SPECULATIVE EMERGENCE: A FORM FINDING TECHNIQUE

Speculative Emergence: A Form Finding Technique.

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A thesis presented to Ryerson University
in partial fulfillment of the requirements of the degree of Master of Architecture in the Program of Architecture

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Abstract

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Master of Architecture, 2019
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Emergence is a result of a complex assembly of interacting systems, which can potentially result in novel patterns and formations. As a result, emergence may be linked to the natural generation of diverse properties. Currently, there exists a distinct knowledge gap between the complex and adaptable systems as seen in nature, and the deterministic, pre-planned approach of current architectural building practice. In order to approach emergence and its inherently novel form for development as a new central tenet to architectural 'evolution', we would need to be less reliant on following deterministic, heavy handed, top-down design practice. By embracing systems thinking, we can work to relinquish old identities and permit emergence into new forms and structures. This requires questioning and speculating how integrated systems within a site can be understood, and as a result an emergent architecture developed through a bottom-up approach may be achieved. This thesis will examine speculative emergence to improve our understanding of bottom up design strategies. The exploration of emergent potentials may lead to an architecture of positive change, away from the deterministic design practice which maintains a stronghold within the architectural world.

Figure 0.01 **Resor House Project, Interior Perspective, Mies van der Rohe Collage**

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For my Family.

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Preface

Deterministic planning and design for permanence is a methodology almost always encountered in contemporary architectural practice. This “top-down” approach to architectural design necessitates the overall focus on the pre-meditated, permanent end product, filtered down into the construction documentation to then be translated into the construction of a building. Such an approach fundamentally limits any deviation from the original idea or spur of the moment adaptation, and future evolution is scarcely tolerated.

Unlike this top-down architectural approach, some of the most resilient and diverse properties known to us - such as the ever-changing ecosystems on this planet - are always in a constant state of flux and adaption. Architecture and buildings are seldom thought of in such a manner. Is this adaptive approach one that could be beneficial to the longevity and viability of architectural design? We can understand that society inevitably thrives on gradual change (less so than sudden disruptions), and the buildings we create should surely be able to evolve with us in a symbiotic way.

The above analysis suggests we should be more attentive to the systems at work, affecting and influencing our surroundings. If we begin to be cognizant of the study of systems theory - the cohesive groupings of interrelated and interdependent elements which can lead to new emergent properties as a result from system change and flow - we can begin to speculate how allowing these pressures to manifest can lead to new, emergent design techniques that ideally can be adapted to architecture as a practice. As such, systems thinking presents a new lens by which we can approach architectural design. How can designers leverage and work together with localized systems influencing the surroundings, and how can we find an advantageous scenario to create a positive feedback loop? This requires understanding that social, environmental, economical amongst other system pressures are changing at a rapid rate, and always evolving. This suggests the need for adaptation and change, which the permanent, top-down methodologies we currently produce cannot support.

How may we encourage adaptive change to occur in a beneficial manner? Designers and architects within the discipline often function very differently than those in other fields who typically attempt to harness systems thinking. This is where the architect has a tendency to approach a design problem from a “top-down approach”, essentially mentally gripping the definitive design development, or an overarching concept which is expected to be carried through to completion. The top-down hierarchy proceeds from the big picture, into smaller segments. In contrast, a “bottom-up approach” is the piecing together of systems, which subsequently give rise to more complex systems. Ultimately, the original systems become the sub-systems of the emergent structure. The bottom up approach focuses more on the desired functionality of the project, and less so the aesthetic outcome.

The essence of systems theory is possibly best explained by the concept of emergence. If sub-systems interact in a particularly beneficial way, conditions for emergent behaviour can potentially ensue. Thus, we can begin to see that these interactions can have an effect on the manifestation of a new, emergent form. By approaching growth and evolution of existing form as being facilitated through a bottom-up approach, we can begin to understand the process by which emergence can influence an evolving system into a thriving state.

This leads us to question what the architect’s role may be in facilitating a reconsideration of the top-down deterministic approach to design. Historically, the very act of designing can be interpreted as definitive decision making,

and aiming for permanence. How can the architect harness the concept of producing deliverables without originally defining the design at the outset, and instead, allow the design/architecture to emerge over time, thus allowing the response to systemic changes? What can we speculate would be possible, if we simply permitted systems influence to harness emergence? Such questions being proposed can help designers articulate the future in a compelling way, and facilitates people discussing valid questions about bottom-up design - which should be regarded as a speculative inquiry; a pondering of the future.

This theoretical critique of contemporary architectural practice lends to the proposition of an alternative approach to design, one which is potentially more sustainable and resilient. This thesis aims to question the missing flexibility found in top-down design, and aims to explore how to deploy concepts of bottom-up design to the architectural process. By situating this thesis within a large, institutional site with a complex background and system drivers, such as the Illinois Institute of Technology (IIT), we can begin to discuss how the inability for this university to react to societal, educational, and institutional amongst other pressures has essentially frozen the campus its original state as it existed 70 years ago. Thus, by understanding that IIT is being shackled by its heavily controlled top-down (Miesian) strategy, the univeristy makes a good test bed for a thesis exploring the possibilities of systems thinking, emergence, and futurist scenarios.

This highlights the importance of discussing the notion of “megastructures” in speculative architecture. A megastructure is understood not as a big continuous building, but rather as an expansive wide-spread network. This network interrelates and facilitates all systems and processes to be utilized and moves to bring this speculative entity into being. Conceptualizing a framework for an approach to speculative emergence upon the IIT campus requires situating this thesis amongst an interrelated framework between the logic of systems theory, emergence theory, and speculative design. To

attempt an approach to reinvigorate the IIT campus, we must perceive it as a megastructure or scaffold framework. To really understand a space or site we must attempt to understand this megastructure, and how far it can be stretched and connected to systems beyond.

Deciphering what systems are acting on this scaffold framework (megastructure) determines how we might speculate on what sort of improved outcomes could occur. The architectural process begins with a way of thinking about an organization in a given place-time then establishes a system of relationships and, finally, achieves physical expression. Ideally, this framework would strive to be an architecture of relationships rather than limited to an aesthetic form. Facilitating the deployment of a scaffold for infinite possibilities of organization and extension can thus initiate emergent potentials, which may be transient, change, and ebb and flow over time.

Concepts such as Mat Building and Spaceframes which propose a loose infrastructural scaffolding based on the systematic organization of the parts may be instrumental in remodeling IIT. The architect can design the system, but cannot expect to control all the individual parts. These theories are represented by a relatively non descriptive architectural armature - remaining neutral in its construction; the scaffold framework is not front and centre, it is simply facilitating. Its job is not to articulate or represent specified functions, but rather to create an open field where the fullest range of possible events might take place. These structures have active interstitial spaces, where the emergent matter internally shapes and channels the space between things, importantly leaving room for the unanticipated. By creating the scaffold as infrastructure, internal emergence is permitted to develop. This involves multiple authors - numerous drivers and situations which lead to contribution from multiple aspects. Infrastructural scaffolding gives direction to future work in the structure not by the establishment of rules or codes (top-down), but by fixing points of service, access, and form (bottom-up).

This megastructure derived from precedent theories and techniques can be

facilitated rationally and respectfully upon the already implemented Miesian grid which houses the IIT campus, and thereby reinvigorate the university for an emergent, adaptive and systems based future. This thesis aims to explore this more fully.

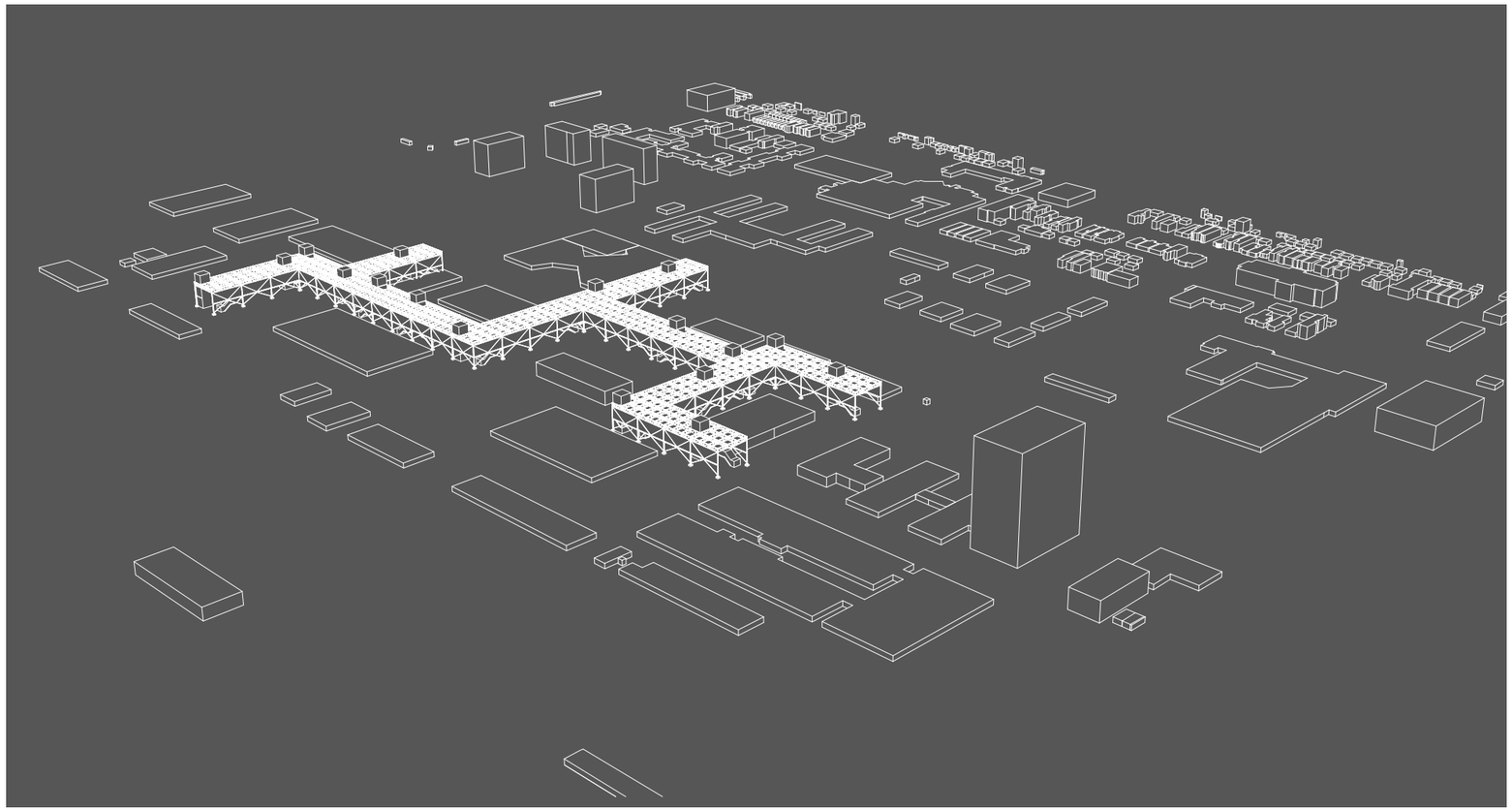


Figure 0.02 **Scaffold Manifestation**

1 Introduction

1.1 Problem Statement

> "Self-formation" and "Natural Constructions" are subjects that need a great deal of commitment and collective and collaborative thought. Research into them needs strong collective leadership. It is endangered if the researchers involved think exclusively of their own narrow subject area, if they forget that they must always see things as a whole. Work on the subject of "Natural Constructions" goes on. What has been done so far is only a tiny part of what has to be done. The most important, as yet still provisional, result is a new interpretation of life's origin and the acquisition of form. Future work requires insights into the formation of objects, of emergence from an unordered state, of creation. It must occur through objective, level-headed research with a clear aim" (Frei Otto, 1996).

There is an undeniable efficiency and resiliency in natural self-forming entities, and it is also undeniable that designers, urban planners and theorists have much difficulty replicating these successes in their respective fields of practice. These "self-forming" processes lead to the emergence of robust entities, showcasing genetic optimization in their particular environment. What exactly is meant by self-forming, emergent entities? The concept of emergence suggests that "as systems acquire increasingly higher degrees of organizational complexity they begin to exhibit novel properties that in some cases transcend the properties of their constituent parts, and behave in ways that cannot be predicted on the basis of the laws that govern their existence" (Kim, 2008, pg. 127). More simply put, the higher order systems or "wholes" which act as an emergent property cannot be reduced to the properties of the lower "parts" or systems that drive the whole. These irreducible properties are called emergent (Heylighen, 1989, p. 2).

When introducing emergence theory into architectural thinking, it is abruptly confronted by the well-known fact that design has historically been practiced with very conscious decision-making, and rigid control. This posits a question as to how to be less dogmatic about how we build contemporary architecture and how permitting change and evolution of buildings can be beneficial for development. Furthermore, understanding of emergent systems within architecture requires us to question whether or not development is a top-down process. By approaching growth and evolution of existing form as facilitated through a bottom-up approach, we can begin to understand the process by which emergence leads a system to a thriving state (Mitiandis, 2009, p.2).

1.2 Underlying Questions

• How can incorporating emergence theory change the way we approach the design of structures? What sort of lessons can be learned from approaching emergence through an architectural lens, and can this new understanding help us create more efficient and desirable structures and communities?

• This thesis aims to address the task of how to facilitate the design of an emergent architecture. What is the framework in which we can conceptualize

and begun to understand how to decode emergent properties?

• What can the architect do to conceptualize, or reinvigorate their approach to designing a built entity, or alternatively, to embrace some unconventional, non-uniform approaches that are in contrast to the accepted structures and methodologies of current architectural practice?

• By grasping an understanding of the complexity of nature, designers can begin to shift their focus from object-oriented design, towards harnessing, understanding, and perhaps even manipulating influencing systems which may affect the design outcome. Can this change in design focus lead to a new, non-predetermined form, which may result in what we can call emergent design/architecture?

• Does this lend to the idea of buildings being constructed incrementally; slowly and less predetermined?

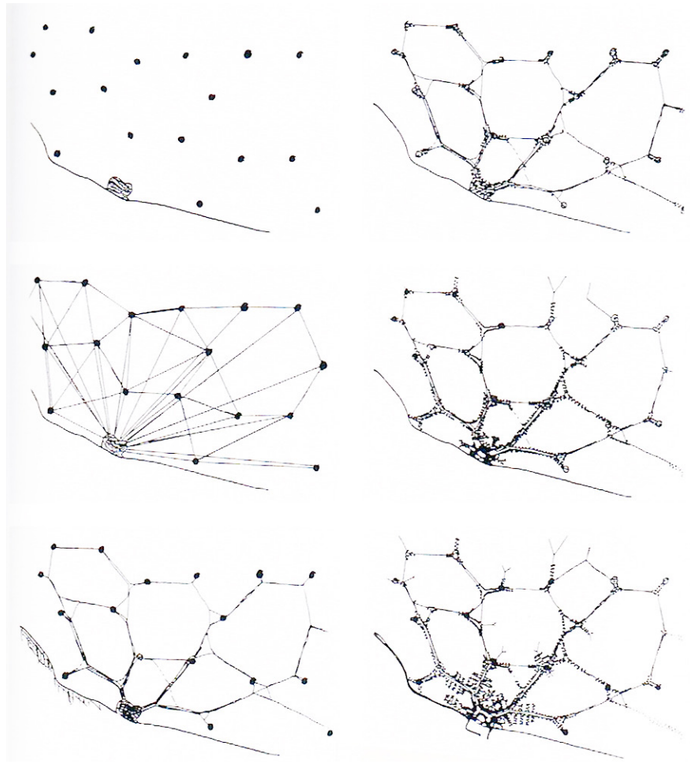


Figure 1.01 **Occupying and Connection: Self-formation. Otto, experimenting with floating magnetized pins that generated a self-organized system through repulsion and attraction**

SECTION ONE

THEORY

2 Background Research

It is apparent that numerous theories to be discussed in this thesis are interrelated, yet may have origins in different fields and disciplines. This requires a clear and concise outline of the theories which will later develop the working framework for this thesis.

2.1. Systems Thinking & Theory

Systems Theory is applicable to numerous disciplines, most succinctly described as the organization of phenomena or elements, independent of their substance, type, spatial or temporal scale of existence (Heylighen, 2000). Systems theory is interested in the principles and manifestations of behaviour within all complex entities, and the way these numerous disciplines describe these behaviours.

Systems are open to the influence of the environment, and can continually acquire new properties or evolve through emergence. Systems theory is predominantly interested in the interrelation of parts, and how these relationships manifest as whole. An example of such a construct is the human body, and how a human being as a whole cannot be reduced to one's internal organs or cells.

As clarified by Heylighen, "systems theory focuses on the arrangement of and relations between the parts which connect them into a whole. This particular organization determines a system, which is independent of the concrete substance of the elements" (Heylighen, 2000).

By attempting to understand systems thinking, we are setting ourselves up with an open mind (no preconceptions) to establish a framework for interpreting the whole big picture, of how these systems may be integrated and their resulting interdependencies. Thus, if we step back and look at the whole picture, we may see an intervention we may otherwise overlook. This essentially tackles root causes, instead of simply fixing elements linearly.

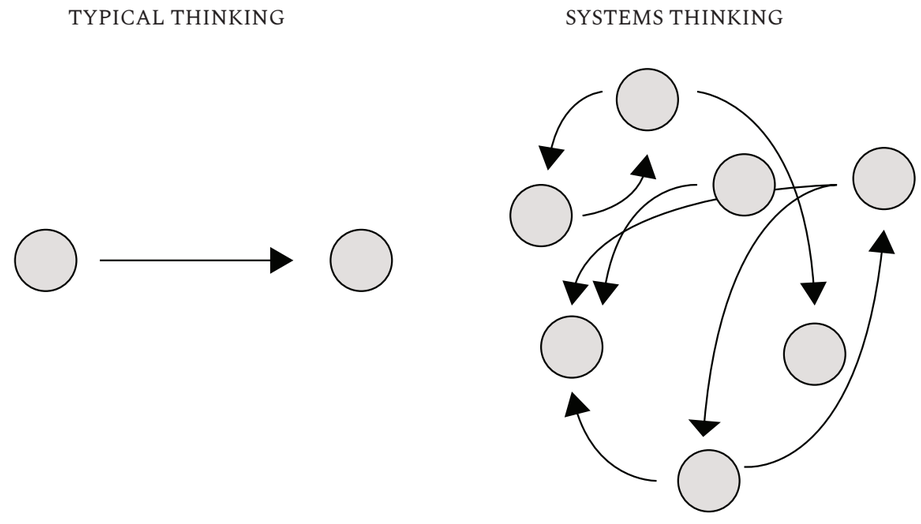
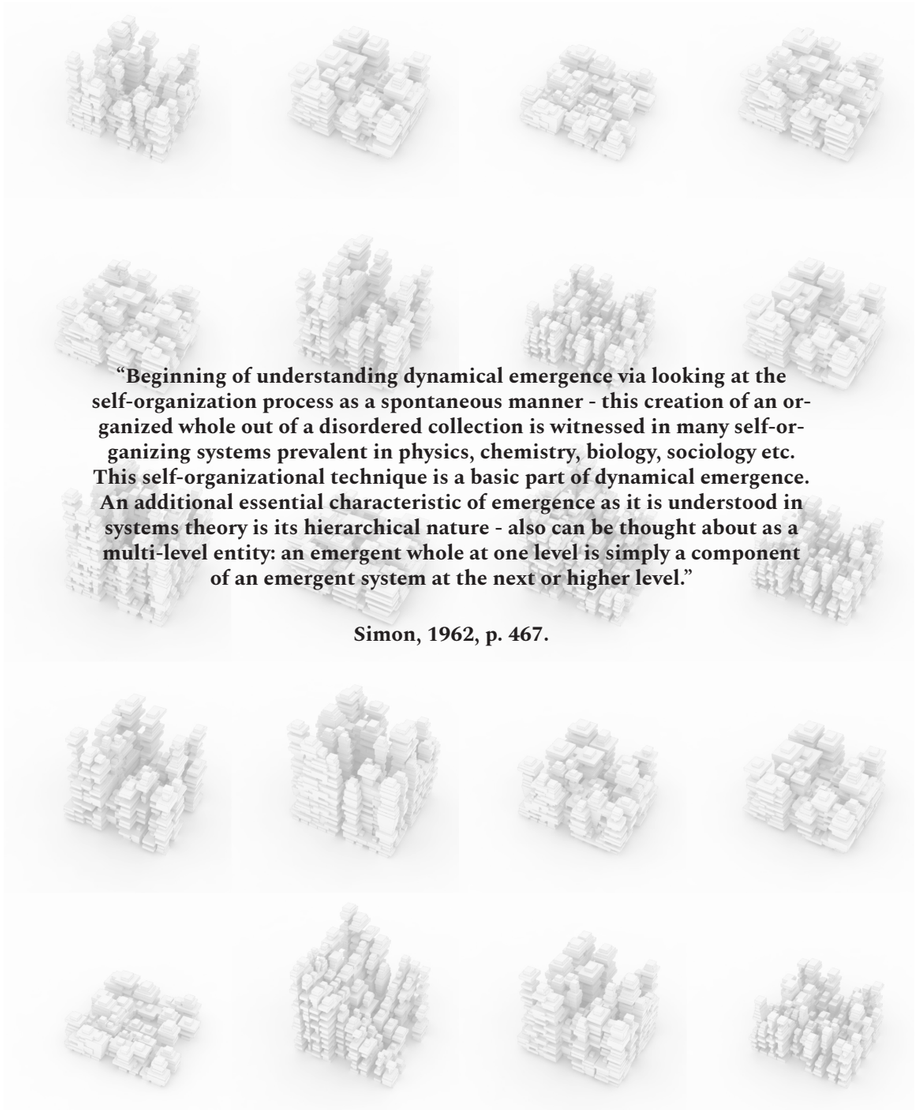


Figure 2.01 **Interconnectedness of Systems Thinking**



“Beginning of understanding dynamical emergence via looking at the self-organization process as a spontaneous manner - this creation of an organized whole out of a disordered collection is witnessed in many self-organizing systems prevalent in physics, chemistry, biology, sociology etc. This self-organizational technique is a basic part of dynamical emergence. An additional essential characteristic of emergence as it is understood in systems theory is its hierarchical nature - also can be thought about as a multi-level entity: an emergent whole at one level is simply a component of an emergent system at the next or higher level.”

Simon, 1962, p. 467.

Figure 2.02 **The AA School - Emergence and Design Seminar**

2.2. Emergence

An emergent behaviour or property may appear when a number of smaller systems operate together in an environment, ultimately forming a more complex collective agency. Therefore, emergence is the arising of novel and coherent structures, patterns and properties during the process of self-organization within complex systems. As elaborated by Michael Weinstock:

“All the forms of life on the surface of the earth, including humans, have also emerged from the process of complex systems that are coupled to the transmission of biologically encoded information over time. Living forms exist in varied populations, and where they organized themselves into social collectives, culture emerges. The architecture of all the forms of nature, their arrangement of material in space and over time, emerges from the dynamic interaction of energy and material within complex systems” (2010, p.245).
The patterns and energy in these systems are subjects to natural ebbs and flows, and as a result these formations may or may not be stable. Flow within systems are moderated by “feedbacks”, which could result in any system collapsing, forced to reorganize, and emerge as a new formation (Weinstock, 2010, p.246).

When analyzing these novel and coherent structures, one can recognize the similarities of these forms with formations of living nature, and even non-living formations found within nature. The form generation present in nature can serve as an inspiration to designers and planners. Approaching emergence as a complex network of processes can potentially lead to novel, coherent structures via coalescence through interactions among the diverse entities of a system.

We can think of chaos as random interactions in a system, without the ne-

cessity of rules or patterns attributed. Emergence occurs when novel, more complex systems form (often unexpectedly) from this chaos, and the resultant emergence is continually ebbing and flowing.

The steady application of emergence theory to architecture is truncated by complexities formulated by architecture's drive for permanence. Form generated within the process of emergence is only always provisional, moderated by feedback loops, resurrecting as resultant, new forms. While emergence is a continuous process, this leads us to the unanswered question as to whether an architecture can be designed in an emergent manner; can characteristics present in emergent behaviours of natural systems be applied to architectural design?

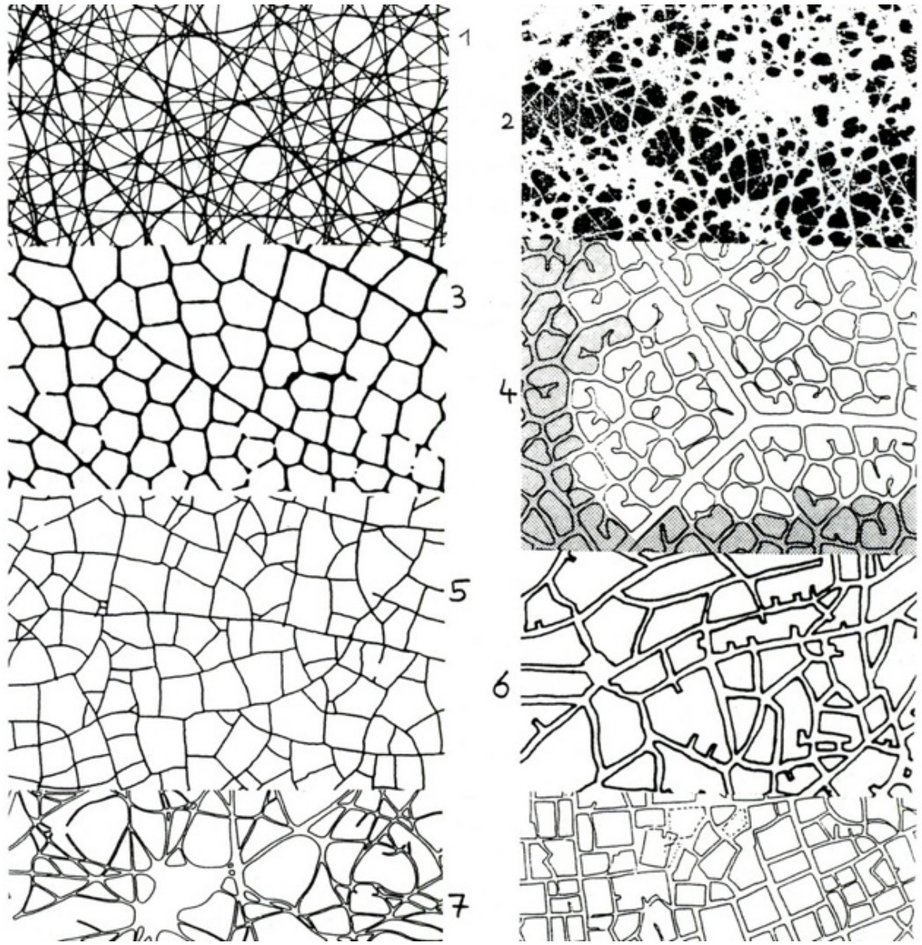


Figure 2.03 **Processes of connection. From Frei Otto, Occupying and Connecting.**

Figure 2.04 **Mediterranean Town Development**

2.3. Self-Organization

Self-Organization is intrinsically tied to emergence. While often spontaneous, it can lead to the development of an organized structure. As explained by Heylighen, this spontaneous creation of a new, “organized whole” from a “disordered” collection of assemblies, is a basic part of dynamical emergence, and it is witnessed in numerous disciplines, such as physics, chemistry, biology, sociology, among others (Heylighen, 1989, p. 4).

Self-organization has intentionally been studied by architects before, perhaps most notably Frei Otto:

> “Typical self formation processes lead to astonishing genetic optimization over the course of time. Processes of change have become so rapid today that current urban-planning theories have been overtaken. But high effectiveness of self-created, in other words unplanned settlements in terms of energy and biology is totally achievable today in natural town and transport planning and leads to ecologically meaningful solutions that are also full of beauty” (Otto, 2009, p.7).

Utilizing this thesis to explore the possibility of an “open architecture for self-organization”, and just how that might be implemented for the facilitation of emergence is elaborated by Bonnitta Roy:

> “The challenge in self-organizing processes, is that we are not used to letting go of old identities and shape-shifting into new ones. We are uncomfortable in the phases of transition, where identities are not yet fixed, or fixed identities

> are being challenged in the process of negotiation. This is why we are so obsessed with fixed roles, which represent past conditions and contexts, while remaining unresponsive to present or future conditions and contexts that otherwise might creatively emerge from the many local interactions between people in organizations" (Roy, 2016).

Furthermore, Roy focuses on the necessity of potential designers' responsibility to facilitate the design of a structure, which via a self-organizing potential is sensitive, adaptive, and most importantly responsive to human values. A structure would provide a strategy, one which would allow for the emergence - facilitated through self-organization. Roy coins this as "open participatory organization", stating that it is possible to design an organization which facilitates specific emergent "locations" which have a resultant "role-identity" associated (Roy, 2016).

Emergence and self-organization may occur separately or in combination, or may drive the development of systems towards new properties, behaviours, organizations and structures. Dynamic processes that unfold over time develop complexity of form and behaviour through the interaction of simple constituents, proceeding without central direction (Weinstock, 2010, p.13). Within architecture and urban planning, it is seldom that we acknowledge that unsuccessful resolution of structures should "collapse", and undergo this further development (Weinstock, 2010, p.12). As humans, when an existing system or organization is not advantageous, we tend to permit a continuation of the current status quo by facilitating a functioning level through the expenditure of energy to artificially keep the system running. This is in contrast to the patterns of natural systems in nature which over thousands of years have continually regenerated and restructured, evolving through self organizational processes to reach optimal functionality. The current state is always provisional, and in flux, adapting to systemic issues as necessary.

2.4. The Notion of the Unintentional

An additional lens to view emergence through is the perception of coming into being, or alternatively, as going from non-existing to existing. This could also mean evolving, moving a system from a less mature to a more mature or advanced state, facilitating a structure that is never static. There is discussion of emergence within numerous disciplines, such as computer science - where Jason Bloomberg elaborates:

> "There's a sense of emergence popular in discussions of emergent architecture: the notion of the unintentional. In other words, there is a spectrum between emergent architectures on one hand and intentional ones on the other, where intentional architectures are essentially pre-planned and on purpose, while emergent architectures are somehow accidental. What most people are apparently trying to say when they use emergent in the context of architecture or design is: by deferring important architectural and design decisions until the last responsible moment, you can prevent unnecessary complexity from undermining your projects" (Bloomberg, 2015).

This introduces the idea of the reluctant architect or designer. By creating certain initial conditions with no particular end state - this brings forward the idea of a more relaxed interpretation on the planning, program, and other design criteria, all allowed to manifest without preconceived notions. This requires an architect who does not control the process of building from start to finish, and delegates a portion of the construction progress to aspects out-

side of their control (Kosec, 2013).

By reconceptualizing the architects role as predominantly facilitating a starting scenario, the architect can pave the way for an architecture based upon the notion of change and emergence. This relaxed (or even reluctant) outlook allows elements to manifest beyond the architects traditional design practice, by aiming to design as less determinant from the outset. This thesis aims to emphasize the understanding that the architect may never truly design emergence, it is simply an advantageous and resilient end goal we can provide the framework for.

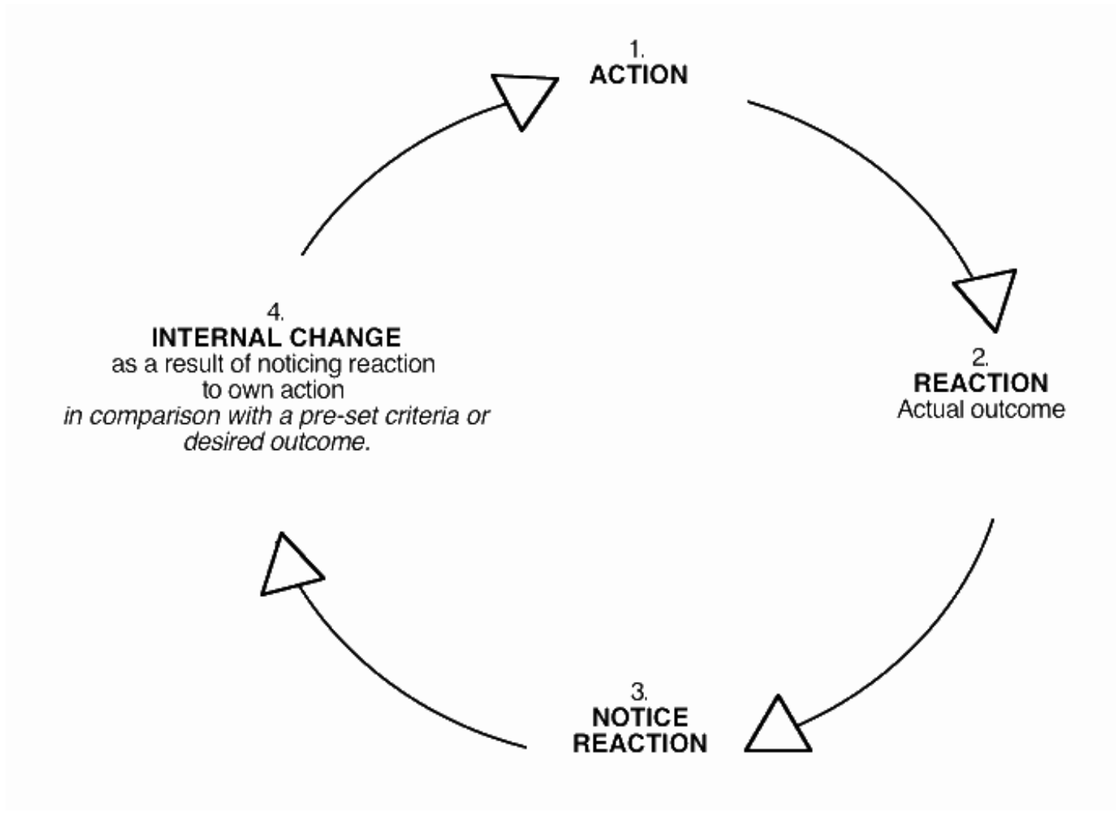


Figure 2.05 **Feedback Loop**

2.5. Feedback

How does novelty emerge? We can think of novelty as the quality of being new, changed, or unusual. Feedback is an essential aspect in a self regulating system. Feedback allows for dynamic responses to stimuli and stressors, and adaptation as a result. Systems regulate through feedback, and this regulation leads to novel forms, or outputs. Output from one interaction influences the next interaction. Additionally, any disruptions to the system can be viewed as signals for potential change.

