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NEW AS RENEWAL
A FRAMEWORK FOR ADAPTIVE REUSE IN THE SUSTAINABLE PARADIGM

A Thesis Presented

by

LUKE A. BECK

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

MASTER OF ARCHITECTURE

May 2014

Architecture+Design Program

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ABSTRACT

NEW AS RENEWAL

A FRAMEWORK FOR ADAPTIVE REUSE IN THE SUSTAINABLE PARADIGM

MAY 2014

LUKE A. BECK, B.S., SUNY COLLEGE OF TECHNOLOGY AT ALFRED

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Directed by: Professor Kathleen Lugosch

The way in which we approach building design is constantly being influenced by evolving economic, environmental and social parameters. These factors have implications on both pragmatic and aesthetic facets of design. The built environment is not autonomous from its immediate site or the ecologies of the region in which it is located, rather, the former must be designed to symbiotically exist within and enhance the latter. The term ecology is defined as “a branch of science that deals with the relations of organisms to one another and to their physical surroundings.” Although this typically relates to biology, the term can be expanded to include economic or social ecology. It has been proposed that architectural design can be informed through and should evolve in relation to; environmental, economic and social ecologies.

This thesis will examine the relationships between these “ecologies” and how they can inform the adaptive reuse of a vacant industrial site. It will include an examination of the paradigm shift from large-scale industrial manufacturing to Small and Medium-sized Enterprises (SMEs) at the economic and social level. It will further discuss the evolution of environmental awareness within this shift and how these values can drive architectural design while allowing for long term flexibility in adaptive reuse.

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INTRODUCTION

This Thesis began with research into the numerous factors influencing the 'green' or sustainable paradigm in Architecture. Each paradigm, with its own accompanying style, also hosts its own set of processes generating a product that is unique to the time before it. This is noticeable throughout the built environment. The application of this project will be an examination of several theories of this paradigm in an adaptive reuse project.

An Architectural Paradigm

Stephen Grabow, in his book Christopher Alexander: The Search for a New Paradigm in Architecture, argues that "the breakdown of the [current] paradigm occurs – just as it does in science – when external anomalies introduce contradictions within its order (p.2)." He proceeds to state that the crisis surrounding the breakdown of a paradigm and the manifestation of a new one is spawned by a social recognition that the current processes in architecture "no longer produces buildings that satisfy people's needs, can be reasonably built and maintained, and are aesthetically pleasing (Grabow p.3)." This parallels Vitruvius' "fineness, commodity and delight." This is an important concept as it lays the foundation for understanding the impetus for 'green' architecture. According to Grabow, architecture is only relevant and useful if it meets three criteria – satisfying people's needs, can be reasonably built and maintained, and be aesthetically pleasing. If architecture fails to meet these needs, the current paradigm will unravel. Part of what makes the field of architecture so tumultuous is the understanding that two of Grabow's three criteria (meeting people's needs, and being aesthetically pleasing) are extremely subjective. The following chapters, and the resulting design application, are intended to cultivate an understanding of how these two subjective parameters have been addressed within the ‘green’ architecture paradigm thus far, and, explore the issues involved with understanding these parameters.

CHAPTER 1

DE-CONSTRUCTING THE SOCIAL CONCEPT OF 'GREEN' BUILDING

1.1 Environmental Architecture as a Social Construction

In an essay entitled "Contested Constructions; The Competing Logics of Green Buildings and Ethics," Simon Guy and Graham Famer examined the ways in which ideas of "green" design and building are interpreted. The authors are reacting to the concepts of green building and sustainability, and are attempting demonstrate the complexities involved with quantifying the issues entangled in the 'green' building imperative.

The reading helps to locate "green" building within the realm of sustainability and environmental consciousness. While there is a very quantifiable process in creating environmentally responsible buildings, i.e. how much energy a building consumes, there is a great deal of controversy regarding the root issues of green building and sustainability and the [limited] role of the architect therein.

Contested Constructions was included within a book of essays entitled Ethics and the Built Environment which was published in 2000. At this time the U.S. Green Building Council and LEED were in their first decade of existence, and conferences regarding the Kyoto Protocol had occurred just three years prior. At this time sustainability was becoming more of a mainstream topic as it related to the built environment. Although the issue was spurred in the 1970s with events such as the oil crisis and publications such as Rachael Carson's Silent Spring, The USBGC and LEED were the first actions to truly apply benchmarks for, and to quantify green building. The essay begins with a quote from Deyan Sudjic in which he stated: "for any architect not to profess passionate commitment to 'green' buildings is professional suicide." The term 'green' though is extremely broad ranging and its multi-faceted nature became the topic of this essay.

The questions brought up in the writing have become ever more pertinent with each progressing year since its publishing. Paragraphs are entitled: *Green buildings as social constructions, as technique, as appropriate form, as social concern, and as social expressions of competing green values*. Similar to the "camps" of naturalism, post positivism, and emancipatory values in research, values of individuals, institutions, and groups create biases towards how green buildings are understood.

1.2 Competing Eco-Logics

Guy and Farmer; in the section 'Green building as technique – the ecological and smart logics,' identify differing technological stances termed 'eco-centric environmentalism' and 'techno-centric environmentalism.' They continue to state that:

> *The emblematic issue here is that sustainability and ethical judgments stem from an ecological view of knowledge which represents the standing of non-human entities, necessarily extending beyond the anthropocentric concerns to encompass a moral concern for the integrity of the natural world.* (Guy and Farmer 2000: 77)

To briefly summarize, the former mentioned is a natural sciences based view that emphasizes the dynamic interaction between the living and the non-living as a critical component in the green design problem. The latter, or *smart* approach as it is alternately termed, asserts that incremental techno-economic change, as well as science and technology can provide solutions to environmental issues. Each of these techniques holds a separate bias regarding what the definition of 'green building' is, how it should be carried out, and what exactly it should accomplish. One can observe this disparity in thinking in the methodologies of LEED and the Living Building Challenge. It can be argued that the LBC considers a broader swath of issues, some of which are more qualitative – for instance, 'beauty and inspiration' is part of LBC's criteria. Within these two rating systems we see a divide in the way that the definition of 'green' building is framed.

Another example/question can be found in the section entitled: 'Green building as appropriate form – the aesthetic and symbolic logics.' Again two competing logics are framed: the aesthetic logic and the symbolic. The aesthetic emphasizes a "future-oriented 'new age' view and the emblematic issue is how to represent the epoch shift of the new millennium" (Guy and Farmer: 79). A goal of this logic might be to create an architectural language in which both the function and the form embody an environmental message. On the competing end, the symbolic logic attempts to engage both environmental and cultural concerns rather than inspire a 'universal, radical change of attitudes.' The emblematic issue here as stated by Guy and Famer (80) is: "authenticity and the notion that truly sustainable buildings need to relate more fully to the concept of locality and place." One can summarize this divide as one between a globalized notion of 'green' and environmentalism and one derived more from cultural or regional nuances. There are many examples of this divide in the current built environment. Nokia's corporate offices located in Gurgaon, India a LEED Gold rating from the USGBC. As can be seen from the images below the building embodies a very sleek modern international aesthetic.

Figure 1: Nokia Corporate Offices

In comparison, the The Druk White Lotus School in Ladakh, India received Best Asian Building, Best Educational Building and Best Green Building awards for its cost effective and sustainable design. *Traditional* Ladakhi architecture was combined with modern day century engineering techniques to achieve high results in severe desert landscape. Rather than build a sleek glass box and control the internal climate with HVAC, mud brick masonry, traditional to the region was used to achieve the desired thermal results.

Figure 2: Druk White Lotus School, Ladakh, India

This essay does not condemn nor praise a specific method of framing the issue of 'green' building, but it does begin to describe the various biases or logics that interact or compete to influence the definition and resulting application of the term. The diagram (Figure 3) portrays what have been defined as the 'Six Competing Logics of Green Buildings.' This table is useful in understanding the levels of interactions between these perspectives on the topic. Any of these logics could be applied, broadened or tested and as seen in the above examples; many currently are.

the competing logics of sustainable architecture

derived from: Simon Guy and Graham Farmer, "Reinterpreting Sustainable Architecture,"
In *JAE*, Steven Moore and Kenneth Frampton eds. (February 2001)

6 logics	image of space	source of knowledge	building image	technology	idealized concept of space
eco-technic	global	techno-rational	future-oriented	high-tech efficient	urban compact
eco-centric	fragile	metaphysics	polluter	autonomous Renewable	in harmony with nature
eco-aesthetic	alienating	sensual	iconic	organic non-linear	consciousness transforming
eco-cultural	local	phenomenal	authentic	common-place	dwelling
eco-medical	polluted	medicine	healthy	non-toxic	life-enhancing
eco-social	hierarchical	sociology	democratic	flexible participatory	non-hierarchical

Figure 3: Competing Logics of Sustainable Architecture

The consideration of "the competing logics of innovation which emerge from particular emblematic issues; [such as] sustainability, efficiency, aesthetics, health, authenticity, and communitarian concerns" is critical in understanding alternative environmental approaches. These approaches can help designers become "more sensitive to the range of possible logics of innovation that may surface in new buildings" and foster design approaches that "bring environmental benefits at a variety of scales."

