Photosynthesizing the Workplace: A Study in Healthy and Holistic Production Spaces

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PHOTOSYNTHESIZING THE WORKPLACE:
A STUDY IN HEALTHY AND HOLISTIC PRODUCTION SPACES

A Thesis Presented

By

KAELI ERIN HOWARD

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

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Department of Architecture
PHOTOSYNTHESIZING THE WORKPLACE:
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Ray K. Mann, Chair

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Chair, Department of Architecture
ACKNOWLEDGEMENTS

For everyone who ever told me “It’s going to be okay”, this one’s for you.
ABSTRACT

PHOTOSYNTHESIZING THE WORKPLACE:
A STUDY IN HEALTHY AND HOLISTIC PRODUCTION SPACES

MAY 2019

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Throughout time nature has been a prescribed healer of stress on the human condition. Its vital integration into our daily lives has been proven by scientific evidence. The majority of Americans spend approximately 1/3 of their life working, whatever that job may entail. Therefore, it makes sense that the environments that we spend so much of our life in for work at extremely important to our physical and mental health, however, current workplace models are not acknowledging that. Redefining the workplace to integrate nature would start to change work life in this country and how work itself is viewed.

This thesis focuses on creating healthy and holistic production spaces for workers in areas like Western Massachusetts. Because this area shares urban and rural qualities while being primarily suburban of major Northeastern cities such as Boston and New York, it provides unique ground for a wide array of work occupations and work types. On
a chosen site of Northampton, MA, a new work model will be developed around the exposure to nature integral to a collaborative co-op/ incubator space for small businesses in the area who need office and production spaces in a community setting.

The progression of this research will lead to a developed incubation space with a positive environmental impact. Precedent research of archetypes such as Michael Singer’s Alterra Atria, and Miller Hull’s Bullitt Center exemplify sustainable criteria in relation to office architecture. By using concepts underlying an even further integration with the community ideas from John Dinkeloo & Kevin Roche’s Ford Foundation Headquarters, Candilis, Josic and Woods’ Freie University Berlin and BIG & Heatherwick’s New Google Headquarters. By creating a building that addresses the diverse makeup of the larger community of Northampton, MA, this co-op space would become an example of how a workplace can work with nature towards a greater impact on the environment post-occupancy.
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CHAPTER 1
INTRODUCTION

This thesis expands on the idea that the introduction of elements of nature into work environments holds the potential to create more beneficial working environments for employees, impacting their overall health and productivity of the work itself. For this thesis, I define nature as greenery, natural light, air flow and awareness of sustainable practices and utilize each in an architectural environment sensitive to employee stimuli through integrative design. Taking the information previously discussed about nature’s pivotal role in human health and the question is asked: how we can make it more accessible and fully incorporated into our daily working lives, so that it benefits from us as much as we benefit from it? Most Americans spend Monday-Friday, in a drab, sterile office building. How exactly could this notion of nature be employed to being about a more cohesive, holistic idea of work in a country definitions of “work” vary by occupation and employment? I will first address the levels of interaction in which we typically experience nature in our daily lives looking at demographics, labor and other statistical data. Secondly, I will utilize that data to assess and evidence that employees across the occupation spectrum are not getting the appropriate amount of exposure to nature for maximum health. From there, further exploration of case studies that are integrating nature into the workplace currently will be investigated to identify successes and areas of improvement. Lastly, from all of this data and assessment a program will be established and design will commence involving this research and site analysis. The product will be a complex of production spaces integrated with nature and rooted in community, leaving a positive impact on its town and the environment.
2.1 Nature’s Influence on History

Throughout history there have existed enlightened thinkers, artists, writers and environmental activists that have had different opinions about human interactions with nature. This investigation starts with American environmentalists Henry David Thoreau, John Muir and Theodore Roosevelt. In the mid-nineteenth century they faced a dilemma remarkably similar to our own time’s perception of the shrinking “wilderness”. After the settling of the western frontier, they feared that loss of “wilderness” would threaten the American national identity (though we now understand that the frontier was full of Native Americans that have been managing the landscape for millennia) (14). This “rugged individualism” in the “valorization of pristine nature as the preserve of authentic individualism”, or “wilderness values” is an idea that is still with us in the 21st century (14).¹

The architectural presence as “objects in nature” or “machines in the garden” is an evocation of such (21).¹ Le Corbusier’s Villa Savoye as a single home in the French countryside acts as the physical embodiment that technology negotiating the interplay between the man-made and the natural (21).¹ However, nature historically is not meant solely for quiet contemplation, but rather meaningful interaction. While it is true that

many regard nature as a source of contemplation, the interaction (seeing, smelling, tasting, etc.) with nature has more benefits to our health and wellbeing. Other architects such as Frank Lloyd Wright rejected the objectification of architecture in the natural world, and rather opted for a style where indoor/outdoor spaces intersected to produce areas that instigated a new definition for living spatially with nature.

2.2 Nature’s Influence on Biology

Eminent American biologist Edward O. Wilson has researched human interaction with nature in South America, coining the term “biophilia”, or the “innate tendency to focus on life and lifelike processes” (1).² He concluded that natural ecosystems are interdependent and constantly influencing each other through “chaotic regimes”² which take shape in adaptive behaviors to increase chance of survival (7).³ But where do humans fall into the system when there is nothing to challenge us? The answer is in ourselves:

“The living world is the natural domain of the most restless and paradoxical part of the human spirit. Our sense of wonder grows exponentially, the greater knowledge, the deeper the mystery and the more we seek knowledge to create new mystery. This catalytic reaction, seemingly an inborn human trait, draws us perceptually forward in search of new places and new life.” (10)²

Wilson claims that humans are part of a system that starts within our DNA, but to understand this system we first must understand its parts.