Thus, feedback within systems plays an integral role in systems management, as any signal can amplify or mitigate a process of change. A system functioning with appropriate feedback in dialogue with its surroundings is essentially having a constant conversation with its environment and subsequent stimuli, constantly ebbing and flowing due to continual dynamic adaptation.

Essentially, the notion of feedback is functioning within the framework of systems, over time, constantly assessing the system and cycling back upon itself to optimistically find the best mutual interconnections and alignments among multiple system agents, or “competing” points of view. Over time, the most beneficial route will be selected, and will become predominant within the system.

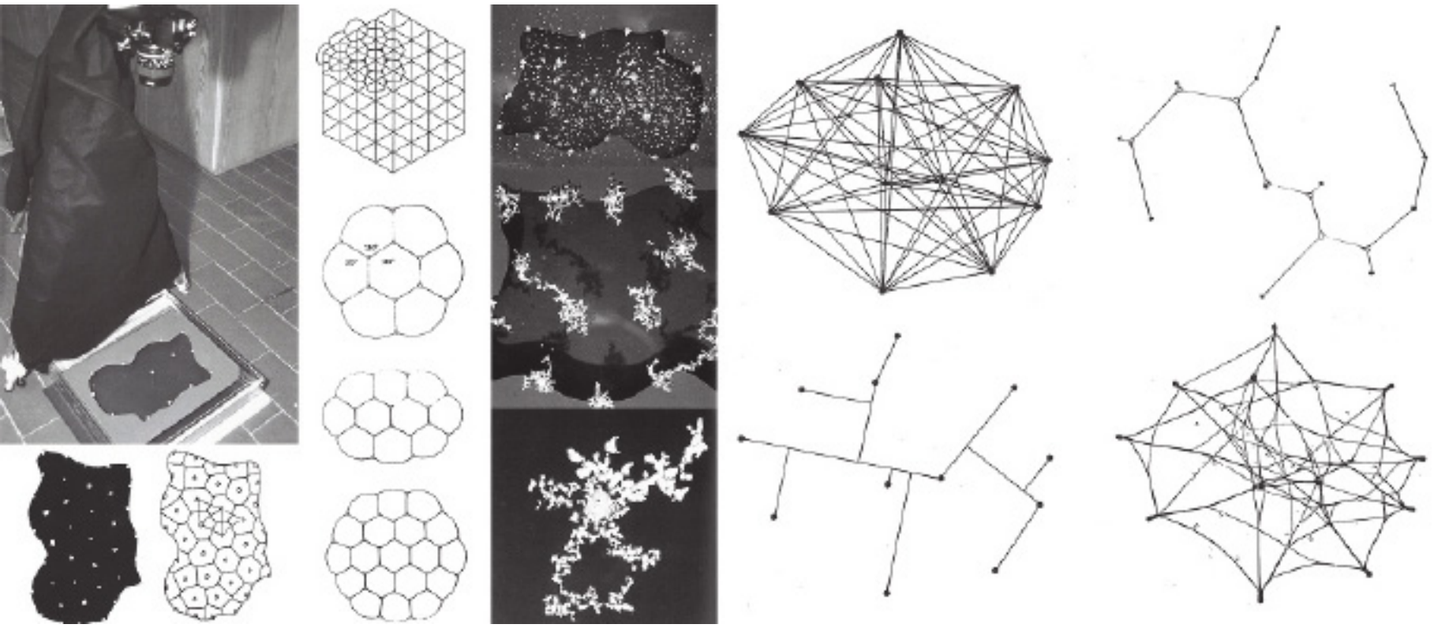


Figure 2.06 **Experimental Models of Self-generating Occupations and Connections.**

2.6. Physical Form Finding Experiments

Clarified by Weinstock et al., morphogenetic strategies for design are not truly evolutionary unless they incorporate iterations of physical modelling. Further elaborated, the importance of developing systems which utilize emergence should be in accordance of exploration into the self-organizing effects of natural form finding. Emergence requires the recognition of buildings not as singular and fixed bodies, but as complex energy and material systems that have a life span, and exist as part of the environment of other buildings (Hensel, Weinstock et al, 2004, p.160).

By researching and emulating successful self-organization in nature, and attempting to understand the processes that shape form, this study of morphogenesis may be beneficial to deciphering beneficial form finding. As explained by Frei Otto, “planning means applying knowledge. Architecture and planned settlements come into being by arranging familiar things. Researching the process of occupying and connecting in nature and technology requires a fresh start, with observations, experiments and the development of explanatory models” (2009, p. 6).

Nets, paths, connections, nodes, occupied areas: these categories laid out by Frei Otto have become study groups for observing self-forming entities. Understanding how nature forms, occupies, and connects itself within our world, could lead to the emergence of new concepts of how to settle, connect, and facilitate architecture in a more successful manner.

Figure 2.07 **1961 ad for Jane Jacobs' Book**

2.7. Organized Complexity

As outlined by Jane Jacobs in the final chapter of her hugely popular The Death and Life of Great American Cities:

> "Thinking has its strategies and tactics too, much as other forms of action have. Merely to think about cities and get somewhere, one of the main things to know is what kind of problem cities pose, for all problems cannot be thought about in the same way. Which avenues of thinking are apt to be useful and to help yield the truth depends not on how we might prefer to think about a subject, but rather on the inherent nature of the subject itself" (Jacobs, 1961, p.428).

Jacobs further elaborates on the importance of new methods for analysis and discovery: new strategies for thinking; puzzles that were once deemed impossible to analyze, became "susceptible to attack." (p.429) Subsequently, Jacobs coins the term "organized complexity", emphasizing the concept of dealing with a problem that involves "a sizeable number of factors, which are interrelated into an organic whole" (p. 432).

As explained by Mathieu Helie, Jane Jacobs had already begun to outline a paradigm for a science of cities - yet perhaps without the developed repertoire of computer science - which has since been able to express and represent the problems of the organized complexity Jane Jacobs spoke of, where formal mathematics at the time of Life and Death of Great American Cities' publishing date failed to explain (Helie, 2018). Jacobs brought attention to the inherent complexity needed for neighbourhood vitality and the difficult nature of singling out system characteristics which are intrinsically inter-

twined.

This leads us to ask: where and how do we even start? How can we arrive at a model that accounts for all relevant systems and details affecting a city or built entity, without averaging or losing emphasis or being biased?

2.8. Top-Down Versus Bottom-Up

Traditionally, the translation of an architectural design and the subsequent building to be all start with a developed plan, which is translated into a construction drawing to give the idea shape. The end result is portrayed even before a single brick is laid, and conceived by the architects usually with a specific style or aim for the design. This process can be referred to the top-down approach to building. The end result will be translated and broken down into the individual components for creation. Potentially more focused on the aesthetic than the enduring functionality, in a top-down approach an overview of the systems may be formulated, but an understanding of the driving subsystems will not be detailed or perhaps even considered. While the schematic design of the building is a piece by piece layer cake, the deployment of a fixed, developed design that is unable to change is where architecture approaches a top-down pedagogy.

Alternatively, the bottom-up approach has a more case by case application to its design, focusing on the desired functionality of the project. Here, the focus is to take small-scale organizations and turn them into large-scale interpretations, piecing together individual elements in order to create something greater and more complex. It is not the creation of a preconceived idea so much as the aim to take the goals for the overall project into consideration. This in turn will determine the scope and manifestation of the final result. Bottom up building is ideal for a more experimental approach to creating, as there is more opportunity to restructure based on contingencies, and the rise of emergence within the design.

While top-down construction is not inherently disadvantageous, or always referring to an ‘archaic’ method of approaching a design project, it can be

thought of a rigid devotion to creating the big picture, as initially intended, and sticking to that idea. In comparison then, the bottom-up approach to design in architecture may be more beneficial, as the design process is flowing, permitting last minute changes and improvements, which would otherwise not be considered in a top-down approach.

Looking to understand the concept of emergence within numerous different disciplines helps to familiarize essential characteristics for utilizing emergence as a form finding technique. This background research helps facilitate the conceptual framework utilized to further the design of this thesis.

SECTION TWO

CREATING A FRAMEWORK FOR EMERGENCE

3 Challenges for Design

While Jane Jacobs spoke of organized complexity in The Death and Life of Great American Cities, she brought attention to the problems within city planning; designers needed to pay attention and start with particulars, observing their behaviour, instead of trying to control for a single variable (Heile, 2012). A formidable problem when studying self-organization and emergence is due to the fact that these systems are incredibly complex, and next to impossible to quantify. It is nearly insurmountable to understand all of the system complexity happening within a region, and may lead to perplexing difficulties attempting to summarize this task on site.

In traditional architectural and engineering design scenarios, elements of a system aim to be controlled, and said system components are outfitted to be stable and predictable. Understanding that complex systems are open systems is important to approach the concept of design as an emergent process. As elaborated by Alberti:

> "... while apparently chaotic there are underlying patterns. Yet, nobody is in control and system functionality emerges from the self-organization of multiple local agents. An emerging built environment, for example, is a cumulative and aggregate order resulting from locally-made decisions involving many intelligent and adaptive agents operating according to diverse preferences and constraints" (Alberti, 2017).

We have historically looked for "stability" in a permanent sense - however

we must understand that permanence and un-changing environments as we perceive them are simply our time-limited perception of stasis (Reed, Lister, 2014). Within a system, stability is never constant, and as such, arguably designing for one fixed, permanent endpoint will not stand the test of time.

3.1. How to Visualize the Emergent Process?

This thesis aims to challenge how we think and approach the concept of emergence within the physical architectural realm. As explained by Holman, we are still learning how to engage with emergence. "We are early in understanding what it means to social systems - organizations, communities, and sectors such as politics, health care, and education. We are just learning how to work with it to support positive changes and deep transformation. Emergence is a process, continual and never-ending." (Holman, 2010).

What is the approach through which we can begin to decode "emergent" properties? And furthermore, what enables our leap into understanding the potential of complex systems, and how this might manifest in a physical construction? As outlined by Reed and Lister, few designers have moved past metaphors and mechanics as learned from ecological models of complex systems into an applicable venture, beneficial to architectural design. Additionally, we have yet to see the incorporation of learned feedback into designs, or to work within any transdisciplinary methods of practice which ultimately could open new exploration into systems (Reed, Lister, 2014).

Therefore, the very act of representing a design for a project that strives to constantly be in flux, and change is a challenge in and of itself. It is perhaps

thinking less of the finalized output represented in this thesis, but more so the framework which will facilitate emergent outcomes which becomes the design the architect can claim responsibility for.

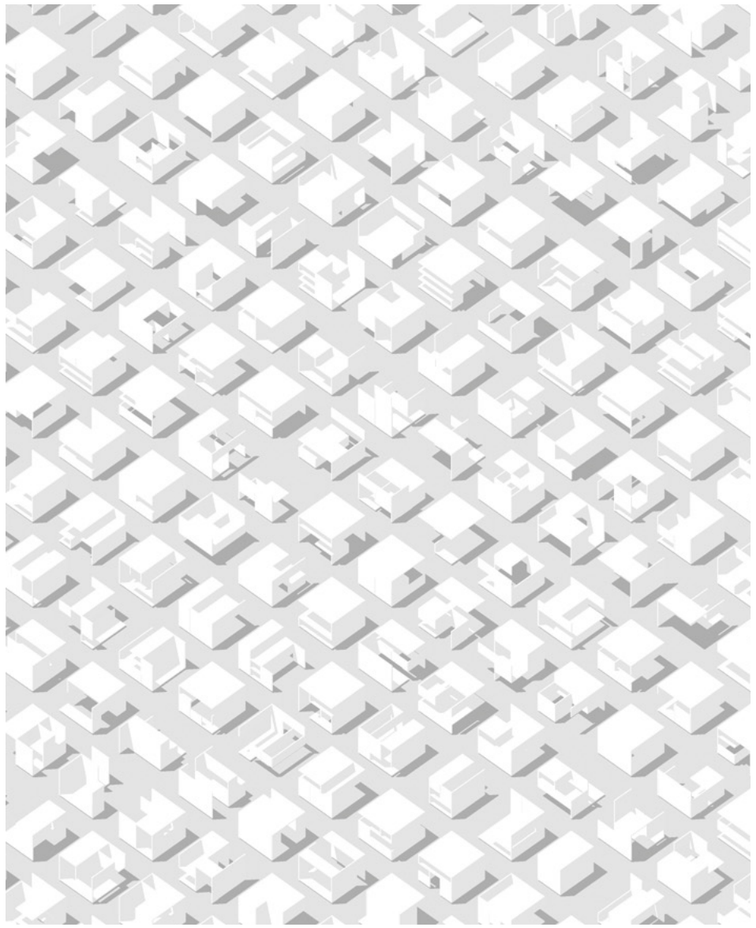


Figure 3.01 **Prototypes**

4 Conceptualization and Application of a Theoretical Framework

This thesis asks how to facilitate an emergent architecture. What is the framework to dive into this task which will help us conceptualize and begun to understand how to decode emergent properties? It is apparent that the numerous theories and background research listed in Section 1 of this thesis document have far reaching capabilities, touching within numerous disciplines. However, to begin to construct how these theories are applicable to architecture requires a further understanding.

While numerous disciplines approach the concept of emergence differently, for this thesis, it is necessary to define the proposed relationships in a clear manner, one that can outline the application of emergence as a form finding technique.

This requires further understanding of how systems theory and emergence have historically been applied to the field of architecture.

4.1. Systems Theory in Architecture

The essence of systems thinking is based around the concept of system wholeness, a concept generated by looking at how the whole emerges from the parts. Thus, a system is a complex being, involving many interconnected elements. These elements can be thought of as “inputs” which may drive the system to a higher order of complexity. Failing to understand that systemic properties are the result of the complex interaction of “inputs” or sub-systems undermines the potential of complex adaptive systems. If we begin to understand the systems influencing architectural design and the emergent potentials, we may produce less rigid, permanent structures with a longer life trajectory. As summarized by architect Mark Miller:

> “Most fifth graders know the natural world is an ecosystem, the economy is a financial system, and getting from A to B across any distance requires an effective transportation systems. While certain existing systems may be extremely logical and clear to us, the application and understanding the inherent intricacies may not be. As designers, architects often function very differently, and definitively. Perhaps it is easier to isolate, to channel analytic methods on specific factors or inputs, to focus on one part in a way that excludes the mess of variables and complexity of a system as a whole. In all institutions, we are historically trained and directed to operate upon parts, not systems” (Miller, 2017).

Technology is not slowing down - our world is full of exploration and rapid change, and this would suggest if our institutions wish to become progressive in today’s day and age - are beginning to understand the necessity of change.

Miller speaks to changes within the educational realm, where educators are shifting to inquiry-based learning approaches, environmental preservationists are embracing multi-dimensional analytics to enable sustainability. This brings to light the necessity for the built environment to adapt in order to accommodate this change technology has brought forward. Miller explains that “architecture should shift from the goal of rigid object creation” and that “systems thinking presents a lens to recognize and see how our built world exists within social, environmental and business realities, which are changing at a rate that traditional architecture can no longer support” (Miller, 2017).

4.1.2. Architects Utilizing Systems Theory

Buckminster Fuller, a successful architect and theorist, was noted for having approached his designs as a systems philosopher (Fuller, 1938). As clarified by the Buckminster Fuller Institute:

> “Synergetics is the system of holistic thinking which R. Buckminster Fuller introduced and began to formulate. Synergetics is multi-faceted: it involves geometric modeling, exploring inter-relationships in the facts of experience and the process of thinking. Synergetics endeavours to identify and understand the methods that nature actually uses in coordinated Universe (both physically and metaphysically). Synergetics provides a method and a philosophy for problem-solving and design therefore has applications in all areas of human endeavour” (Edmondson, 1987).

As further elaborated by Fuller, his concept of synergetics acts as a proponent of Systems Thinking. Thus, synergy is meant in accordance of the behaviour of whole systems, and the fact that their behaviour is not predicted by their parts taken separately. Fuller's concept of Synergetics is interested in the production of the machine as a whole, and not the individual parts. Synergetics by nature was broad, utilizing expertise in various sciences and arts such as thermodynamics, chemistry, psychology, biochemistry, economics, philosophy and theology (Edmondson, 1987).

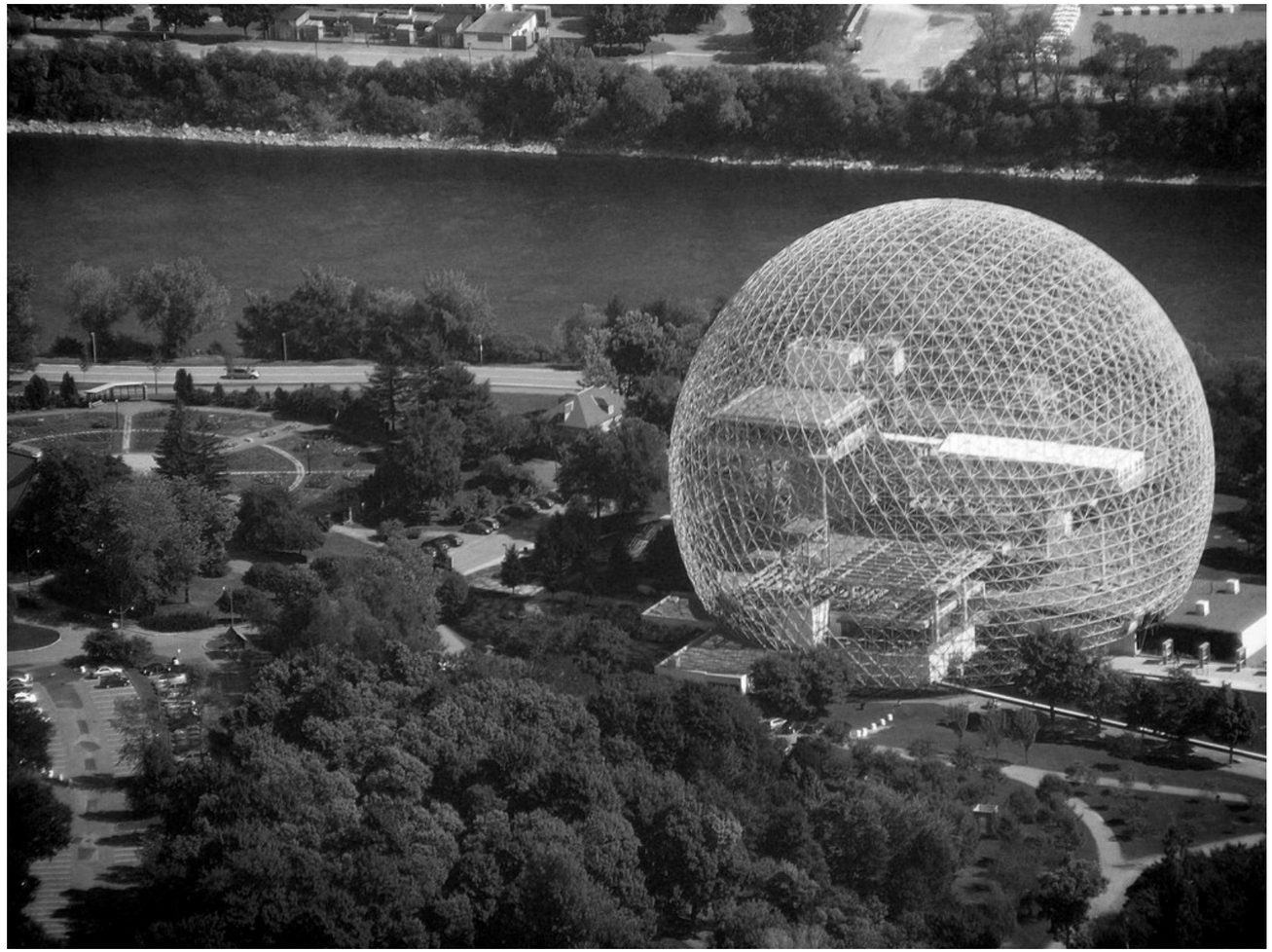
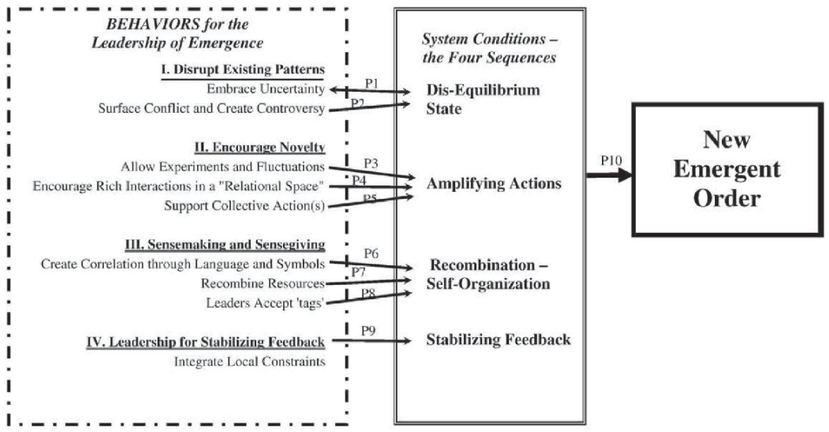


Figure 4.01 **Buckminster Fuller's Montreal Biosphere**

4.2. Emergence Theory in Architecture

The essence of systems theory is possibly best explained by the concept of emergence, where the whole is greater than the sum of its parts. New properties emerge at the level of the whole. This evolving of the new property happens through the interaction of the constituent parts.



Particular behaviours can be pinpointed which may possibly lead to emergence, as outlined by Plowman and Litchenstein in The Leadership of Emergence: A Complex Systems Leadership Theory of Emergence at Successive Organizational Levels. If particular sub-systems interact in a particular and beneficial way, thus leading to behaviours that generate the conditions for emergent behaviour - we can begin to see that interactions of systems which have an effect on the manifestation of new, emergent form.

Figure 4.02

4.3. On Speculative Design

What if? Speculative Everything. If ____, then ____
(Dunne, Raby, 2013, p. 2).

Architects and designers are typically seen as “problem solvers”. In Speculative Everything by Anthony Dunne and Fiona Raby, professors at London’s Royal College of Art, the question is posed: “What if instead of solving problems, [architects] posed them?” Thus, design is a tool that is used to describe possible futures, and question the status quo. Dunne and Raby propose the question “what if”, as an intended opening of debate and discussion about the kind of future people want, and plausibly do not want as well. Speculative Everything outlines prospective results that thinking and questioning the future in such a fashion can conjure up (Dunne, Raby, 2013, p. 2). By being skeptical of possible futures, this debate may open up other possible avenues for design not previously conceived of.

While daydreaming about the future in a speculative way may be critiqued as being too frivolous, not realistic enough, or perhaps generally just too speculative to strictly be design, the questions being proposed help designers articulate the future in a compelling way, and gets people discussing valid questions - this should be regarded as an inquiry, and a pondering of the future. Dunne and Raby attempt to showcase how speculative thinking can begin debate, and reveal choices we may not see immediately, but exist beyond our present day constraints. Thus, design could be coined as a “catalyst for social dreaming, collectively redefining our relationship to reality” (Dunne, Raby, 2013, p. 2).

The fictional nature of speculative futures stem from a what-if question, and

are intended to open up spaces for debate and discussion. There are by virtue, provocative, and fictional. This fictional nature requires viewers to suspend their disbelief and allow their imaginations to wander, to momentarily forget how things are now, and wonder about how things could be (p. 3).

Dominant forces which shape our cities and architecture of the past are being replaced by technologies, systems, and networks. Acknowledging this, the architect needs to change their method of practice. Speculative architect Liam Young of the Strelka Institute in Moscow claims that architects need to intervene in these systems beyond shaping the physical building. By doing so, speculative architects will primarily create narratives on how this change in

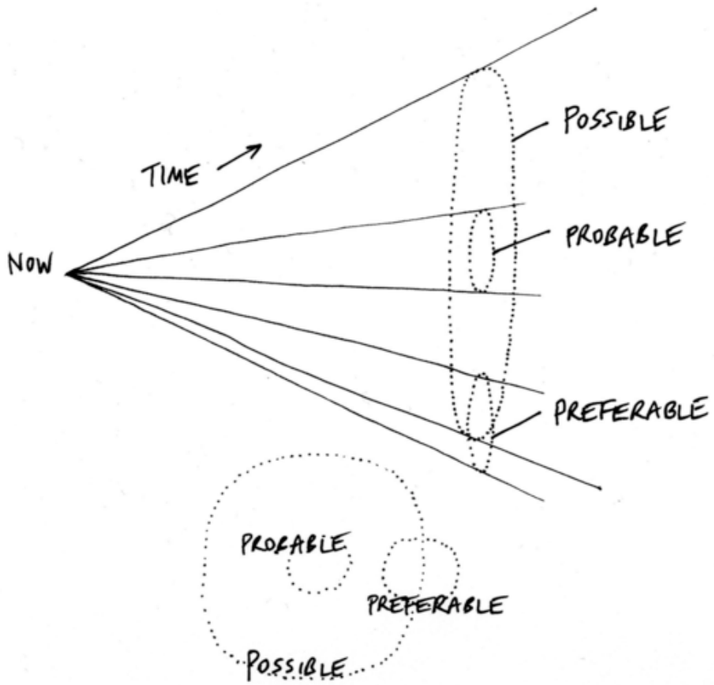


Figure 4.03 **The Cone of Speculation**

technology, systems, and networks influences space, culture and community. Ultimately, speculative architects "try to imagine where new forms of agency exist within the cities changed by these new processes" (Babkin, Young, 2017).

Perhaps this seems far fetched, however, is speculative architecture something radically new? Liam Young argues that the tradition of architectural practice has been speculative for much of its existence. An example given is then fact that a huge amount of architectural competition entries are never manifested into a real legitimate entity. We can also argue that architecture has a long history of unbuilt projects, where groups such as Archigram, and their activity in the 1960s was influential without physical construction. Archigram was partially responsible for an entire cultural shift from "thinking of architecture as something massive, big, and permanent, to something that could be flexible, disposable and temporary" (Babkin, Young, 2017).

Liam Young further discusses the important notion of "megastructures" in speculative architecture. Young relates a megastructure not as a big continuous building, but rather an expansive wide-spread network. This network interrelates all processes utilized and affected to bring this speculative entity into being:

> "We have to consider it to realize the conditions that construct our experience in the modern city. In order to truly understand a site in a contemporary sense, we should no longer think only about a point on a map, but about network conditions. That is a new form of site. So, an architect making something now needs to site their work within these megastructures and start to design within them. It is a designing relationship that occurs across multiple sites and multiple temporalities" (Babkin, Young, 2017).

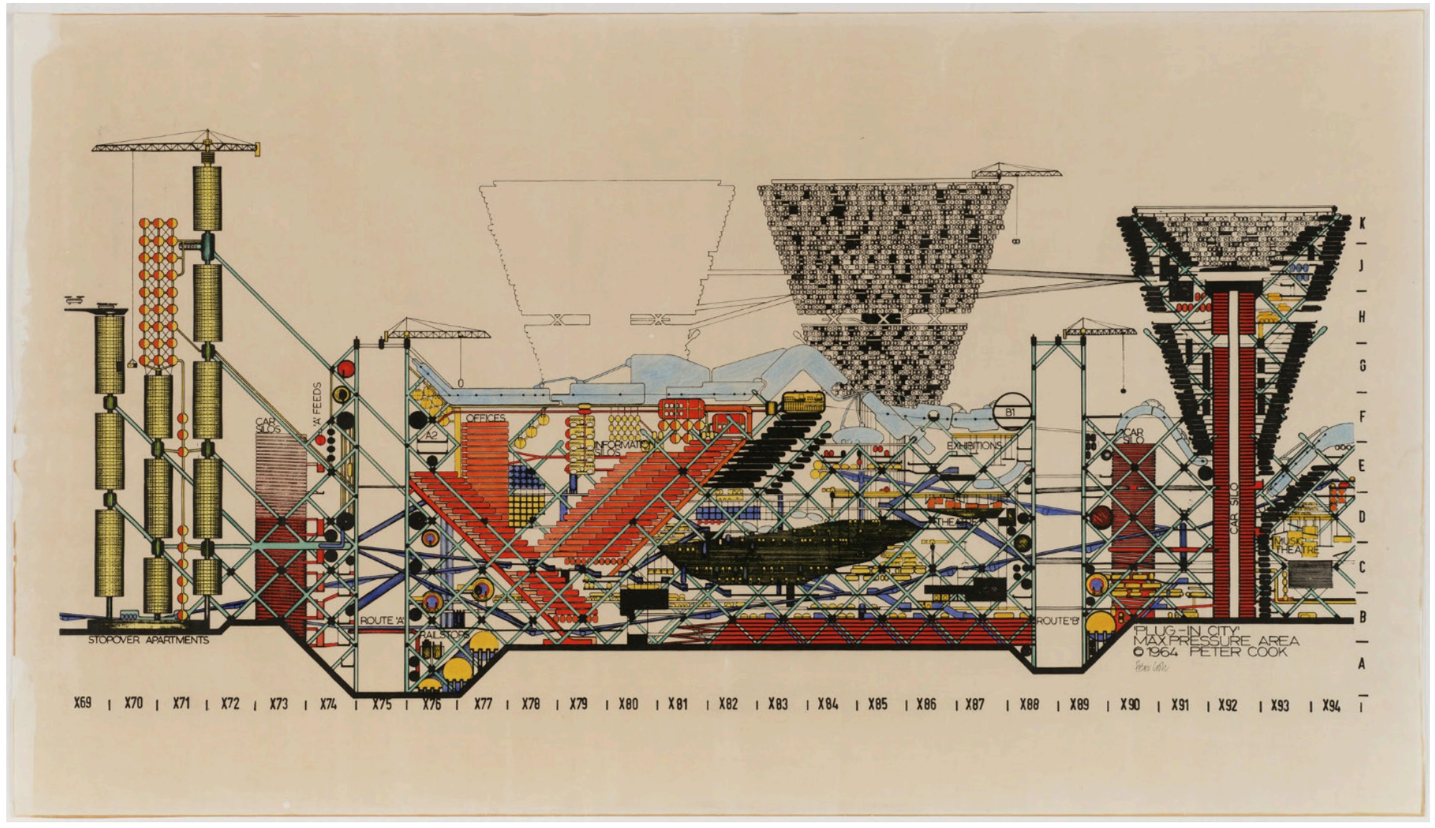


Figure 4.04 **Peter Cook: Plug-in City**

Archigram (of which Peter Cook was a founding member) were a radial group of architects producing visionary creations in the 1960s.

Plug-in City was designed as a megastructure which was to encourage change through obsolescence; constantly changing with removable sections, and designed for continual rebuilding.

- Bevin Cline, 2002, p.142

Figure 5.01 **Mies van der Rohe, Crown Hall Model**

5 Site of Speculation: The Illinois Institute of Technology

The Illinois Institute of Technology (IIT) is a private university situated in the south side of Chicago. The campus is synonymous with Mies Van der Rohe and many of his ideals, such as extreme minimalism - which is often stated through his trademark “less is more”. The master plan of the campus, as conceived by Mies and Ludwig Hilberseimer, is based on a 24’ x 24’ grid, with a module height of 12’. These modules were used to rationalize the spatial organization of the campus, as well as to guide structural placement. It was stated by Mies that “orderliness was the real reason” for his adoption and widespread rigour to IIT’s grid (Perez).

These regimented grid dimensions were determined from the hypothesized typology of rooms to be facilitated on campus - mainly classic classrooms, drafting rooms and laboratories. The logic was determined by typology of furniture deemed necessary in each room to be created. The logic grew, and then became a reverse logic for planning the growth of the campus; such that furniture determined room size (according to typology), which determined size of the resultant building, which together spatially following the Miesian grid, created the campus layout (Perez).

Mies’ architectural style and campus plan was facilitated by extreme clarity and simplicity. The IIT campus became indebted to the grid, both the larger logic of space allocated between buildings, and continuing through to the internal space. During his 20 years as director of the department (1938-58), Mies focused his efforts on the creation of “universal spaces”, of which open

concept interiors were situated within regimented, clearly arranged structural frameworks. In the case of numerous Miesian buildings, and certainly the IIT campus - these buildings featured prefabricated steel members enunciated with large sheet glass elements. The international style associated with Mies, having origins in the German Bauhaus began to be an accepted model for building in American cultural and educational institutions. The IIT campus is a true testament to this strong willed ideology of this time in history, as the campus grew to contain 20 works by Mies, clearly enunciating Mies' ideology (Perez).

Furthermore, Mies' vision and projects became revered, and Miesian Architecture to this day is highly regarded. While Mies' designs are readily critiqued as singular projects - little discussion has been published on whether the design decisions implemented during the birth of IITs (still utilized) master plan have withstood the test of time. It is almost as if IIT today is a crystallization of a world view from a previous moment in time, never adapted, hardly changed or questioned. It simply appears to be sitting there, unsure of how to step forward, with paralyzing trepidation.