1.3 The Role of Risk

Architectural movements are often related to, or even reflections of social views at a certain point in time. The 'Green' movement is no different. Much of angst regarding the detrimental effects of the built environment on the natural environment has spawned from increasing social awareness of environmental risks. *This can become a problem when attempting to design a quantifiable object, such as a building, based on a risk that may have a subjective social definition*. John Hannigan wrote a book titled Environmental Sociology; A Social Constructivist Perspective in which he describes the ways in which environmental risks are constructed and perceived.

Hannigan states that "as a society, we still have to make social judgments about the magnitude of risk." This is a useful statement as Architecture often bridges certain gaps between social science and 'hard' science. Hannigan (p.133) continues to draw from Hilgartner's examination of the conceptual structure of social definitions of risk. Hilgartner asserts that these 'social definitions' are comprised of three main conceptual components: "an *object* deemed to pose the risk; a putative *harm*; and a *linkage* alleging some causal relationship between the *object* and the *harm*."

This trend can be observed in numerous architectural experiments in the current paradigm. Edward Wilson's Biophila Hypothesis is a strong example. The hypothesis argues a human affinity for living systems and is steeped in evolutionary psychology. In the case of Biophilia, the *object* posing risk can be interpreted as anti-humanistic architecture. Modernist architecture for example, with its mechanistic forms, devoid of any relationship to the human condition could be construed as a risk to human health. The *harm* can be quantified as well; sick building syndrome for example is caused by the off-gassing of building materials exacerbated by a hermetically sealed space. The *linkage* lies within evolutionary psychology.

CHAPTER 2

EVOLVING A METHODOLOGY

As with previous architectural paradigms, certain buildings are designed that exemplify specific values emergent at that time. These are often experiments based on a specific thread of research. For example, Le Corbusier's Villa Savoye arguably epitomizes the Modernist view of Form follows Function. Many of Frank Lloyd Wright's projects at this time exemplify slightly different values that that of Corbusier, but, when compared to another paradigm, such as that of Victorian architecture, tend to portray a great deal of similarity to the work of other Modernist architects. In other words, despite various differences, the experimental work of architects within a certain paradigm, tend to exhibit a common thread of thought and consciousness.

2.1 Aesthetics and Performance

Susannah Hagen, in Taking Shape: A New Contract with Nature discusses some of the differences in thought regarding architecture and the environment. Hagen identifies two factions which although not necessarily at odds, seem to define each end of the spectrum of environmental consciousness. The Arcadian perspective, Hagen states, seeks a "pre-industrial" relationship between the built and natural environments, while the Rationalist majority has placed emphasis on developing contemporary environmental design tools without bias towards era. While each of these camps share different methods and perspectives, their overall agendas lie within the same ethical framework. Some common values include; optimism about the possibility of positive change, and a heavy reliance on phenomenology interpreted by architectural theorists. Another key commonality is the emphasis on the reinstatement of *human* subject to a central position within moral discourse and environmental action.

Published in 2001, the book appeared on the scene of growing environmental discourse. There seems to have been an almost frenzied scramble to interrogate the notions/buzzwords such as sustainability and green/environmental architecture and design in general. Titles of books and essays published around the same time include Cradle to Cradle: Remaking the Way We Make Things, Understanding Sustainable Architecture, and "Contested Constructions; The competing Logics of Green Buildings and Ethics." Hagan is clearly addressing the uncertainty of designers, architects, and the general public as to how architecture and design relate to sustainability and the natural environment. In the introduction, Hagen identifies the practice of drawing from both Rationalist and Arcadian logics as a highly sophisticated one in which "they [architects] discuss form in the same breath as they discuss energy efficiency. (Hagen, xi)" She proceeds to state that culturally, this method has barely been acknowledged by collective consciousness. Furthermore, it is perceived as a process that encourages stasis rather than drives change. She criticizes this as a failure by the standards of environmentalism as environmentalism actually a dichotomy that drives change *while* protesting certain changes that have already occurred. Hagen criticizes conservatism both in thought and architectural form, stating that respecting nature should not automatically lend itself to such conservatism. It seems as though these criticisms arose from critiques of the first attempts (in the late '90s – early '00s at least) to make buildings "environmentally sustainable" through the use of technology and limitation of form.

Hagen continues to introduce several logics that can potentially frame endeavors of environmental architecture. One of which is presentation. Hagen (xi) states:

> *"In the ideological battle between environmentalism and consumerism, presentation is everything. A practice that is perceived to be as regressive is at a disadvantage against one that is perceived as innovative, however harmful at some level this innovation may be."*

The perception of a presentation is completely reliant on factors such as time in history, location, and audience. What is perceived to be innovative or "green" currently will almost certainly be perceived differently half a century from now. Indeed, fifty years from now the critical need to address climate change on all fronts will either be lessened, or our opportunity to make any positive change might have vanished without our making any achievement.

Some other questions posed in the introduction include:

> *What then is 'environmental' or 'sustainable' architecture? Is it the plurality of existing architectures made more environmentally sustainable? How is one to decide, what is more important in environmental terms –* ***architecture that expresses its sustainable condition more successfully than it operates sustainably, or vice versa?***

To assist in framing answers to these questions, Hagen poses three criteria that might be used to form opinions. These include 'symbiosis,' 'differentiation,' and 'visibility' (re-representation).

2.2 Symbiosis, Differentiation, Visibility

Symbiosis is described as a "more co-operative material relation between building and environment" and is furthermore a "pre-requisite for environmental sustainability." This parameter allows architectures to maintain their existing identities. A built example of 'symbiotic' architecture could be any LEED certified building. The new Life Sciences building at UMass Amherst is designed to meet LEED Silver standards yet it arguably maintains the aesthetics of a(n) educational/institutional, laboratory science, and contemporary university work of architecture.

Figure 4: Life Science Laboratories at UMass Amherst

Differentiation pertains to the influence of nature on environmental forms, with no reference to sustainability. Gaudi's Sagrada Famillia, or many of Calatrava's sweeping birdlike forms hint of influence from the natural world yet *functionally* they may not be the most environmentally sustainable building by current standards.

Figure 5: Milwaukee Art Museum – Santiago Calatrava

Figure 6: Sagrada Familia – Antonio Gaudi

Visibility, binds the process of form making to environmental modes of operation. While there are ways to accomplish this, for example the use of a renewable resource such as wood to create a flowing structural from in Yale's Kroon Hall (also LEED Platinum), it can be argued that this piece of criteria may be hindered by changing perceptions even if the design is in fact informed by nature and not simply representational of it.

Figure 7: Yale School of Forestry – Hopkins Architects

2.3 Response

Hagen seems primarily concerned with the views of those directly related to either the built environment or the natural one. How does the general population (or other building professionals) fall within the spectrum of Arcadian to Rationalist? And how might the views of the populace inform a contract between architecture and nature? In placing architecture within the environmental imperative, I believe it is important not to become so esoteric as to alienate those for whom we design. Hagen makes a strong statement that public perception is vital in the success of an architectural movement, yet (at least in the early portion of the book) only really discusses the theories and views that someone with architectural or design training might bring to a discussion about nature and the built environment.

If architecture is in part validated through persuasiveness, or its ability to educate, then where does public perception come into play, and how is it studied, understood, and applied to design practice? In defining an appropriate architecture-nature aesthetic relationship, it is important to consider should be achieved by an "architectural expression of environmental sustainability." Hagen presents the viewpoints of architects of Arcadian and Rationalist camps and uses these to frame her theory, yet the discussion could be enriched if the biases and perceptions of the lay-person were considered. Rather than implementing an architectural aesthetic to appease designers and architects, a study could involve forming an aesthetic that communicates a "contract with nature" to those with limited or no formal design education or sophisticated nuances.

In order to propose a method of testing theory; consider the following posited by Hagen (p. 5):

"architectural expression of environmental sustainability has not been universally welcomed in environmental circles is that representing a new contract between nature and architecture does not in any way imply the architect has successfully signed up to it. In other words, the building may speak of a new regard for nature-as-model and still operate in an entirely conventional way."

The theory that forming a new contract between architecture and nature involves numerous dimensions could be tested on a participatory design process involving a variety of professionals and non-professionals with perspectives and backgrounds relevant or not relevant to the built and natural environment. Each could be encouraged to articulate their ideas of what values environmental architecture should espouse.