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² Edward O. Biophilia. Harvard University Press, 1984
Architect Buckminster Fuller proposed this idea under the label of “synergy” in his 20th century writings. Particularly in his 1968 *Operating Manual for Spaceship Earth*, he vouches for phasing out all “fossil fuels and atomic energy… our ‘savings account’ [and] moving to natural energy ‘income’ from harnessable [solar, wind and geothermal] ” (209-210)³. Here we begin to analyze how a part influences a whole. Burning astronomical amounts of fossil fuels is hurting the system, our planet. Fossil fuels were an easier fuel source in the beginning but now their toll on the planet is recognizable. Our biophilic dispositions in our species’ DNA fostered new thinking and innovative ideas like Fuller’s as well organizations like Green Build, LEED, etc. Biologically we must do our part as a part of the whole to heal and regenerate our planet for future systems to grow and succeed.

2.3 Nature’s Influence on Psychology

Not only has nature affected humans biologically throughout history, it had also had a great influence on our psychological processes. Scientific evidence confirms the fact that exterior exposure benefits full body cognition. Roman physician Cornelius Celsus’s early records (5 BCE) show that “garden walks, exposure to light, a closeness to water and other nature based activities were effective components of standardized plans to improve mental health” (11).⁴ Late 19th century’s Mother of Modern Nursing, Florence Nightingale, made similar discoveries. In the healthcare world, references to the benefits of fresh air and natural light by windows as a positive expenditure of patient recovery and

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shortened stay length are taken very seriously (96). Studies also show that ICU areas with even small windows are “associated with less frequent delusions, hallucinations and depersonalized post-recovery” (96)—all characteristics of mental health conditions.

Lastly, psychologist Stephen Kaplan theorized that nature alone is able to restore cognitive functions that are easily worn down by overstimulation in the modern world (63). Studies show that when comparing views of screens to views of the natural landscape, nature restores us from ‘directed attention fatigue’ from too much exposure to technology (17). Evolutionarily coming from nature, humans benefit from the
regenerative qualities of light, air and green healing, becoming the base from which we can wholly function.

2.4 Nature’s Influence on Humans

Many of the buildings we interact with in rural or suburban America have a similar hierarchical layout: a large parking lot before a structure, with a perimeter of gardened/shrubbed area in between. In cities there are more often no areas for greenery, adequate sunlight penetration or ventilation. This alarming lack takes its toll on human health. A recent study in Denmark found that people living 2/3 mi from green space were 42% more likely to have high stress, 30% higher anxiety and lower overall health scores (26). This study magnified can be linked to another involving social stature and wealth. Scottish researchers studying dense Japanese cities came to the conclusion that nature could be an equalizer in terms of overall health. Low-income inhabitants exposed to high levels of greenery had lower mortality rates compared to the wealthy who were not exposed to as greenery. When low-income was connected with small amounts of green space, the health comparison with the rich became significantly increased. Unable to afford otherwise, greenspace became the independent variable capable of saving lives in lower income populations (27).

Cognitive functioning in classrooms of children in early phases of mental development was also examined. “Natural views and an opportunity for sunlight” from larger window areas produced students 15% faster in reading and 23% better in mathematic scoring (95).
Adding plants to these indoor settings such as classrooms can also increase Indoor Air Quality by 75% (88) because of nature’s cleansing ability. To a degree, plants can handle environmental chemicals, “metabolizing and transporting to soil where bacteria can render them less harmful”, which is why NASA employs vegetation to keep astronauts healthy while living in enclosed synthetic spaces (88). Other positive health contributors include phytoncide, plant oil vapor and negative ions. Phytoncide, more commonly attributed to aromatherapy, is about the wide range of scents that work together on the olfactory senses, which then enter the brain and bloodstream (82). Japanese doctors encourage ‘forest bathing’ or shinrin-yoku—the practice walking in nature trails—as a holistic method to aid in healthy living (3). Benefits include decreased stress hormones and anxiety, and increased pain thresholds, antioxidant defense systems and immune function (83). On a molecular level, negative ions are the product of atom splitting in forests or near bodies of water, thus exposure to the negative ions is responsible for the success of shinrin-yoku on human health (82). In addition, studies show that the plant oil vapor with negative ions can “enhance the production of the brains own calming chemical” called GABA while increasing serotonin (84).
3.1 Acknowledging the Relationship

Architecture is a complex form of creation but after analysis, the creation may actually be simple. Nature impacts history, biology and psychology whereas architecture is impacted by history, biology and psychology. These factors influence architectural design because there is no pure idea that is created without past or present influences from all backgrounds.

Architecture and nature can be viewed as seemingly separate ideas, however this analysis has shown they boil down to the same basic principles. Because nature influences by history, biology and psychology and architecture is influenced by history, biology and psychology that means that nature and architecture have shared principles. Because of this, this should absolutely be integrated. In the midst of climate change, and other environmental issues, the present is a vital moment to find roots in the relationship between nature and architecture. By redefining our presence on earth as a sustainable product of the living landscape and built environment around us we may begin to address environmental and personal health issues.