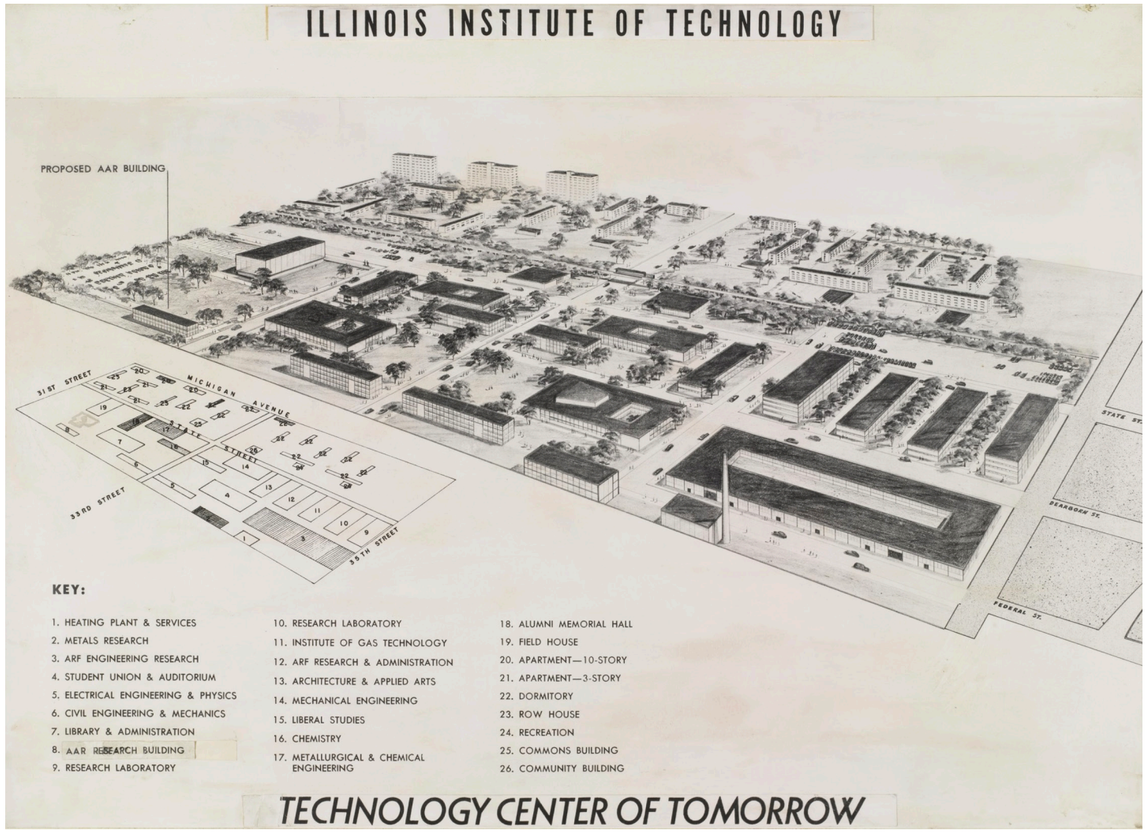


Figure 5.02 **IIT Master Plan, Illinois, "Technology Center" c. 1942-46**

5.1. History of the Illinois Institute of Technology

The inherent complexity currently residing within and affecting the IIT campus stems from a varied history that began even before Mies was appointed to design the current master plan we now know. Looking at the history of the neighbourhood, the campus integration, and current outlook can help us begin to think about some of the following questions: How did the IIT campus come into fruition? And why is it pressurized to maintain its original integrity?

Cities - let alone smaller urban design entities such as the expanse that is the IIT campus - are incredibly complex, layered and textured. The current history embedded within the IIT campus is facilitated by day to day activities, and student interaction - however we can be blissfully unaware of the history of the site, and the processes through which the IIT campus came into fruition. “There is a contradiction between the way we often look at and act in our cities as though they are timeless and without any history, and the important roles that time and history play in setting the stage for our actions.” We must be aware of the impact history has on a campus such as IIT, and how this sets a stage for our actions going forward (Robbins, El-Khoury, 2013, p 3).

By 1940, The Illinois Institute of Technology was created through the merger of the Armour Institute and the Lewis Institute - the latter being a west side Chicago institute offering liberal arts, science and engineering courses, founded in 1895. The merging of The Armour Institute and the Lewis Institute called for a new master plan. Mies van der Rohe had arrived in Chicago in 1938 (after the closing of the Bauhaus) with the understanding he would restructure the curriculum of the architecture school; however, soon after, Mies was awarded the commission to redesign the campus and its buildings, an unprecedented offer to design a university.

Figure 5.03 **Illinois Institute of Technology, Mies van der Rohe, 1940**

Mies was tasked with the expansion of IIT's campus, upon the merger of the Armour and Lewis Institute. The original allotment could not accommodate the growing institution. This expansion of IIT was facilitated in Chicago's Near South Side. Historically the area was of high African American population during the great migration north after the Civil War. The tabula rasa which was facilitated for IIT caused a huge displacement of what had been known as the bustling Bronzeville neighbourhood, home to many African Americans coming seeking a new life up North. The obliteration of the Bronzeville neighbourhood is apparent in Mies' presentation collage techniques. This tabula rasa erased 100 acres of one of Chicago's densest and liveliest neighbourhoods, in order to facilitate a much lower density campus. It is not difficult to understand this superimposition, with a quick glance of these simple collages, almost as if the campus was overlapped, with no consideration of what was originally residing on the land (Whiting, 2004).

5.1.2. Bronzeville and the Mecca Flats - The Preexisting Culture of Chicago's South Side

Bronzeville is known as the "Black Metropolis" and the "Black Belt", and is considered the centre of African-American history on Chicago's South Side. The beginning of 1916 marked the commencement of the Great Migration, when African Americans left the South, and headed towards Chicago where there was a promise of less oppression and better job availability (Bean, 2019). However, a harsh reality - this promise fell short, and conditions were still segregated and repressed. The area in which African Americans were forced to live through restrictive covenants upon arrival in Chicago was dubbed the Black Belt - these were white owned housing that became dilapidated and

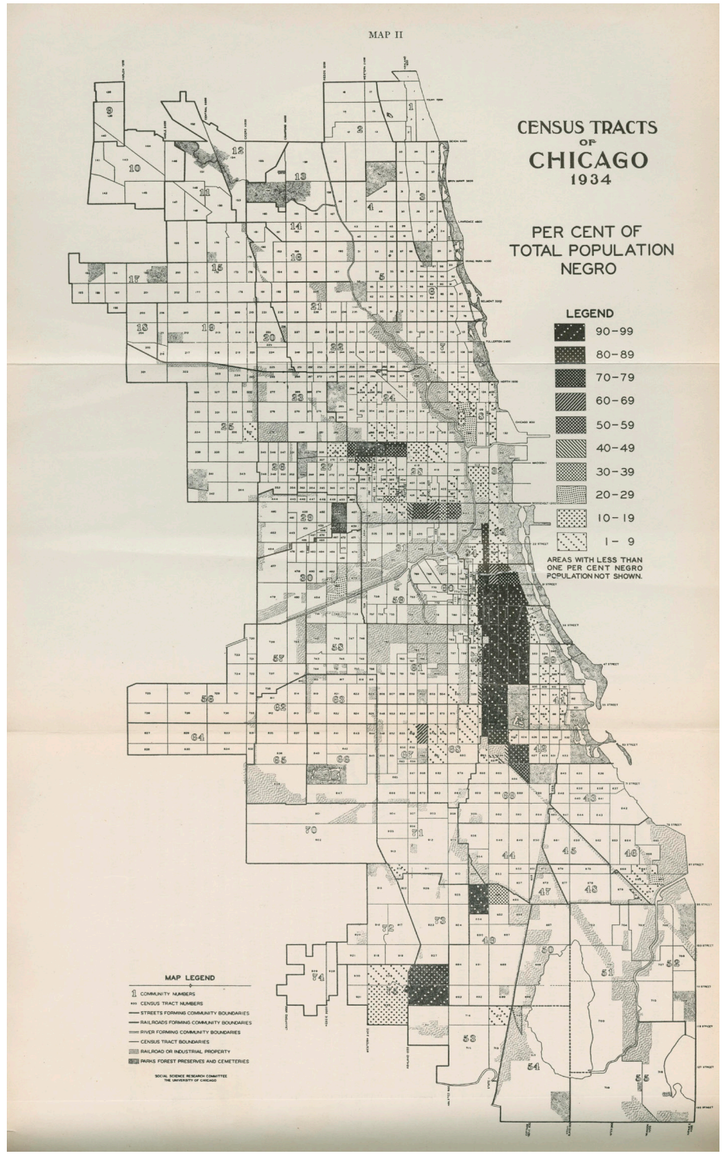


Figure 5.04 **Census Tracts of Chicago, 1934. Bronzeville located within the 90-99 percent location on Chicago's South Side.**

densely populated (Whiting, 2004).

One region of interest within the Black Belt was the Mecca Flats. This housing structure historically resided precisely where Mies Van der Rohe's S.R. Crown Hall, IIT's school of Architecture is now situated. Originally constructed in 1892 to house white visitors to a World Fair, the Mecca flats is a prime example of rich Chicago history erased by the Tabula Rasa of the IIT campus. This housing complex preceded the university campus by nearly six decades. Historically, State street was a line of racial division in the south side of Chicago, and the location of the ornate building was perilously close to this division line - white residents were located to the east and African American residents to the west. This over time permitted the movement of African Americans into the Mecca flats, and a sense of community flourished in the Bronzeville neighbourhood. Bronzeville's residents worked hard together to produce a sense of community and institutions that did not fall to racial restrictions which were enforced elsewhere within the city of Chicago (Altshuler, 2018).

This resulted in what was described a vibrant area, "jammed with black humanity", with the Mecca Flats situated right in the middle of an entertainment strip on State Street. Eventually, "As the building fell into disrepair, IIT purchased the Mecca and spent 15 years fighting with residents and housing advocates who opposed the university's plan to demolish the structure as part of the expanding campus. The Mecca was finally demolished in 1951" (Altshuler, 2018).

A large swath of history of the near south side of Chicago was effectively erased at one time with the implementation of the IIT campus. The forced exodus of this once vibrant urban area, produced a large diaspora of the original tenants throughout the city. Looking to the original representational collages of the master plan of IIT, it appears as a large sweep of open landscape situates itself upon a completely unsuspecting neighbourhood of high

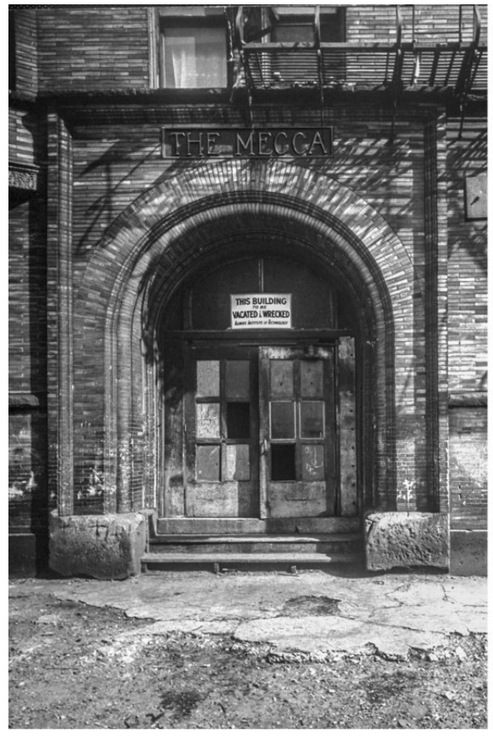


Figure 5.05
Figure 5.06
Figure 5.07 **The Mecca Flats**

density - an area that was essentially row houses. This was a form of urban renewal that has resulted in a complete transformation of this area.

The example of the Mecca Flats helps contextualize the influence the systems that once were in play could have had on the direction of new development on the land which is now the IIT campus. Additionally, according to the Mies Van der Rohe Society at Illinois Institute of Technology: "The campus excels in defining the relationships of campus to city, buildings to campus, and voids to buildings." However, it appears that the systemic drivers of the historic Near South Side of Chicago were hardly taken into consideration with the design and deployment of IIT. This transformation from residential to institutional severed numerous relationships, and acted as a clean slate, hardly being influenced by the surrounding systems at work.

Figure 5.08 **Regal Theatre, Bronzeville**

5.2. Critiques of the Illinois Institute of Technology

A critique of the IIT campus can be read from Rem Koolhaas' perspective in response to Miesian architecture, especially as a present day architect attempting to traverse into the adaptation paradox plaguing the campus; Mies' legacy, pedagogy, and attention to detail has become so revered and engrained within the campus, much of any adaptation to his pure forms is met with resistance and likely contempt. Koolhaas' work with OMA questioning and developing a drastically new design for the IIT campus is a clear example of attempting to drive the campus in a different direction.

Koolhaas touches on the concept of loyalty in his article Miestakes published in a+t 23. New Materiality. He opens his article, clearly stating "I do not respect Mies, I love Mies. … Because I do not revere Mies, I'm at odds with his admirers." Koolhaas pens this response to an article written by John Vinci, Adjunct Professor at the Illinois Institute of Technology, published in the Chicago Tribune.

Vinci questions the integrity of Koolhaas, and whether his designs should be permitted to attach to Mies Van der Rohe's award-winning Commons Building, furthermore suggesting by doing so would "alter the existing in such a way that it is no longer retains its pristine and elegant symmetry." Furthermore, Vinci claims this renovation is ironic, suggesting that while the city of Chicago's historic and architectural monuments are for the most part flagged for preservation, the act of imposing OMA's design on the IIT campus is an issue to become upset over. This, he claims, is architectural vandalism (Vinci).

Furthermore, Koolhaas critiques Mies on his lack of contextual influence on his designs. "Mies does not design individual buildings, but a formless condition that can manifest itself as building anywhere, be (re)combined in an infinite number of configurations." He points to the modularity of the IIT campus, that this could imply extension and revision, yet they choose to exist in an almost limbo, "hovering between recessive foreground and prominent background." (Koolhaas).

"In its current form, Mies' IIT is marooned. The true crisis of IIT is not its relative neglect but the disappearance of the city around it. This brutal cancellation has turned the campus into a metaphorical tabula rasa surrounded by a real tabula rasa; the disappearance of the city has pulled the rug out from underneath Mies" (Koolhaas).

Figure 5.09 **Mies van der Rohe and Rem Koolhaas**

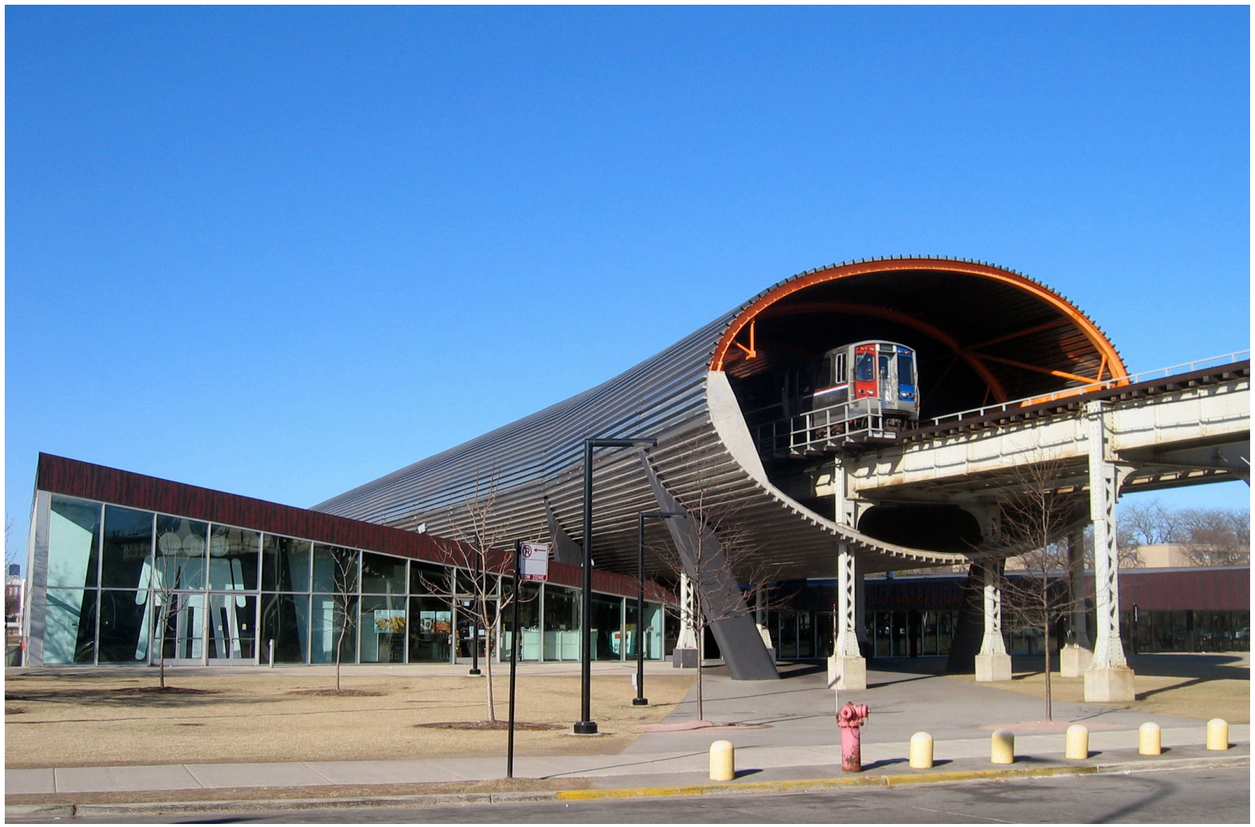


Figure 5.10 **OMA's McCormick Tribune Campus Center**

5.3. Reason for the Selection of IIT as a Testbed

The Illinois Institute of Technology consists of the greatest concentration of Mies van der Rohe designed buildings anywhere in the world. The problematic nature of the IIT campus currently stems from the inability of the institution to "seamlessly evolve", while it appears to maintain loyal to the original, implemented Miesian ideals, prohibiting progressive enhancement. This stagnation becomes apparent upon visiting the campus; the questionable respect and loyalty to Mies' pedagogy has left the IIT campus static and limited. Furthermore, the campus has been described as an "autonomous island that disregards its physical and social context" (Whiting, 2013, p. 81). This blatant original disregard for the surrounding context has facilitated this continuing dissociative state from the surrounding Chicago neighbourhoods.

The slow demise of appearance and general lack of upkeep of the IIT campus - in spite of the legacy of Mies - suggests that there is a general problem with the way in which the systems are permitted to work within the university. Mies' legacy has drastically impeded change upon the campus, and any new structure that has been built has experienced a huge amount of speculation and criticism (examples being Rem Koolhaas' new McCormick Tribune Campus Centre).

The inability for the university to react to societal, educational, and institutional amongst other pressures has essentially frozen the university as it existed 50-plus years ago. This crystallization in time showcases the inherent problems with this preservative way of thinking, highlighting the problems from not paying creedence to a system of dynamic feedback. Thus, the absence of systems thinking is showing the some of the major reasons for lack of development, change, or positive growth for what should be a bustling university.

Thus, understanding that IIT is being strong held by heavily controlled top-down (Miesian) strategy, we can acknowledge and critique the inhibitive nature of too much precision and determinacy of the architect, loyal subsequent users adhering to Mies' ideals, and the strive for permanence that resulted in an inability to change or adapt. Analyzing these qualities of IIT makes the university a good test bed for a thesis exploring the possibilities of systems thinking, emergence, and being speculative about future scenarios upon the campus.

5.3.1. The Cultural Influence of Mies Van der Rohe

This leads us to the following particular questions: What exactly is the cultural influence of Mies van der Rohe? And how has this affected architecture and development on the IIT campus going forward? Additionally, what precisely is so honoured in Mies' work that we are unwilling to let the campus evolve over time?

As previously stated, Mies' cultural influence and history has been restricting architectural change upon the IIT campus, and as such, this specific situation of the existing buildings upon the campus can be regarded as an example of a top-down approach, inflexible to change. Mies' works developed into a new level of simplicity and rationale, and he is well known for pioneering the use of extensive glass in building. Mies' architecture is profoundly ideological, rational, and known for its pure geometry. As a result, Mies played a large role in the development of the new style of modernism (International Style); Mies became highly influential in the 20th century, and had a huge affect on this enduring architectural style (Stott). Mies' minimalist style became so

popular; his famous statement of "less is more" has been widely adopted, and utilized by people who may not even be aware of its origins. As outlined by Stott:

"Mies began to develop [the modernist] style through the 1920s, combining the functionalist industrial concerns of his modernist contemporaries and an aesthetic drive toward minimal intersecting planes - rejecting the traditional systems of enclosed rooms and relying heavily on glass to dissolve the boundary between the building's interior and exterior" (Stott).

Mies' design practice focused upon structure striving for minimalism, and the use of glass and steel. This in turn highly influenced architects and design to come in 20th century.

Mies van der Rohe was also well known for his artistic collages and montages, and his own unique pproach to architectural conceptualization and representation. These works are compositions which favoured heavily upon white space; embracing minimalism, light line work showcasing perspective grids, and elements assembled within the vignette. These collages were restrained and methodical, and as such could be thought about and assessed in a similar manner to Mies' built works.

As critiqued by Koolhaas in Miestakes, Mies' vision as shown in collages and models were shown without much context, arguably done, as Rem describes, to "support [Mies'] campaigns" (Miestakes). Lack of contextual influence implies perhaps Mies' viewed his work as not affected by the immediate surroundings, therefore, these designs could be compelling situated nearly anywhere. Koolhaas states "it is the beautiful ambiguity of the IIT Campus that the status of its built substance oscillates between object and tissue, that its modules imply potential extension yet end emphatically" (Miestakes). It could be argued that Mies' method of representation within his collages lend to the idea of placelessness, layering, juxtaposition, and remixing, all of

which configures the project or the city. As a result, these collages and montages can be thought of displaying a juxtaposition between the coexistence of continuity and new beginnings (Frohburg).

The scale in Mies' drawings are often kept ambiguous, and by doing so the "collage is able to maintain a dynamic relationship between the presence of form and the spatial field, captivating the beholder again and again. Through this restless shifting of perceptions and by dissolving familiar relationships Mies van der Rohe relays the sensation of uncertainty in space and time. The beholder is drawn into the ever-expanding pictorial space of the new architecture and into the maelstrom of modern life" (Frohburg).

Why is it then, that these collages as depicted by Mies - are suggesting the opposite of what is happening on the IIT campus? As discussed previously, with the arrival of the new master plan of IIT, little layering, juxtaposition, and remixing was being permitted, and Mies favoured more of a true urban renewal. IIT has not been viewed as a juxtaposition between continunity and new beginnings; there has been little permittance for an ever expanding scene, or a shifting of perception within the IIT campus.

Mies is often quoted as stating: "architecture is the will of an epoch translated into space" (Van der Rohe). Until we understand this time sensitive manner, all new architecture will be unsettled and questionable. If we attempt to apply this thinking to a new design method, or a new architecture - arguably the current architectural designs we preoccupy can be thought of as uncertain, tentative, and to be determined. Our past architectural designs, too, were a chaos of undirected forces - and the outputs at certain times are bound to their own time stamp; buildings focused, shaped and moulded by the stressors at that time. Therefore, as such, buildings historically have been characterized by their own time frame, yet seldomly adapting, evolving or understood to embrace change going forward, in an attempt to always be current and "time-sensitive".

Mies' use of modern materials such as plate glass and steel, the creation of open and free space can be summarized through his expression "less is more". While Mies delivered the architectural body, the creation of a building's soul, however, was the requirement of the occupants of the building. Thus, the occupation over time should be expected to shift, and if we deliver an architecture anticipatory of change, a building could be responsive to a shift in system requirements, and the resultant deliveries.

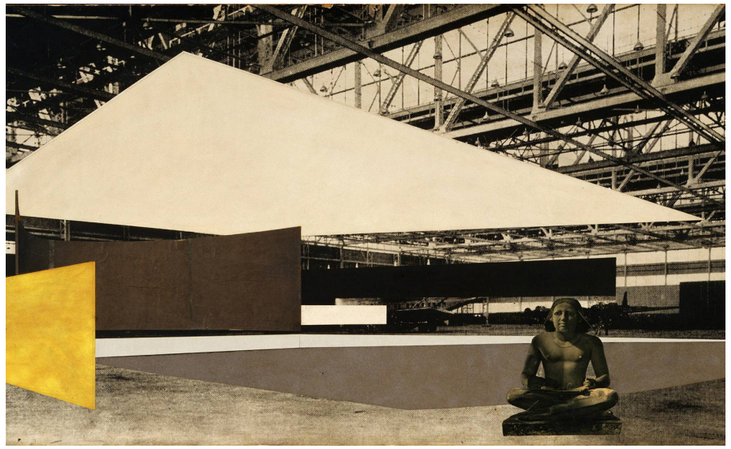


Figure 5.11 **Interior perspective of Project for Concert Hall, 1942, by Mies van der Rohe**
Figure 5.12 **Perspective of living room through the south glass wall of the unbuilt Resor House project (Jackson Hole, Wyoming), 1937–1941, by Mies van der Rohe.**

5.3.1.2. Mies as Both Top-Down and Bottom-Up

While the architecture in the context of IIT may never be strictly either top-down or bottom-up in fashion, there are elements of both schemes we can engage with, and critique by using this campus as a test bed. While Mies' campus development was drastically different from other universities typical overall plans of quadrangles and radial development, the overall grid module denotes a relatively understandable method of building deployment and rules. Since the realization of the masterplan, there has been nearly no development, even though the interstitial gridded space may suggest future development or emergence could one day strike, even if it simply has not. Continuous change is an inherent implication of the master plan, however, it simply has not been permitted.

Thus, Mies' prototype for designing a new University typology revolved around three elements which have become the norm over the decades following: the demolition of buildings to create a Tabula Rasa for new development, the lack of adherence to the street front, and the injection of new buildings that are treated as objects (Postwarcampus). Additionally, Mies took a drastically different step from the fabric of the 19th century city and the quadrangular, neo-gothic campus of the University of Chicago.

The self reliant, lack of contextual acknowledgement, and definitive, little to no evolution marks the IIT complex as relatively top-down in nature. The site itself, however, encourages emergence in other ways. The grid based module was a 3-dimensional planning tool - and was denoted as important to Mies as it was a guiding principle that determined future buildings, and assured that buildings would not be facilitated in a haphazard way. As outlined by Detlef Mertins, the module was also viewed as allowing for flexibility in that Mies found that several different program types worked well within the

constraints of the module. It was also conceived as in anticipation of both technological needs fluxed, and for future expansion (Mertins). If this is the case, there were elements of emergent potentials embedded in the original scheme by Mies, yet over time, it appears this evolution not been able to manifest, and emerge.

This suggests that perhaps Mies' intention for the IIT campus was more bottom-up than the current campus demonstrates - however it is the inheritors of the university which have instilled the notion of being adverse to change. This can be thought of as resistance of the bottom-up concept. The perpetual cultural influence and legacy of Mies has acted as a building "lock", ensuring the crystallization of the buildings as they were upon conception, seldomly embracing or mitigating change on campus.

Additionally, one could argue that the program within cultural and educational buildings are more prone to the shifting and changing of significance, as logically, educational programs change, teaching style evolves (the digitization of resources, and the use of technology in the classroom), and enrollment demand in programs ebbs and flows. Since IIT consists of educational programming, understandably this program could be thought of as changing more than other Miesian commercial or residential buildings. We can think of how this influences IITs lack of flexibility and how this is problematic - the way universities function today is not the same as it was 50 years ago. Over time, universities are becoming less about traditional lecture style teaching, and more embracing of other platforms for teaching. Students are able to attend classes, workshops, or embrace experiential learning, and as a result, require different types of physical space upon the campus proper. Is this the "campus" of the future?

In comparison, alternative universities are often active on the procurement of new land, new buildings, and expansion of program, and further still, often embrace the diversity of numerous architects' visions in the development of

new buildings facilitated around existing master plans. A prominent example of such would be Massachusetts Institute of Technology (MIT) campus, where over the years, some of the world's best-known architects have contributed buildings across the site, ranging in styles including neoclassical, modernist, brutalist, and deconstructivist (Howarth). This invitation and inclusion for innovative design and implementation of numerous styles upon the MIT campus is drastically different treatment than the criticism OMA's McCormick Tribune Campus Center has received once it was perceived as infiltrating the Miesian ideals and campus structure. MIT facilitates diverse campus design, with a perceived embracing of building diversity and change over time.

Understandably, expansion on the IIT campus was possible, it was just not perceived as allowable. Mies' grid suggests and encourages emergence and development, yet the campus appears stagnated, and lacking the ability to adapt.

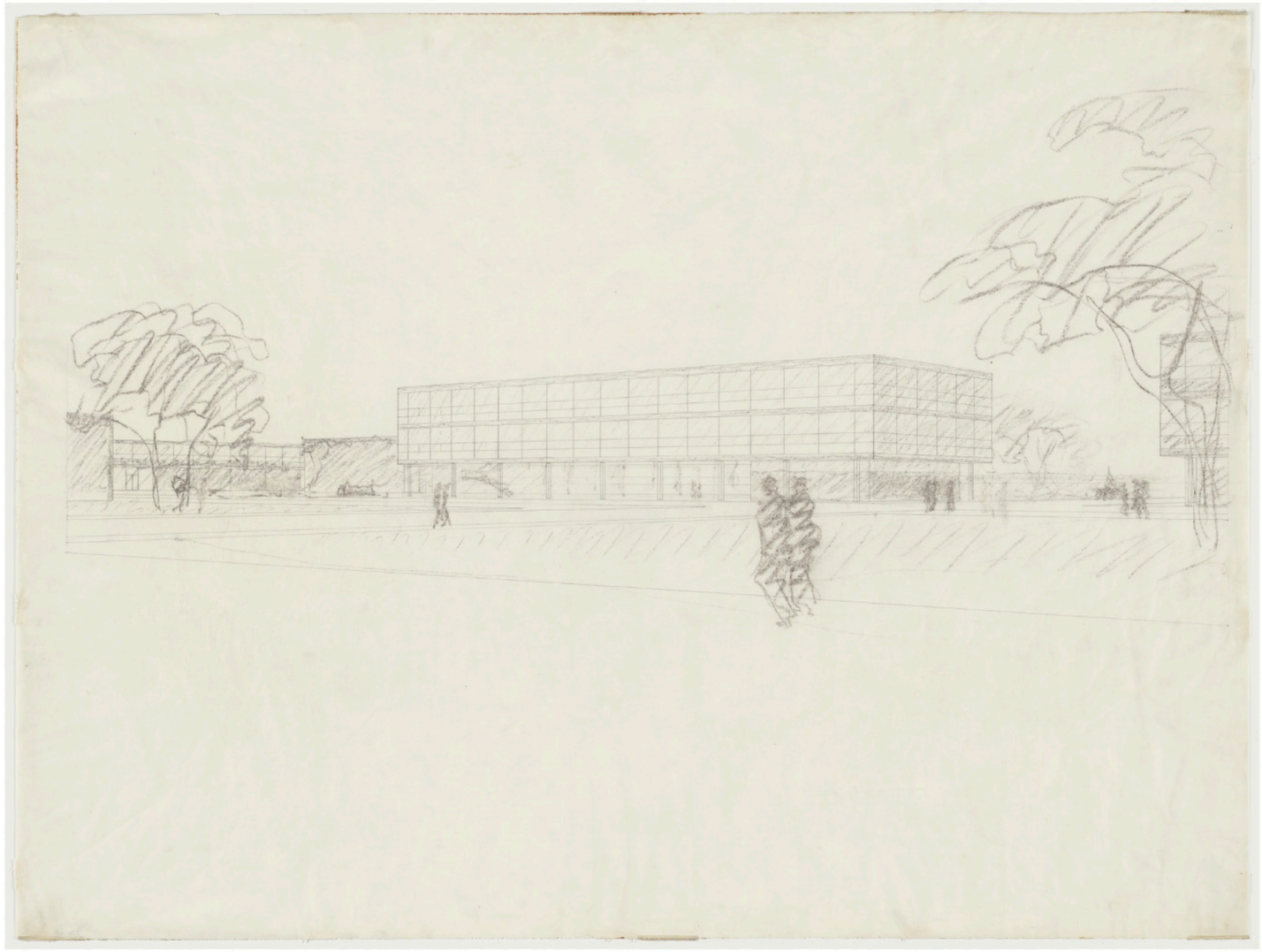


Figure 5.13 **Ludwig Mies van der Rohe**
Illinois Institute of Technology, Chemistry Building (Wishnick Hall), 1945-46

6 Rationale for a Speculative Framework

Moving forward with the interconnected theories, a subjective visual framework was developed for how to interpret the connectivity between research and deployment of a scheme.

By attempting to understand and harness distinctive inputs, and understand how these might lead to new emergent potentials, the user can then speculate upon what physical manifestation may arise.

For this exercise, what was stated as progressive or conservative speculation was utilized, to help direct brainstorming of emergent potentials.