Finally, in comparing and contrasting Hagen's theories with those of Stuart Brand in How Buildings Learn: What Happens after They're Built; we see yet another level of complexity added to Hagen's identification of various competing logics in how architecture's relationship to nature is perceived. Brand too, places an emphasis on biases, assumptions, and perceptions as competing logics, although in the process of planning and programming for the design of buildings with regard to their future uses rather than in relation to the natural environment. Both, interestingly, allude to the notion of change occurring from the bottom up versus being imposed from the top down. One potential topic that could be derived from the comparison of these two texts is an investigation of the ways in which the added imperative of planning for a building's spatial, aesthetic, and programmatic evolution might affect, further complicate, or enrich the dilemma over the relationship of a building to the natural environment. A second topic could investigate the ways in which certain buildings, built with no consideration to energy conservation or sustainability have “accepted” or “rejected” retrofits to become more sustainable. Brand criticizes buildings planned so rigidly that they are unable to evolve to meet new standards and needs, programmatic or otherwise without total elimination of aesthetic character. Hagen lists symbiosis as one of three modes of environmental engagement. A building, in achieving a symbiotic relationship with the environment; meets “environmentally responsible” criteria, yet maintains its own character and identity. ***Could a process for building exist that addresses Brand’s emphasis on ability to evolve without loss of aesthetic character by way of Hagen’s given lens of ‘symbiosis’?***

2.4 Final Notes

Based on the research and reading conducted during this portion of the project; several takeaway points can be gathered that will aid the design application in the second part of this paper:

1. There is no single, incontestable ‘green’ or sustainable building type. ‘Green’ is not merely a label that can be attached to a building, but rather a process, understanding, and set of values that is inherent to the architectural process.
2. Many environmental-architecture ‘solutions’ are responses to the social construction of a certain risk. This does not always have to be an environmental risk.
3. Paradigms within the field of architecture will come and go. Architects and Design Professionals must have the ability to cull useful

information from the experimentation in the design field during the chaotic times of an emerging paradigm.

CHAPTER 3

APPLIED HOLISTIC SUSTAINABLE THINKING

3.1 Case Study: Angus Technopole

The previous chapters have discussed the multi-faceted nature of architecture in the arena of sustainability. Each of the design experiments within this movement has yielded a set of results that can be synthesized into a useful methodology for future design. Furthermore the issues discussed are relevant ones, and should not be forgotten once the exploratory phase of green architecture dies down, or once the fantastic forms have been exhausted. Rather than dive headfirst into the next bubble in popular architectural practice, professionals should look for ways to expand the lessons learned from previous movements in more sophisticated and nuanced ways. Guy Favreau of AEdifa Architecture + Engineering provides a sound example of this thinking:

> *"The next challenge to all green design should be the integration of buildings and city planning within their context as a seamless fusion of each other. Connecting buildings and urban planning to the cultural context in an age of globalization is a strong ecological statement, as it offers more cultural diversity with less inclusion and more inclusion."*

The following case study were chosen as it is similar in numerous ways to the application portion of this project. The discussion and analysis will continue to focus on the criteria set forth by Grabow: satisfying the user's needs, build-ability and ease of maintenance, and aesthetic quality.

3.1.1 Overview

The Angus Technopole is a business park located in Montreal's east end that specializes in environmental technology. The site formerly housed the Canadian Pacific locomotive assembly plant which was a focal point of the community, and whose closure was followed by a decline in local industry and employment. The reuse project is defined by a broad social and environmental vision that includes: the renewal of a historic landmark, a response to evolving economic conditions, and the reuse of a brownfield in a major urban core (McMinn, Polo 4543). It furthermore stands as an important model for the cultural interpretation of sustainability. Although, according to McMinn and Polo, the building's use of environmental systems is at a lesser level of sophistication that those found in other reuse projects, it provides a strong example of recycling and reuse of materials and assemblies, and the consideration of community connectivity.

3.1.2 Design Process

Originally, the owners of the site, Canadian Pacific, intended to convert the site into a residential and commercial district. Members of the community though, wishing to preserve the site as a pillar of the local economy, lobbied for the retaining of its industrial vocation. This action was successful and the Societe de developpement Angus (SDA) was created to foster the goal of creating 2,000 on-site jobs in a 10 year span. The SDA accomplished this by providing support services to help realize projects aimed at the social and economic aspects of sustainable development. Architecturally, the SDA's goal was to design features and facilities to maximize site potential and align with the environmental and social objectives of the project.

These objectives included:

1. The integration of neighboring urban fabric in a continuous manner, particularly pertaining to; the preservation and reinforcement of scale and character, the linking of existing grid systems and streetscapes, diversified land uses, relatively high density and greening of streets.

2. The transformation of the Locoshop into a multi-functional industrial center to house small and medium sized businesses (SMEs) emerging in various sectors of the new economy.

3. The demonstration of the terms of ecological building with the incorporation of environmental criteria in all phases of its design development including; de-allocation and decontamination of old installations, reutilization of existing materials, design of new, more efficient, installations with the objectives of optimizing energy, flexibility of space planning, the use of environmentally friendly materials and state of the art construction techniques.

   1. In terms of programming, the upper levels of the "Locoshop Angus," were populated offices and research studios, while light industrial uses were developed on the main floor. A central interior street gives access to these individual spaces and acts as a central organizing spine while providing access to natural light.

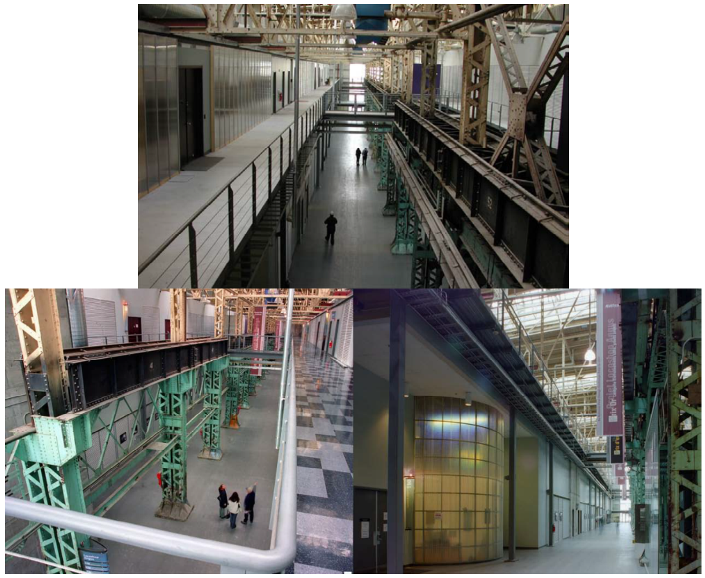

Figure 8: Angus Technopole "Organizing Spine"

The notions of critical regionalism in this case informed the adaptive reuse process. Much of the original steel structure was retained and left exposed to provide a link to the industrial heritage. The new program was seen as a series of "insertions" into the bays of the existing structure. Retaining the old structure created a dramatic contrast with the new building assemblies which feature lightweight steel, fiberglass, and wood. The detailing and connections of the new assemblies are minimal, conservative and "matter-of-fact" with a focus on highlighting the character of the original building (figure 9).

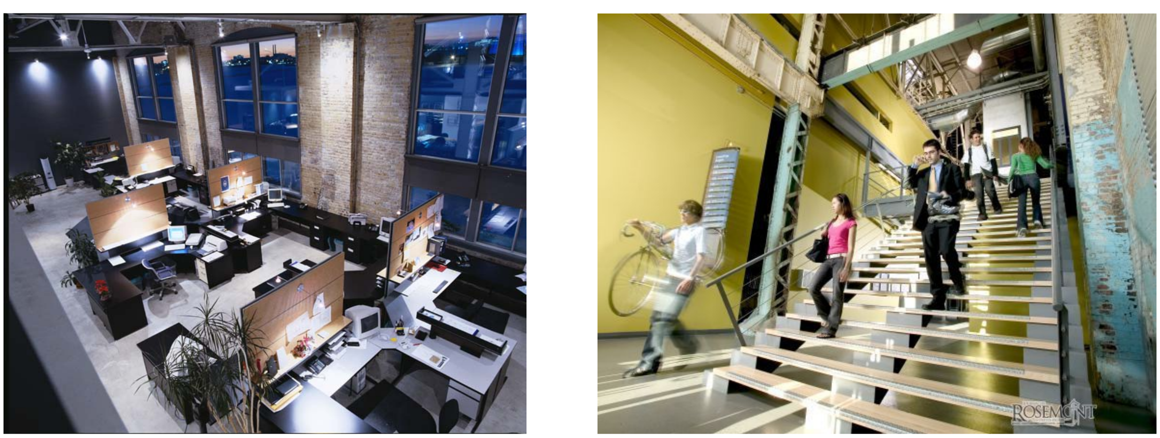

Figure 9: Angus Technopole Spaces

The reuse process did involve some challenges that yielded innovative solutions. The pouring of new foundations for some of the new building assemblies would have compromised the existing slab and the poor soil beneath much of it. In response, a new cover of concrete was poured over the existing slab. This doubled as an economic benefit as it saved excavation and disposal costs.