3.2 Clarification: ‘Nature’ + ‘Daily’

While it has been established that a daily exposure to nature is integral to our health, the exact definitions of ‘nature’ and ‘daily’ mean many things. For this discussion,
I have concluded nature to be the exposure to greenery, the exposure to sunlight and access to well ventilated spaces. I have also included that nature in architecture relates to the awareness of sustainable practices and passive strategies. For most people, a daily activity that they have in common is going to work, whatever that may entail. A recent study from the Gettysburg College states that the average person spends 1/3 of their life at work, which the US Department of Labor synthesized to be approximately 85,000 hours. This means that the environments that we spend so much time in are bound to impact our health. Moving forward, this thesis will show how an exposure to nature in the workplace can positively improve occupant health and business productivity.

Figure 2: Clarification of Terminology
(Based off Gettysburg College Study and US Department of Labor Statistics)
3.3 Reevaluating the Relationship: A New Workplace Approach

Design in the case of work has to consider the employee on a multifaceted platform. Despite the specifications of each job, which vary across the board, there are some factors playing into all occupations. These include an individual’s mental state, the functionality of the space and a sense of unity. Mental state refers to the environmental impacts upon the individual’s mind. These impacts affect employees on an individual basis, because of discrepancies in perception and what works best for each individual. Studies show that mental health would be most influenced by the bringing sunlight and greenery into the workplace, helping restore attention. The functionality of a space refers to the physical definitions of the space and how the individual interacts with and exists in that workflow. Elements like material usage, ceiling heights and spatial circulation in program formation influence how the individual fits into their space. Lastly, creating a sense of unity in the workplace is crucial. By having places that cater to the collective, collaboration and teamwork increase. This creates a ‘common goal’, which employees can strive to achieve. An optimal workplace is one that understands that the needs of occupants vary by circumstance, and which can adapt to accommodate those needs for the sake of health and productivity.
Figure 3: A New Approach to the Workplace
(Based off Knoll, Workplace Research, Holistic Ergonomics Infographic, 2015)
CHAPTER 4
WORKPLACES DEFINED

4.1 A Programmatic History of the Office

Typical workflows are trying to, but not successfully encouraging an optimal workplace for the health of its employees and occupants. Management theorist Joanne Yates’ 1993 book, Control Through Communication, presents the accumulated knowledge from decades of office development. She states that “the problem is people don’t know what to do with offices. ‘The old shipshod way of our forefathers,’ prevailed in office design. In other words, there was no design at all” (9). The earliest forms of office layout started in the late 19th-early 20th century with “clerical workers massed together in highly regimented rows to mimic factory floors in an endless sea of desks” (44). Nikil Saval describes in Cubed that the birth of the office was a dismal one and from the beginning workers suffered from decreased motivation and speed (44).

BusinessWeek founder Frederick Winslow Taylor proposed that this was because of lack of workplace efficiency, thus he began timing tasks and evaluating effort, concluding that the office itself is an object of systemization (56). Oxford dictionary defines a ‘system’ as an equation of things working together as part of an interconnected network, and in this equation slow parts affected overall business success. His development of scientific management, or Taylorism, encouraged the hustle and bustle of office workflow seen in the 20th century. Although productivity is a vital part of business success, Taylor’s analysis ignored the fact that these unproductive people also worked in spaces lacking in

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6 https://en.oxforddictionaries.com/definition/system
stimuli (44). Edward T. Hall’s *The Hidden Dimension* expanded on this stating: “the drama of a civilization that has forgotten its understanding of its surroundings also took place in the banal setting of the office—since inattentiveness to one’s environment was even more common in spaces people cared less about, like the workplace” (188).  

This factor of office flow was considered in 1960s work of Robert Propst, inventor of the modern cubicle (Figure 4). A new architectural attitude emerged: “man and his [office] environment participate in molding each other.” While the Action Office cubicle of four moveable walls and workspace was a product of the privacy vs. openness battle in office layouts there was still a lack of stimuli for employees (Figure 4).

“Office Landscape” or “Burolandschaft” (Figure 5) developed by the German-American Schnelle brothers in the late 1950s describes an internal environment that is the opposite of the cubicle. It works by “delineating common pools of activity and sinuous paths of workflow to encourage face to face interaction with ones peers (20). An open plain of space sees work areas and desks arranged by type of work (Figure 5). For example, engineers would be grouped with engineers, architects with architects and landscape designers with landscape designers, all housed in a large area. This is great for idea-bouncing and team progression, however, privacy and individual workflow is compromised.

In the history of the office there are many accounts of workers commenting on lack of light or proper ventilation, however office layout pioneers in the mid-later 20th century do not count those factors as stimuli for a productive office environment.
Action Office: “Coherent Structures”

Figure 4: Miller & Propst’s “Action Office”
Nikil Saval, *Cubed*, 2014
(Photo: Newell Post, Wiki, Web)

Birth of the “Cubicle”
- SUCCESES: quiet, personal, intimate, minimize distraction
- FAILURES: seclusion, hierarchy, minimized interaction

Hierarchical, closed-off, disengaged, boundaried, independent

Floorplans & circulation reflect such
- primary
- team meeting

Figure 5: Office Landscape
Nikil Saval, *Cubed*, 2014
(Photo: Newell Post, Wiki, Web)

Burolandschaft: “Office Landscape”

Birth of the “Flexible Office”
- SUCCESES: sense of unity, collaboration, streamlining workflow, interaction
- FAILURES: privacy and trust issues, noise control, employee health, distractions, hierarchy still there

Systematic, connected, spatial, separated, grouped, called-out

Floorplans & circulation reflect such
- primary
- enclave
- community
- refuge
- team meeting
- assembly
4.2 A New Programmatic Stance

One of the research questions investigated in this thesis is how to handle creating healthy working environments that can be both beneficial to the individual and the collective. Figure 6 diagram for reimagined working is based off the Knoll Workplace Research for immersive office planning. It gets at creating spaces for formal and informal collaboration, while offering spaces for quiet individualism in the context of a larger community.