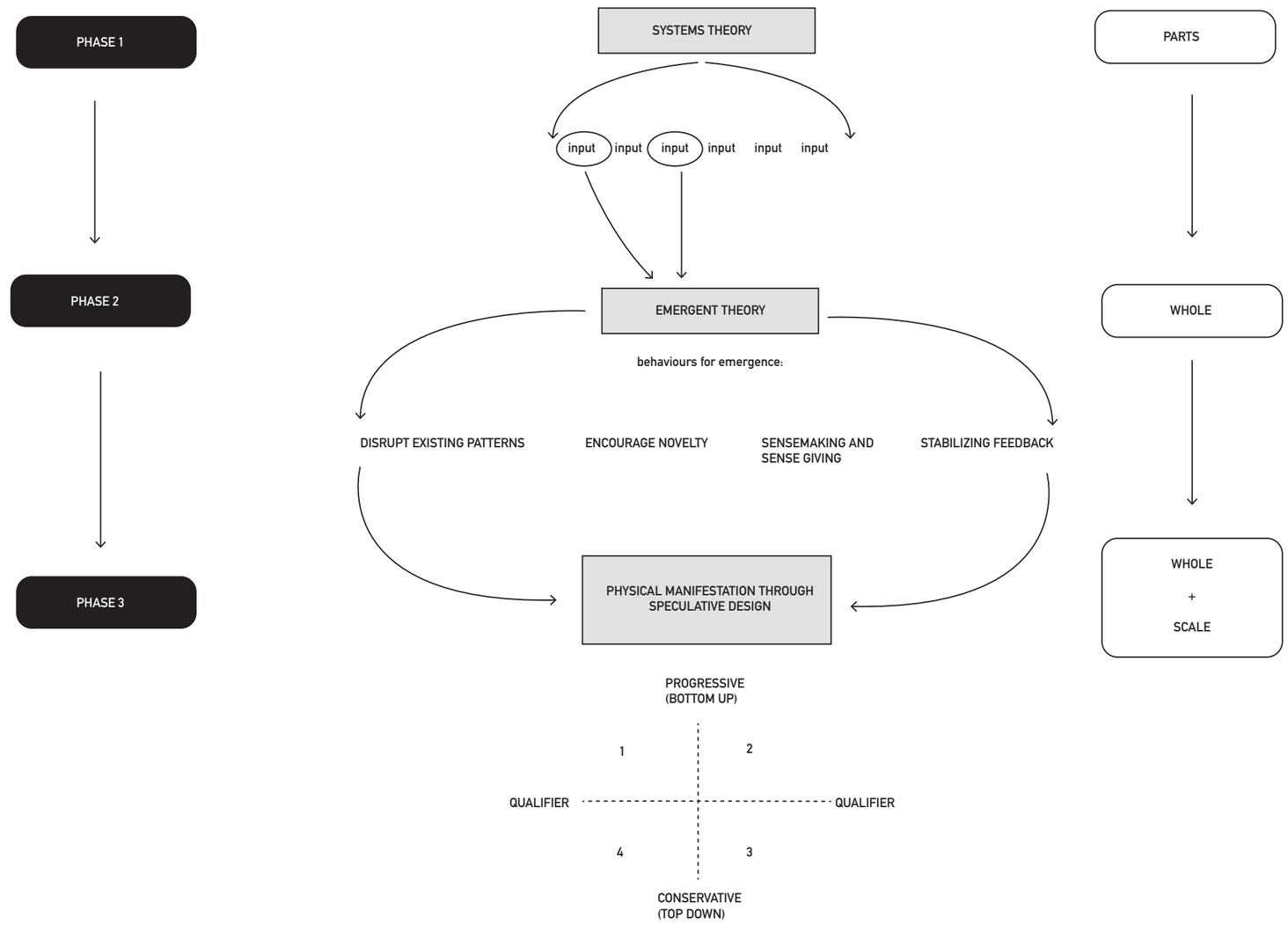


Figure 6.01

6.1. Systems Theory as a Driver for Emergent Outcomes

Architect Mark Miller outlines the concept of systems-thinking in architecture as a relatively simple premise: “to approach solving a problem by considering all the inputs as part of a connected whole.” This is acknowledged, of course, with the fact that this becomes a very complicated reality when a designer needs to actually accept and execute based upon that premise (Miller, 2017).

We can think of systems theory as an approach for understanding the natural world as a set of interactions, and information flows, which is regulated by a variety of feedback processes. This application is widely understood with the application to ecological diversity (Hartvigsen, 1998, p.427). Changing one part of a system - or the particular inputs - will likely affect other parts of the whole system - often with predictable patterns or behaviour. Thus, outlining key “inputs” within the system that is the Illinois Institute of Technology, we could expect emergent outcomes as a result.

This thesis aims to leverage and work together with the system drivers upon a site, which can subsequently create a positive feedback loop. Certain elements or design decisions could align to create a positive force.

Therefore, thinking of emergence as an explanation of how natural systems have evolved and maintained themselves, we can question what sub-systems or inputs can lead to the production of diverse, complex architectural forms and their resulting effects, stemming even further into innovative designs and responsive environments.

6.2. Key System Inputs

Exploration into key elements affecting the IIT campus begins the exercise of how to speculate an emergent architecture. Beginning with data mapping and outlining of these elements (as perceived) is critical for assessing a systems thinking analysis going forward. Key inputs affecting the university campus could be elements such as:

- Surrounding population density
- IIT campus population density
- Formal and Informal functional programming
- Thoroughfares/circulation
- Campus Programs/Faculty Arrangement

6.3. Emergence Theory as a Driver for Speculative Outcomes

This leads to the question as to whether or not an architect can design an emergent outcome, design for an emergent outcome, or even design in a way which might encourage an outcome with emergent characteristics. What is the role of an architect attempting to design for emergence? Conscious design decision making sways a physical building to exist as the designer premeditated - arguably leading the outcome, and not allowing it to come into being, to evolve. This seems counterintuitive, as the elimination of a top-down approach is what permits natural emergence to occur. Thus, the bottom-up approach acts as a piecing together of systems to gain insight to the emergent system outcome, and what could plausibly exist.

Outlining of emergent behaviours for the sake of this thesis have been listed

as (Lichtenstein, Plowman, 2009, p. 621):

- Disrupting existing patterns (embrace uncertainty)
- Encouraging Novelty (allow experiments and fluctuations)
- Sense Making and Sense Giving (recombine existing resources)
- Stabilization (integrate local constraints)

Thus, as explained by Lichtenstein and Plowman, by altering the original context with these key goals in mind, these four behaviours can give rise to emergent outcomes. If we are acknowledging the processes and systems which can lead to emergence, for the sake of this thesis, this requires us to become speculative about what these possible emergent entities could manifest into. Emergence is a continual process, a product of the interactions amongst diverse systems. In order to facilitate a point of departure from the beginning to understand systems thinking and emergence theory as applied to the IIT campus, to a physical manifestation and change at a particular time (i.e. a window into the emergence process, and acknowledging that emergence is a continual process), a speculative design outlook is essential to propose what these immanent patterns of being could be, and how to manifest them. Further explained by Manuel DeLanda:

> "The view of the material world that emerges from these considerations is not one of matter as an inert receptacle for forms that come from the outside, a matter so limited in its causal powers that we must view the plurality of forms that it sustains as an unexplainable miracle. It is not either an obedient matter that follows general laws and that owes all its powers to those laws. It is rather an active matter endowed with its own tendencies and capacities, engaged in its own divergent, open-ended evolution animated from within by immanent patterns of being and becoming" (2012, p. 16).

Thus, open-ended evolution requires speculation about just what that element could be, at any given time. According to Benjamin Bratton, he discusses that "each temporal scale has its own version of "the future" and some are more interesting to speculative design than others. He additionally states that:

> "instead of concluding that the future (and futurism per se) is lost, we should commandeer modeling infrastructures for better and more vibrant purposes. For this, speculative models are rotated from one purpose to another: less to predict what is most likely to happen (deriving value from advance simulation of given outcomes) than to search the space of actual possibility (even and especially beyond what any of us would conceive otherwise). That is, predictive models are adaptive because they need to be descriptive, but for speculation, models are prescriptive because they need to become normative" (Bratton, 2016).

Thus, this thesis proposes design as a tool an application which can begin to describe possible futures, and question the status quo. That the question of "what if" can lead us to speculate about potential emergent futures, if we permit certain drivers into the system, and inhibit others. We cannot predict the future, however, we can speculate about a future that users of the IIT campus may or may not want. This is in conjunction with the inhibitory nature of the university, where this sort of imaginative speculation of what could be is very rarely developed.

6.4. Progressive Versus Conservative Speculation

By virtue of attempting to categorize speculative outcomes and invigoration to the IIT campus, a quadrant system for thought research has been proposed. Key elements such as a progressive (bottom-up) approach, versus a conservative, Miesian (top-down) approach are two main qualifiers. The other two elements depicted, are what are “run through” the system as an exercise to produce speculative outcomes. Thus, “speculative fiction” can begin the grounds of how to approach design for the future of the IIT campus. Similarly explained by Reiser and Umemoto in their book Atlas of Novel Tectonics: “This is not a book of recipes, but more so a suggestion of operating within the discipline” (2006, p. 33).

Figure 6.02 **On Speculative Design, Ayr - British Pavilion at the 2016 Venice Architecture Biennale**

7 Speculative Emergence

Conceptualizing a framework for an approach to speculative emergence upon the IIT campus requires situating this thesis amongst the logic of systems theory, emergence theory, and speculative design. To attempt to approach the IIT campus in such a manner we may choose to perceive it as a megastructure or framework. To really understand a space or site we must attempt to understand this megastructure, and how far it is stretching and connecting to systems beyond. As speculative architect Liam Young explains,

“we have to consider it to realize the conditions that construct our experience in the modern city. In order to truly understand a site in a contemporary sense, we should no longer think only about a point on a map, but about network conditions. So, an architect making something now needs to site their work within these megastructures and start to design within them. It is a designing relationship that occurs across multiple sites and multiple temporalities” (Young, Babkin, 2017).

This brings forward the exercise of outlining elements as the designer of this thesis perceives as acting on this framework/megastructure (Figure 6.01).

PHASE 1: This is categorized as naming key INPUTS (Section 6.2) as data mapping/issues pinpointed at the IIT campus, examples being systems at play within the following issues:

- Surrounding population density
- IIT campus population density
- Formal and Informal functional programming

- Thoroughfares/circulation
- Campus Programs/Faculty Arrangement

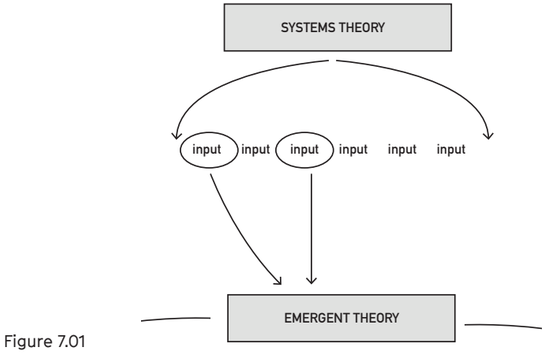


Figure 7.01

PHASE 2: Which become sub-systems to be applied through the key BEHAVIOURS OF EMERGENCE (Section 6.3):

- Disrupting existing patterns (embrace uncertainty)
- Encouraging Novelty (allow experiments and fluctuations)
- Sense Making and Sense Giving (recombine existing resources)
- Stabilization (integrate local constraints)

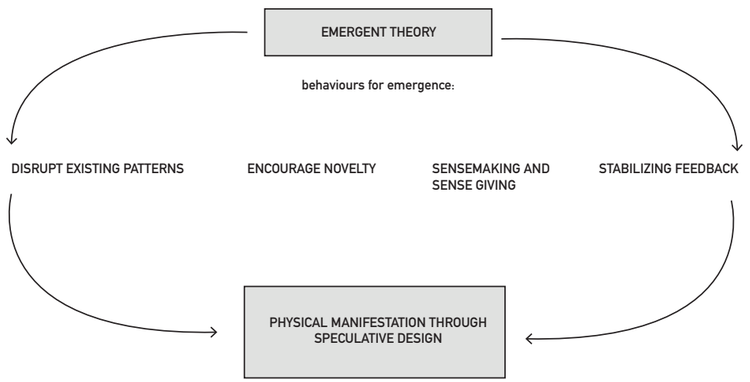


Figure 7.02

Continuing through the framework, we can apply these original system inputs through an additional step in the framework, through the lens of emergent development. This can lead to defining a particular scenario, or essentially spur on a speculative design. Giving rise to a physical manifestation via speculative design as facilitated through defining the growth scenario.

PHASE 3: Definition of the growth scenario, via progressive or conservative approaches. Via brainstorming through scenarios set up through a grid matrix, this begins to let us speculate about possible outcomes due to particular drivers. Two key certainties for speculation depend upon a progressive, novel formation (bottom up), versus the alternative; conservative, Miesian (top down) approach.

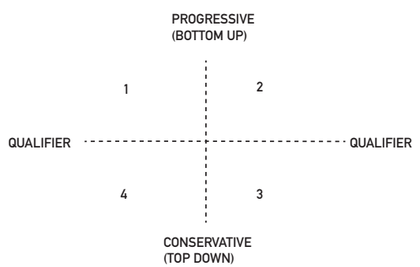


Figure 7.03

Via filtering ideas through two other qualifiers, four quadrants of speculative scenarios can be facilitated. This is a stepping stone of thought work to begin to understand where design can take a step in the emergent process. This also continues the exercise of speculative futures, where we can start to understand a future for IIT the users may, or may not want.

Speculating upon various resultant invigorations of the IIT campus can leave us with multiple proposals with different levels of merit. However, what numerous speculative proposals do agree upon is the necessity of densification and repurposing of the campus. “Increased population, although an important ingredient, cannot support significant change without the accompanying desire to create intensification, which can be described as qualitative increase in active opportunity” (Mitiandis, p.61).

SECTION THREE
DEPLOYMENT

8 Existing Complexities Summarized

IIT expresses elements of top-down control, and as a result has been lacking flexibility as it ages, unable to adapt to a changing environment effectively. Mies' solution for the university campus was deployed, and over the years the campus' inheritors moved forward without much consideration of the pursuit of flexibility over time, from the perspective of the users, the general change of needs, amongst other stressors. Thus, for the sake of this thesis the interpreted lack of evolution of IIT lies in the absence of growth and adaptation, which in all intents and purposes is an integral part of what makes a progressive university campus.

This thesis aims to begin to become cognizant (albeit within a subjective perspective) of the perceived existing conditions on the IIT campus, of which should be acknowledged and worked through:

- Rigidity to the Miesian ideals
- Inability for faculty buildings to grow and evolve
- Lack of proper maintenance
- Growing student population without proper resources

8.1. Adaptation/Transience/Lack of Permanence

This calls for the infusion of the IIT campus with a new layer of use. This introduced layer of activity is intended to react to existing conditions and drivers, while acting as a catalyst to induce further change. It is within this created interstitial space between the newly implemented systems and the existing structures that holds the potential for increasing intensification and rejuvenation, allowing emergent structures to arise (Mitiandis, 62).

This means a goal of a bottom-up structure, without the end goal of true permanence. This is facilitated through a preemptive structure, which acts as a responsive scaffold or megastructure, allowing the systems surrounding it to influence its program and shape. This implemented design on the IIT campus becomes within itself an architecture facilitating change.

Figure 8.01 **Emergence in Urban Environments**

9 Precedent Analysis - Megastructure Theories

This thesis will look to precedent theories for formal organization in architecture and urbanism to explore the emergent potential in the IIT campus. Megastructures, Mat-building and Infrastructural urbanism theory contribute to the current discourse on the development of stable built environments in an unconventional, bottom up fashion.

9.1. Mat-Building Techniques

"Dismantling and reframing programme and composition, mat-building envisaged architecture as a dynamic, flexible armature" (Calabuig, Gomez, Ramos, p. 83, 2013).

Mat building is a process in which additive elements are implemented upon a site, functioning as a growing armature. The mat is often constructed from repetitive structures, yet is sensitive to variations on site, functioning as a a highly responsive land-use planning technique. Mat building is a formal organizational strategy in architecture and urban design. This strategy was formulated by Alison and Peter Smithson's fascination with Greek and Arabic architecture with inherent examples of sustainable built environments. The Smithsons discuss interest in the Arabic Kasbah, seeing the possibility for changing complexity: "full of starts and stops and shadows... with a degree of connectedness to allow for change of mind and the in-roads of time" (Smithson, 1974). Thus, the development of the mat building technique was intrinsic to the process of development itself, where additive elements were of utmost importance, along with a play between variation and repetitions of form (Fores, p. 73). Evidently, the mat building becomes a large scale developed for density structure, with its rationale accurately modulated on the basis of a grid (Calabuig, p. 86).

In the words of Alison Smithson, "mat-building can be said to epitomise the anonymous collective, where the functions come to enrich the fabric, and the individual gains new freedoms of action through a new and shuffled order, based on interconnection, close-knit patterns of association, and possibilities for growth, diminution and change" (Smithson, p. 1974). Thus a mat building becomes an abstract organization, a responsive matrix for construction from relations among elementary units or modules. Therefore the importance of the structure would be emphasized as being a "set of rules for defining relationships and correspondences" (Ferrer Fores, p. 88).

Furthermore, it is important to note that mat buildings are not intended for a static permanent outcome. As elucidated by Fores:

"Instead of a static architectural composition, mat-architecture is the installation of a generative structure: urban forms shaped by the unique characteristics of particular places, specific patterns of human association, open to transformation, respectful of local nature and climate. The mat was intended to provide flexibility in planning for a range of functions over time, thus assuring its own longevity; its very realization is spread out over time and subject to revision and adaptation" (Ferrer Fores, p. 74, 2011).

Mat-Building was conceptualized during a time of social and economic growth after the Second World War in European cities requiring new programmes for the growing middle class (Calabuig, p.84). Universities were being commissioned with short lead-times and governed by notions of flexibility and growth. For institutional buildings such as post war universities, the success in the mat building technique was such that within their lack of formal definition, lead precisely to the key for their potential multiplicity (Ferrer Fores, p. 74, 2011).

Smithson outlined the necessities of mat building as: “interconnection, close-knit patterns of association and possibilities for growth, diminution and change” (Smithson, 1974). Mat building has the potential to help us begin to understand how to handle uncertainty and emergence on a site, especially one of a larger scale, additionally working in an institutional setting. The architecture of the mat building was supposed to be a responsive, highly woven structure, responsive enough to be able to grow in space in potentially unlimited ways, learning and adapting with multiple contingencies that would evidently take place.

9.1.2. History of Mat-Building

“Mat building emerged in the late 1950s as a consequence of the debates within CIAM (Congrès Internationaux d’Architecture Moderne, the International Congresses of Modern Architecture) over principles of functional zoning. A group of young architects, called Team 10, suggested an alternative to the functional city described in Le Corbusier’s Athens Charter (1933), in which the four functions of daily life - living, working, circulation and recreation - were segregated from one another.” (Fores, p. 74).

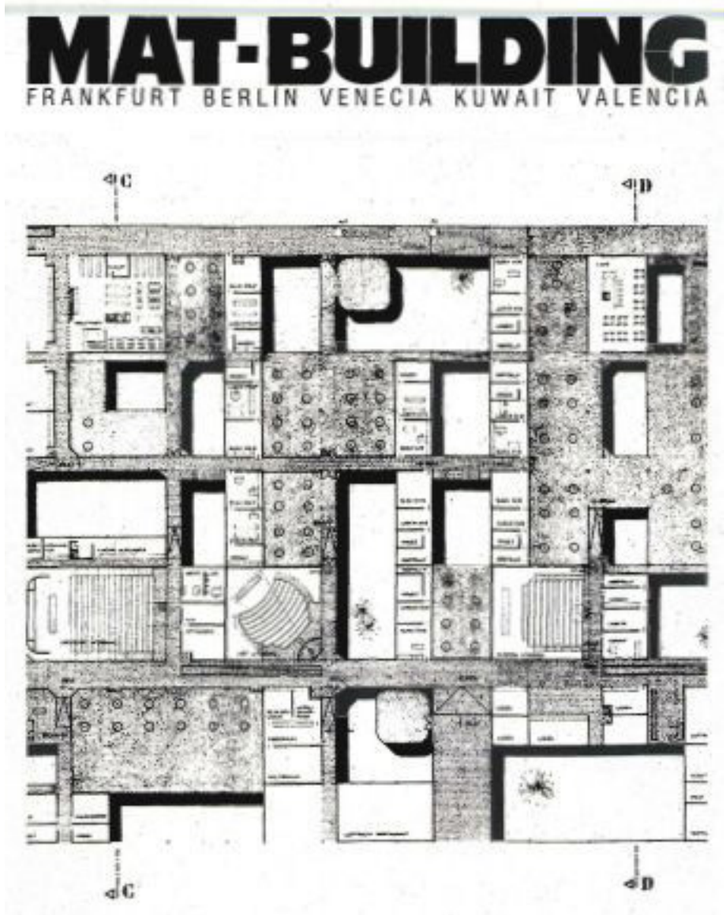


Figure 9.01 **How to Recognize and Read Mat-Building**

Alison Smithson discussed the concept of mat buildings at Team 10 meetings, clearly outlining the importance that these structures were not predicated on a particular architectural style or language. Smithson stressed the importance of interconnectedness, and the necessity of the ability for growth, decline in size, and change (Smithson, 1974). This group of young architects banded together to demonstrate an architecture focused on a different approach to urbanism; to propose architecture and urban design attempting to understand the importance of community identity. This was after Team 10's architectural approach to the incorporation of the social sciences in their relational thinking of the program. Examples of Team 10s thinking can be understood in their approach to the concepts of association, the approach to understanding urban life as a function of its inhabitants relationships, not the output of buildings (Calabuig, p.84)

The Smithson's were intrigued by groupings of dwellings that were fostering community, and had developed a natural, reciprocal relationship to their environment. Essentially these communities were influenced by their surroundings, whether that be the topography, the environmental conditions, or existing buildings. This led to the conclusion of the Smithsons that the structure of cities was less so reliant on their geometries, but more so with the activities happening within them (Calabuig, p.77).

These activities were described via Alison Smithson as "the articulation or materialization by building and spaces, by paths and places, and by the careful articulation of public and private control" (Ferrer Fores, p. 77). This is in contrast to standard modes of architectural practice which commonly overlooks the particularities of its location and uses. The Smithsons argued that architectural order should be derived from existing community hierarchies and contextual associations. The system of relationships and patterns of encounter, which the cells and stems of the cluster generate, provide the spatial framework for these hierarchies and associations" (p. 77).

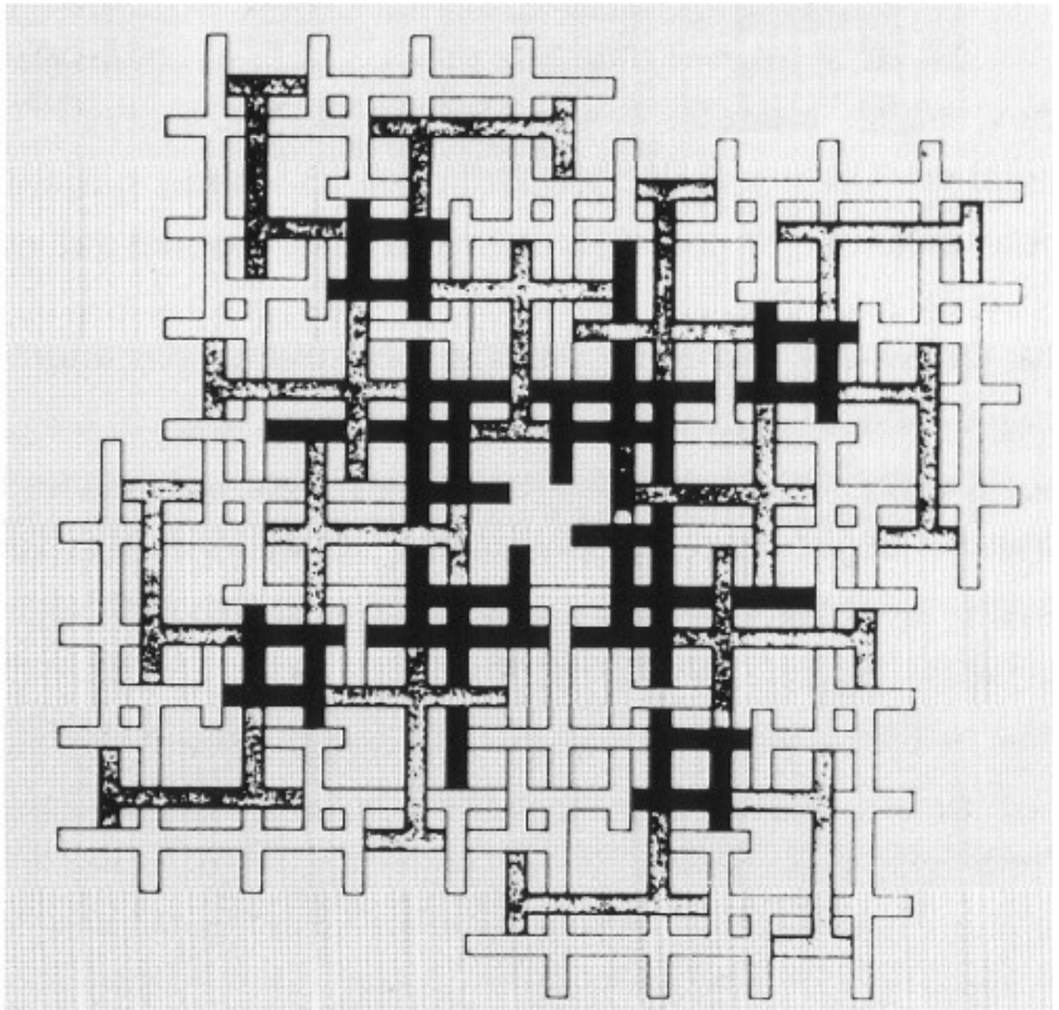


Figure 9.02 **Piet Blom Mat Building**

9.1.3. Breakdown of Components of Mat-Building

The prototypical mat building is encouraged to grow in potentially unlimited variations over the course of time. This also means that the mat building would be able to adapt to numerous contingencies implemented upon the structure over its existence. This emphasis on 'indeterminacy of form' links the mat building as a large system, where the less important element was the final physical form, but more so the steps and subsequent system inputs that allowed it to get there. The mat is never complete, it is always becoming, or diminishing. Thus, Mat Building aims to dismantle the original compositional strategies of architecture, lending to the idea of architecture existing as a flexible armature.

Re-evaluating the concepts which lead to the formation of mat building, we can explore the possibility for mat building to be advantageous to the Illinois Institute of Technology campus and other contemporary environments.

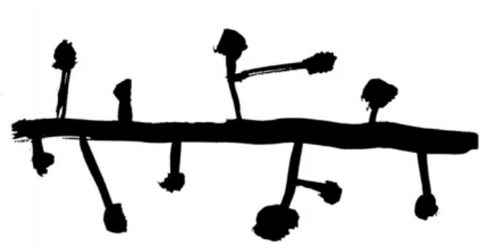


Figure 9.03 **Cell to Cluster**

Team 10 began to reconceptualize urban design utilizing "tissue" as a metaphor. This began with the single dwelling cell. Team 10 visualized this as re-assembled into allotments which was considered "an attempt to discover

structuring principles which might be applicable to the organization of the physical environment" (Avermaete, 2005). This reassembly was done so in an attempt to establish intricate spatial variation between private and public space (Ferrer Fores, p.75).

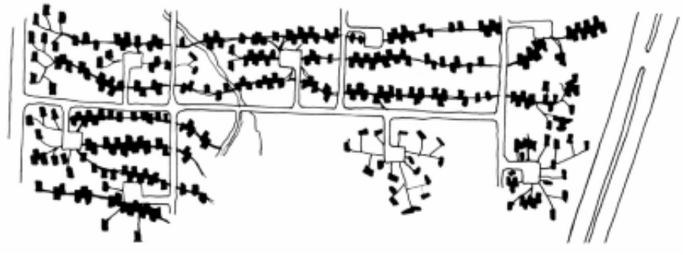


Figure 9.04 **Cluster to Stem**

Ultimately, for Team 10, architecture's aim was to uphold a 'carrying order', or act as an infrastructural project capable of variation and growth. Furthermore, the Smithsons actively studied urban clusters of dwells, where community was fostered and developed a natural relationship to their environment. These systems influencing clustered relationships and patterns of encounter, developed into what were coined "stems". These stems provided the spatial framework for clusters, hierarchies and associations (Ferrer Fores, p.78) This stem can be thought of as a street, full of public life. This allowed access to clusters, yet also functions as a place to facilitate human encounter.

Elaborating from Stem into Mat - further developing the role of the stem in linking clusters, this densification eventually leads to a two dimensional network of stems and clusters, eventually even more so towards the development of a densifying mat. "Through its organizing network of circulation routes and support systems, the mat provides an even greater flexibility for unifying diverse clusters of activity in multiple directions. It can grow along any of its stems in two dimensions (Ferrer Fores, p. 78).

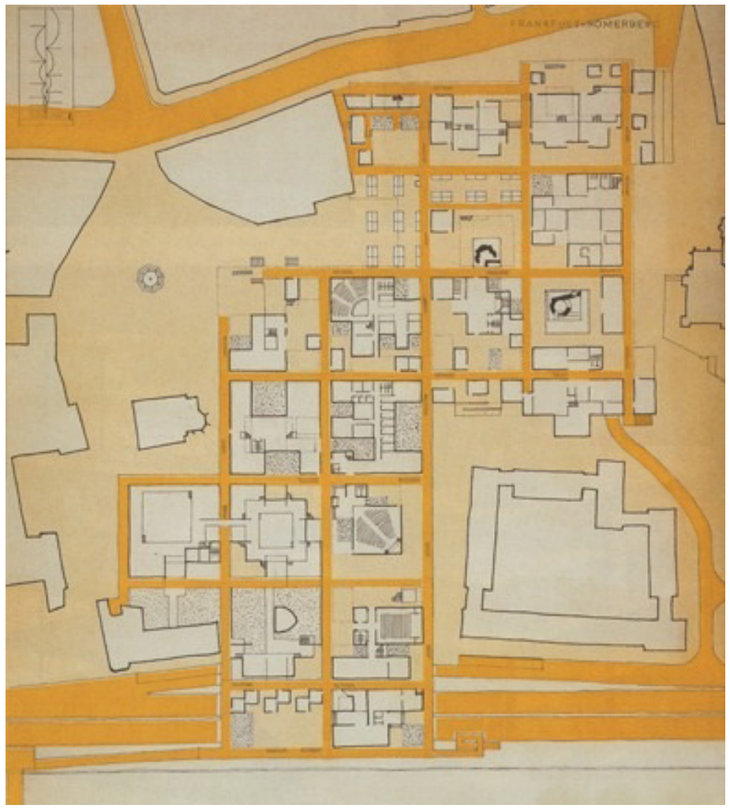


Figure 9.05 **1963 Competition Drawing for the Reconstruction of the centre of Frankfurt-Römerberg, Candilis, Josic, Woods and Scheidhelm**

9.1.4. Mat-Building Case Studies

Case Example: The Smithsons and Peter Sigmond competition entry for Hauptstadt Berlin (1958).

Development of the concept of mobility and connectivity within an urban site was developed in an unconventional way between the Smithsons and Peter Sigmond for their competition entry for Haupstadt Berlin (1958). Diverting away from CIAMs previous concepts for “functional cities”, this competition showcases the Smithsons thinking for post-war cities. Instead of divisions and segregation of activities, the competition proposal emphasized the importance of the relationship between the individual and the city, or at the larger scale; the part and the whole (Ferrer Fores, p.79). According to the Smithson’s, “the urban forms of Berlin Haupstadt have as their basis the idea of mobility, of absolute maximum mobility, achieved by a layered movement pattern that separates the various means of expression and gives to each its own geometry, its own formal expression” (Smithson and Smithson, 2005).

“Smithson defined the term “mat-building” as a structure whose order is based on three parameters: interconnectivity; relational patterns; and opportunities for growth, decline and change.” (Ferrer Fores, p.81)

In the Haupstadt Berlin competition, two dimensional , layered upon one another circulation tactics are utilized, one upper level network for pedestrian activity, and one lower level for vehicular traffic. This proposed pattern was done to declare the importance and the necessity for flexibility to accommodate growth and changes in use, over time (Ferrer Fores, p.80). The different levels were accessed through escalators from street level, and the upper pedestrian level was conducive pedestrian activity. This overlay of movement

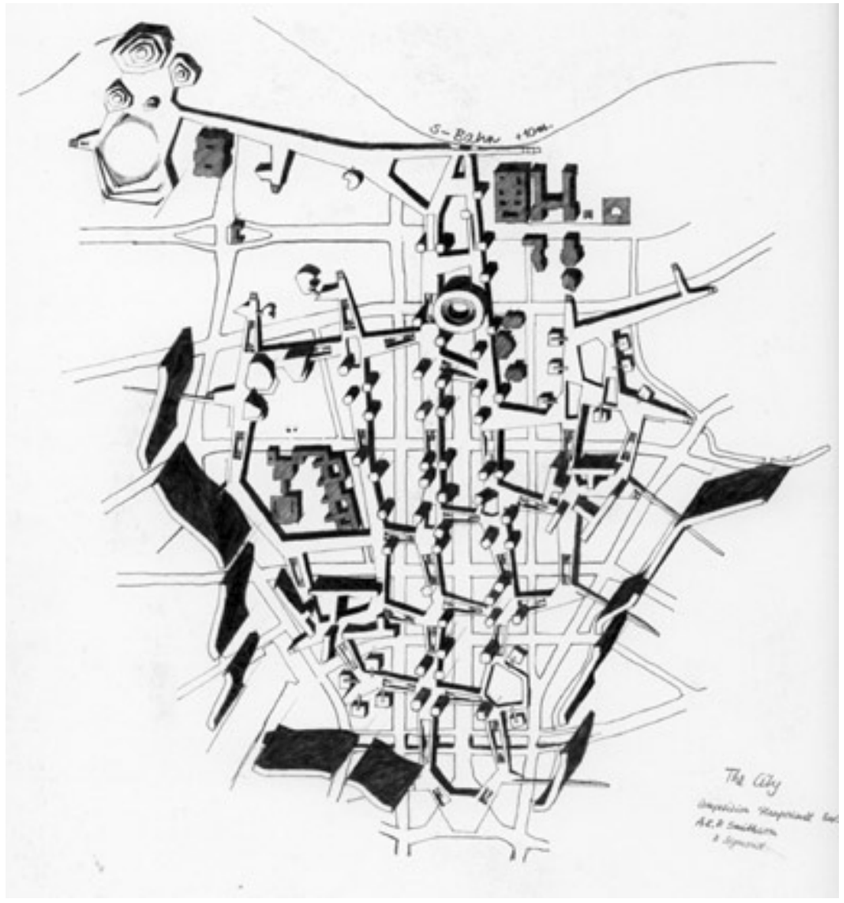


Figure 9.06 **The Smithsons and Peter Sigmond Competition Entry for Hauptstadt Berlin (1958)**

systems was a novel way of approaching a new understanding of mobility, and growth and potential change.