The design goals of this project contain several sensitivities that highlight the ways in which architecture might be evolving within the paradigm of sustainability. The concept of reusing existing building stock is a central feature and is tied in with the maintaining of a historical icon that highlights the industrial past of the region. Rather than constructing a sleek, generic "green" business park on the outskirts of the city, a site was remediated within an urban core to preserve an industrial cultural identity and heritage while embracing new economic and environmental needs.

CHAPTER 4

PROJECT APPLICATION

4.1 Overview

The Industrial Zoned building was home to the Riverside Paper Company. Completed in 1895, the building is actually comprised of five interconnected segments altogether totaling around 205,000 S.F.

The location of this building is relevant as it sits in the study area for the South Holyoke Redevelopment Strategy. This strategy outlines goals to improve the social, economic, and environmental quality of the neighborhood. One Cabot Street is a former paper mill so; it is ideally suited to host a similar program type. Furthermore, a point of interest in the South Holyoke Revitalization Plan included the creation of employment and business opportunities (p.19). This point of interest has not been exhaustively researched as it is outside the immediate scope of this project. Instead, two concepts regarding an evolving business landscape are identified and used to suggest a program throughout the building. The two concepts that will be discussed regarding the program are the transition from “Low Road” to “High Road” creation, manufacturing, and production; and the concept of Skills Ecosystems. Both of these are related to light manufacturing which is a useful skill and can yield high wages and can help foster smaller, local scale, culturally based businesses which is a desire outlined in the SHRP (p. 19).

4.2 Suggesting Program

Program, in former movements, such as Modernism, has been generally treated as the Perennial function of Architecture and thus the drivers of the design, while functions such as light, heat, circulation, structure and energy have been the transient ones. This design exploration seeks to reverse this order, treating the latter flows as the drivers, and organizing program based upon their distribution. The anticipated result will be a specifically generic set of novel architectonics derived from the Capture, Channeling, and Composition of these re-determined Perennial variables.

As One Cabot Street is a former mill building, it is ideally suited to host a similar program type. Furthermore, a point of interest in the South Holyoke Revitalization Plan included the creation of employment and business opportunities (p.19). Manufacturing is useful skill and can yield high wages. The SHRP also outlines the desire for more culturally based businesses (p.19). Two concepts discussed regarding the program of this building are the transition from “Low Road” to “High Road” creation, manufacturing, and production; and the concept of Skills Ecosystems.

4.3 High Road vs. Low Road Manufacturing

In an Economic Policy Institute briefing entitled “Renewing U.S. Manufacturing; A High Road Strategy” Susan Helper outlines the differences between the two strategies, identifies economic, social, and environmental gains that can come from such a shift, and outlines some initial strategies to bolster such a shift in practice. The differences between these two strategies can be observed across categories of: Technology, Economy, Environment, Skills & Education, Division of Labor, and Products and Processes. Figure

10 outlines each strategy's tendency towards addressing each of these factors. By reusing this building, an incubator will be created for start-up enterprises that utilize High Road Manufacturing and business processes. As is portrayed in Figure AAA, High Road processes hinge on a tangential, rather than hierarchal distribution of knowledge and skill, which in turn can lead to higher wages amongst workers since each will possess specialized knowledge.

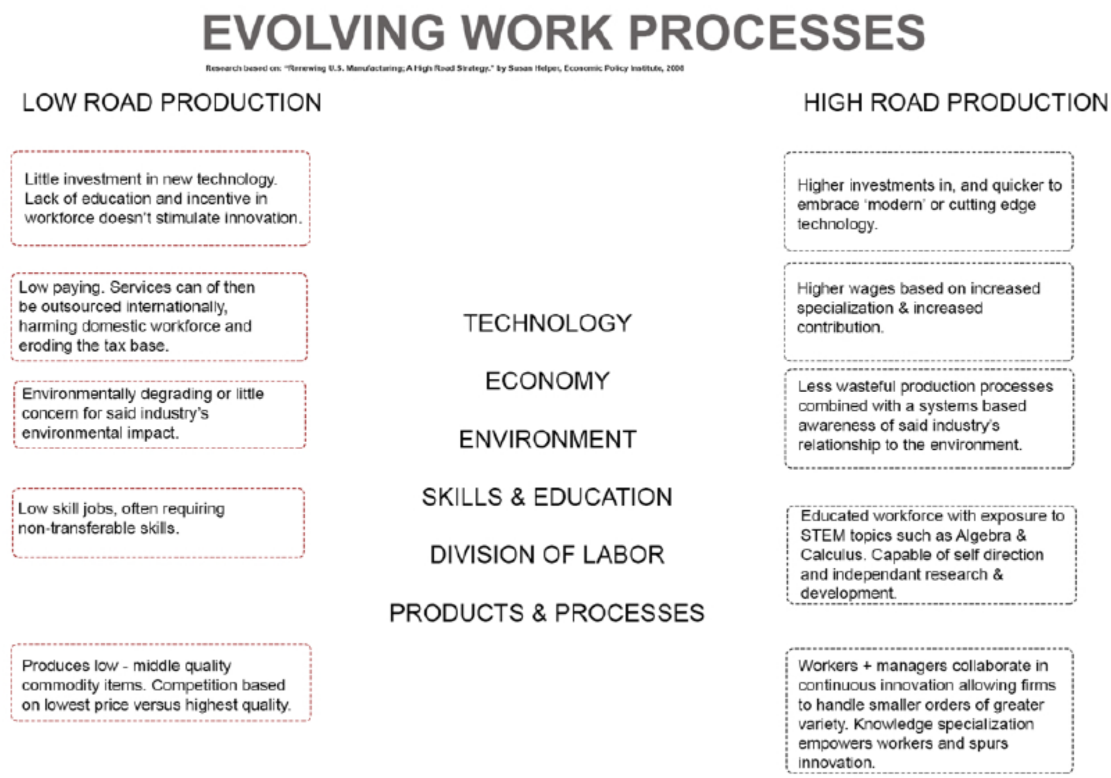

Figure 10 – Evolving Work Processes. Note: Image created by Luke Beck

4.4 Skills Ecosystems

According to Windsor, a "skills ecosystem" is defined as: "a self-sustaining network of workforce skills and knowledge in an industry or region." While specific definitions and objective descriptions may vary, the general concept revolves around clusters of industries through which skills and knowledge can feed off one another and grow as a whole. A similar type of system is observed in the Angus Technopole project discussed earlier, in which community businesses with vaguely similar social, economic, and environmental goals interact. Such a concept can be applied to this project in numerous ways. For example: if a start-up company were to occupy a portion of the Cabot Street building conducting research and development regarding the 3D printing of components for solar panels, the groundwork could be set for other start-ups with goals relating to the solar panel industry to move into the building and add to the collective research thereby creating a system of innovation within the industry. No specific uses such as the one outlined will be directly envisioned in this project, but the goal is to provide the basic infrastructure for these types of systems to evolve.

4.5 Addressing Basic Needs

To assist in the decision making process, two overarching objectives have been identified for the user processes within this study. The first is to foster the growth of high road creation and production industries, and the second is to facilitate the accretion of these individual groups into a resilient skills ecosystem. The first will be addressed by providing basic infrastructure for various needs of these startup companies. The second will be addressed by creating deliberate meaningful means for connection and collaboration between these different groups.

The clusters of program will be further divided by nature of the business. Space will be allocated for Woodworking, Metal working, 3d Printing, and “Creative-Hybrid” Industries. For the purpose of visualizing the potential activity in these spaces, a quick narrative has been written for each of the cluster types.

4.6 Visualizing Amenities

Rather than specifically define program uses throughout the building, programmatic “gradient” will be suggested through the optimization of the “perennial” variables of the building that are being addressed. The objective will be to host some light wood and metal working, as well as 3D printing operations. This make-up of seemingly disparate skills with some underlying similarities could potentially aggregate into a skills-ecosystem considering the potential for “new” creative industries to arise. These programmatic uses will be fostered based on a gradient and cluster approach based on anticipated amenities needed. The amenities under consideration include: circulation, space (structural layout), fire codes, access to water, ventilation requirements, materials workflow and manufacturing processes, lighting requirements, privacy, and business cycle. Amenities will be provided and tailored for three generic ‘centers’ in which most relevant programmatic uses should fit. These will be Centers of Making, Centers of Business, and Centers of Collaboration (or shared space). All are outlined below, and will be discussed in terms of services (equipment and code issues), and user requirements (spatial and environmental issues related to how the users will inhabit and interact within the space).