Workplace Culture & Programmability

Reimagined Working: “experiential cohabitation”

This proposal for a collaborative workplace develops new workflow through categorization of space. There is an emphasis on different spaces for individual and collective that offer both production and rest. Varying programatic spaces encourage a unique environment for sharing ideas, promoting company success through diversity.

Figure 6: Workplace Culture & Programmability
(Based on Knoll Workplace Research, Immersive Planning: From Research to Realization: An Experience-Based Workplace, 2016)
CHAPTER 5
CONTEXTUAL ANALYSIS

5.1 Northampton Work Data

I have chosen my site to be located in Northampton, Massachusetts. Because this thesis revolves around work and its varying definitions, it is important to look into the labor statistics for Northampton to better understand how its occupations are represented. This town has an interesting organization of conditions with some urban, suburban and rural characteristics, meaning that the occupations reflected in the town’s economics are greatly varied relative to one another.

Figure 7: Northampton Employment by Sector
(Northampton’s Economic Community Profile, 2011, Web)
Figure 7 (above) displays the relative percentage of businesses there are per sector in Northampton. As one can see education and health services, hospitality and entertainment as well as retail make up the most of the employment. This makes sense because Northampton is home to Cooley-Dickinson Hospital as well as many small businesses for self care centered around health. Other small business have a high emphasis on entertainment such as the Iron Horse theatre venues, and numerous galleries for art around the city. Small eclectic retail spaces also thrive in Northampton, giving the town a diverse and lively personality.

Figure 8: Northampton Business by Sector
(Northampton’s Economic Community Profile, 2011, Web)
Figure 8 (above) furthers the data, looking at the number of businesses per sector in Northampton, which is incredibly important because of the variety of small businesses in the area. Comparing the graphs, it is important to note that employment numbers are dependent on business size. Large businesses employ many people while small businesses employ much less, so that even though the dark purple sectors (above) falling under education and health services seem smaller in comparison to other sectors, on the employment graph they take up the largest percentage. Cooley Dickinson is a large hospital employing many people and schools employ many people as well, establishing a larger ratio than say a small business.

5.2 Work-type Analysis with Exposure to Nature

Figure 9: Expanded Businesses by Sector
(Northampton’s Economic Community Profile, 2011, Web)
From looking at occupational data, I extracted some of the jobs that are common in Northampton but vary across the board and put them on a spectrum to show how much each job is exposed to nature in general (Figure 10). Nature, again, is defined as exposure to sunlight, access to greenery and fresh air as well as inclusion of sustainable practices. The maximum exposure rate is given to those who spend most of their time outside while the minimum exposure rate is given to people who spend most of their day inside. However, there are some stipulations, like proximity to windows, etc. for those who fall in the middle of the spectrum. The middle of the spectrum is mostly dependent on work environment circumstance.

Figure 10: Gradations of Exposure to Nature in Relation to Work
I considered these various exposure rates while thinking about a typical day for each job extracted in Figure 9. Acknowledging that everyone spends their extracurricular time differently, I specifically looked at the hours of a typical 9a-5p workday and how much exposure people may have to nature, or as clarified before sunlight, greenery, fresh air and sustainable practices. Figure 11 is based off the loose analysis of how those occupations may spend their day. Below, one can see that the typical days vary and for example, a landscaper/horticulturist would get approximately seven hours of exposure compared to the potential one hour a financial advisor would get. This analysis pinpoints the population that is potential best served by the integration of nature into the workplace.

Figure 11: Gradations of Work Exposure to Nature in a Typical Day
6.1 Program Analysis

The research and work data thus far helped inform my program analysis process. Returning to the Reimagined Working diagram, I exchanged for program (Figure 12). This program was developed thinking about how individual makers would benefit from each other and how their work could bring the community of the work park, as well as
the community of Northampton, together. Further, the program and variance of spaces has sparked the beginning of the possibility of different occupation types being housed not only on the same site, but in the same building. This new take on a co-op creates a collaborative work place for business owners that are in need of workshop and office shapes. This building typology would be an incubator space for small businesses in Northampton. Ideally, businesses moving from at home workshops could rent space here until they are ready to graduate to their own individual warehouses or studios.

6.2 Transparencies

By creating the program laid out in Figure 12 as a work application, further consideration was then given to what type of use each space would get in terms of public vs. private. Through this consideration, assessment was given to the various programmatic elements for potential use as both public and private (Figure 13). Sectionally, mixing of public and private spaces throughout a building—rather than assigning all public space to the ground floor made for very interesting areas of intersection. There areas of intersection in this project are referred to as “transparencies” because they act as spatial transition areas and line softeners between public and private. Because of this, transparencies act as the primary place nature is interjected into this architectural scheme. The exposure to nature in these areas happen through the incorporation of mezzanines, light transfer and multilevel sightlines involving the presence of greenery.
6.3 Key Subsystems

Because this investigation takes place in understanding nature, it is important to keep in mind a synergistic design mentality. Each system in a building is interdependent on one another. A “synergistic design mentality” would be one that keeps in mind this interdependency and designs so that each can flow with minimal disturbance on one another, as well as on the environment. For example, these production spaces are meant to be a healthy habitat for both human and plant occupation that can flourish in harmony.
The plants output molecules into the air that affect our cognitive ability as a side effect of their various states of energy transfer. Because of this, humans feel rejuvenated and want to spend more time in these spaces, which supply more carbon dioxide into the air for the plants. Figure 14 explains the interdependency of systems with a focus on how a development should impact its immediate as well as greater surroundings. These where the sections discussed in Bill Reed and 7Group’s *Integrative Design Guide to Green Building*. By comparing each category and the main points that comprise them, links can actually be made between, revealing the interdependency of habitat, energy, water and materials and how to harness it for a complete site design.