It is important to emphasize that the proposed pattern can accommodate for growth and flexibility changes over time. “The Smithsons emphasized ‘the feeling for change’, so that buildings, roads and services can develop freely according to their own laws without compromising the development as a whole” (Smithson and Smithson, 2005).

Other architects adopted the technique of mat building - namely Georges Candilis, Alexis Josic and Shadrach Woods with German architect Manfred Schiedhelm - notably successful in their winning of the design competition for the design of the Free University of Berlin. The structuring concept of the mat was further developed in their design proposal.

This proposal was deemed to be a “city in miniature” based around a double level grid, with most public interaction and functions on the ground level. The architects proposed wider pathways, and supplementary routes serving less trafficked areas. This resulted in abundant opportunities for communication and exchange between various parts of the mat (Ferrer Fores, p.81). Additionally, a plethora of pedestrian pathways, vertical connections, covered lateral connections, ramps and escalators created and continually generated a spatially diverse structure (ibid).

“Architecture and planning”, argued Woods, “which are part of the other are concerned with the organization of places and ways for the carrying out of man’s activities. The architectural process begins with a way of thinking about organization in a given place-time then establishes a system of relationships and, finally, achieves plastic expression“ (Woods, 1962). Woods et al. were looking to generate a new scaffold for formal expression, which would link various program elements, yet be sensitive to the necessity of continuous flexibility and change. Ultimately, Woods et al. utilized their mat

building approach to ensure abundant opportunities for communication and exchange for the users of this “city in miniature.” This pushed for the maximum amount of exchange between various parts of the mat, without sacrificing each buildings autonomy (Ferrer Fores, p.81).

Thus, rather than giving an object definitive form, the Mat is a planning instrument that allows the urban environment to be mixed and structured over time (Avermaete, 2005). The mat framework or scaffold provides an open to interpretation flexible space, relating to a site via a continuation of the urban fabric up into its own spatial planning network (Fores, p. 82). The goal is for the neighbouring or existing urban fabric to flow, integrate and influence throughout the development of the mat building. Mat-buildings thus establish a system of relationships, present and potential, between the built and the natural. “The very essence of mats is urban: architecture of relationships rather than form.” (Fores, p. 82)

Ultimately, it must be expressed that simply summarized; the mat building technique aimed for potentially infinite possibilities of organization and extension.

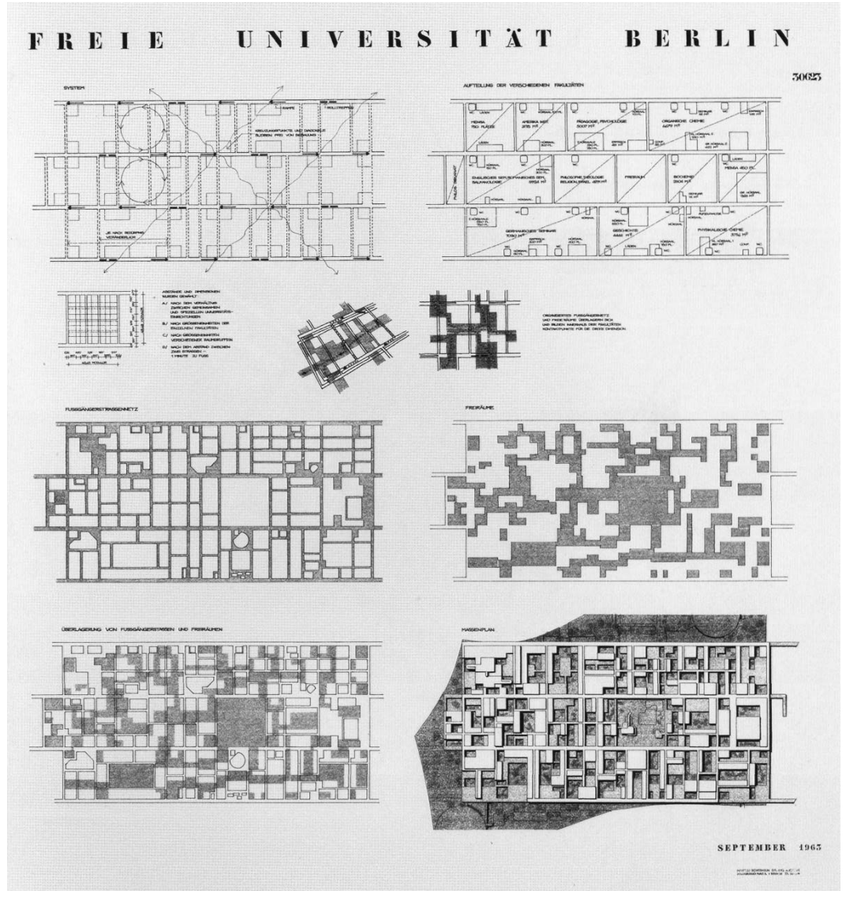


Figure 9.07 **The Free University of Berlin (Candilis, Josic, Woods and Schiedhelm – 1963)**

9.1.5. How Could Mat-Building be Advantageous for the Illinois Institute of Technology?

With the background outlined on mat building, this leads to the question why the intrinsic elements of this method could be beneficial for the application to the Illinois Institute of Technology. Mat building methodology revolves around a thoughtful interaction with an existing well-established setting. Focusing our logic for the development of another programmatic layer upon the existing elements of IIT allows us to contemplate the generation of a new built layer which is respectful to the existing.

The IIT campus is trepidatious of change, and any new structure is often met with severe criticism and skepticism. An example of this is the previously mentioned OMA's McCormick Tribune Campus Centre. This structure is drastically different than the international style implemented by Mies', calm, rectilinear structures. Is there a possibility for new development to be predicated on an existing compositional network, such as Mies' 24' x 24' grid? This existing logic could be utilized to cater to the sites future needs in an appropriate and respectful manner, and more conducive for assimilating with the existing logic with less criticism.

The mat typology of development takes into consideration the existing urban fabric, while applying a new flexible framework which relates to the already existing. As clarified by Ferrer Fores: "Mat buildings thus establish a system of relationships, present and potential, between the built and the natural. The spaces of transition and connection offer 'poetry of movement' and a 'sense of connectivity'. The very essence of mats is urban: architecture made of relationships rather than form (p.82)

9.1.6. Stan Allen on Expanding Mat-Building

Architect and theorist Stan Allen elaborates upon his concept of Infrastructural Urbanism within his publication: Points + Lines, Diagrams and Projects for the City. This terminology was developed beyond the explanation of mat building and the lessons architects can learn from Alison Smithson's work:

"The lessons of mat building in general have been internalized as a series of architectural objectives: a shallow but dense section, activated by ramps and double-height voids; the unifying capacity of the large open roof; a site strategy that lets the city flow through the project; a delicate interplay of repetition and variation; the incorporation of time as an active variable in urban architecture. The ongoing dialogue of project and response continues to add to the catalog of potential mat building effects." (Allen, p. 121, 2001).

One major component of mat building to bring emphasis to is the lack of discussion of style or appearance. The output of a mat building is more predicated on the organizational, less so the overall aesthetic or appearance. Inside of the mat structure, the form is generated via the connection of module to module, more so than the overall geometric figure (p. 121, 2001). Furthermore, as summarized by Allen, mat buildings "operate as fieldlike assemblages, condensing and redirecting the patterns of urban life, and establishing extended webs of connectivity both internally and externally" (p.122).

Thus, mat building appears to be asking the question: How to give structure for the natural, emergent unfolding of urban life, without doing away with the architect's responsibility to provide some essence of order and aesthetics? Allen begins to discuss the concept of mat building in addition to the concept of a loose scaffolding which functions around the systematic organization of the parts. He clarifies that "the architect can design the system, but cannot expect to control all the individual parts" (p. 122). Thus,

the understanding of the overall construct must come from the organization of the parts, as the whole, realized system is never truly seen. Mat building recognizes that authentic urban city culture emerges naturally, over an extended period of time, and is never truly finished evolving. Furthermore, as expressed by Allen: “Mat building is anti-figural, anti representational, and anti-monumental. Its job is not to articulate or represent specified functions, but rather to create an open field where the fullest range of possible events might take place.” (p.122).

In summary, mat building is represented by a relatively non descriptive architectural frame - remaining neutral in its construction, yet supporting an emergent form within. The characteristics of mat building as structures which have active interstitial spaces, where the implemented matter internally shapes and channels the space between things, importantly leaving room for the unanticipated. Importantly, the transition spaces between modules which have been inserted into the mat building infrastructure are not neutral. Instead these links and nodes come together to form a continuous fabric through internally differentiated space (p. 122).

While the Smithsons may of been some of the first to understand this approach to urban architectural design, Stan Allen elaborates further upon the concept of mat building, beginning to think of it as the implementation of infrastructure to influence the future development of the city (p. 123).

9.2. Infrastructural Urbanism

Within Stan Allen’s Points + Lines, Diagrams and Projects for the City, numerous urban design projects are outlined, and the strategies which were implemented to invigorate existing conditions. This important concept, coined Infrastructural Urbanism lends strongly on the concepts of Mat Building as previously discussed.

> “Going beyond stylistic or formal issues, infrastructural urbanism understands architecture as material practice - as an activity that works in and among the world of things, and not exclusively with meaning and image. It is an architecture dedicated to concrete proposals and realistic strategies of implementation and not distanced commentary or critique. It is a way of working at the large scale that escapes suspect notions of master planning and the heroic ego of the individual architect. Infrastructural urbanism marks a return to instrumentality and a move away from the representational imperative in architecture.” (Allen, 1999, p. 52).

Allen continues to elaborate his concept of “material practices” (such as ecology and engineering) where these practices are concerned more with the behaviour of these large scale assemblages, and less with “what they look like”. This leads to the question being asked: why isn’t architecture ever approached as such? These material practices work more so with the inputs and outputs of energy. These material practices showcase an open catalog of techniques, yet the important notion here is that there are no preconceived formal means to an end (p. 53). Allen emphasises the fact that material practices do not attempt to control or predetermine meaning. “Material practices

are not about expression - expressing either the point of view of an author or of the collective will of a society; rather they condense, transform, and materialize concepts" (p.53).

Furthermore, Allen explains the importance of architecture in comparison to strictly technical professions such as engineering. He deems architecture is unique, in its capacity to "structure the city in ways not available to practices such as literature, film, politics, installation art, or advertising." (p. 54). That architecture can act as a literal, as well as figurative scaffold for a "complex series of events not anticipated by the architect - meanings and affects existing outside of the control of a single author that continuously evolve over time" (p.54). Thus, we can think of infrastructure not so much as proposing new buildings and definitive designs, but more so to construct an eventual development of the site itself. As summarized by Allen: "This scaffold being implemented thus prepares the ground for future building and creates conditions for future events. Its primary modes of operation are: the division, allocation, and construction of surfaces; the provision of services to support future programs; and the establishment of networks for movement, communication, and exchange." (p.54).

It is important to note that infrastructures are intended to be flexible and anticipatory. Time is a huge factor, and thus, infrastructures are open to change. This is a special scenario, where emergent elements are both precise/permanent and indeterminate at the same time. Thus, Allen emphasizes the importance that infrastructures do not progress towards a determined state, yet are always loosely evolving and changing within an envelope of predetermined constraints.

This involves multiple authors - numerous drivers and situations which lead to contribution from multiple aspects. "Infrastructures give direction to future work in the city not by the establishment of rules or codes (top-down), but by fixing points of service, access, and structure (bottom-up). Infrastructural work moves away from self referentiality and individual expression towards collective enunciation." (p. 55). Additionally, these infrastructures may be static on their own, but facilitate systems of flow, change, movement, and exchange. In Infrastructural Urbanism - as coined by Stan Allen, form is deemed as important, yet more so for what it can do, rather than what it looks like.

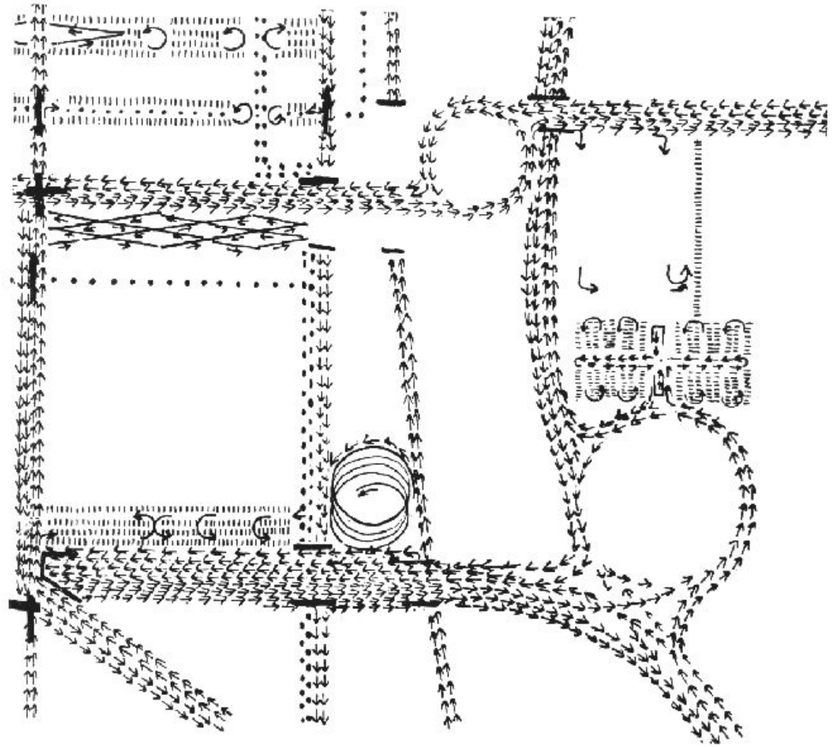


Figure 9.08 **Although static in and of themselves, Infrastructures Organize and manage complex systems of flow, movement and exchange. Allen uses Louis Kahn Movement Diagrams as an example of these exchanges**

9.3. The Legacy of Megastructures

As showcased within the Team 10 meetings, and Alison and Peter Smithson's new approach to urbanism, a cultural rebellion in the late 60s could be felt within the practice of architecture; an apparent push back against monolithic concrete buildings, which were viewed as oppressive and incapable of change (Murphy).

In contrast, numerous architects of this era (late 60s) were interested in methods which facilitate greater freedoms and choice through high-technology (ibid). Large, industrial megastructures dubbed "Spaceframes" became the focus on numerous progressive groups. As elaborated by Murphy:

> "Figures such as Cedric Price, Archigram and Yona Friedman seized upon the space frame as a metaphor; as a way to represent a fluidity and a freedom that was lacking in other forms of architecture. A vast empty space frame could be endlessly reconfigured in almost any way depending upon the desires of the inhabitants, leading to seminal clip-on architectural proposals such as Cedric Price's Fun Palace, Archigram's plug-in city, all of which make prominent use of the space frame as an indeterminate structure that could be added to or even dismantled with relative ease" (Murphy).

Freidman's Ville Spatiale was a concept for an elevated city space, where people could work and live, establishing a freedom of choice for the inhabitants. This was to be accomplished while enabling the growth of the city and restraining the further use of land. It was of great importance to Friedman to propose a technique for city dwellers to give meaning to their environment. As explained by Yona Friedman, he was looking for techniques that will enable people a trial-and-error planning process where nothing is completely

fixed, or fixed very minimally. Only then, he states, can architecture be truly mobile. Friedman brought emphasis to the concept of architectural improvisation - Which is stated as completely contrary to architectural education. The idea of architecture, Friedman states, is to build for eternity (Belogolovsky).

Friedman continues to explain the difference between flexibility and the "over definition" of architectural design. The difference to Friedman, is that simply providing empty "premises" on each floor acts as a large "shoebox" whereas his proposal for his Ville Spatiale proposes truly empty "space" with no definitive enclosure, floors, ceilings. As explained by Friedman: "a space frame-structure, a minimal one, is envisioned as an antigravity device simply for hanging volumes freely imagined by the user. A structure having no floors, no walls, no roofs, nor any preconceived containers or shapes; that is the ville Spatiale. The user-self planer can install anything, even a tower into that grid. Imagine, having improvised volumes "floating" in space, like balloons" (Belogolovsky).

Freidman's Ville Spatiale had little impact on the ground, where the structure implemented decisively was like lampposts to attach containers to facilitate form houses. This, as he described, lacked preplanning. You were simply to plant these posts wherever you perceived a possibility. Friedman used photomontages of actual city elements to drive home his principles. Over many years, the architect utilized Ville Spatiale in numerous competitions to garner interest in his ideas and the possibilities they represented.

The concept of spaceframes was not just limited to architectural theory and provocative scripts. Several examples were built, perhaps none as famous as Buckminster Fuller's Geodesic dome for Montreal's Expo 67. The construction of this massive structure symbolized the climax in the spaceframe progressive craze, and the excitement around the utopian credentials these frames entailed. However this craze did not last.

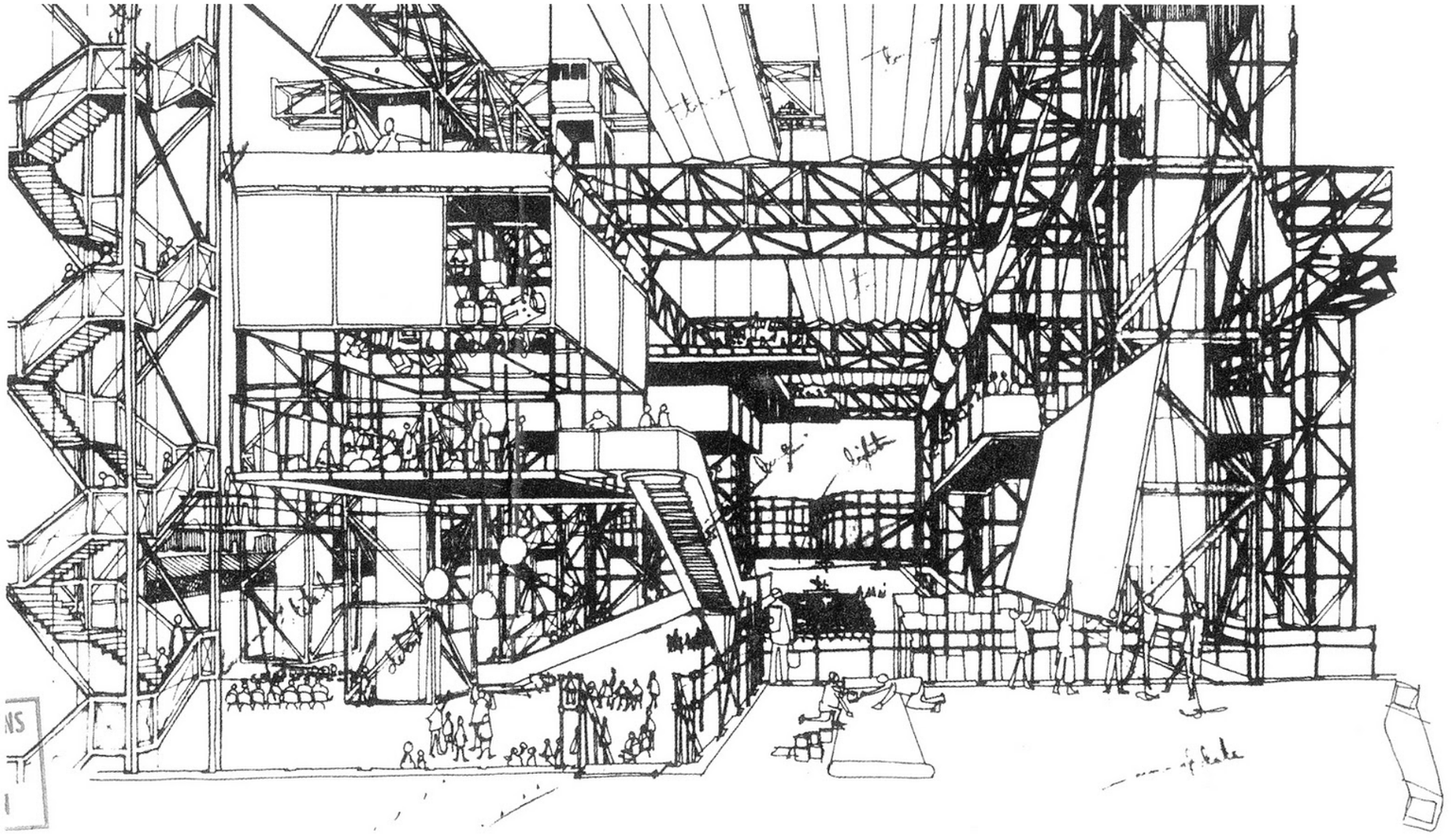


Figure 9.09 **Cedric Price Potteries Thinkbelt**

9.3.1 Critique of Megastructures (Spaceframes)

Over time, the romanticized idea behind space frames changed gradually. Arguably, the ideas conceived by these forward thinking architects couldn't be maintained. As outlined by Murphy, the oil crisis of 1973 had vast economical and ecological consequences, leading designers to really question whether there was indeed a true limit to plausible growth within building. Ideologies supporting the space frame - such as Buckminster Fuller's massive geodesic dome at Montreal's Expo 67 helped keep the idea of universality alive - yet over time, the space frame was almost delegated to become "cheap, airy structures somewhat lacking in zeal - factory sheds, train and bus stations and canopies outside provincial shopping centres." (Murphy). It is not uncommon to associate these types of structures hard to maintain, and become rather sad and neglected over time.

If there are indeed limits to growth, and limitations on this symbolic structure of freedom - why revisit this past ideology?

New appropriations of space frame designs facilitated through advances in digital design (such as parametric software) has lead designers towards compositions containing a space frame skeletal structure, which almost suggests a reversal of fortunes of the original idea. Large, singular forms are facilitated by the space frame, essentially "lurking" behind the implemented facade. The space frame facilitating this form has been hidden behind a shiny cladding, where the emphasis of the structural element is mostly hidden, and not at the forefront as it once had been. As a result, this (often) glass facade "mask" situated over the frame becomes the majority of emphasis, not the space frame itself, as previously encouraged. As outlined by Murphy, "there is something contradictory in the use of such a potentially universal structure in the service of bespoke, highly complicated formal expressions." The space frame which was developed to facilitate a myriad of functions, now seems to exist solely as the skeleton of impressive, parametric facades.

As questioned by Murphy: "Surely this humble and yet utopian structural unit deserves better? Can the space frame not be rehabilitated as a structure under which we would be proud to stand?" Can we embrace the potential of the space frame, without simply utilizing it to achieve our flexing of fanciful architectural needs?

What are the elements of Price's, Archigram and others proposals that could be beneficial for IIT? Fluidity and freedom of internal workings can be utilized to encourage emergence, showcasing that alternative forms of architecture are more steadfast, and lacking the ability to change over time.

Figure 9.10 **Zaha Hadid Architects**

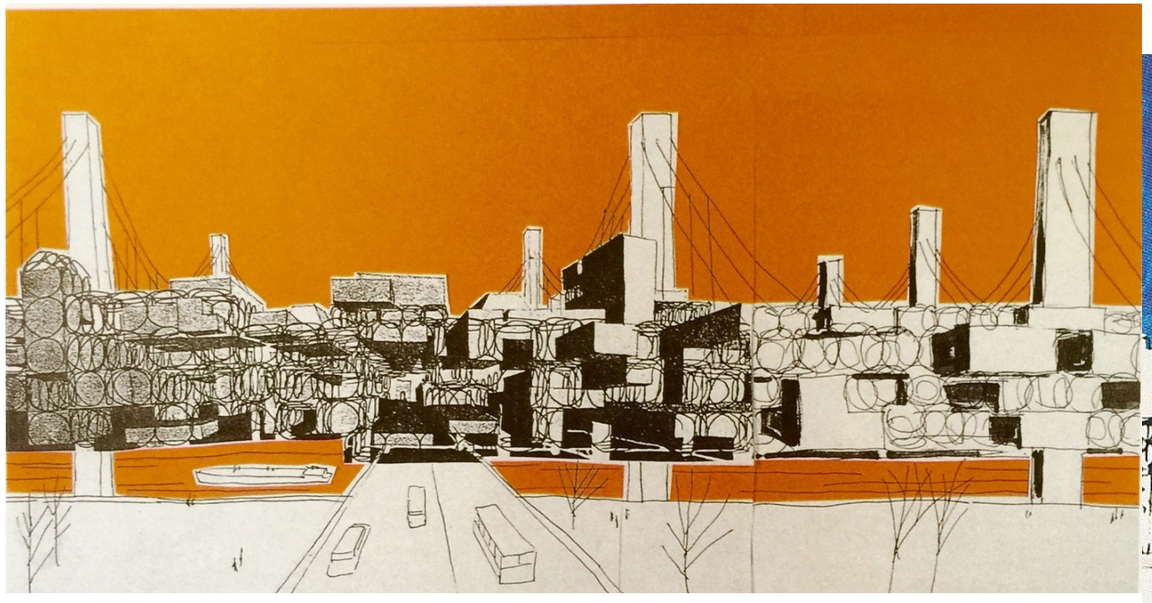


Figure 9.11 **Yona Friedman, Ville Spatiale**

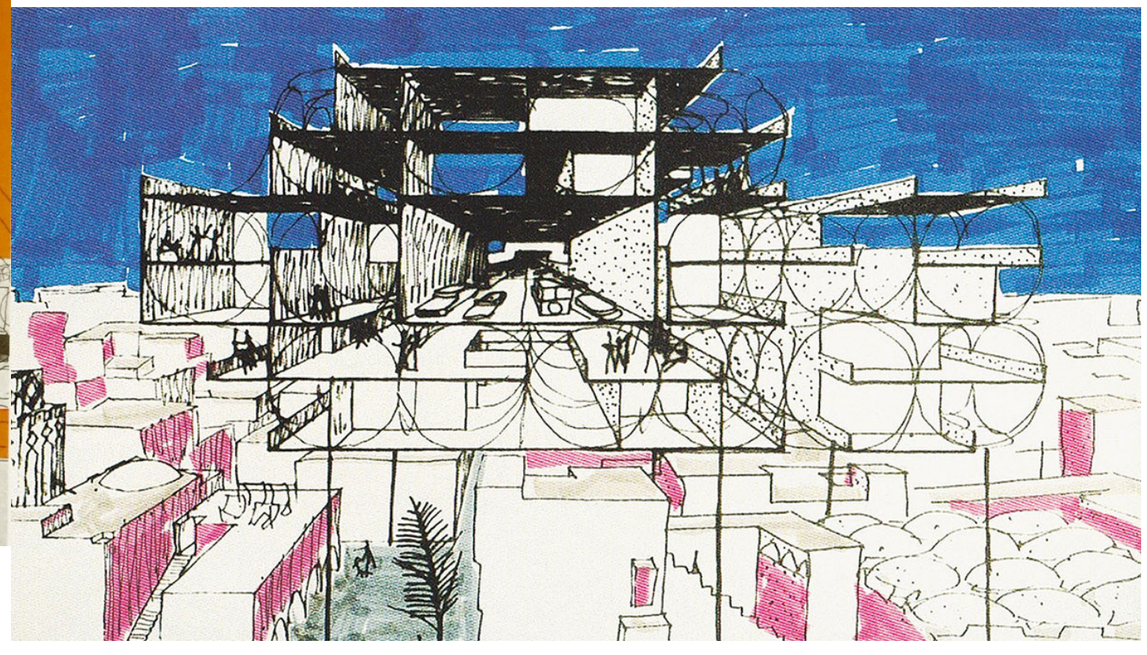


Figure 9.12 **Yona Friedman, Ville Spatiale**

10 Applying Megastructure Techniques to the IIT Campus

How can we be anticipatory in architectural design, while working with an existing set of conditions, especially those as implemented through a revered architect? Thinking within the realm of speculative emergence, what is the beginnings of a mat infrastructure on the IIT campus, and where does it grow and spread to? Infrastructure, by definition, facilitates.

By implementing a new infrastructure predicated on the logic of the IIT grid, this new element can begin to deploy megastructure techniques to developing the land use beyond what is currently being done.

As outlined by Allen:

“Infrastructure works not so much to propose specific buildings on given sites, but to construct the site itself. Infrastructure prepares the ground for future building, and creates the conditions for future events. Its primary modes of operation are:

- The division, allocation and construction of surfaces
- The provision of services to support future programs
- The establishment of networks for movement, communication and exchange.

“Infrastructural systems work like artificial ecologies. They manage the flows of energy and resources on a site, and direct the density and distribution of habitat. They create the conditions necessary to respond to incremental adjustments in resource availability, and modify status of inhabitation in response to changing environmental conditions” (Allen, 1999, p. 84).

Utilizing existing urban vocabulary to build upon itself, a scaffold can facilitate new urban development without standing out from the rest of the campus as a new icon. New development does not necessarily have to be a clear analogue to the existing fabric of IIT and Mies’ ideals. Mies van der Rohe’s IIT campus has already been designed around a 24’ x 24’ grid. Similar to mat-building projects such as the Free University of Berlin as designed by Georges Candilis, Alexis Josic and Shadrach Woods with German architect Manfred Schiedhelm, which was modulated in a 65.63 metres allotment, (roughly the distance covered by a one-minute walk) the grid can still be a determining factor for mat building strategies. While IIT is functioning on a smaller scale, similar logistics for future planning can be sought out in a similar mat-building fashion.

Analysis of existing mat-building projects show an underlying pattern, resulting in a complex grid of strips forming an almost tartan pattern. Here, each strip can be thought of as a widened grid line, one which can house new functions and program. “This purpose-built grid is simply a framework or fixed base upon which a volume may (or may not) be built. It is precisely this ambiguity that enables compositional flexibility resulting in stratified and profusely perforated buildings” (Calabuig, p. 87).

Keeping a similar mindset, the development of IIT can be thought of a new network of modules clustered, facilitated by a similar grid system, and structural system as implemented by Mies Van der Rohe. For example, Crown Hall was progressive, facilitated by a suspended roof, without interior columns. This created a universal space, which could be endlessly adapted for new uses. Taking this application - we can utilize this general idea throughout the whole campus.

Impressive, yet, we can see now the lack of availability for IIT to evolve

past the walls created and designed by Mies as it is maintained. What of an infrastructural system conceived on the same logic of Mies' rigorous grid and structural systems, but becomes permissible for evolution, change, and incremental growth? Additionally, Crown Hall was constructed with "off-the-shelf" parts, including standard glass panels, steel I-beams which made the building economical to construct. This was facilitated through carefully proportioned, repetitive elements, seemingly simple through its uniformity and precision.

Ideally, this scaffold infrastructure implemented on the IIT campus is idealized to support the event, without being the event, or the focus. This scaffold allows for the exploration of potential moves, ebbs and flows, and the emergence of needed programme to allow IIT to evolve in a positive way. Responding to the existing grid matrix, we can recognize and respond to designing within the realm of the 24' x 24' grid designed by Mies. This creates a thoughtful interaction with the well established rhetoric instigated by Mies van der Rohe, and allows the implementation of nodes which will subsequently link the generation of a new layer around logical, established elements. The "responsive matrix" to be implemented on site is therefore expecting an input from particular selected drivers, which can help drive forward the speculation of the design process.

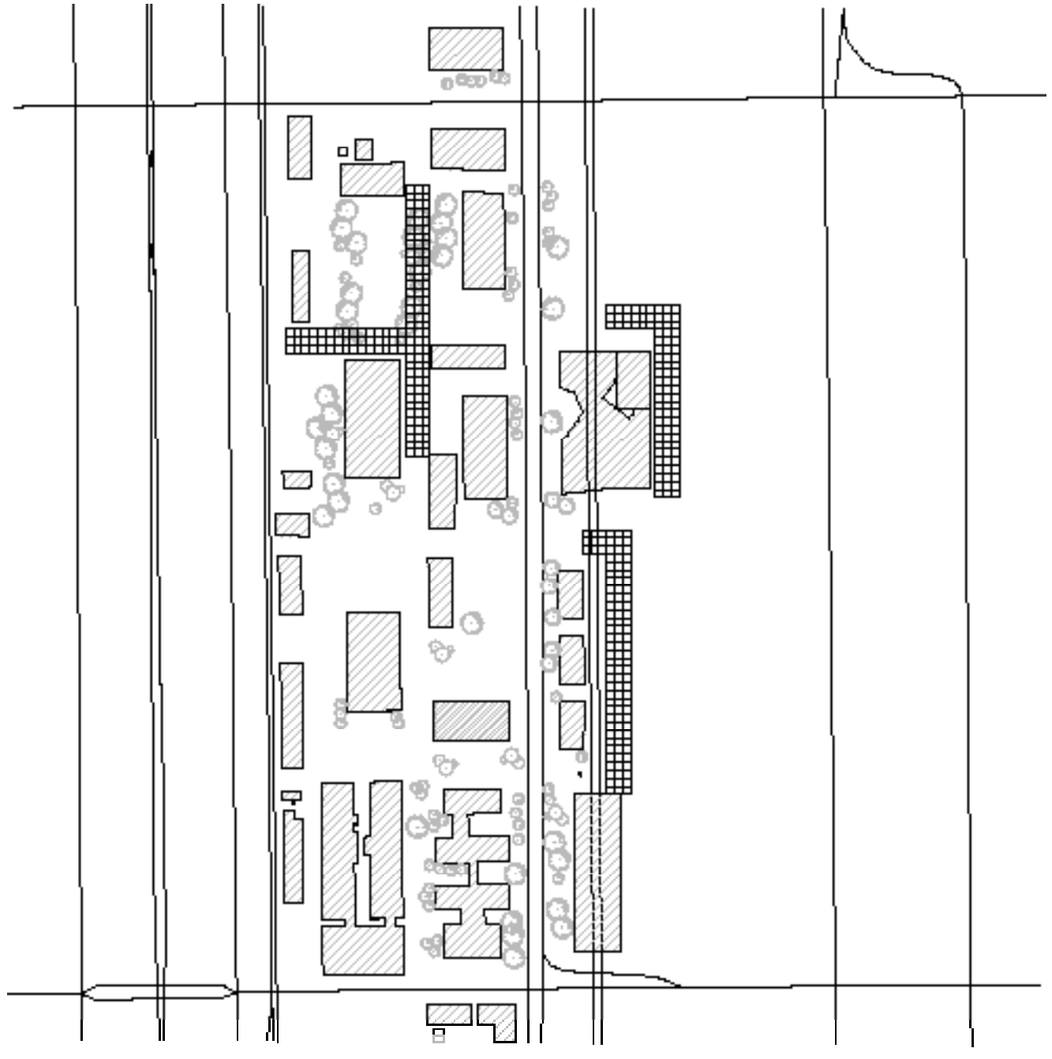


Figure 10.01 **Possible Scaffold Manifestation, a Snippet in Time**

11 Design Exploration

Utilizing these precedents for development leads us to question what elements of the approaches outlined are best suited for implementation upon the IIT campus? This revolves around developing an architecture based on accommodating future change, and which can permit bottom-up emergent influence. An infrastructure to facilitate emergence, of which drives form finding experimentation.