4.7 Centers of Making

In these spaces users will be developing products using tools and machinery such as 3D printers, CNC routers, woodworking tools etc. These spaces will require the “tightest” gradient of programming requirements due to logistic issues as well as code requirements.

4.8 Centers of Business & Centers of Collaboration

These spaces will include offices, open work and research areas, and client meeting/conference spaces. It is in these areas (and in the shared spaces) that the greatest potential exists for utilizing natural modes of ventilation, heating and lighting, and due to the ‘looser’ restrictions in terms of service equipment and code regulations, there will be some overlap between the business areas and shared spaces in terms of services and user requirements.

CHAPTER 5

RESPONDING TO PERENNIAL ENVIRONMENTAL FORCES

5.1 Overview: Response to Perennial Environmental Forces

Perennial: lasting a long or apparently long time; enduring or recurring

Environmental: relating to or arising from a person's surroundings.

Kiel Moe argues in Convergence: An Architectural Agenda for Energy that "Architecture is a capture, channel, and composition device for people, structural loads, energy, heat and light. (Moe, 250)." He considers these to be the perennial forces affecting architecture. When considering building reuse, it makes sense to respond to the forces that have enduring or recurring effect on the building (read user's surroundings). This chapter will begin to identify some of these Perennial Environmental Forces, what there constraints are, what are some of their potential functions, and how the built environment (in a general abstract sense) interacts with these forces. The following step(s) will analyze how the building at One Cabot Street interacts with these forces and generate some design interventions with (to quote Hagen p.98) "a view [or emphasis] to increasing the reflexivity, and so the visibility of environmental architecture."

5.1.1 Identifying Forces

Moe lists people, structural loads, heat, energy and light as some potential generative forces, but this study will be using "spatial forces" (which relate to the movement and activity of people within a space), light, air and water.

5.2 People and Space

5.2.1 Constraints

This topic concerns the movement and activity of people within a space, and how … the ways in which space is designed is constrained by several variables, including but not limited to: building codes, programmatic needs, Proximetrics, Anthropometrics, and Ergonomics.

5.2.2 Functions

Marston-Fitch (p. 206) discusses physical space (in buildings or otherwise) as a full system of vectors of force acting upon users. While some of these forces are subjective, he identifies some objective ones which include:

Psychological: the motivation of the individual, or the incentive to accomplish a certain action

Physiological: the physical condition of the individual with reference to the energy required for the action

Sociocultural: the type of behavior that the space is deigned to elicit

Microclimatic: the actual environmental conditions occurring on the site

Topographic: the contours, textures and shape of the surface on which the action transpires

Furthermore the concept of functional distance is considered. Anthropologist Edward Hall studied and proposed some standards for spatial dimensions for different levels of social interaction. According to Marston-Fitch (p. 207), Hall “visualized each individual as centered in a concentric series of balloons or bubbles of private space” and these “concentric spheres represent optimal distances for a hierarchy of interpersonal relationships.” The resulting figures are as such: 1-1/2 feet; intimate, 1-1/2 – 4 feet; personal, 4-10 feet; social-consultative, and 10-30 feet; public. These figures will be used to determine a functional spatial gradient through which to distribute generic programmatic layouts.

5.2.3 Interaction with the Built Environment

James Marston-Fitch in American Building; The Environmental Forces that Shape It lists three space planning characteristics which are typically found in buildings: Compression, Flexibility, and Mechanization (Marston-Fitch, 305).

Compression is the oldest and simplest of the three and is characterized by a ‘fixed’ space that accommodates multiple uses. Compression can be created at a variety of scales, for instance Figure 11 portrays a parlor in a home. Parlors were could be used for entertaining company, wedding and funerals to name a few uses.

Figure 11 – Typical Victorian Parlor

At a larger more public scale, a space such as the interior of the Pantheon (Figure 12) lends itself to massive public gathering.

Figure 12 – Pantheon

Marston-Fitch (p. 307) describes Flexibility as “the natural result of the rapid rate of change that obtains in industry, commerce, and all urban institutions in general.”

Finally it is acknowledged that “the multiple use and flexible organization of space are, at the contemporary scale, inconceivable without a high degree of building mechanization, (Marston-Fitch 309)” and, “if space is at such a premium that it must be intensely used, then it must be flexibly organized, readily convertible from one use to another (Marston-Fitch, 309).” A less technologically evolved society would warrant separate structures for uses that have separate distinct requirements for illumination, acoustics, ventilation, and temperature. Due to technological improvements in the past century, this type of design scheme is possible through mechanized structure as can be seen in the Dee and Charles Wyly Theatre designed by OMA.

The Dee and Charles Wyly Theatre, designed by REX/OMA (Joshua Prince-Ramus, partner in charge, and Rem Koolhaas), at the AT&T Performing Arts Center in Dallas. Photo by Iwan Baan.

Figure 13 – Dee and Charles Wyly Theatre

In the Wyly Theatre (figure 14) the seating on the main level changes between a proscenium, thrust, and flat floor theater configuration. In conventional theater design, front of house and back of house functions are circled around the auditorium and fly tower. The OMA design team decided instead to stack these amenities above and below the auditorium level (Figure 15). This design strategy enables different functions that require different programmatic configurations to be carried out in a single space.

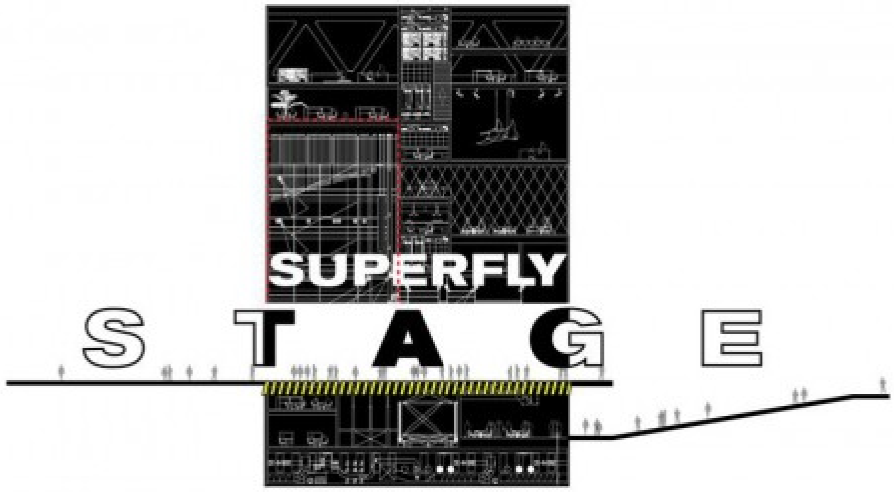

Figure 14 – Wyly Theatre Organizational Section

While the building under study in this project is not a theater, the case study of the Wyly Theatre is useful in that it provides a clear example of the use of mechanization in space planning.

5.2.4 Analysis and Generation

As discussed in the paragraph about spatial constraints, building codes are one of the stricter, if not the most strict determinants of spatial layouts. Therefore they are considered first in the building analysis. According to what is observed in the floor plans of the existing building there are four stair 'cores,' and it looks as if two of these contain elevators. On the Northeast side of the building there is also an area for shipping and receiving area with loading docks. The locations of these egress areas are shown in figure 16.

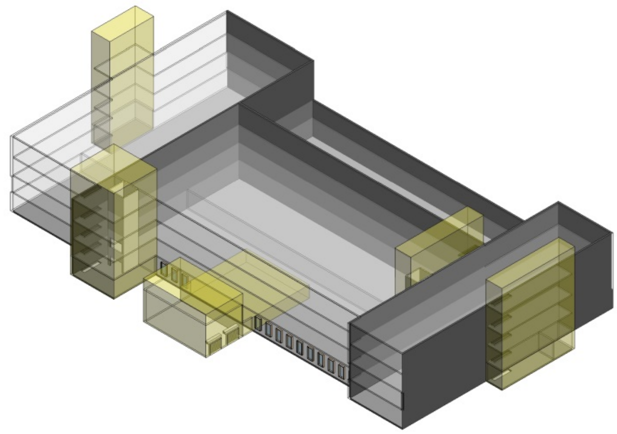

Figure 15 – Existing Circulation Cores. Note: Image created by Luke Beck

5.2.4.1 Space and User Needs

In a publication in conjunction by HOK Design Group Inc. and the Biomimicry Group Inc. titled Genius of Biome: Temperate Broadleaf Forest, the concept of the eco-tone is introduced and described as an edge that supports diversity and species interaction while creating robust systems capable of buffering disturbance Eco-tones can be observed in nature in instances such as the transition from a forest to a field. The diagram in figure 17, taken from the Genius of the Biome publication portrays two variations of the eco-tone, or edge condition, and some patterns of movement that can be extracted from their study.