Figure 14: Four Key Subsystems of Building Performance and Optimization
(Based off Bill Reed and 7Group’s *Integrative Design Guide to Green Building*)
6.4 Materializing a New Work Model

Solidifying the program lead to the development of square footages through considering what each space’s needs would be in terms of equipment and occupancy (Figure 15). Overall the work park is set to be a total of 100,000 square feet. Workshop areas and offices have the largest square footages attributed because they will contain the most regular amount occupancy on a daily basis. Also, equipment is needed for each of the workshop spaces. Set-ups like commercial kitchens, woodshop machinery and ceramic kilns could be used. However, it is also acknowledged that the amount of space for any sort of crafting area, with storage and table space relative to business and occupancy comfort, will lead to large amounts of square footage needed. Additionally, office and small business spaces require the same needs, but their specific equipment needs fluctuate. When looking at the numbers, workshops and office spaces with meeting areas take up half of the program’s square footage. The second largest programmatic area is for greenhouses, which take up a fourth of the overall square footage. Because their presence in workplace health is has been evidenced by the research, they are situated in transparencies between most spaces. This large amount of greenhouse space in different architectural locations makes for various sizing opportunities (from large atrium greenhouses to small nooks for employees to pause during the workday). Community areas compose the other fourth of the square footage, with a large amount going to the show space for the artisans and makers that will occupy the workshop areas.
<table>
<thead>
<tr>
<th>Use</th>
<th>Square Footage</th>
</tr>
</thead>
<tbody>
<tr>
<td>workshops</td>
<td>45,000 sf</td>
</tr>
<tr>
<td>office space</td>
<td></td>
</tr>
<tr>
<td>meeting spaces</td>
<td></td>
</tr>
<tr>
<td>community/gallery</td>
<td>13,000 sf</td>
</tr>
<tr>
<td>daycare</td>
<td>4,000 sf</td>
</tr>
<tr>
<td>retail/restaurant/cafes</td>
<td>12,000 sf</td>
</tr>
<tr>
<td>interior green space</td>
<td>23,000 sf</td>
</tr>
<tr>
<td>train concourse</td>
<td>6,000 sf</td>
</tr>
</tbody>
</table>

Figure 15: Square Footages
CHAPTER 7
TRANSLATING NATURE FOR THE WORKPLACE

7.1 Case Studies

7.1.1 The Ford Foundation Headquarters, Kevin Roche + John Dinkeloo, NYC, 1968

The Ford Foundation Headquarters is located on a block between 42nd and 43rd streets in New York City. Amidst this corporate jungle sits Ford Foundation’s ten-story building that features a 160-foot atrium at the center. It’s footprint and height conscientiously observes the lines and planes created by the other buildings and existing parks in the surrounding urban fabric. Particularly, Tudor City apartments along the river near the site which contain lots of open space, gardens and playgrounds. Kevin Roche and John Dinkeloo thought that the Ford building should relate to this city model rather than the typical office blocks throughout the city.

The main goal of the building was to “provide agreeable working conditions [that] foster a sense of community among the 350 employees”. This was mainly achieved through the large atrium that housed 37 various trees as well as bushes, grasses and

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flowers scheduled to bloom year-round.”\textsuperscript{10} This interior courtyard adds dimension to the typical New Yorker’s level of interaction with nature because Roche & Dinkeloo chose to disregard the precedent idea of a large exterior front plaza. They rather move that space in the interior as part of an integral office program. The atrium recycles the building 250,000 cubic feet of air because of incorporation of plants and operable windows between floors to center atrium\textsuperscript{11} (Figure 16).

One element that the Ford Foundation Headquarters’ focuses on is human scale and occupant interaction. Their angle was to have transparent offices where one could be seen from the atrium defining their workplace as a “large family treehouse working in unity.”\textsuperscript{10} Everything in the office was designed for the space, which Kevin Roche stated “made for complete uniformity like the traditional office implied, but in a new way.”\textsuperscript{7} This strategy was more instructive to the interaction levels between employees and employers, which attempted to break the social hierarchy in office structure.

While there were many traditional office standards the Ford Foundation Headquarters broke, there were also many factors that were not incorporated. This building was done in a time where sustainability and energy conservation wasn’t at the forefront of the industry, thus there is no solar, wind or water collection for future use. The environmental impacts of the building are more than a typical office because of its excessive use of glass (which was most likely not efficiently paned). Environmental disturbance as well as site integration and transportation are categories where the Ford

Foundation flourishes because of its urban context and flat site. Materially, granite was brought in from South Dakota, which contrasts the Tudor brick boldly, but perhaps another material locally sourced from the area would have made an even bolder impact.