11.1 Creating a “Responsive Matrix” Infrastructure on the Existing Mies van der Rohe Grid

The notion of encouraging emergence upon the IIT campus through a new growing and emerging infrastructure can be approached through:

1. The reaction to site specifics, and areas for potential. By taking into account local conditions existing on the university the proposal will be invariably altered as it reacts to different system inputs already existing on the site, and those which differ throughout the university campus.

2. Creating an infrastructure which contains in itself the ability to accommodate for a range of spatial conditions which will further exacerbate site specificity and diversity on campus.

3. Understanding that the notion of convergence of systems within said infrastructure can create a product that is greater than the sum of its parts (Mitiandis, 65).

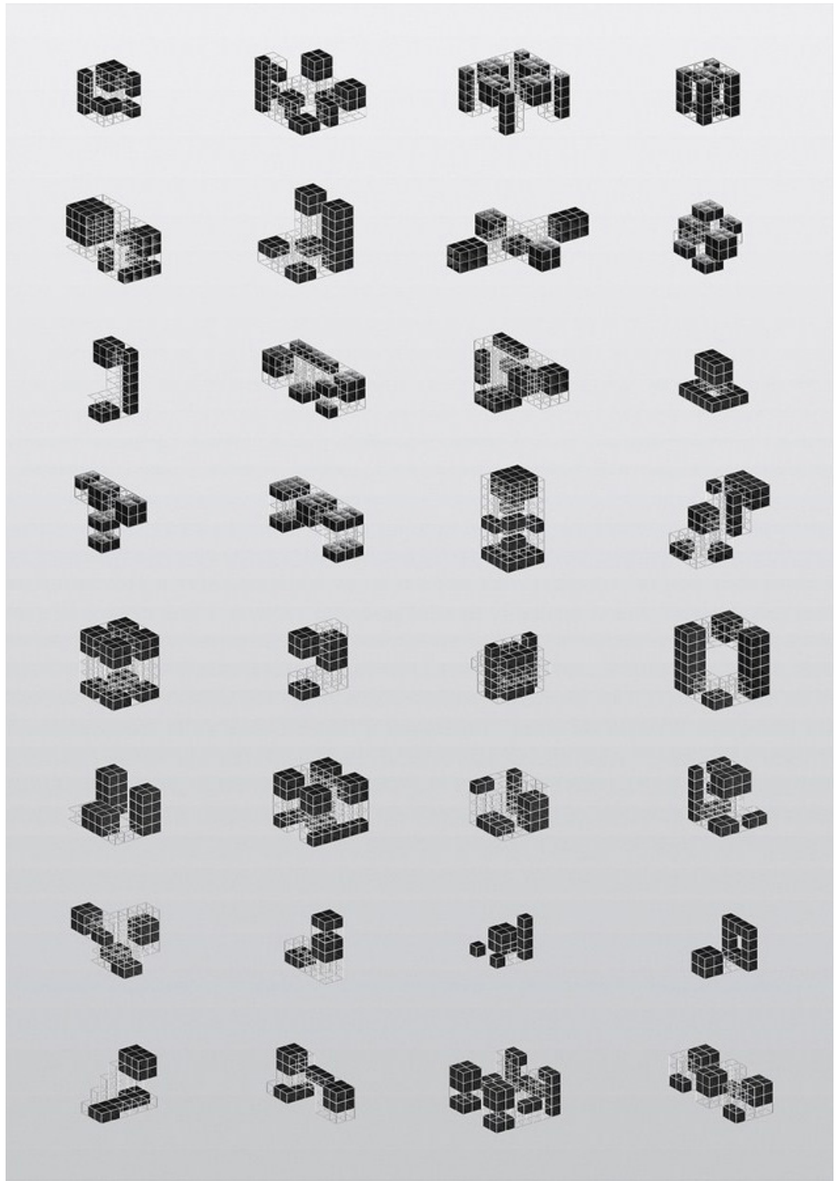


Figure 11.01 **Architecture Beyond Mass**

11.2 Design Development

This thesis aspires for speculation upon the implementation techniques for a bottom-up architecture, without the end goal of true permanence but rather, an architecture designed for accommodating future emergent change. This is facilitated through a preemptive structure, which acts as a responsive scaffold or megastructure, allowing the systems surrounding it to influence its program and shape. This scaffold armature is to be populated with program and shape. As such, this armature equires a preceding design, but also allows for an emergent manifestation within over time, of which cannot be designed for.

This thesis proposes that while the infrastructural scaffold is inherently designed by the architect (and thus is a top-down entity)., this is the end of active designing. This scaffold supports and encourages emergence, through the brewing of a responsive matrix, which is the result of bottom up strategies. The architect designs the infrastructure to be implemented upon the IIT campus, which facilitates and supports the “emergent guts” within itself.

The resistance to the alteration of the concept has been problematic for IIT.. What is open to adjustment going forward? What is fixed? While mat building techniques have been implemented in large scale urban projects, and large scale institutions, this thesis aims to bring additional focus on the smaller scale implementation, in a vignette showing how different system pressures on potentially opposing corners of the IIT campus may manifest differently.

This showcases that this thesis is dealing with numerous levels of emergence:

- 1. The ebb and flow of a scaffold structure developing and diminishing in a mat building technique and approach. This dynamic element grows, shrinks, and changes over time.

- 2. The inherent nature of said scaffold to facilitate modules within, showcasing the ability of bottom-up development, allowing imposing systems to direct and influence what the scaffold supports, maintains, and relinquishes. This brings emphasis on the play between permanence and transience on site.

- 3. The ability for dynamism on site. This also brings forward emphasis on the need for understanding that the most important aspect in this development is the inhabitant - and allowing the desires of the student body and faculty to really develop the future nature on the IIT campus, less so a 70-plus year old pedagogy. This is to argue that architecture cannot just be modified by the architect themselves, but by those who use it.

11.3. Areas for Potential - Implementation of Nodes and Linkages

Establishing a “starting point” strategy for a responsive matrix infrastructure requires the acknowledgement of elements on the IIT campus that identify as advantageous entryways for future development. The elements demarcated as nodes are locations within the IIT campus which have been selected due to their high densities of surrounding behaviours, needs, information, or services. These nodes act as anchors, adhering the web of the scaffold to the tradition of the existing IIT campus.

Understanding where to implement these nodes for the beginnings of a new infrastructure begin with assessing the IIT campus for areas perceived as logical as potential starter nodes. Examples of such areas could be particular faculty buildings lacking support and program, buildings unable to expand due to regimented Miesian ideals, high levels of student body activity, or areas necessitating a pedestrian connection. These are areas which pique interest and are burgeoning with potential.

These nodes are implemented first, and become a starting point where the responsive matrix can grow from. These nodes act as anchors, adhering the web of the scaffold to the tradition of the existing IIT campus. Nodes can subsequently become further interconnected once linkages are created between the multiple scaffolds growing upon the campus. Once this connection begins to other existing implemented nodes elsewhere on campus, the scaffold can grow and expand, linking and developing similar in fashion to the mat building typology.

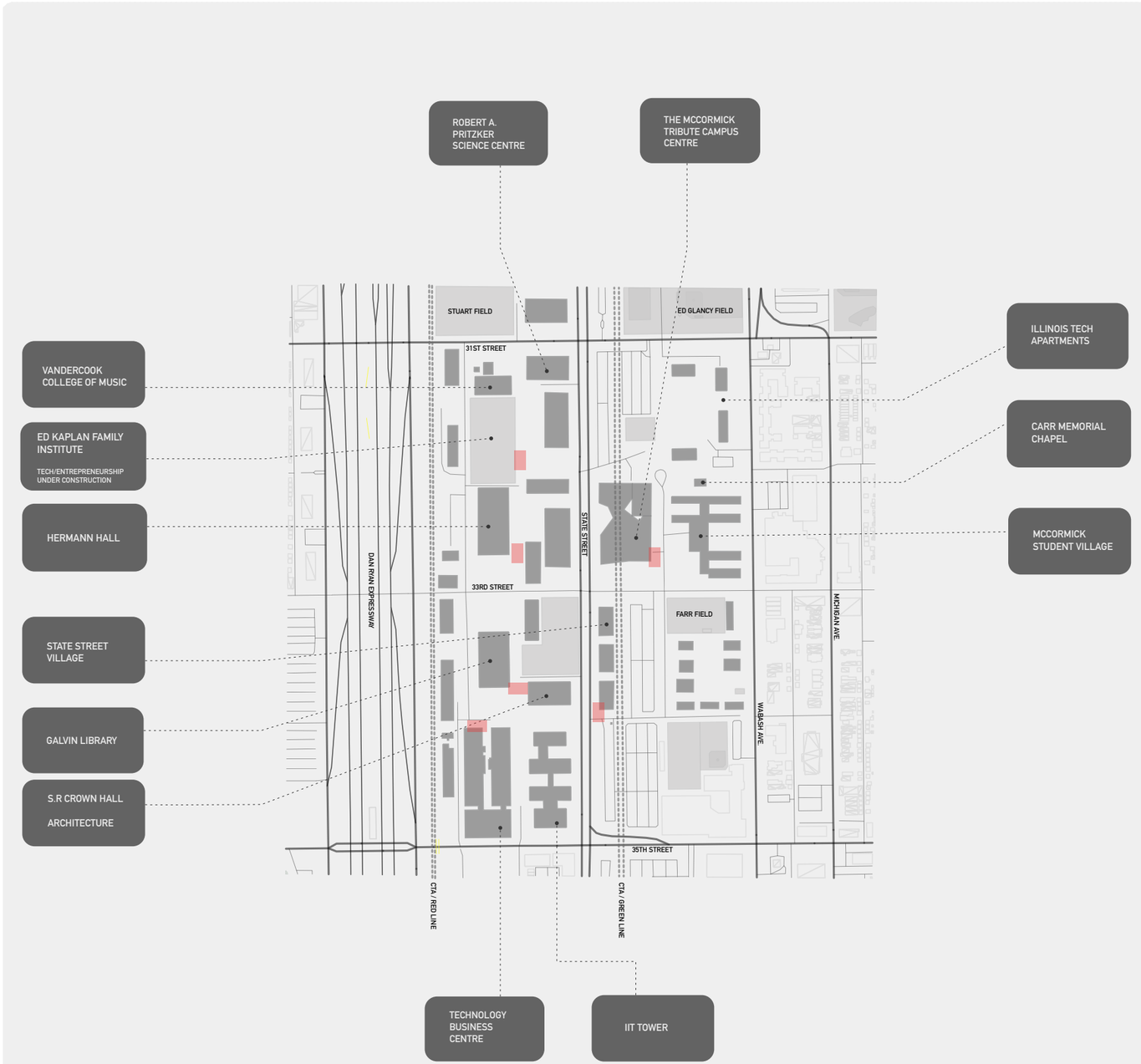


Figure 11.02 **Potential Node Placement**

This leads to IIT emerging (over time) as a deeply interconnected “city” with secondary thoroughfares, open meeting spaces, courtyards and multiple walkways. Through the ability of an infrastructural scaffold which facilitates a responsive matrix of programs, supporting the articulation of several spatial and constructive elements - elements can arise which are different through the developing scheme, and which will permit an incredible variety of outputs within a controlled modular system.

11.4. Permanence Versus Transience in Design

There are numerous elements in this proposition that straddle the question of permanence versus transience. IIT within the script of this thesis has been understood to have had too much precision of the architect and inheritors of the campus present, resulting in a top-down design ethos which lead to permanence and the inability to change, evolve, adapt, or deal with contingencies on site. The concept of evolvability and allowing necessary elements to emerge when necessary could introduce and facilitate resilience on site longer than maintaining the status quo. This perspective aims to showcase an alternative, and provide the missing flexibility IIT should have had.

Therefore this scaffold is an infrastructure which allows for continuous adaptation of itself, while it is understood that it is a non permanent structure which is meant to be assembled and disassembled as seen fit.

The scaffold is therefore not read as a single project, nor does it have one, linear outcome. The scaffold can be read as spreading across the campus, adapting and shrinking to assist program where needed, yet can also be read in smaller vignettes, understanding how the scaffold can flux and adapt to particular drivers in situ. The scaffold has multiple scales of operation. There is constant shifting and moving within the scaffold, allowing contingencies to manifest and harnessing the possibilities of transformation.

The scaffold is meant to be read as infrastructure, potentially unfinished, and simply a means to support the emergent “guts” of itself. The rationale is based on the permanent Miesian dimensions already present upon the IIT campus. This nod to Mies brings emphasis to his rationale, yet as a comparison, the interrelations within the scaffold bring forward an emphasis on emergence, and the performative abilities the scaffold permits. The scaffold can permit as many iterations as necessary, and allow the IIT campus to evolve in a way that its requirements demand, in a way that Mies legacy has prohibited prior.

This thesis also acknowledges the complications behind typical architectural representation techniques to attempt to bring to life the concept of emergent architecture. This complication arises due to the fact that for any representation is simply a snippet in time; a crystallization of an architect’s vision at present. The act of this representation is in itself permanent, for a project that strives to constantly be in flux, and change. The scaffold has many lives, and therefore the transient nature of this must be elaborated.

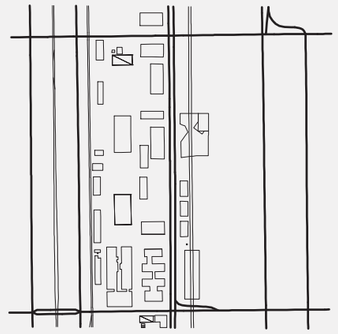


Figure 11.03 **IIT Base Campus Plan**

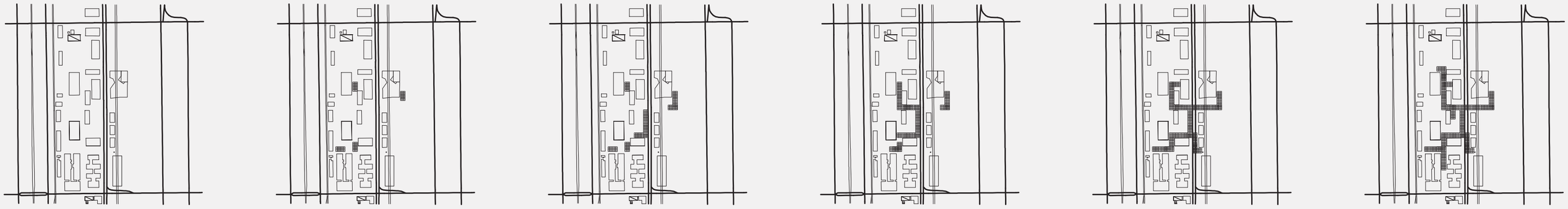


Figure 11.04 **Scaffold Growth Over Time, Development from Placed Nodes.**

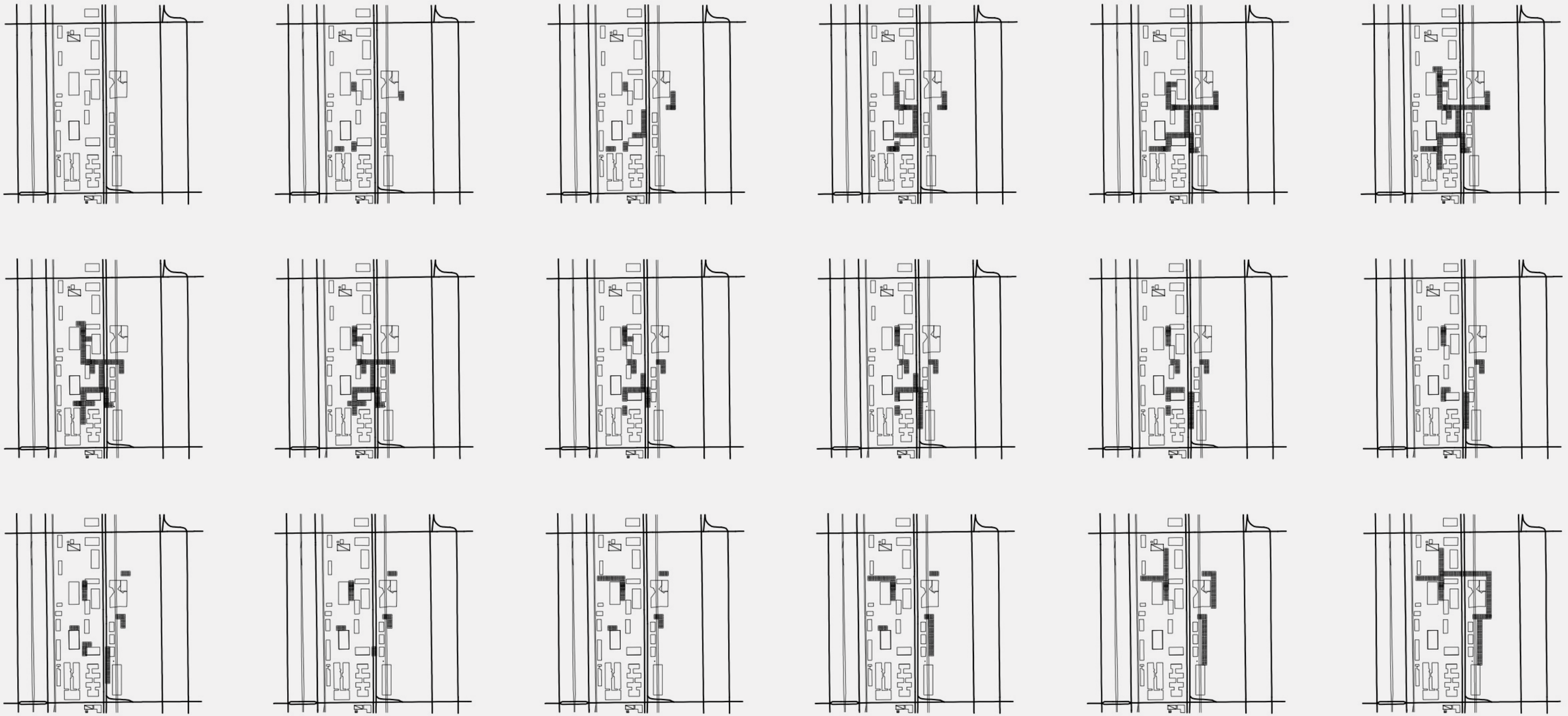


Figure 11.05 **Growth and Diminution**

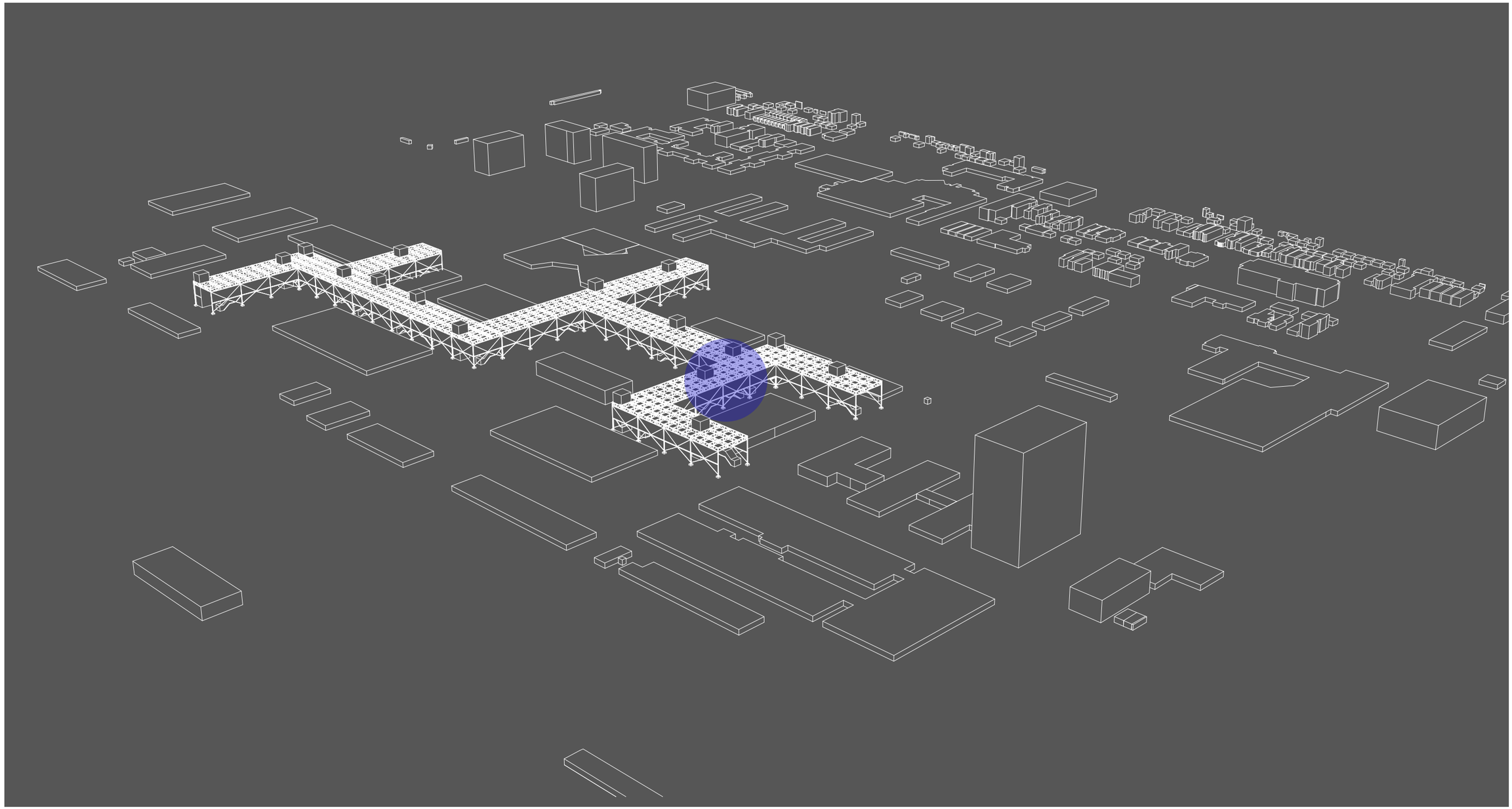


Figure 11.06 **Portion of Scaffold for Further Investigation**

11.5. Infrastructural Scaffold Manifestation

The logical reasoning for the Miesian grid continues to exist to this day. The grid is the existing “ground”, and there is an inherent ability for emergence, but it was never perceived as such, or encouraged. There is a potential for emergence on this campus, and this thesis aims to activate it.

The grid exists as a permanent fixture on the IIT campus. The existing Miesian architecture exists as permanent elements as well. This is where mat building techniques come in as a response to the existing, a transient element which reacts, and ebbs and flows, being respectful to what has already been developed.

To activate an additional programmatic layer, the aforementioned nodes are implemented on site as means of access. These include stairs and service systems and are treated as relatively fixed. These nodes are located around certain areas for potential. Nodes are the starting point of this scaffold, which serve the more flexible linkages facilitating functional zones. Additionally, these nodes aim to implement a methodical approach and small footprint to enable the growth of the campus while restraining the use of the land underneath the development.

The scaffold is implemented around Miesian grid dimensions. This scaffold adheres and develops around the rationality of the original grid. This aims to generate a new layer which is respectful to the existing, yet additionally aims to edit Mies’ ideas and logic in a way that Mies would never have done. The scaffold is constructed, yet can be dismantled or can achieve diminution. There is an element of both permanence and transience to the scaffold. This is a flexible megastructure on a scale relating across the campus. The mat typology implemented here offers a flexible scaffold, which relates the existing

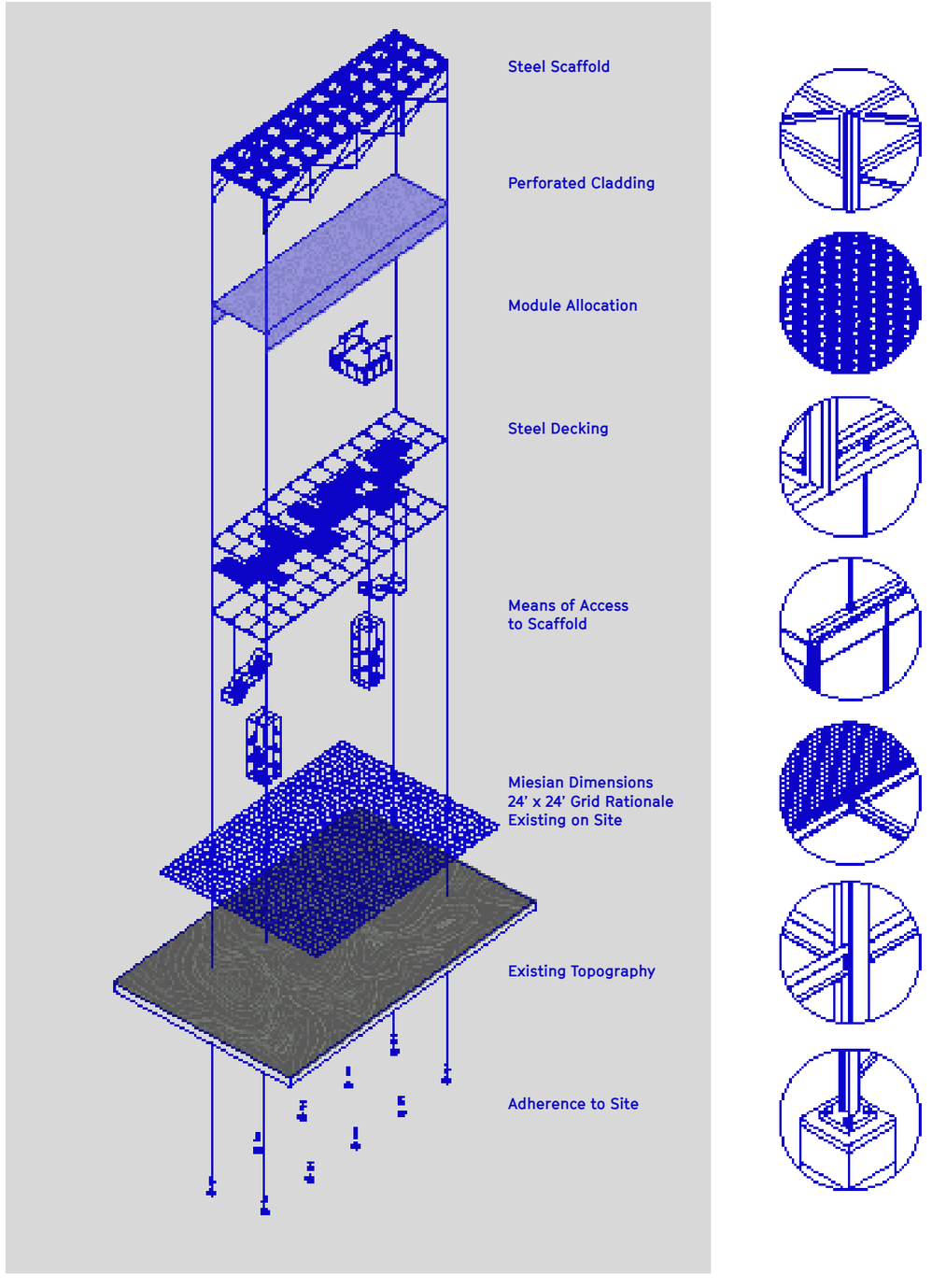


Figure 11.07 **Scaffold Components and Connection Details**

site through, lifting it to an uninterrupted continuation. It is permanent in the sense that it supports supplementary program within, yet can act as an element which can shrink and grow, wherever needed - to support emergence.

The scaffold facilitates and in turn becomes neutral infrastructure, as this allows for infinite variation of emergent architecture to be achieved within its structural supports. Changing, transient, and non permanent modules are situated within, where needed, for however long. Infrastructure, in this sense facilitates and supports the modules. The infrastructure is emergent, however, it becomes the backdrop to the program and encourages the unforeseen spatial organizations to arise. As the scaffold runs and snakes its way through campus, developing and retracting where needed or no longer, the inserted modules are influenced by their surroundings, the systems at work affecting the scaffold in proximity. This scaffold supports the event, without being the event.

11.6. Modules + Emergence Within the Scaffold

While the scaffold adheres and develops around the rationality of the Miesian grid, the modules for implementation are predicated on Miesian dimensions, appropriately fitting in to the existing Miesian dimensions on campus. Modules are designed to slot into the scaffold, and can be easily shifted and manipulated by the user according to the systems influencing the module's state.

Additionally, with methodical adherence to dimensions as proposed by Mies, the overall composition of the module follows suit; predetermined apertures facilitating openings for glazing or more opaque cladding can easily slot in - allowing the architect to determine the level of opacity to the module. It is

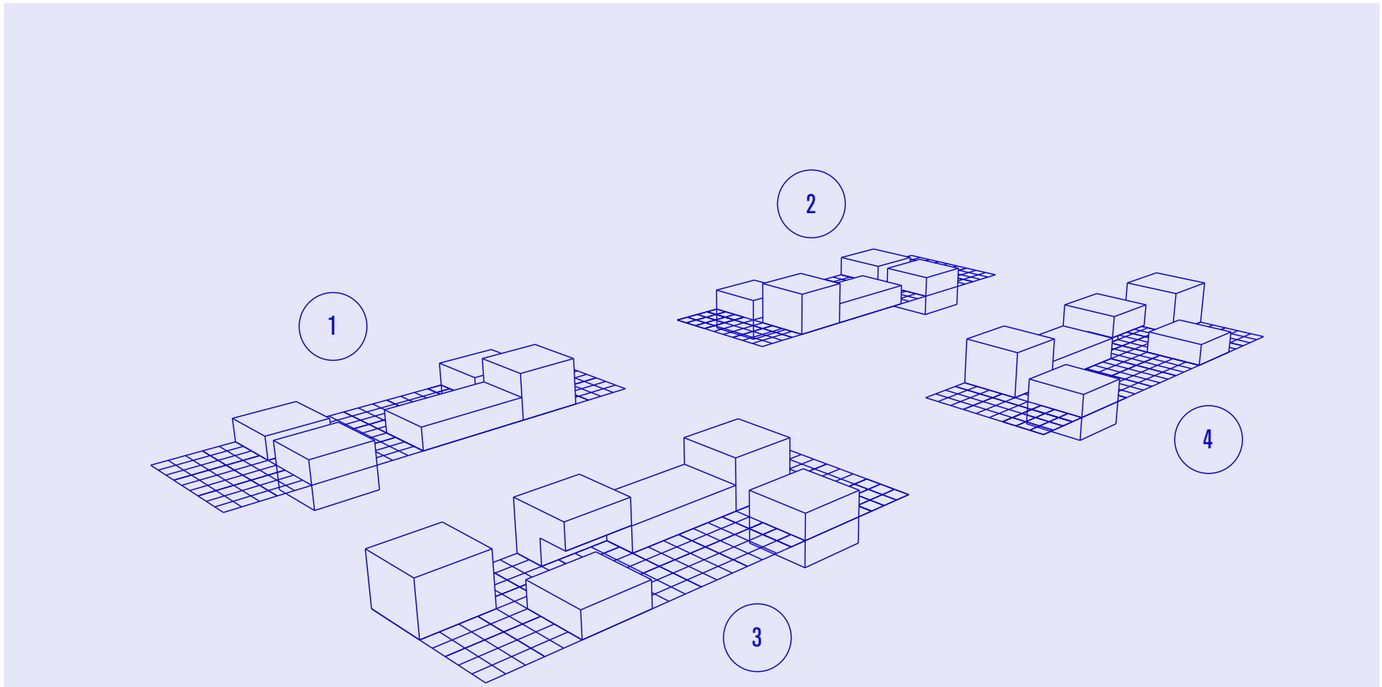


Figure 11.08 **Potential Module Organization Study**

here that the design “ceases” - it is understood that certain types of program require more glazing than others, or a more expansive footprint, or even double the ceiling height of a particular module, yet the usage of the module is not prescribed by the architect. Different arrangements of modules are responsive to different system drivers on the scaffold armature. Variation of size - width and height - and also depth are influenced by programmatic pressures on the system. A 12 foot module height for additional administration space may be more than satisfactory, however, a workshop or a new auditorium may require additional 24’ height achieved by stacking modules.