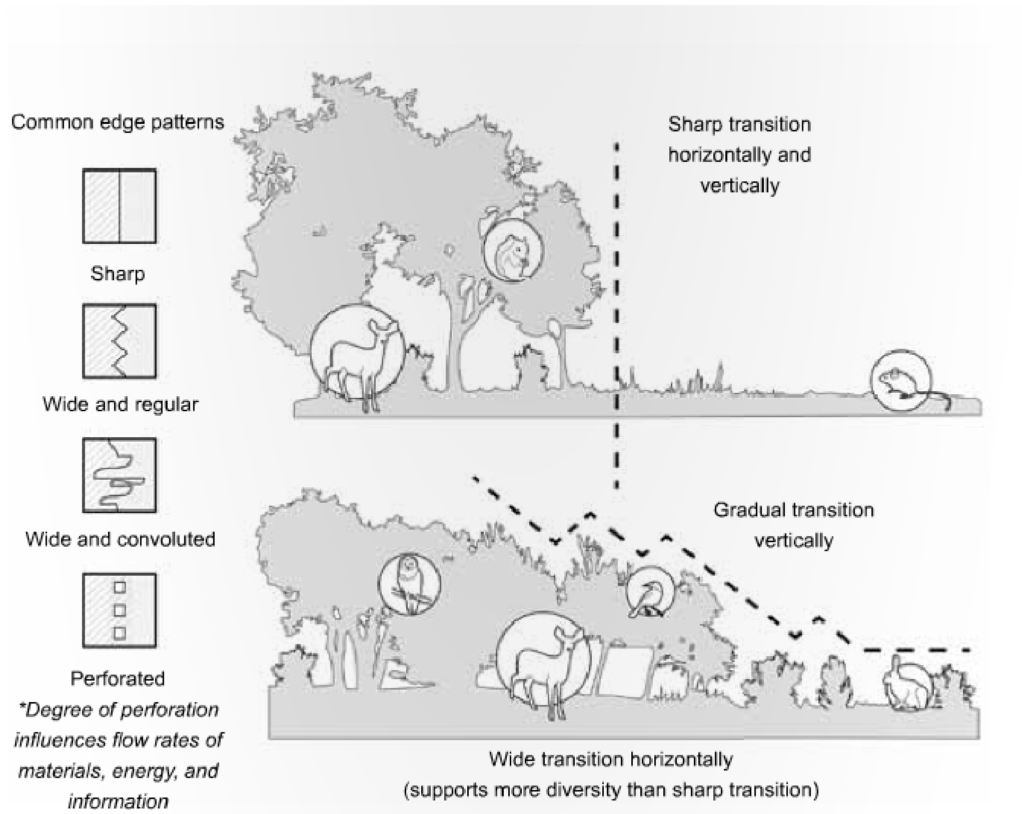

Figure 16 – Eco-tone. Note: Image created by HOK Group Inc. and Biomimicry Group Inc.

The authors (p. 133) extracted a related design principle from the study of this natural edge condition:

> *Transition zones represent opportunities to leverage and optimize diversity and interconnectedness. The two main elements that contribute to a robust, resilient edge system are its physical structure and highly interconnected and interdependent relationships among its users. Edge systems with wide transitions between different environments support higher diversity and have more capacity to absorb disturbance. The greater the differences between transitioning environments; the higher the potential for a rich edge system. Adjusting the degree of open areas within the transition zone will influence the rate and ease with which energy, materials and information can flow.*

The question remains whether this principle can be applied to the building under study. The suggested program provides amenities for multiple types of businesses with similar strategies involving high road manufacturing processes. Could transition zones between different use types throughout the building create an edge system that creates interdependent relationships and fosters a skills ecosystem? The User Need being addressed here is the creation of a/an common area(s) within the building through which interdependent relationships between different businesses can form. Figure 18 recaps the design principles recently discussed. These, alongside the concepts of compression, flexibility, and mechanization will be the drivers for the design of the common area atriums in this building.

Related design principles:

- Edges are zones where materials, energy, and information accumulate.
- Edges support diversity because it is easy to find resources that meet needs for survival and well-being.
- Wide transition zones are more robust and resilient than sharp transition zones.
- Adjusting "perforations" in a transition zone influences rates of material, energy, and information transfer.
- Highly interconnected relationships result in robust transition zones.

Figure 17 – Edge Condition Design Principle. Note: Image created by HOK Group Inc. and Biomimicry Group Inc.

The stair cores serve a necessary purpose for egress codes, but do not necessarily promote any sophisticated qualities in terms of user interaction or aesthetics. So to create a more robust "edge-gradient" between different levels, interior non-fire stairs will be placed. The maximum travel distance to an exit in an un-sprinklered building of this type is 200 feet. This condition is currently met by the existing stair cores. The stair interior of the building was not factored into this study as it does not exit to the exterior. Figure 19 shows a typical floor plate and the location of the existing stairways.

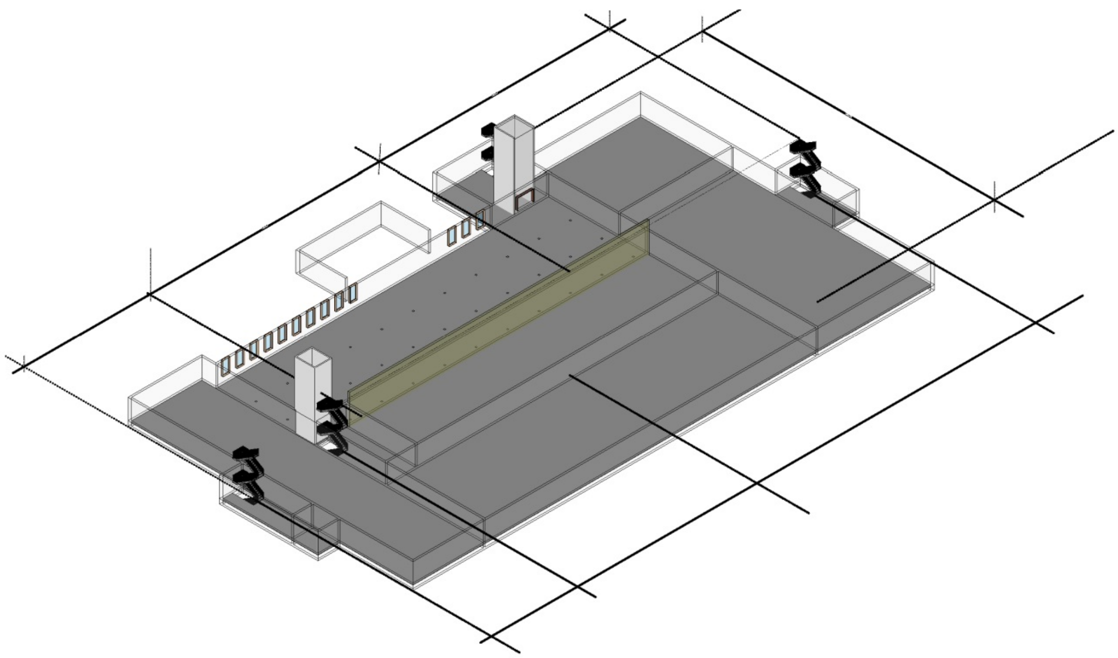

Figure 18 – Typical Floor Plate and Existing Stairwells. Note: Image Created by Luke Beck

The next 'overlay' being used is one that studies potential edge zones supporting both horizontal and vertical user movement through the building. This study was completed in tandem with the analysis of the interaction of natural light with the building which is discussed in the next section (5.3), and only reads like a linear process in the paper. So the suggested edge locations are based on more inputs than simply spatial planning and codes. The final overlay studies potential points of interaction in the edge conditions shown in the second overlay. The potential user interactions will be discussed in the paragraph regarding novelty and aesthetics in space as these temporal interactions will be a result of the performance of the design. As discussed previously, it is the performance of a particular set of design strategies that will be informing novelty and aesthetics in this project.

5.2.4.2 Space and 'Build-ability'

To examine levels of build-ability, the qualities of compression, flexibility and mechanization will be used as drivers. To study the implementation of each of these tectonic qualities, a set of User Needs to support the program at the edge/condition/atria were inferred: At these atrium areas, vertical circulation will occur between levels and horizontal circulation will occur between various 'firms' within the building. These atriums will also host common space and shared resources such as meeting areas.