7.1.2 Omega Center for Sustainable Living, John Todd + BNIM Architects, Rhinebeck, New York, 2003

The Omega Center is a destination for holistic healing and spiritual wellness located on a plot of 250 acres in New York’s Hudson Valley. Approximately 5,000 sf of that is built, while 24,500 sf is terraced and 20,000 sf is dedicated to wetlands. The building itself is an “Eco Machine”, which mimics nature’s

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natural flows and expresses nature’s ability to be self-sufficient and the primary “design teacher”. The building form is two shed-like structures with a flat-roofed lobby. The larger butterfly section holds the living machine (two aerated lagoons) and classrooms, while the smaller butterfly is a laminated timber structure with mechanical rooms and bathrooms. The façade of the building is made of weathered Cyprus wood salvaged from a nearby mushroom farm.

BNIM Architects worked with John Todd to design a building that aimed beyond sustainable performance. Using the Living Building Challenge as a tool, records of environmental and climate data played a large part in achieving an integrated design for building function and operation. GPS coordinates of the building site were used for solar patterns, expected temperature and humidity levels throughout the year. In addition, native ecosystem characteristics and plant communities were studied to understand the regenerative patterns in the Hudson Valley.

One main tactic used on site is a water reclamation system, which is able to function with the help of beneficial bacteria, plants and other organisms consume the pollutants in the water. This is without the use of chemicals and harsh environmental pollutants. The roots of the plants in concrete tanks create a home for microbes that “scrub the water of unwanted toxins”.

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meaning the system boasts approximately five million gallons of cleaned water a year.\textsuperscript{17}

After purification, the water is returned to a large aquifer underneath the Omega building.\textsuperscript{14}

In addition, “all electricity needed for the building (on a net annual basis) is provided through on-site renewables and careful selection of materials creates a healthy indoor environment where common toxins have been minimized or eliminated altogether.”\textsuperscript{14} Passive strategies focus on building orientation for solar harvesting and natural ventilation. Impacts of structure on thermal mass and water design on landscape architecture required a level of integrated work by all teams involved, so a shared BIM model during design and collection of post-occupancy data (Figure 17).\textsuperscript{14} The processes utilized in the Omega Center are still being monitored for success and efficiency today.

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7.1.3 New Google Headquarters, BIG + Heatherwick Studios, Mountain View, California, 2015-present

The newest design proposal for Google Headquarters is being constructed currently in Silicon Valley, Mountain View California. Located outside San Jose, this renovation/addition seeks to add to the Google campus, but redefine the traditional notion of the workplace. With plans to break open the hermetic office park, the complex will also dramatically lower its energy use, and create a new structural model flexible enough to mold to the changing progression of work.\(^\text{18}\) The total square footage is set to be 2.5 million for approximately 20,000 workers, however, only 1/5 of that is approved currently.\(^\text{17,19}\)

Four buildings are proposed for the project, with a proposal to demolish more than a dozen aged structures the company is using now and also remove copious amounts of its surface parking. This will be exchanged for extensive landscaping, public space as well as restored waterways and native ecosystems from “dead” lands.\(^\text{17,20}\) Revamping the streetscape to make the complex open employees, visitors and residence of the town, Google is branching past the traditional corporate design to make the campus welcoming to everyone.\(^\text{19}\) A public green loop that links the parcels of the campus via bike lanes and walkways aims for safety, reducing single vehicle occupancy, present gridlock and environmental impacts.\(^\text{17,18}\) The entire bottom floor is dedicated to business space,


community venues, etc., meaning Mountain View residence can “walk/ride along green corridors, eat at indoor/outdoor cafes, shop at retail stores and play in the parks. Instead of a corporate campus, the North Bayshore becomes a new neighborhood (Figure 18).”

Structurally, the building is four blocks with tent-like structures spread intermittently. “Supported by a cable-net grid, the tent-like structures rise on widely spaced columns.” The airy quality of the tent membrane is made possible by a lightweight system with two layers insulating airspace between the outer membrane, which integrates PV and roof vents to exhaust in a fire, and the inner membrane.” This contrasts the stacked floor plates of workspaces, which permit access to daylight as well as natural ventilation while controlling solar gain and encouraging office layout flexibility. The large canopies regulate the climate and interior air quality while dealing with sound, which leaves the overall space free of “architectural limitations” such as fixed walls and furniture. The plans for the workplace employ a modular column, beam and floor-tray system that could reach up to eight stories.

This promotes a light quality to spatial planning, with the mobility to reconfigure the structure as the company changes. This overarching theme of sustainability addresses the future of building typologies for work while also changing the way people think about their workplace and built environment relationship to the community surrounding them.
7.1.4 Alterra Atria, Michael Singer Studio, Wageningen, Netherlands, 1999

Alterra is the Dutch research institute focusing on environmental balance and sustainable ecosystems. Chosen to provide “sculptural interactions” within the building’s “core environment”, Michael Singer worked with architects Behnisch and Partner and landscape architects Copijn Tuin as well as the future scientists working in the building. Themes of balance and tension create the foundation for architecture so that occupants may move back and forth from indoor to outdoors during their workday. The human relationship with earth is reciprocal and balanced, questioning fundamental architectural assumptions and bringing together building and site codependency.

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The building forms a rectangular figure 8 around the garden focal points for sculptural interaction, emphasizing natural light/color for cozy and inviting places for occupants to gather. The sculptural water pools also contain decks and pavilions for gathering as well. Materials were mostly sourced locally and regionally, employing the same roofing seen in the tomato greenhouses of the countryside.