Modules of varying heights and widths can be developed, and manipulated, permitting a trial and error process for the users and participants of the scaffold to test what best suits the system acting upon the scaffold structure. It is the users of the scaffold environment (faculty, staff, student body) who give meaning to their environment. These modules are fashioned in numerous manners, and suspended to the scaffold; facilitating a relative ease of change of program. This establishes a freedom of choice for the inhabitants, and also exaggerates the fact that the inner workings of the scaffold routinely appear different throughout the campus. Steel decking is slotted into place where needed, to facilitate movement around the infrastructure. Interstitial space between modules further becomes manipulated by the users, allowed to be developed however needed in that moment. Supplementary stairwells bring users up from street level, activating the IIT campus from grade.

As the scaffold densifies and begins to emerge to fit the needs of the IIT campus, it becomes a thickened, three dimensional construct for occupation, supplementing the existing ground plane at IIT. The scaffold is not intended to function independent of the existing IIT campus, but to act as a secondary “weave”, integrating and touching down to the ground where needed, ultimately becoming woven together with the existing to supply a more dense, efficient whole.

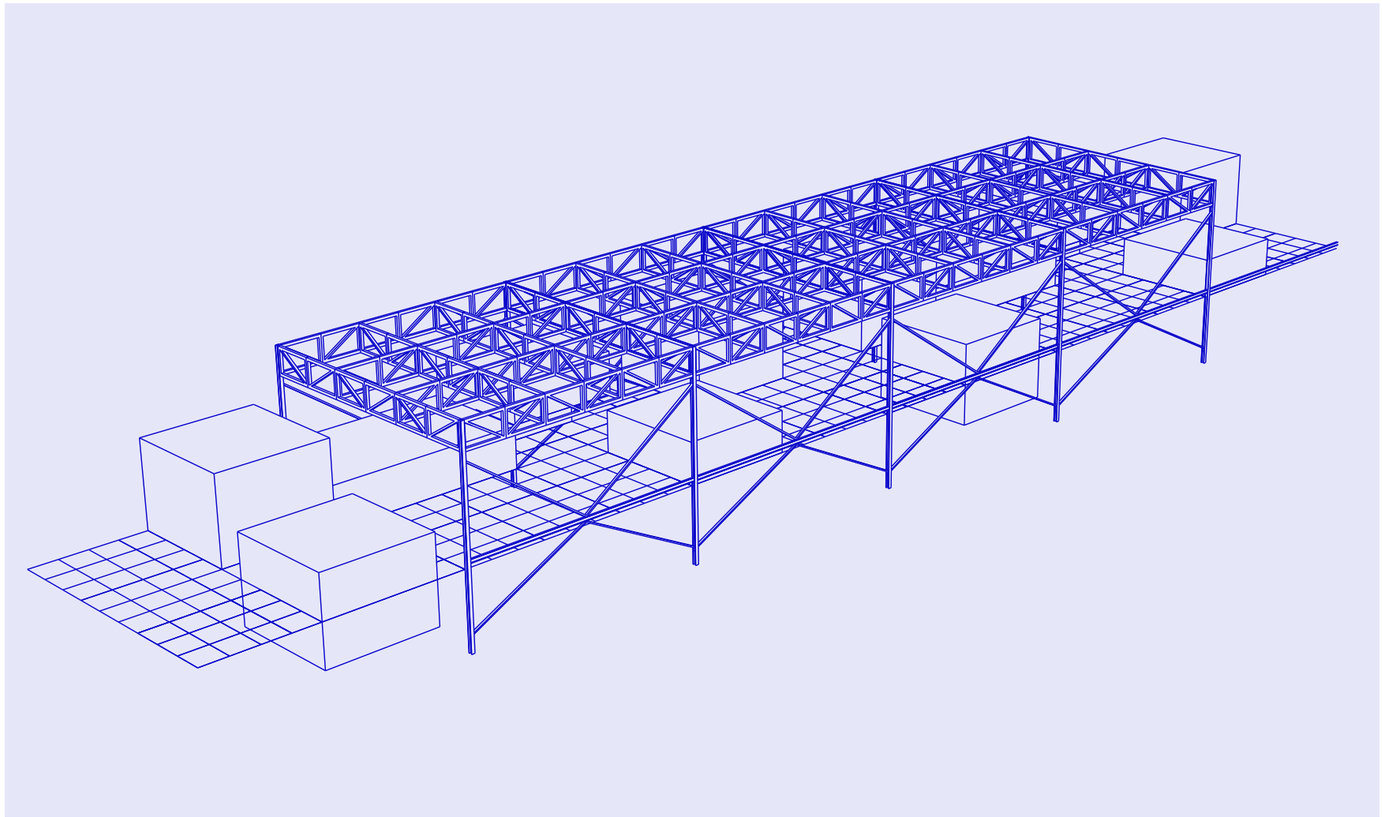


Figure 11.09 **Module Organization Within Scaffold**

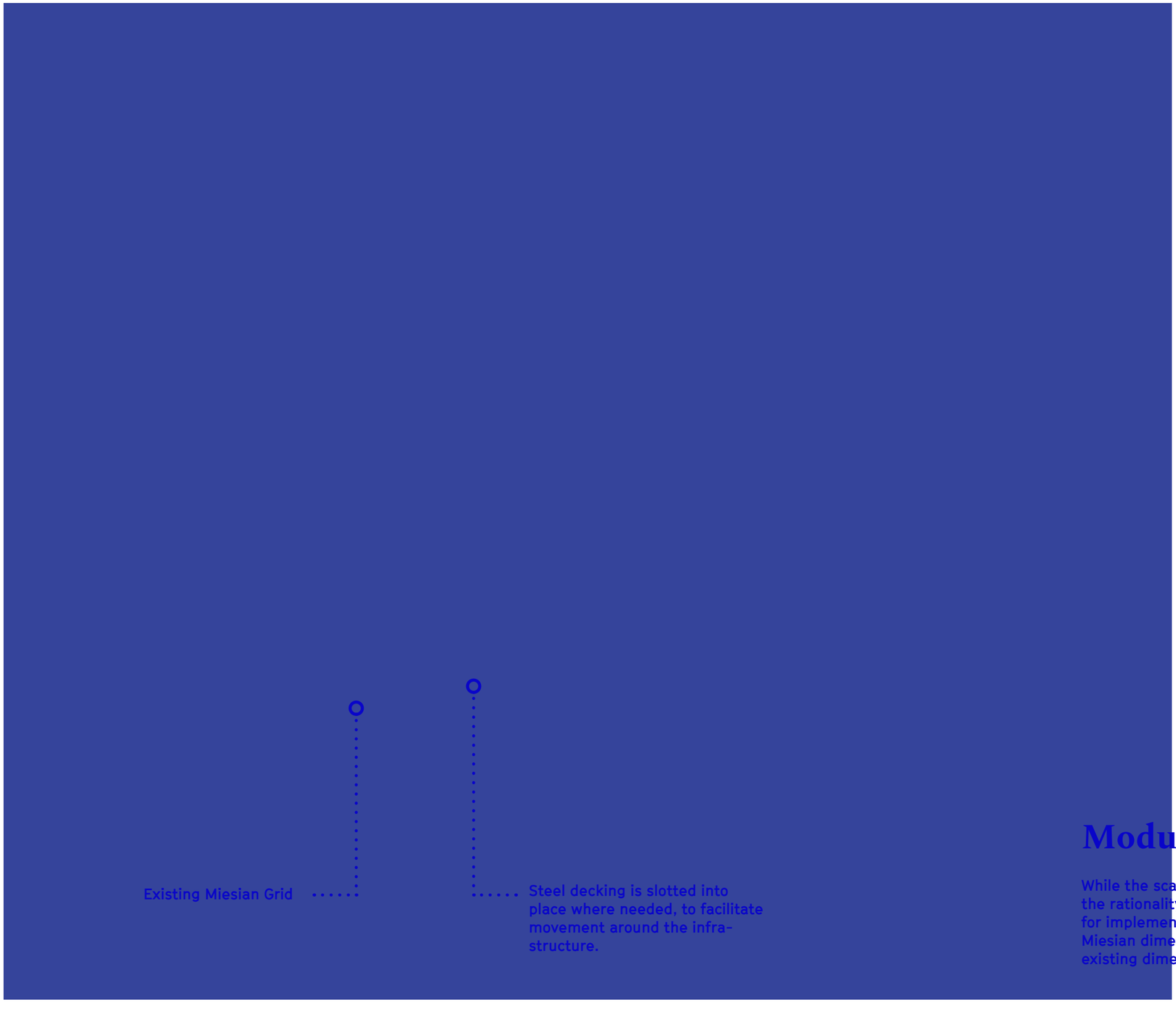


Figure 11.10 **Module Composition**

Module Composition

While the scaffold adhers and develops around the rationality of the Miesian grid, the modules for implementation are additionally predicated on Miesian dimensions, appropriately fitting into the existing dimensions on campus.

Thus, the modules become spaces as determined by the inhabitants, where system pressures are manifested through the allotment of modules to fill the desired need. The disposition, volumes, and forms can change according to changing system pressures, and as a result, the architecture of the modules can continuously adapt to the users' needs. The architecture of the modules aims to only provide the framework; the inhabitants are destined to construct their programme as they see fit, according to the needs and ideas, ultimately being free from the preconceived "ideas" of the master builder Mies.

As described by Yona Friedman:

> "Architecture is the void and architects are, in general, sculptors of the void. This is a different approach where architecture can be changed easily because it is the inhabitants that decide, like furniture. If you look at a building complex whose units have identical floor plans, each apartment will still be used differently: each inhabitant uses his or her domain as he or she sees fit. All together, this produces a complexity. The architect provides the structure and the inhabitants fill it out." (Freidman, 2018)

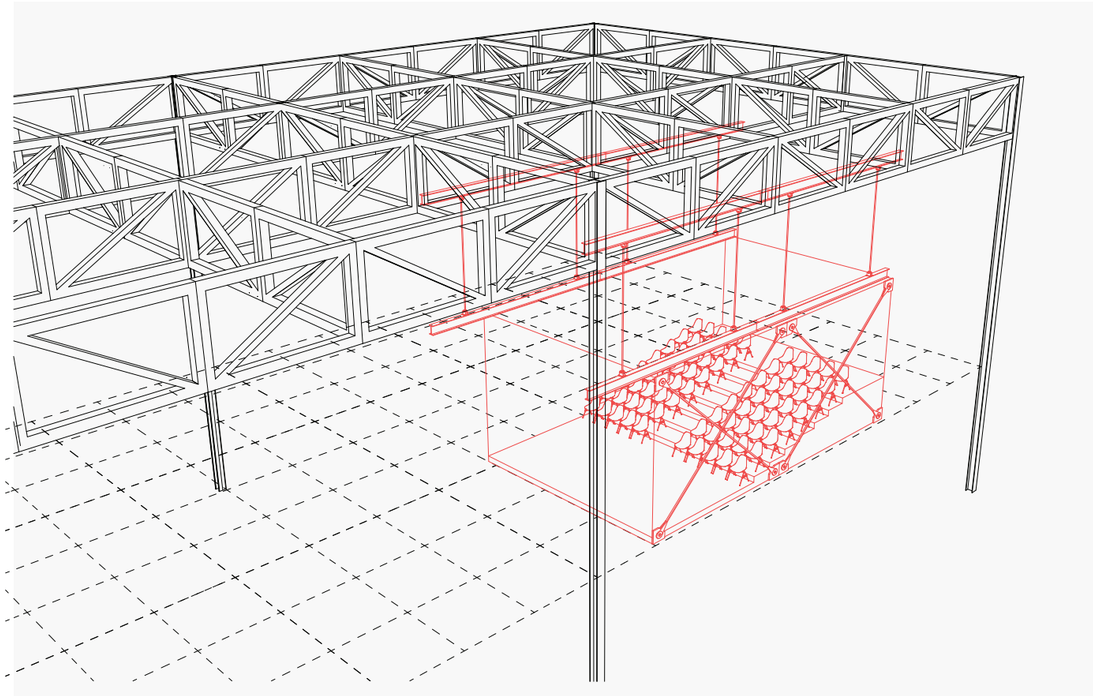


Figure 11.11 **Hanging Module Study**

11.7. Scale - Different Areas of Focus

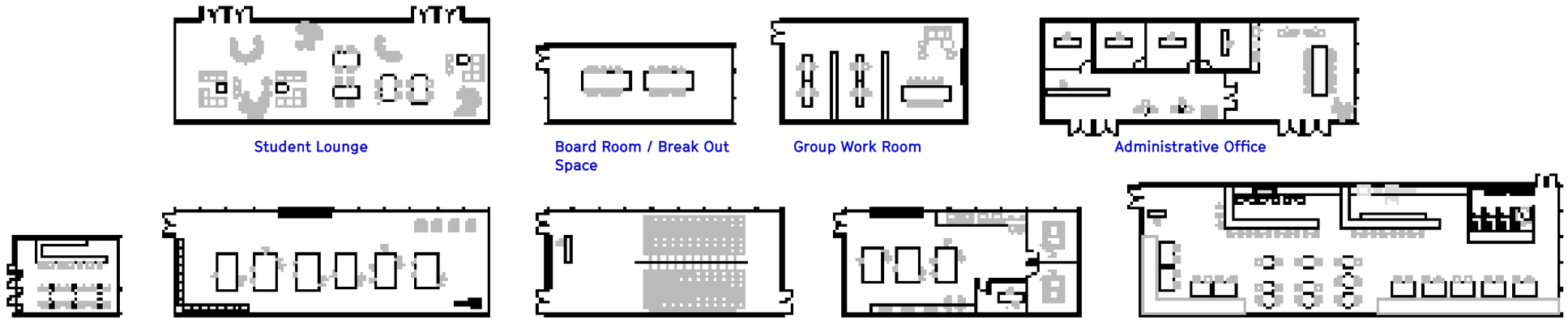
While the inception of mat building upon the IIT campus has us focusing on a larger, more macro urban platform, it is important to highlight the overarching urban plan of the IIT campus versus areas of closer inspection and the responsive matrix as situated in proximity. This acts as a focused view, or vignette into a portion of the scaffold, showcasing the systems acting upon the scaffold at that precise location. For the scaffold is an armature which is weaving its way over the IIT campus in its entirety, and different locations will be intrinsically affected by different systems surrounding, and their influence. For this thesis, we intend to look at a particular case example, that will serve as a proof of concept. This vignette will not be a finalized answer, or solution, it is, at best, a conditional place holder of the concept.

The intent here is to begin to speculate what systems are acting upon areas on the IIT campus where surrounding points of interest would be of influence. Thus, this thesis is considering different levels of emergence - whether this is the overarching scaffold sprawling where needed over the entirety of the IIT campus versus the system influence of modules within the scaffold as situated next to a particular faculty building.

An example being Crown Hall, IIT's school of architecture. If the faculty "could expand" to fit its needs, what would this look like? The infrastructure facilitated through the campus integrates these system outputs, and develops, allowing these necessities to emerge in proximity to the campus faculty building. This leads to the speculation of if encouraged to emerge over time, what supplementary program would support Crown Hall? Examples revolve around elements which have been noted as lacking within the existing faculty building at present: a workshop, more private studio spaces, presentation rooms, pin-up spaces, private cubicles, lunch hall, dormitories, and a student lounge to name a few.

Thus, the understanding of the overall construct must come from the organization of the parts, and these parts which are influenced by their surroundings and system influences. The whole, realized system is never truly seen, and is constantly in flux. A vignette into a particular piece of the scaffold can help explain what may emerge, if given the opportunity. This speculative thinking can be applied numerous times, in an attempt to understand how emergence may pan out widespread across the IIT campus.

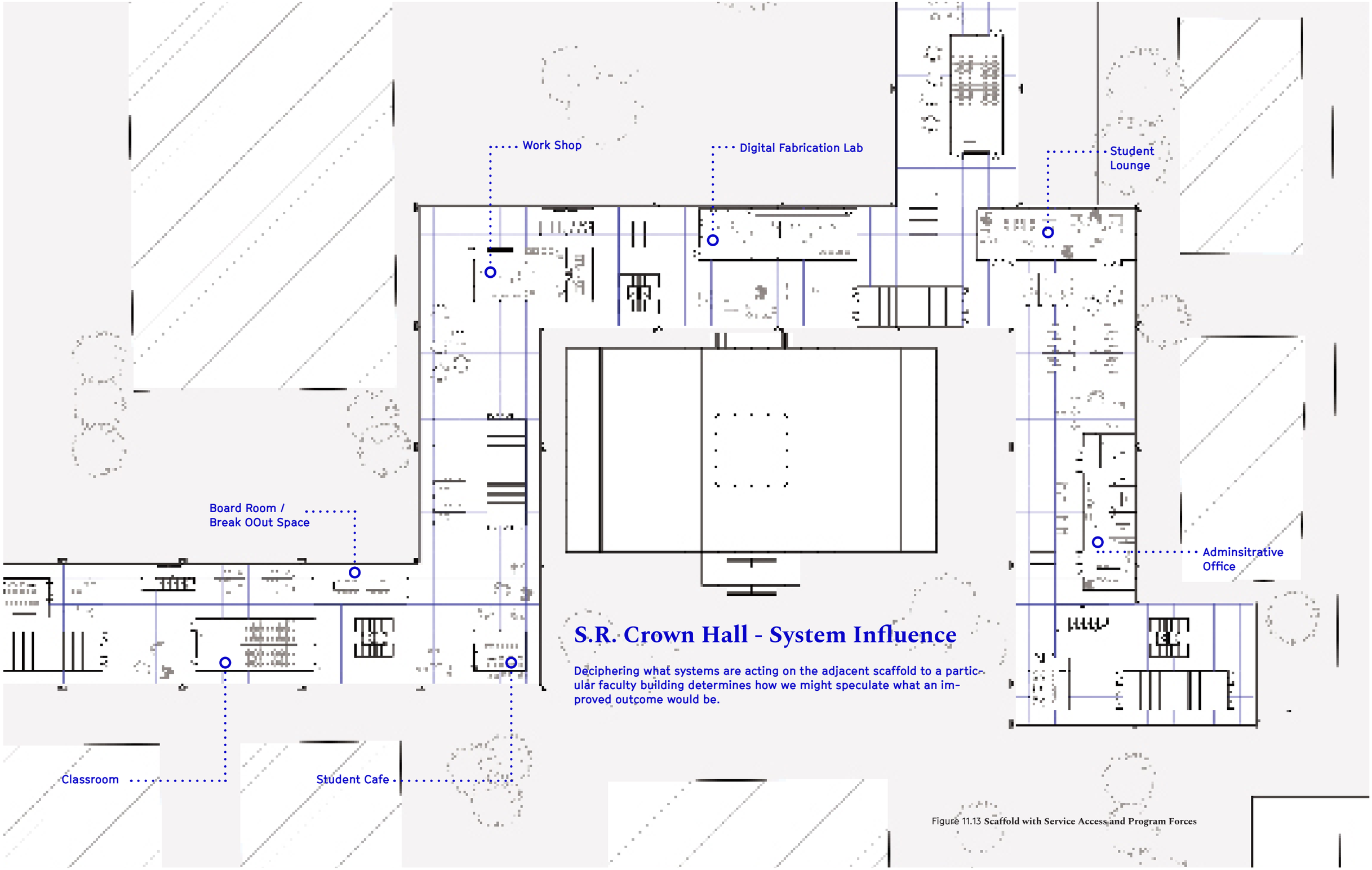
Thus, this vignette showcases the understanding of the overall scaffold construct comes from the organization of the parts. This recognizes that that authentic IIT urban culture emerges naturally, over an extended period of time, and is never truly finished evolving.



Speculative Module Layouts

Modular layout allows non stop configurability of internal spaces, expansion of modules, and change of programme at relative ease.

Figure 11.12 **Speculative Module Layouts**



S.R. Crown Hall - System Influence

Deciphering what systems are acting on the adjacent scaffold to a particular faculty building determines how we might speculate what an improved outcome would be.

Figure 11.13 **Scaffold with Service Access and Program Forces**

Removal of panels allows for implementation of specialist programmatic needs.

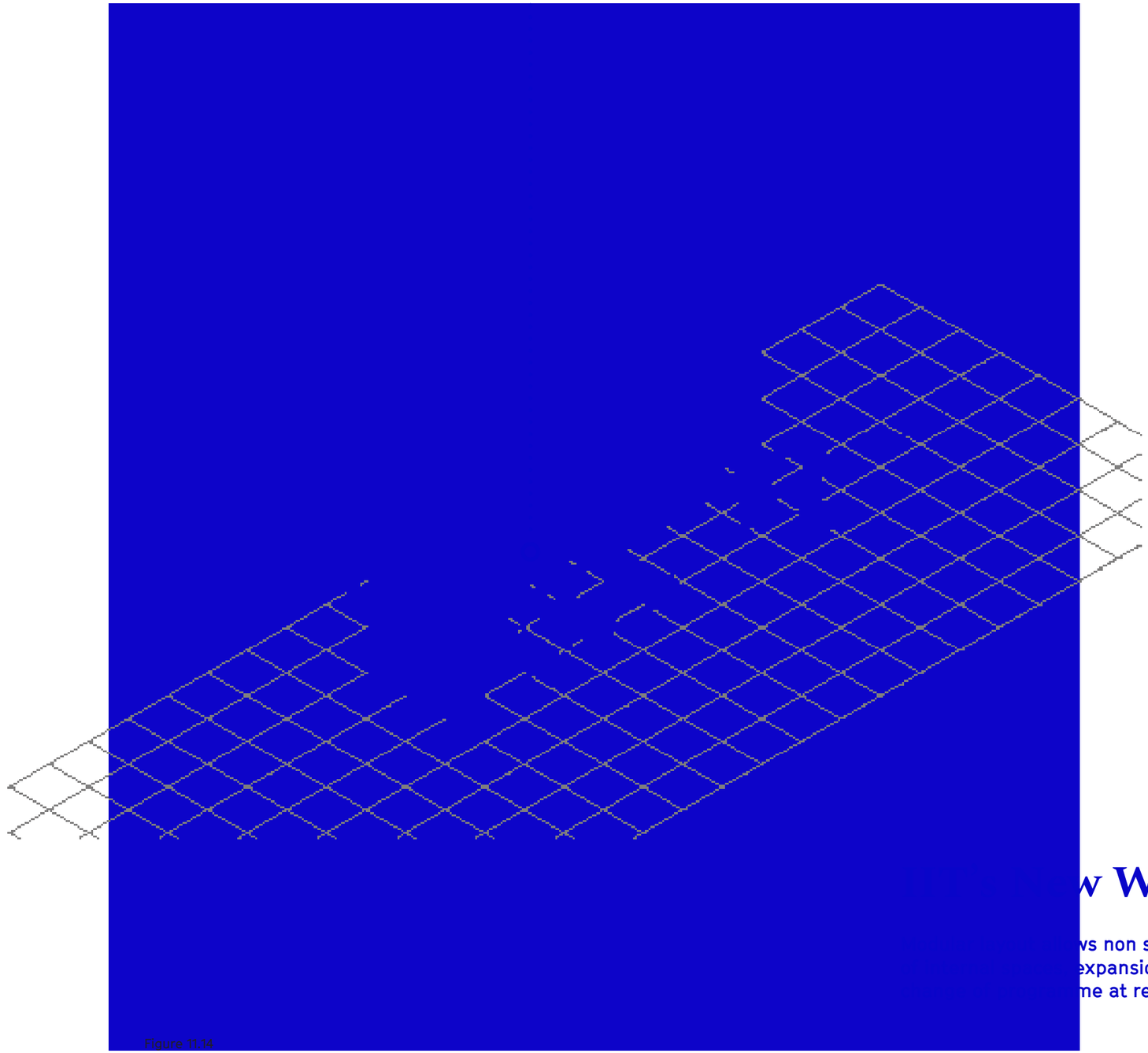


Figure 11.14

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vs non stop configurability
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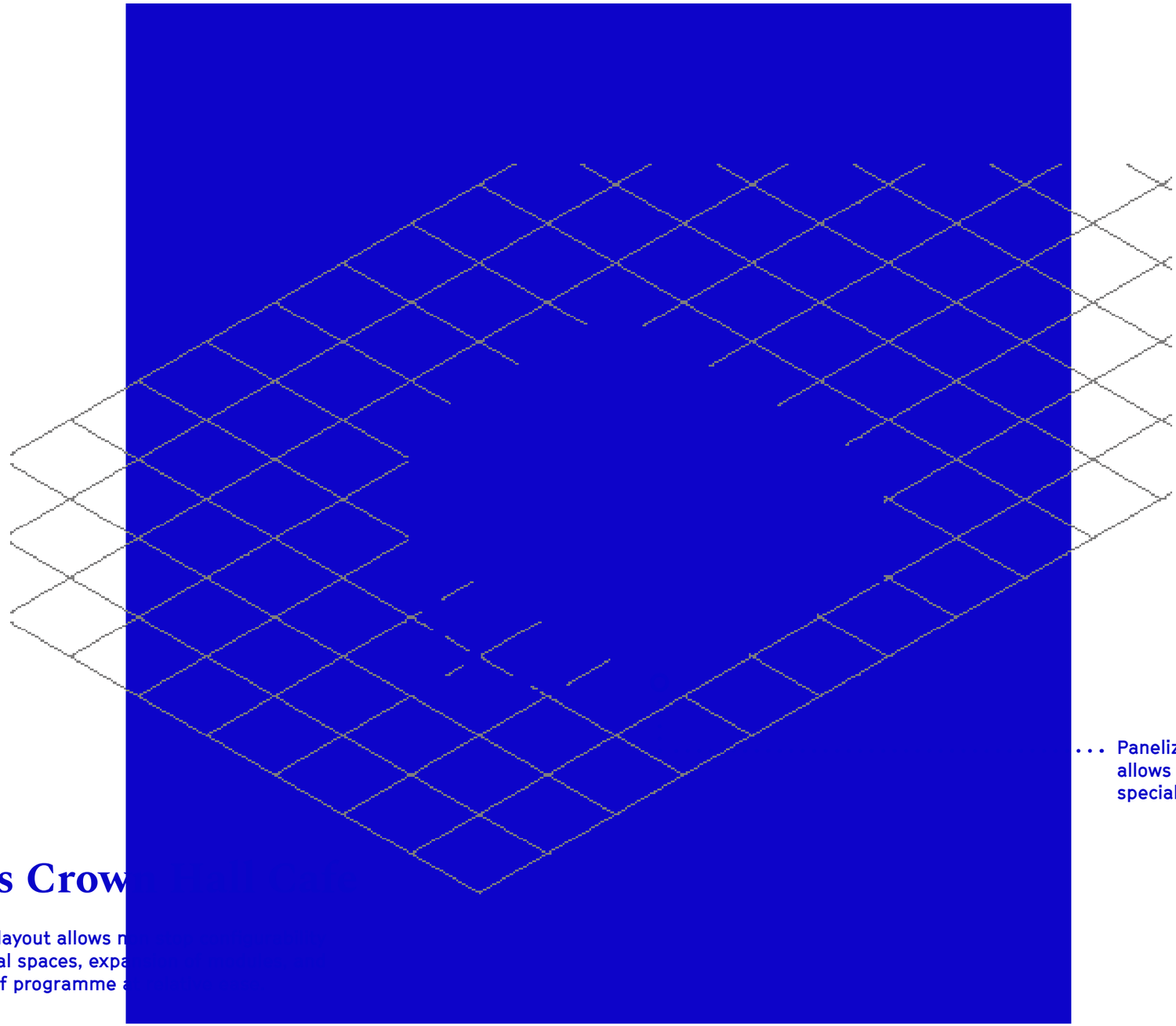


IIT's Crow

Modular layout allows n
of internal spaces, expa
change of programme a

. . . Panelization of module walls allows for adaptability for special programmatic needs.

Figure 11.15

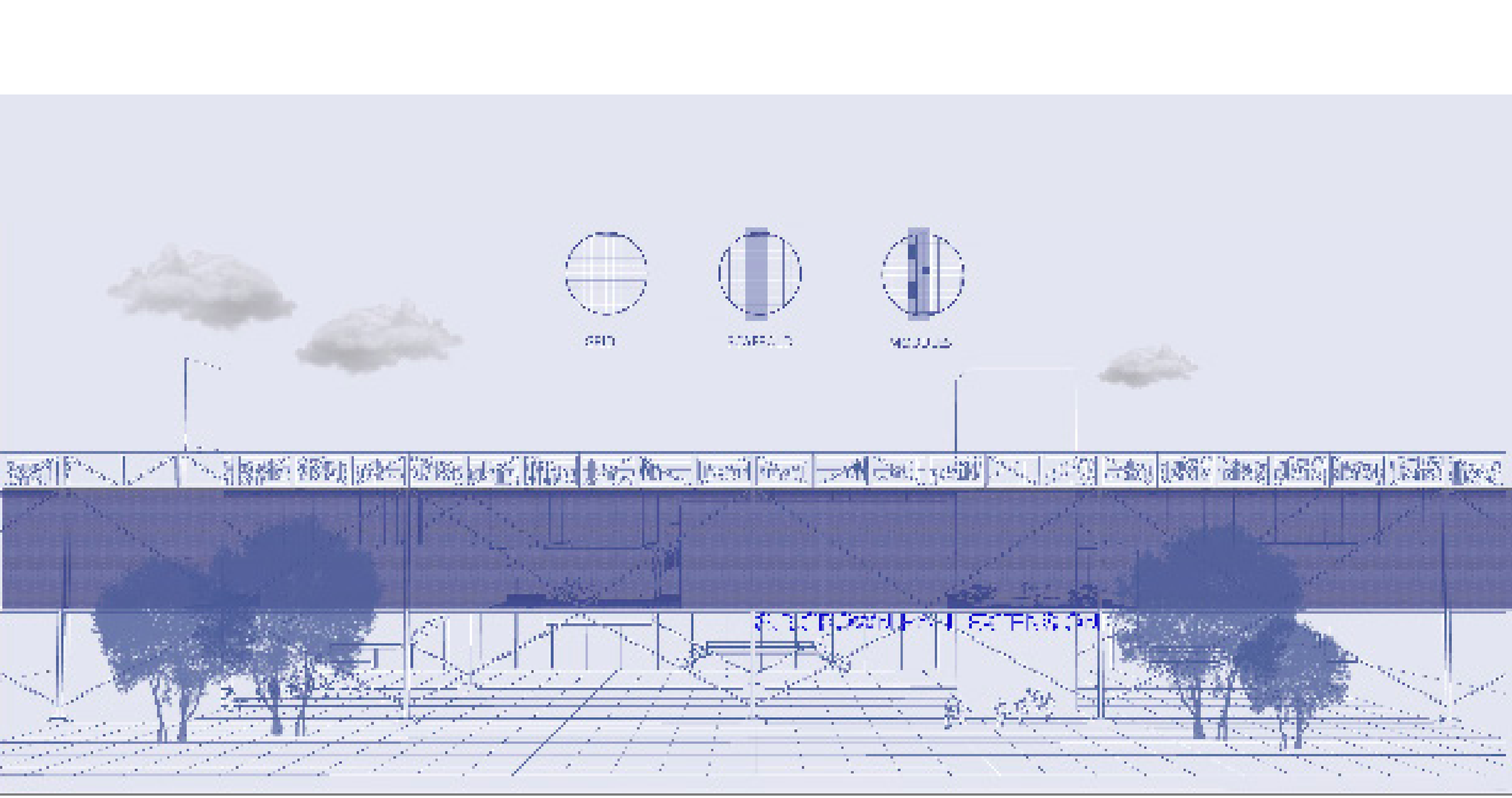


Figure 11.16 **Overall Composition**

12 Conclusion

As summarized by Christopher Alexander:

> "If you want to make a living flower you do not build it physically with tweezers, cell by cell, you grow it from seed. If you want to design a new flower, you will design the seed and let it grow. The seeds of the environment are pattern languages" (1970).

IIT was selected as a test-bed for theoretical system drivers of which I perceived could potentially influence emergent development. This study revolved around extensive research into systems theory, emergence, speculative design, all while attempting to understand how these theories are related on a larger scale; between self-organization, the notion of the unintentional designer, top-down versus bottom-up construction. The IIT campus was selected to bring to light the new emergent approach to contemporary architectural practice, as outlined in this thesis. The aim was to summarize just how much the university was antithetical, or hindered to pursue progressive, adaptive design.

The backbone to this thesis deals with complex theories - often based in less subjective fields of study - which opened up a world of challenges I did not fully anticipate, or knew how to approach in an architectural lens. Deciphering what systems I perceive as acting on this scaffold framework determines how one might speculate what an improved outcome could be. While acknowledging this analysis in this study is limited in the essence of which these systems are understood from my perspective and opinion only, it is difficult to quantify a fully encompassing, true systems analysis on this level of work.

Thus, this vignette showcases the understanding of the overall scaffold construct comes from the organization of its parts. The design vignette developed within this thesis can only represent a small portion of how a structure of such magnitude would actually function and be deployed over time. This also recognizes that the authentic IIT urban culture emerges naturally, over an extended period of time, and is never truly finished evolving. This thesis does acknowledge that the realized construct is developed from the relationship of the program parts organized and designed to be able to react to the local, temporal, and nuanced desires of the IIT campus.

This attempt to graphically represent the bottom-up approach to architecture is not easy to accomplish. This is simply one small instance in this structures proverbial lifetime, and my own personal interpretation of what I speculate that condition to be. Arguably, by doing such, I am designing a representation or "end point", that is intended to not be designed or static. This exercise could be run by numerous authors, and it would be of great interest to see what other implementations could manifest. For the system is never stagnant, and it is ever changing. Any fixed graphic representation can only convey one snippet in time, while the actual proposition is continually in flux. The sole constant in the system is change - of something that will not last forever.

Additionally, this thesis aims to address beneficial methods of approaching architecture and urban planning issues, often bringing to light mid-century theories which have now become passe. Mat building, infrastructural urbanism and superstructures all bring to light elements of design I perceive

as beneficial for an IIT expansion. When analyzing self-generating forms, one can recognize the similarities of these forms with formations of living nature, and even non-living formations found within nature. Arguably, if the determinant ideology was lessened on the IIT campus, over time, this thesis argues that the campus could rectify any problems, as a self regulating entity.