5.2.4.3 Space and Novelty/Aesthetics

Where then, does the issue of novelty/aesthetics come in to play, and how is it represented? This has been a recurring theme in much literature regarding sustainable architecture. It is argued in this Thesis that the design strategy for this building reuse is about performance. Rather than exploring the architecture of this building as an artifact, it is being explored as a translator for various environmental forces, or, as described by Kiel Moe, a capture, channel, and composition device.

5.3 Light

5.3.1 Constraints

Sunlight has numerous constraints, for the purposes of this study, it is being considered as a function of *time* (both diurnally and annually) and *space* (interior and exterior).

5.3.2 Functions

Although it can serve numerous functions, for clarity purposes these have been grouped into the categories of *Illumination*, *Heating*, and *Energy* (either for production or assisting in conservation of non-renewable sources). These categories can be further parsed; for example: If a building's structural interaction with light can be considered to Filter, Manipulate, or Exclude (explained next); these actions could, either individually or coupled, create instances of direct illumination, indirect, ambient, etc.

5.3.3 Interaction with the Built Environment

According to Marston-Fitch (p.117), buildings relate to their Luminous Environment in three ways at the *structural* level. These are Light Exclusion in which light is prevented from accessing a space, Light Manipulation in which direct light is diffused or altered in some way to achieve a specific objective, and Light Filtration where light is allow to pass through a space with little alteration other than filtering out qualities such as heat (an example would be heat-rejecting glass).

5.3.4 Analysis and Generation

The siting of this building allows for generous South-East and South-West exposure.

The combination of buildings to create the main “building” has resulted in a collectively deep floor-plate. Subsequently much of the building’s interior will not have access to natural light.

Zone A: This zone is characterized as having gratuitous direct solar exposure and relatively consistent exposure across four seasons. In terms of orientation, this zone is located at the southern corner of the building and extends along the southeast and southwest corners; this includes the entire roof plate as well. This zone yields the possibilities of harvesting sunlight for illumination, heating, and energy production.

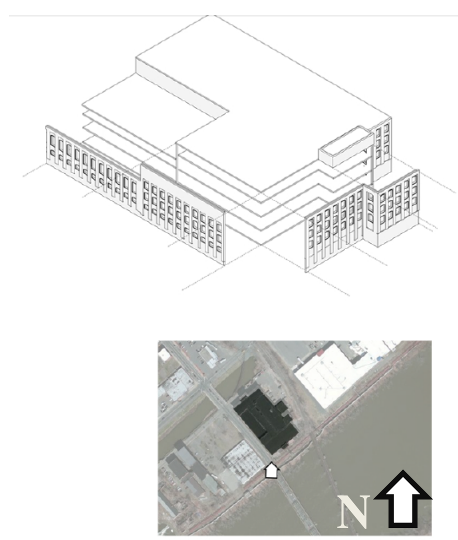

Figure 19 – Zone A. Note Image created by Luke Beck

Zone B: This zone has variable and inconstent solar exposure daily, and across seasons. Located at the east and west corners of the building and extending slightly towards the north and west corners, these sections of the façade will be impacted by direct light as the sun sinks lower in the sky in the morning and evening. Short durations of exposure limit the useability of light throughout the day and the low angle of the sun during times of exposure will generally require the exclusion of this light to prevent glare etc.

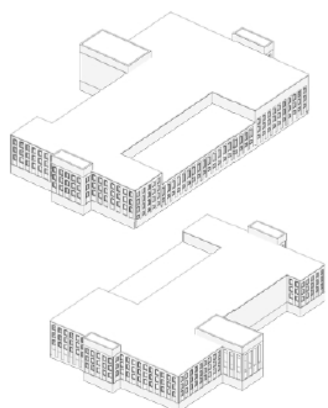

Figure 21 – Zone C. Note Image created by Luke Beck

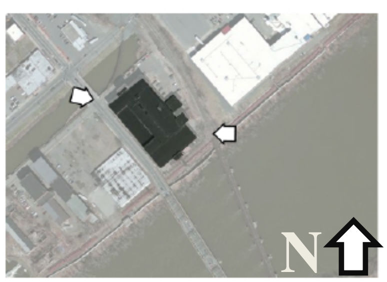

Figure 20 – Zone B. Note Image created by Luke Beck

Zone C: Encompassing the north side of the building, this zone will have access to indirect light throughout the day.

Zone D: This final zone includes all interior spaces with no current access to sunlight.

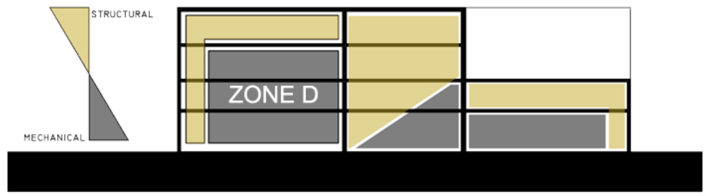

Figure 22 – Zone D. Note Image created by Luke Beck

As for the generation of design decisions, the concept of dispersed atria through the building will be considered. Again this is not the only potential optimization of sunlight in the building, but it serves as an example to discuss how this ‘force’ can be captured, channeled and composed in the design. These atria will be analyzed based on the three criteria of addressing (a) user need(s), build-ability, and novelty/aesthetics.

5.3.4.1 Light and User Needs

While there are numerous ways in which light can be channeled through the building to assist various programmatic goals, this study focuses on implementing atria at strategic locations to link different portions of program clusters both vertically and horizontally in the building. The basement and first floor of the building will generally host Centers of Making housing amenities for 3D printing, CNC manufacturing and other potential uses such as wood working. At the lowest levels of the building and especially toward its core, natural light will not be readily available which is acceptable as production tasks will require a more consistent quality of light provided by artificial sources. The atria extending down from upper levels will create breakout spaces with some ambient daylight filtering from above as well as create some lines of sight and circulation (excluding enclosed fire stairs) from the upper business areas into the Centers of Making.

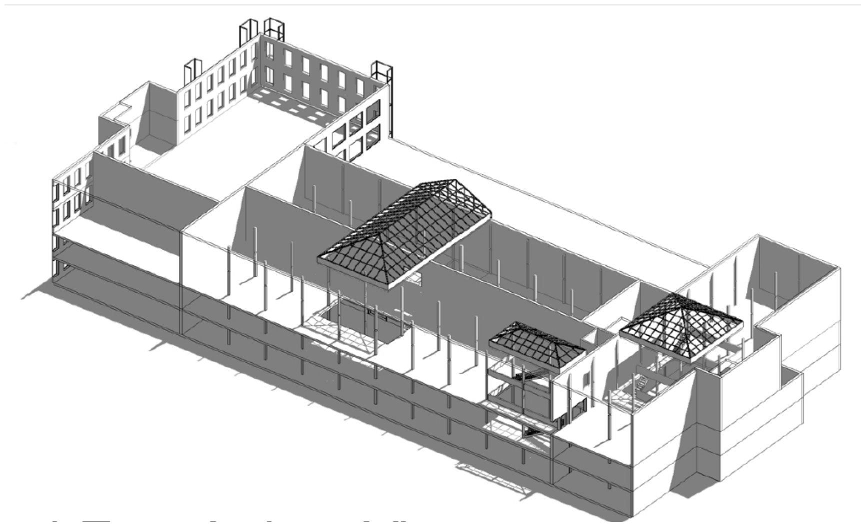

Figure 23 – Potential Atria Locations I. Note: Image created by Luke Beck

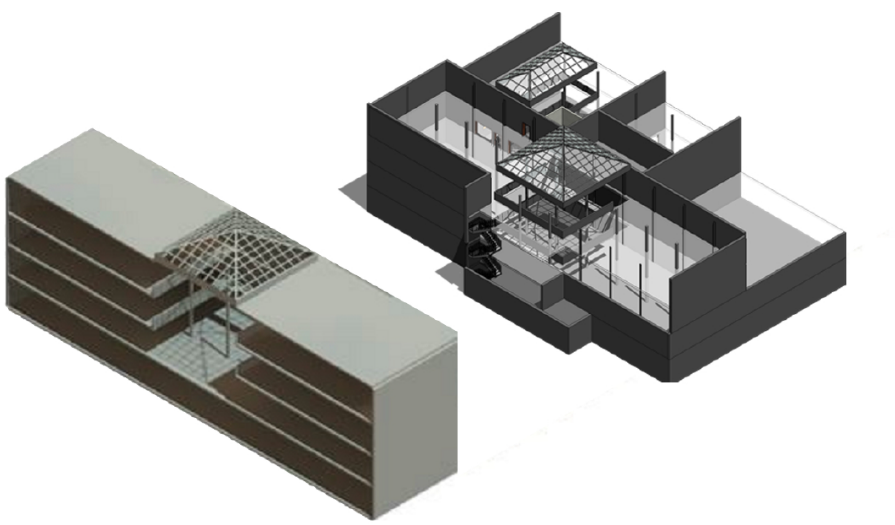

Figure 24 – Potential Atria Locations II. Note: Image created by Luke Beck

5.3.4.2 Light and 'Build-ability'

Dimitris Theodossopoulos discusses design interventions such as atria in Structural Design in Building Conservation. Regarding new space enclosures, Theodossopoulos (p.138) states: "roofs over open internal spaces or atria in a historic (read 'existing' for this project) building are designed to requalify, often radically, the original design by providing more enclosed areas or rearranging access to the building." He proceeds to discuss several issues that should be addressed in these types of interventions which include: design process and form, structural layout and materiality, construction processes, and environmental performance. These are examined as they pertain to a basic example atrium in the building under study. Since the 'build-ability' issues will directly influence the aesthetics; this discussion will be continued in the following section regarding Light and Novelty/Aesthetics.