At a technical level, Alterra succeeds in executing regenerative thinking for the building’s operations. As the “lungs and kidneys”, the atria clean air and cleanse graywater of the institute while providing climate control (Figure 19). Several consecutive pools work together as water flows through. The first pool houses fish and vegetation that clean the water with microbes, which then continues to a second pool where the water is filtered and the cleansing process is completed. From there, water runs through pipes and drips into a cistern for storage and recycling for the buildings irrigation system and toilets. Storm water is also caught as runoff into an exterior retention pond, which is filtered into the interior atrium pools.

Temperature is from interior to exterior controlled in the building through mediation of the plants within the atria. With a large glass roof, the solar heat gain coefficient is important, especially in a working environment with office and gathering spaces as primary program. Increased ventilation to the space and the evaporative cooling of the plants combined with the pools for humidity control allow for Alterra to require no air conditioning. Each atria wing has plantings that respond to the amount of solar

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emitted into the space. The west wing has more lush plants, while the east has more arid plants.\textsuperscript{22}

![Figure 19: Alterra Atria Center Atrium](Photo: Alterra Atria Gardens, Michael Singer Studio, Web.)

7.1.5 Bullitt Center, Miller Hull, Seattle, Washington, 2012

Miller Hull’s 52,000 sq ft/ 18.5$ million Bullitt Center is a six-story workspace building with 250 year lifespan, estimated from its successful execution of regenerative architectural techniques.\textsuperscript{24} The building is “headquarters for the environmentally focused” and houses four tenant companies sharing in said mindset, some of which were involved in the design and development of the property.\textsuperscript{23 25} The Bullitt Center is also


being termed one of earth’s “greenest constructed buildings” as part of the Living Building Challenge.23 Denis Hayes, president and CEO of the Bullitt Foundation stated approached the challenge from a neutral standpoint. “Denis was clear that it couldn’t be too much of a hippie experience”, stated Miller Hull partner Craig Curtis, “it had to be a place where people would want to be and where they would enjoy working.”23 Revolutionary for its successes, the Bullitt Center shows that an “office building can show the highest level of sustainability while offering competitive rental rates”, creating a new model for variable climates around the world.26

The structure is composed of six stories, four heavy timber framed sitting on two stories of poured concrete podium, creating a constant thermal mass temperature.23 Seismic is resisted in a steel lateral system and the 14’ floor-to-floor height is accentuated with large windows, thermally glazed to emit light into the core of the office layouts.23 The radiant floor taps into 26 geothermal wells to control heating and cooling with passive strategies.23

Although the building “may not resemble a Douglass Fir forest, it does function like one” (Figure 20).23 The building obtains all of its water from rain on site (feasible in the Seattle climate) and in one year consumes less electricity than the roof’s PV array generates.23 Because the array is so wide (going beyond parcel boundaries and Seattle code) the owners must pay an annual fee to the city for airspace occupation.24 Looking at electricity from an operational standpoint, the upfront costs for all the HVAC equipment are much higher than a conventional system, however data shows the operating costs are

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much lower. In a typical Seattle office, HVAC accounts for 35%+ of the electric load.\textsuperscript{24} The plug loads of the building are where the most energy (50%) comes from and tenants agree to a certain energy allowance as part of their lease agreement before occupancy.\textsuperscript{23} The EUI target for this building was 16kBtu per square foot (it achieved lower), which is more than an 80% savings in comparison to traditional office buildings.\textsuperscript{24}

Water management starts through an activated charcoal water system that filters chlorine out of the faucets from the purification process of rainwater to potable water.\textsuperscript{24} 70% of the rainwater is collected through the roof and is eventually returned to the earth in a bioswale and constructed wetland atop the lower floor roof extension. The toilets foam for aesthetic reasons mimicking a typical toilet and compost the leachate drained to contribute to city compost rather than the municipal sewer system like typical office buildings.\textsuperscript{24} Because of its unique circumstance and location, the developer is trying to designate the building as its own water district.\textsuperscript{23}
7.1.6 Genzyme Center, Behnisch Architekten, Cambridge, Massachusetts, 2004

The Genzyme Center located on a former brownfield site in Kendall Square, Cambridge, housing the Genzyme biotechnology Corporation. This 12-story 350,000 sq ft and 140$ million building is adjacent to the MIT campus, offering space for student study opportunities. The building is a series of about 920 individual workplaces within ‘dwellings’ that make this structure keen to a ‘vertical city.’ Each floor has informal gathering space, conference rooms, kitchens, outdoor terraces, and gardens with focal vertical and horizontal circulation. The configuration of these spaces alternate open workspace with closed cells to create a diverse and flexible office landscape.

Traditional hierarchy of office architecture is challenged in the Genzyme Center in many ways. First, this “city within a city” uses color to convey different spatial depths when viewed from different areas of the building. Secondly, within a set of colors, employees are given the opportunity to choose their own furnishings for their work environment. This establishes individualism in the workplace, which encourages creativity and success because people are able to have a voice in what they like in their workplace environment. Next, instead of the top floor being a CEO penthouse, it is used as a cafeteria space for all employees. This breaks down the office social hierarchy and encourages movement of all employees vertically throughout the building. Lastly, all

workspaces have direct views of nature, whether it be the externally to the Charles River or internally in the atrium.29

