and Material Techniques. New York: Princeton Architectural Press, 2010.
- Jan Gehl, Life Between Buildings: Outdoor Space and Outdoor Buildings, 1980, pg. 146
- Kiesler, Frederick, Luca Lo Pinto, and Vanessa Müller. Function Follows Vision, Vision Follows Reality. Berlin: Sternberg Press, 2015.
- Kohlstedt, Kurt. 2020. "Urban Ghosts: Remnant Stories Of Building Demolition & Graffiti Removal - 99% Invisible". 99% Invisible. Accessed January 15. https://99percentinvisible.org/article/urban-ghosts-remnant-stories-building-demolition-graffiti-removal/.
- "Lean-To | Urbanrock Design". 2003. Urbanrockdesign.Com. https://urbanrockdesign.com/lean-to/.
- Lewis, Paul, Marc Tsurumaki, and David J. Lewis. Manual of Section. New York: Princeton Architectural Press, 2016.
- "Loop Chair - Boaz Mendel". 2010. Sites.Google.Com. https://sites.google.com/site/mendelboazdesign/home/loop-chair.
- Liaropoulos-Legendre, George. Ijp - The Book of Surfaces. London: Architectural Association, AA Publications, 2003.
- Mari, Anthony Di, and Nora Yoo. Operative Design: A Catalogue of Spatial Verbs. Amsterdam, The Netherlands: BIS Publishers, 2018.
- Mari, Anthony Di. Conditional Design: An Introduction to Elemental Architecture. Amsterdam: Bis Publishers, 2017.
- Miodownik, Mark. Stuff Matters: Exploring the Marvelous Materials That Shape Our Man-made World. Boston: Mariner Books, 2015.
- Moe, Kiel, and Ryan E. Smith. Building Systems: Design, Technology, and Society. Abingdon, Oxon: Routledge, 2012.
- Moe, Kiel. Convergence: An Architectural Agenda for Energy. London: Routledge Taylor & Francis Group, 2013.
- Najle, Ciro. The Generic Sublime: Organizational Models for Global Architecture. Cambridge, MA: Harvard University Graduate School of Design, 2016.
- "Ped Stop | Urbanrock Design". 2003. Urbanrockdesign.Com. https://urbanrockdesign.com/ped-stop/.

- Phillips, Stephen. “Toward a Research Practice: Frederick Kiesler’s Design-Correlation Laboratory.” Grey Room 38 (2010): 90-120. doi:10.1162/grey.2010.1.38.90.
- Picon, Antoine. Digital Culture in Architecture: An Introduction for the Design Professions. Basel: Birkhäuser, 2010.
- Ponce de León, Mónica. 2020. "Lover's Lane Residence — Mpdl Studio". Monicaponcedeleon.Com. Accessed January 6. https://monicaponcedeleon.com/Lover-s-Lane-Residence.
- “A Public Surface: Finding Space in the Margins | Mark Robbins; Kim Shkapich; Jeanine Centuori; Norman Millar”. 2003. Hollywood, CA : Center for Community Research and Design at Woodbury University.
- Serraino, Pierluigi. “Review: Elastic Architecture: Frederick Kiesler and Design Research in the First Age of Robotic Culture, by Stephen J. Phillips.” Journal of the Society of Architectural Historians 77, no. 2 (2018): 229-30. doi:10.1525/jsah.2018.77.2.229.
- "Slim Stores | Urbanrock Design". 2003. Urbanrockdesign.Com. https://urbanrockdesign.com/slim-stores/.
- Srinivasan, Ravi, and Kiel Moe. The Hierarchy of Energy in Architecture: Emergy Analysis. London: Routledge, 2015.
- Sullivan, Louis H. 1896. The Tall Office Building Artistically Considered.
- Townsend, Anthony M. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia. New York: W. W. Norton & Company, 2014. “Digitally Mediated Urban Space: New Lessons for Design.”
- “The Enduring Lives of Sasa Machtig’s Modular Creations.” Metropolis. August 16, 2017. Accessed March 27, 2019. https://www.metropolismag.com/cities/the-enduring-lives-of-sasa-machtigs-modular-creations/?utm_medium=website&utm_source=archdaily.com.
- "The Studio For Urban Projects » About Us” . Studioforurbanprojects.Org. http://www.studioforurbanprojects.org/about/about-us/.
- "Urban Voids—Recoding Functionless Areas In A City". 2015. Phys.Org. https://phys.org/news/2015-11-urban-voidsrecoding-functionless-areas-city.html.
- Wexler, Allan. 1991. "Screen Chair". Allanwexlerstudio.Com. http://www.allanwexlerstudio.com/projects/screen-chair.
- Wexler, Allan. 1998. "Chairs". Allanwexlerstudio.Com. http://www.allanwexlerstudio.com/projects/chairs.

- Wexler, Allan. 1998. "Folded Houses". Allanwexlerstudio.Com. http://www.allanwexlerstudio.com/projects/folded-houses.
- Wexler, Allan. 2020. "Biography". Allanwexlerstudio.Com. Accessed January 10. http://www.allanwexlerstudio.com/biography.
- Wexler, Allan. 2020. Allanwexlerstudio.Com. Accessed January 14. http://www.allanwexlerstudio.com/projects/little-office-building-2.
- Wexler, Allan. 2020. Allanwexlerstudio.Com. Accessed January 14. http://www.allanwexlerstudio.com/projects/crate-house.
- Wheeler, Stephen M., and Timothy Beatley. The Sustainable Urban Development Reader. London: Routledge, 2014.