5.3.4.3 Light and Novelty/Aesthetics

Building off of the public edge condition discussed in the section 5.2, a glazed roof will be examined over one of the atria locations, in this case, over the middle portion of the building as seen in figure 26. This particular area of study involves all four of the previously described daylight zones.

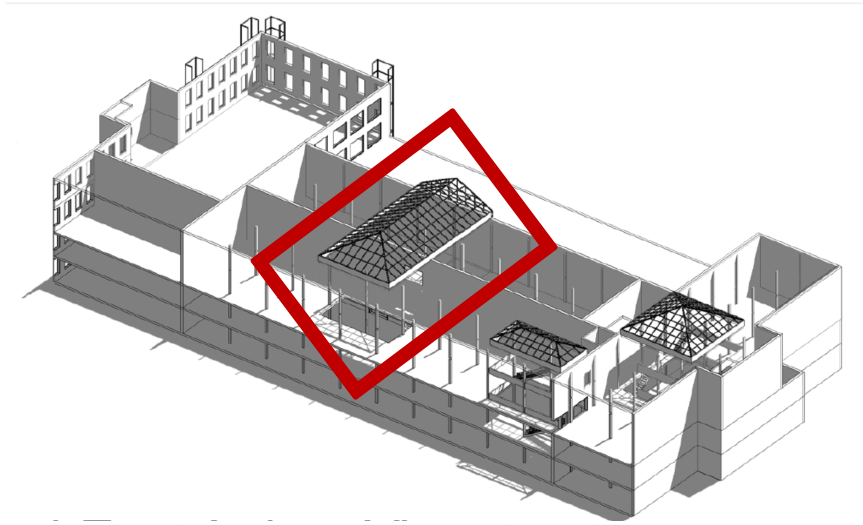

Figure 25 – Atrium Study Locations I. Note: Image created by Luke Beck

To create these atria the roof plate will be broken. Since this design intervention will serve mainly to allow the passage of light though various levels of the building, the existing structural field should not need to be altered drastically. Specific information regarding the construction of this building was difficult to obtain, but some inferences were made, given its date of construction, 1895, and based on information from the book The Design of Steel Mill Buildings and the Calculations of Stresses in Framed Structures published in 1903 by engineer Milo S. Ketchum. The decision to use assumptions regarding the construction of this building is being justified on the grounds that this Thesis only seeks to explore conceptual design strategies. Ketchum (p. 1) divides steel mill buildings into three classes: steel frame mill buildings, steel frame mill buildings with masonry filled walls, and mill buildings with steel beams resting on load bearing masonry walls. Based on the building's height and brick envelope, it is likely and therefore inferred that this building has a steel frame with masonry filled walls.

The glazed atrium roof will cover a roughly 40 foot by 80 foot portion of the building. These dimensions were chosen assuming a typical 20 foot steel structural bay, since using multiples of 20 feet would allow the existing structural supports to be utilized in supporting the atrium roof. As for roof form, a simple pitched roof was chosen with a gabled edge at the southeast side to prevent precipitation from falling directly onto the roof below which could be utilized as a public roof terrace.

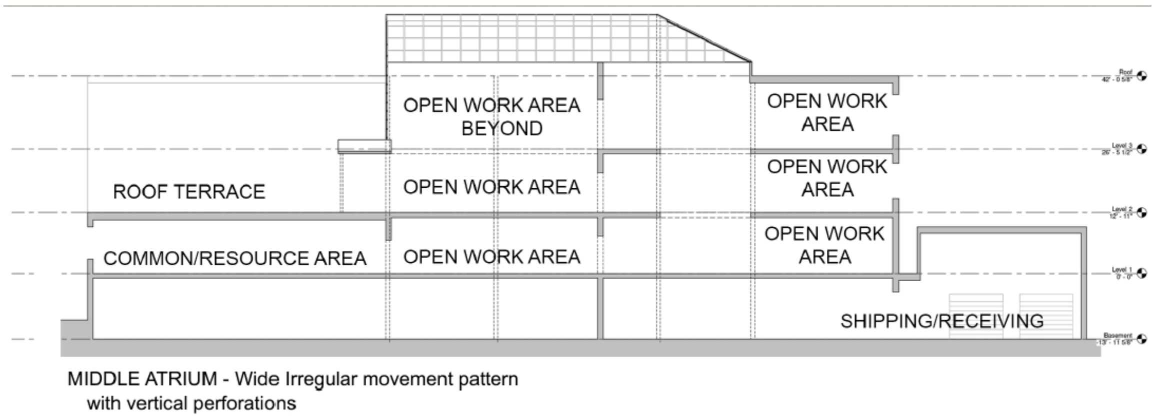

Figure 26 – Atrium Section. Note: Image created by Luke Beck

A trend observed in the Angus Technopole case study was the deliberate distinction made between new structural and material installations and existing ones. This can serve various objectives with one being a desire to preserve the ‘character’ of a structure. While the importance of this is understood, preservation of a structure’s character is not an objective in this project. Rather, tectonic distinctions between new and existing will be made to ease the construction process and to avoid compromising the original structure’s ability to transfer structural loads. While it may be possible to rest a new atrium roof on the existing structural skeleton, it is being proposed that a new structure will be built and sit independent from the existing one.

CONCLUSION

To reiterate the opening sentence: This Thesis began with research into the numerous factors influencing the ‘green’ or sustainable paradigm in Architecture. Some key points taken from the “unpacking” of sustainable architecture as an idea included:

1. There is no single, incontestable ‘green’ or sustainable building type. ‘Green’ is not merely a label that can be attached to a building, but rather a process, understanding, and set of values that is inherent to the architectural process.
2. Many environmental-architecture ‘solutions’ are responses to the social construction of a certain risk. This does not always have to be an environmental risk.
3. Paradigms within the field of architecture will come and go. Architects and Design Professionals must have the ability to cull useful information from the experimentation in the design field during the chaotic times of an emerging paradigm.

The application portion of the project hinged mainly on the first point; which explains sustainable architecture as a ***process*** that involves systems thinking at numerous levels, rather than an end product sporting a certain aesthetic. From this strain of thought a methodology was created that allows for a combined systemic and intuitive approach to a design process in which Perennial Environmental Forces act as design drivers. Identifying these forces can be both pragmatic and creative, for instance water is a tangible issue to which buildings relate, yet other less tangible ‘forces’ such the ways in which user requirements for space evolve over time could be proposed and analyzed.

To summarize the proposed process:

1. **Identify** environmental forces
2. List their **Constraints –** for example water can be a function of precipitation, water vapor in the air etc.
3. Brainstorm potential **Functions –** for example water can be used for heating, cooling, irrigation, de-humidifying etc.
4. List ways that this force typically **Interacts with the Built Environment** – for example; can a building’s tectonics filter this force? reject it? etc.
5. **Analyze** the ways in which the specific conditions of the building and site interact with this force
6. **Generate** design strategies to optimize the force’s various functions based on the criteria of addressing **User Needs, Build-ability**, and **Novelty/Aesthetics.**

Future Directions

The options discussed in this paper are not exhaustive and the framework is left open to creative exploration. The actual design studies did not include every possible function served by the forces under consideration, mainly due to time constraints. By juxtaposing or overlaying all of these criteria, a very sophisticated and integrated building system could be visualized.

Furthermore there lies the issue of quantifying the usefulness or effectiveness of any of the possible functions. For example, could a metric be created that determines when and where to optimize individual functions and where or not to couple them into a combined design feature or strategy?

This Thesis has hopefully presented the need for a systems based approach to adaptive reuse projects with goals relating to sustainability, and furthermore it hopefully has demonstrated ways in which a process based design approach can yield novelty and aesthetic expression in functional, environmentally reflexive architecture.

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