The experiments attempting to outline a logical emergent path brought up numerous issues with the concept of basing a thesis around emergence. This thesis struggled with the definitive stance upon the line between top-down and bottom-up, which enlightened me to the issue that any design work with human input is never solely bottom-up. For myself, as the designer, to speculate about what could be, is inherently designing or premeditating differently than how another designer may approach it.

This is how the concept of a scaffold armature, or a bare bones assembly which could support intrinsic emergent elements was spurred on. Perhaps the architect could design (admittedly top-down), but only to a certain point, where the natural progression of emergent elements could be supported. Through intentions and expectations of what I, as the designer, perceive to be beneficial to the advancement of the Illinois Institute of Technology, it became very apparent that simply summarizing an enormous task such as “designing for emergence” was inherently difficult, plausibly virtually impossible. However, this thesis represents powerful techniques to engage with overcoming the inherent limitations of top-down architectural approaches.

13 Appendix

As a designing exercise, I attempted to construct my own conceptual framework for emergence, as “run through” the Illinois Institute of Technology. This was executed in phases, which are outlined within this overarching drawing.

This drawing attempted to focus my understanding of the interrelated dynamics between systems theory, emergence, and speculative outcomes. These phases as I approached this algorithm are implemented in this drawing, with visual cues illustrated below. This drawing was subsequently broken down and presented in more “zoomed in” phases.

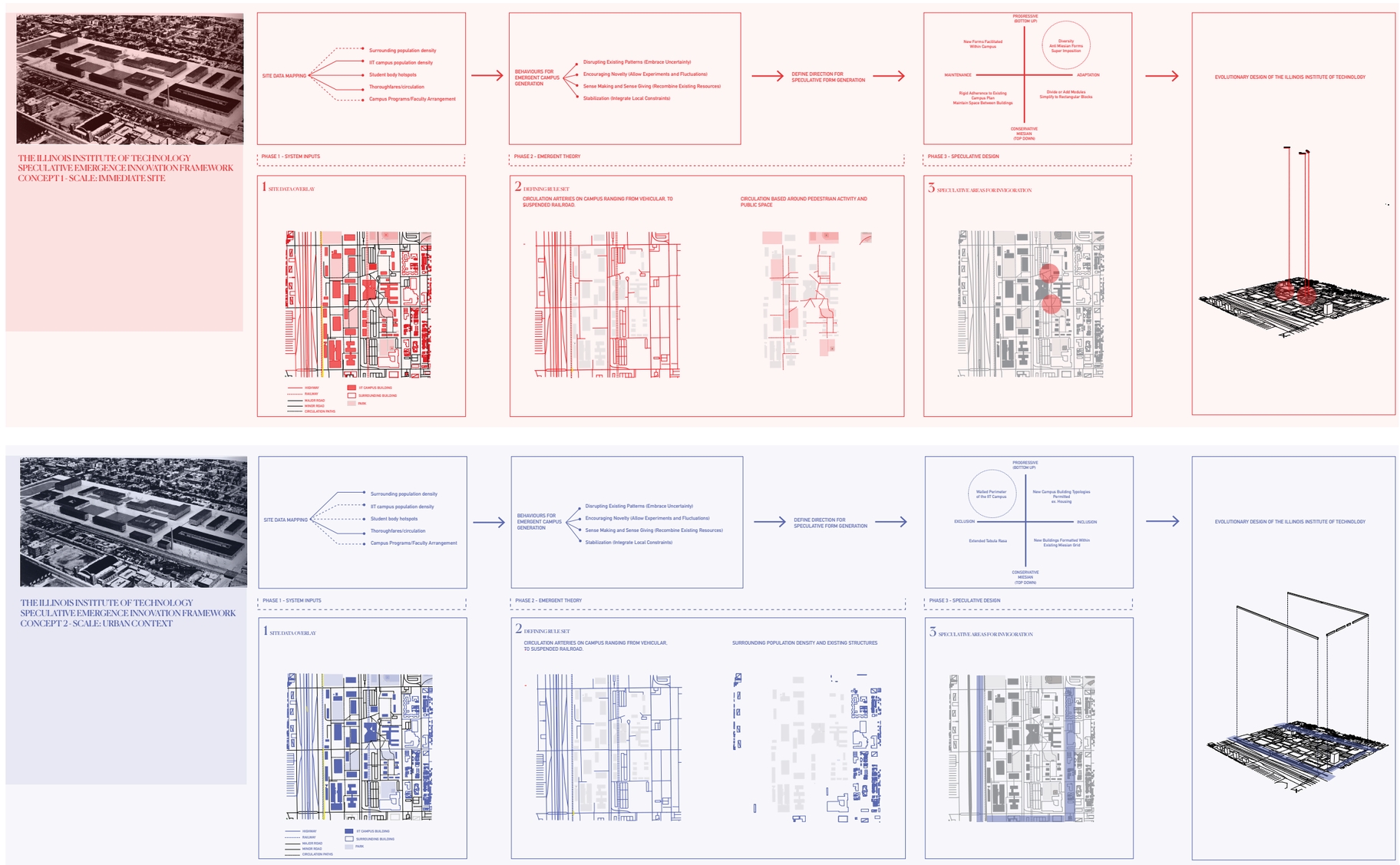
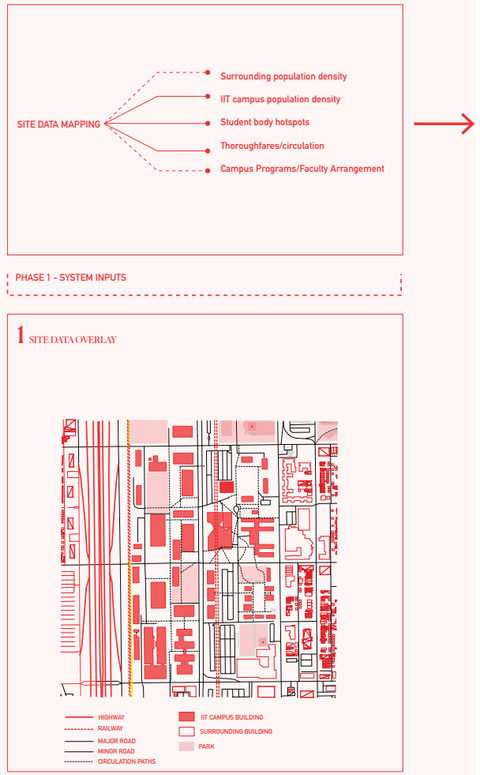


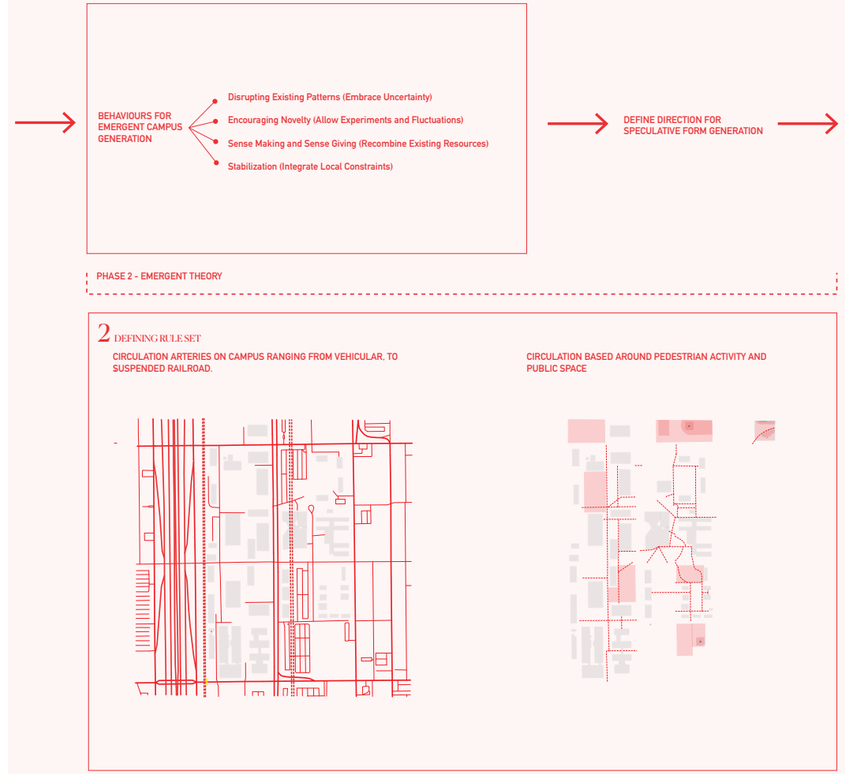
Figure 13.01 **Overall Algorithms**

THE ILLINOIS INSTITUTE OF TECHNOLOGY
SPECULATIVE EMERGENCE INNOVATION FRAMEWORK
CONCEPT 1 - SCALE: IMMEDIATE SITE



These are inputs I have deciphered for my conceptual framework, and this acknowledges there is no way a designer could begin to comprehend all of the inherent complexity within this site. For the sake of this exercise, I have chosen a certain subset of “drivers” to be utilized. For each drawing completed I am taking into consideration some inputs, and some I am not.
Below, an overall site map showcasing points of interest which are labeled will further be broken down to showcase drivers implementing emergence upon the site. Listed here are elements such as highways, major roads, minor roads, railroads, pedestrian pathways, parks and the like.

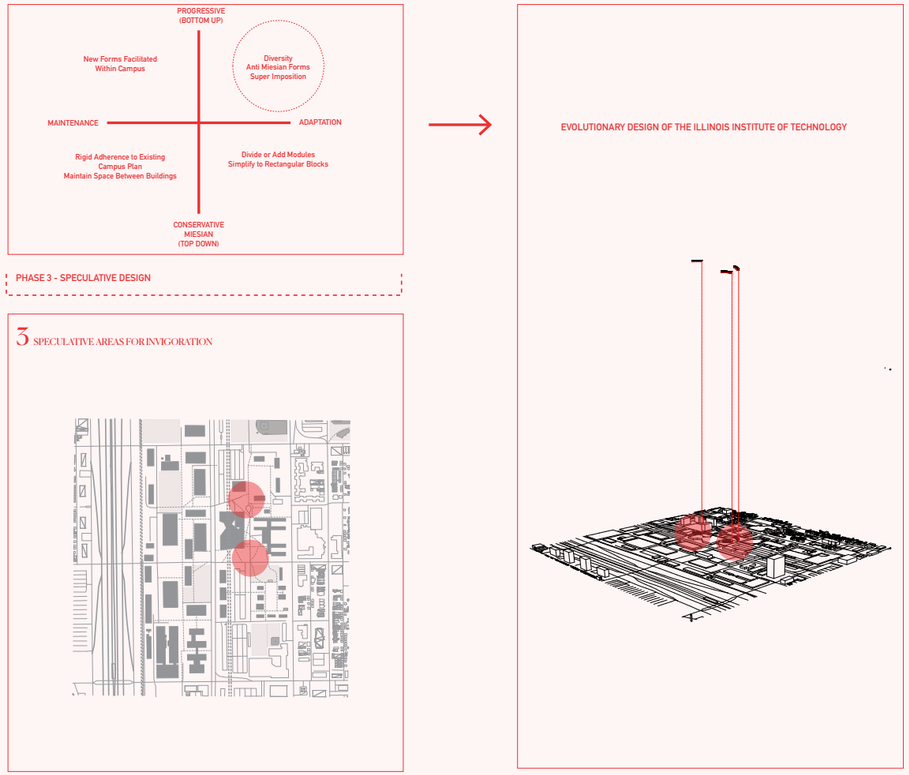
Figure 13.02 **Section 1**



Continuing through the framework, we can apply these original system inputs through an additional step, through the lens of emergent development. This can lead to define the particular scenario, or essentially spur on a speculative design exercise.

Below are highlighted in red the key system inputs which are are being applied through and thought about and applied to these key behaviours for emergence.

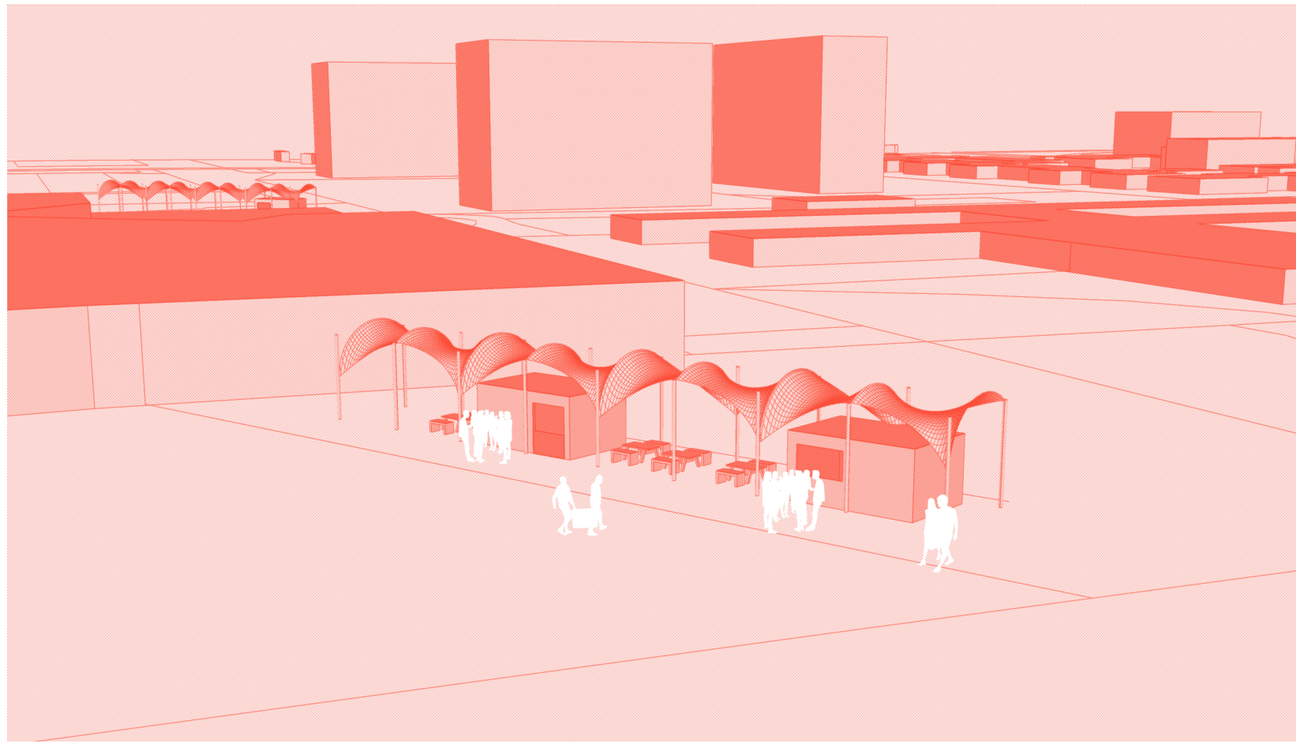
Figure 13.03 **Section 2**



Definition of the growth scenario, via progressive or conservative approaches. Via brainstorming through scenarios set up through a grid matrix, this begins to make us speculate about possible outcomes due to particular drivers. Two key certainties for speculation depend upon a progressive, novel formation (bottom up), versus the alternative; conservative, Miesian (top down) approach.

Via filtering ideas through two other qualifiers, four quadrants of speculative scenarios can be facilitated. This is a stepping stone of thought work to

Figure 13.04 **Section 3**

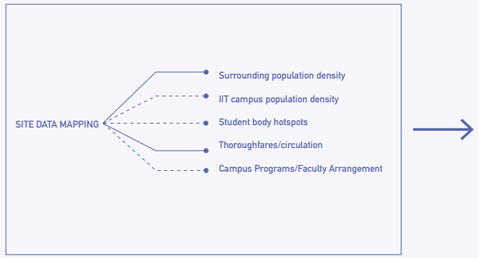


begin to understand where design can take a step in the emergent process. This also continues the exercise of speculative futures, where we can start to understand a future for IIT the users may, or may not want.

For this exercise, this is where the architect or designer depicts these qualifiers. For this exercise, we are considering the pros and cons of Maintenance or Adaptation. From these hypothesized outcomes, one can be selected for implementation. Speculative areas for invigoration have been selected from the defining rule set. Here, we see that an interesting outcome between a progressive bottom up approach, and adaptation, is the implementation of diverse, anti-Miesian forms, superimposed upon the existing IIT grid.

Figure 13.05 **Output**

THE ILLINOIS INSTITUTE OF TECHNOLOGY
SPECULATIVE EMERGENCE INNOVATION FRAMEWORK
CONCEPT 2 - SCALE: URBAN CONTEXT



PHASE 1 - SYSTEM INPUTS

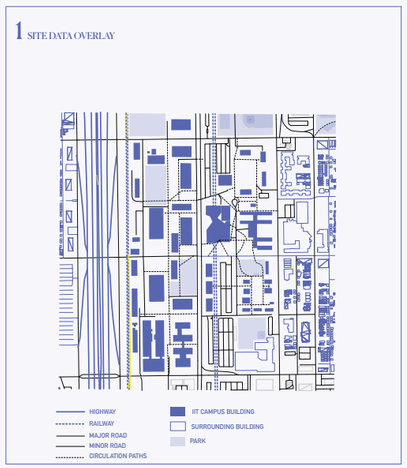


Figure 13.06 **Section 1**

PHASE 2 - EMERGENT THEORY

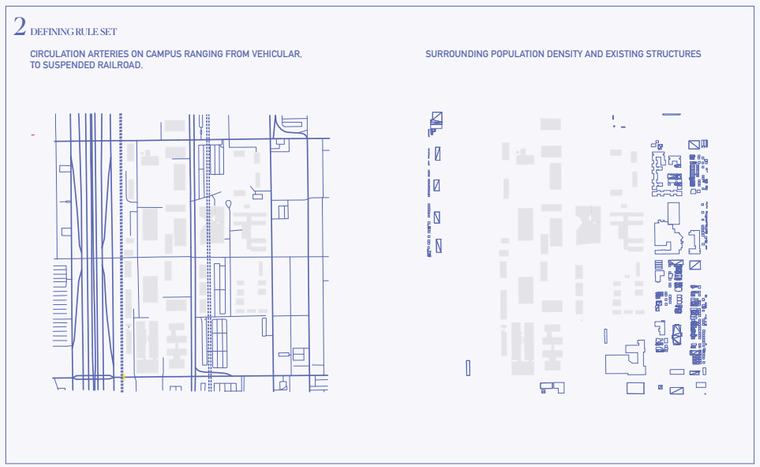


Figure 13.07 **Section 2**

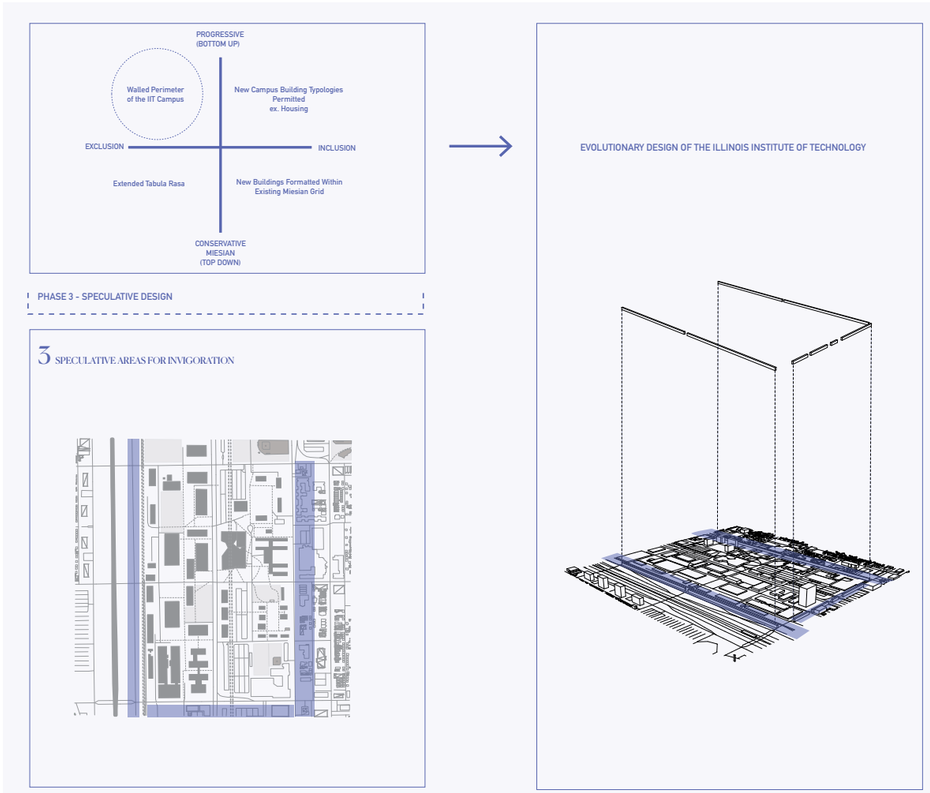


Figure 13.08 **Section 3**

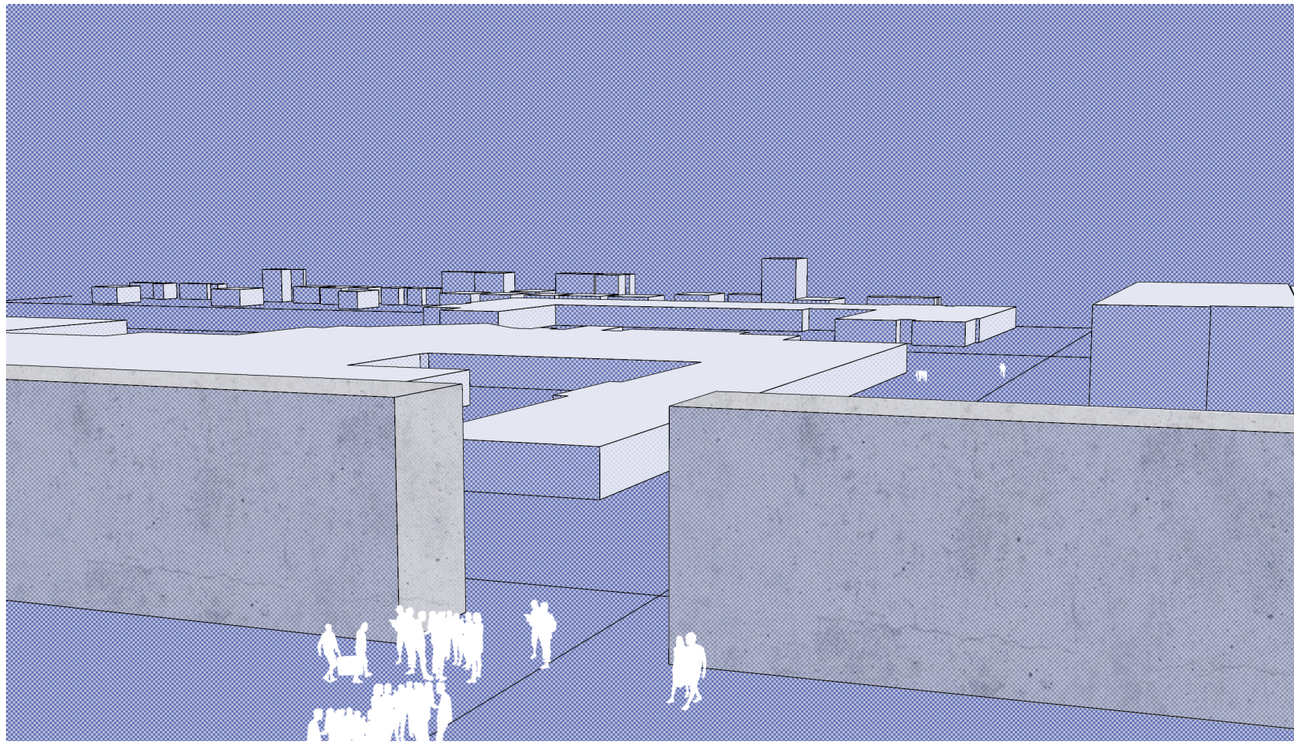


Figure 13.09 **Output**

Bibliography

Alberti, M. (2017). Simulation and design of hybrid human-natural-technological systems. Technology|Architecture + Design, 1(2), 135-139

Alexander, C. (1970). The Environment. The Japan Architect, p 54.

Allen, S. (2000). Stan Allen Essays. Practice Architecture, Technique and Representation. Routledge, New York.

Allen, S. (2002). Mat Urbanism: The Thick 2-D. In Sarkis, H. Case: Le Corbusier's Venice Hospital and the Mat Building Revival. Prestel. (p. 118 - 126).

Allen, S. (1999). Points + Lines, Diagrams and Projects for the City. Princeton Architectural Press, New York.

Altshuler, J. (2018). The Architect's Newpaper. Historic Mecca Flats Apartment Building Unearthed in Chicago. Web. Accessed from: https://archpaper.com/2018/07/mecca-flats-chicago-crown-hall/

Babkin, S. (2017). What is Speculative Architecture? FAQ by Liam Young. Interview. Accessed from: https://strelkamag.com/en/article/what-is-speculative-architecture

Bean, A. (2019). Chicago Detours, Bronzeville Neighbourhood. From: https://www.chicagodetours.com/bronzeville-neighborhood/

Belogolovsky, V. "Interview with Yona Friedman: "Imagine, Having Improvised Volumes 'Floating' In Space, Like Balloons"" 27 Jan 2016. ArchDaily. Accessed 16 Jun 2019.

Bratton, B.H. (2017). On Speculative Design. Dismagazine. Accessed from: http://dismagazine.com/discussion/81971/on-speculative-design-benjamin-h-bratton/

Brownell, B., Swackhamer, M. (2015). Hyper-Natural: Architecture's New Relationship With Nature.
(pp. 18-25). New York, Princeton Architectural Press, 2015.

Burkhardt, B. (2016). Natural Structures - the research of Frei Otto in natural sciences. International Journal of Space Structures. Vol 03, Issue 1, pp. 9 - 15.

Bloomberg, J. (2015). What is Emergent about Emergent Architecture? Web. Accessed from: https://intellyx.com/2015/09/28/what-is-emergent-about-emergent-architecture/

Calabuig, D. (2013). The Strategies of Mat-Building. Architectural Review 2013.

Cline, B. (2002). Matilda McQuaid, ed., Envisioning Architecture: Drawings from The Museum of Modern Art, New York: The Museum of Modern Art, 2002, p. 142.

De Wolf, T., Holvoet, T. (2005) Emergence versus Self-organization: Different concepts but Promising when combined in Engineering Self-Organizing Systems: Methodologies and Applications. Lecture Notes in Computer Science/ Lecture Notes in Artificial Intelligence. New York: Springer, 1-15.

DeLanda, M. (2012). Emergence, Causality and Realism. Architectural Theory Review, 2012.

Dunne, A., Raby, F. (2013). Speculative Everything. Design, Fiction and Social

Dreaming. MIT press.

El-Khoury, R., Robbins, E. (2013). Shaping the City: Studies in History, Theory and Urban Design. Routledge, London.

Gunter, D. (2010) “Emergent Morphogenetic Design Strategies”. Graduate Theses and Dissertations. From: http://scholarcommons.usf.edu/etd/3433

Ferrer Forés, J.J.. (2011). Mat urbanism: Growth and change. 73-83.

Fuller. R. B. (1938). Nine Chains to the Moon, (Anchor Books [1938] 1971) pp. 252–59.

Freedman, Y. (2018). The Architecture of People. From: https://www.thesitemagazine.com/read/architecture-of-people

Frohburg, J. (2017). The Architect Mies van der Rohe as a Visual Artist. The Goethe Institut. From: https://www.goethe.de/en/kul/bku/20931979.html

Hartvigsen, G. et al. (1998). Use and Analysis of Complex Adaptive Systems in Ecosystem Science: Overview of Special Section. Ecosystems, v.1 (5)

Heile, M. (2018). Neural Networks - A New Model for “The Kind of Problem a City is”. Web. Accessed from: https://www.thenatureofcities.com/2018/04/29/neural-networks-new-model-kind-problem-city/

Hensel, M. (2004). Finding Exotic Form: An Evolution of Form-finding as a Design Method in Emergence, Morphogenetic Design Strategies. London, AD/Wiley, pp. 26-33.

Hensel, M., Menges, A., Weinstock, M. (2004) Frei Otto in Conversation with the Emergence + Design Group, Vol. 74 No. 3, pp. 18-25.

Hensel, M., Menges, A., Weinstock, M. (2004) Introduction to Emergence: Morphogenetic Design Strategies. The Digital Turn in Architecture 1992-2012.

Heylighen, F. (1989): “Self-Organization, Emergence and the Architecture of Complexity”, in: Proceedings of the 1st European Conference on System Science, (AFCET, Paris), p. 23-32.

Heylighen, F. (2000): “Referencing pages in Principia Cybernetica Web”, in: F. Heylighen, C. Joslyn and V. Turchin (editors): Principia Cybernetica Web(Principia Cybernetica, Brussels), from: http://cleamc11.vub.ac.be/REFERPCP.html

Hinton, G. (2018). Deep Learning—A Technology With the Potential to Transform Health Care. Web. Accessed from: https://jamanetwork.com/journals/jama/article-abstract/2701666

Holland, J. (1998). Emergence: from Chaos to Order, Oxford University Press (Oxford).

Holman, P. (2010). Engaging Emergence, Turning Upheaval into Opportunity. Berrett-Koehler Publishers, San Francisco, 2010. Accessed from: http://peggyholman.com/papers/engaging-emergence/engaging-emergence-table-of-contents/part-i-the-nature-of-emergence/chapter-1-what-is-emergence/

(Howarth, https://www.dezeen.com/2017/04/21/architecture-mit-massachusetts-institute-technology-10-impressive-campus-buildings/

Jacobs, J. (1961). The Death and Life of Great American Cities, Random House, New York.

Kim, J. (e.) Bedau, M., Humphreys P. (2008). Emergence: Contemporary Readings in Philosophy and Science. MIT Press.

Kosec, M. (2013). I Would Prefer Not To: The Emergence of the Reluctant Architect. Accessed from: http://futurearchitectureplatform.org/projects/7c92df-dc-d0a9-4ff6-80e3-4ffe732ad97f/

Lichtenstein, B., Plowman, D. (2009). The Leadership of Emergence: A Complex Systems Leadership Theory of Emergence at Successive Organizational Levels. The University of Nebraska. Accessed from: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1065&context=managementfacpub

(Deflet Mertins."AIT/IIT: Open Campus." Mies, 244-305. (New York, NY: Phaidon Press, 2014.) 245-246

Miller, M. (2017). Systems Thinking and Architecture. MKThink. Accessed from: https://medium.com/mk-ink/systems-thinking-e648240c4138

Mitanidis, T. D. (2009). In dialogue with emergence. Theses and dissertations. Paper 555.

Murphy, D. (2018). The Legacy of Megastructures. Icon. Web. Accessed from: https://www.iconeye.com/architecture/features/item/9462-the-legacy-of-megastructures

Otto, F. (1996). Finding Form: Towards an Architecture of the Minimal. Edition Axel Menges, 1996.

Otto, F. (2009). Occupying and Connecting: Thoughts on Territories and Spheres of Influence with Particular Reference to Human Settlement. London/Stuttgart: Edition Axel Menges

Perez, A. (2010). AD Classics: AD Classics: IIT Master Plan and Buildings / Mies van der Rohe. ArchDaily. Web. Accessed from: https://www.archdaily.com/59816/ad-classics-iit-master-plan-and-buildings-mies-van-der-rohe/

Reiser, J., Umemoto, N. (2006). Atlas of Novel Tectonics. Princeton Architectural Press, 2006.

Roudavski, S. (2009). Towards Morphogenesis in Architecture. International Journal of Architectural Computing. Vol. 07, Issue 03). pp. 345 – 363.

Roy, B. (2016). An Open Architecture for Self-Organization. Our Future at Work. Medium. Web. https://medium.com/open-participatory-organized/an-open-architecture-for-self-organization-4e85d4413e09

Schaur, E. (1992). Ungeplante Siedlungen – Non Planned Settlements (IL 39), diss., Stuttart.

Schumacher, P. (2011). The Autopoiesis of Architecture: A New Framework for Architecture. West Sussex,United Kingdom: Wiley.

Simon H.A. (1962): The Architecture of Complexity, Proceedings of the American Philosophical Society 106, p. 467-482, reprinted in: Simon H.A. (1981) : The Sciences of the Articial (2nd ed.), (MIT Press, Cambridge MA).

Smithson, A. (1974). 'How to Recognize and read Mat-Building. Mainstream architecture as it developed towards mat-building', Architectural Design, no. 9.

Stott, R. (2019). "Spotlight: Mies van der Rohe". Arch Daily Web. https://www.archdaily.com/350573/happy-127th-birthday-mies-van-der-rohe

Van der Rohe, LM (1924). Architecture and the Times. From: (https://

modernistarchitecture.wordpress.com/2010/10/25/ludwig-mies-van-der-rohe%E2%80%99s-%E2%80%9Carchitecture-and-the-times%E2%80%9D-1924/)

Weinstock, M. (2006). Morphogenesis and the Mathematics of Emergence. Theories and Manifestoes of Contemporary Architecture. C. Jencks and K. Kropf. Chicester, West Sussex, Wiley-Academy: 351-352.

Weinstock, M. (2006). Self-Organization and the Structural Dynamics of Plants. Architectural Design.Vol. 76, Issue 2.

Whiting, S. (2004). Chicago - Superblockism: Chicago's Elastic Grid. In El-Khoury, R., Robbins, E. (Ed.) Shaping the City: Studies in History Theory and Urban Design (p. 69-85). Routledge, London.