The central atrium mentioned previously is the large vertical void, which becomes the driver for organization in the Genzyme Center. All programed space is organized around it so that natural light may funnel into the core of the building while city views are prioritized.26 75% of employees receive direct natural light, a statistic aided by the vertical Helios suspended atop, extending down the center of the atrium.26 The reflective chandelier has 16 mobiles and 768 prismatic plates supported by steel cables. Each reflects light from the “prismatic skylight” and “seven automated sun tracking rooftop heliostats into the interior space.”26 Integrating light further, there is a reflective wall on the south side of the building with” 22 lamella panels, which catch sunlight and disperses further.”27 Automated louver blinds encompass 40% of the buildings perimeter for efficient lighting controls (Figure 21).27

The Genzyme Center also boasts a LEED Platinum certification with a “32% reduction in water consumption and 25% reduction of storm water runoff due to rainwater collection and a 36% cut in energy from

Figure 21: Genzyme Lighting and Ventilation Strategy (Photo: Genzyme Center Headquarters Building, Behnisch Architekten, Web.)
integration of natural lighting, passive solar, smart window technology and passive planting strategies.” The central atrium is an air duct, meaning that the internal environment is regulated by operable windows, all 800 of which are left open during nice weather to help ventilate the space. Lastly, the 3-foot loggia curtain wall keeps warm air out in the summer and retains heat in the winter while a complex cooling system uses steam from a nearby power plant to cool the building’s interior.”

7.1.7 The Freie University of Berlin, Candilis, Josic Woods and Scheidhelm, 1963

The Frei University of Berlin belong to the architectural style called “MAT Building” meaning that the building is part of an established module usually containing strong links to assessibility, layout, daylighting and ventilation. The simple module is repeated as often and in any pattern desired until overall form is achieved. MAT buildings are also known for its “organizing network of circulation route and support systems, providing greater flexibility for activity in multiple directions.”

The University itself had a goal of demonstrating the “environmental responsiveness of [the] MAT building in the context of a large and rapidly evolving institution.” Developed as a “city in motion” the complex was brought down to the level of the pedestrian resulting in ‘groundscraper organization that increased opportunities for communication and exchange without autonomy.” The architects of the Freie University also designed parks, courtyards, terraces and green roofs to be

interspersed within the layout of the building modules.\textsuperscript{35} This scheme explores a hope for society that social interactions can be encouraged by architects through the design of successful spaces.\textsuperscript{36}

There are many small nuances that the Freie University succeeded at and can be applicable to this project. Looking in section (Figure 20) one can begin to see that the layout of spaces like blocks stacked on one another conveys many opportunities for transparencies. The Freie scheme utilizes transparencies both indoor and outdoors while taking its levels both above and below ground. Many scholars are discussing the MAT building as a form of sustainable reemergence because of its simplicity and straightforwardness that can be adapted to whichever site or orientation. The simplicity of form but adherence to a grid brings order to an otherwise clustered program, which is applicable for a large work complex desired for this integration of nature in the workplace.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{Figure_22.png}
\caption{Freie University Plans and Sections for Competition Entry (Photo: Tom Avermaete. \textit{Another Modern: The Post-War Architecture and Urbanism of Candilis-Josic-Woods} (Rotterdam: NAi, 2005), 322-323 )}
\end{figure}


CHAPTER 8

IMPLEMENTATION FOR DESIGN

Site: 200-190 King St., Northampton, MA

Figure 23: Site Orientation
(Photo: Google Maps, Google Earth)

8.1 Intro

The site for which I plan to execute this new take on a maker space is located at 200-190 King Street in Northampton (Figure 22). A location on King St. poses unique challenges and opportunities for the town. North King St. takes on an identity of a typical shopping center with a Walmart and Stop and Shop. South King St. begins at a 4-way
intersection in the heart of downtown Northampton. Here, an eclectic mix of restaurants, businesses and community areas reside. As the town of Northampton begins to think about how this site will be redeveloped, issues with identity come into play because it is centrally located between two very important and very different districts in the town. Going forward with design, the approach to this site as a potential connector will be instituted as a middle transitionitory space.

8.2 Brownfield Acknowledgement

It is important to address the fact that this site on King St. is a brownfield and that there may be potential issues in site redevelopment. When thinking about brownfields there are a couple of categories to consider because of legalities, responsibility and monetary involvement. Those categories include Known Cost, Risk & Uncertainty, a Potentially Responsible Party, Risk Assessment, Incentives and Perception. Costs are a large driver in potential brownfield redevelopment, so it is important to identify what costs are known as factors in financial pro forma for project feasibility. In addition, unknown costs are added to the total as safety measures to compensate. This increases return but adds elements of Risk and Uncertainty to the project. The Risk and Uncertainty is approached carefully by the Potentially Responsible Party because if there is no new agreement on terms then legalities would fall on them. Risk Assessment of redevelopment of the brownfield is conducted to study the severity of contamination and any potential risks unearthing of the site may impose. In relation to Risk Assessment,

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project incentives may be offered for cleaning of the site. Considered real estate deals, brownfield credits are offered by the government. Lastly, sometimes what accentuates the severity of the brownfield is actually perception. Uncertainty affects not only investors, but the community as well who are concerned about what may be a potential risk for the town they live in.

Based on excerpts from Mississippi Department of Environmental Quality and the EPA's Brownfields Program Supporting Safe Property Redevelopment.

Figure 24: Brownfield Basics
(Based off MassGov’s Energy and Environmental Affair Data and MassDEP Waste and Reportable Releases)

There is a lot of talk throughout Northampton about this King St. site being a brownfield, however, it is mostly the perception factor. The town residences believe that this brownfield site is much more contaminated than it really is. Contrary, this previous Lia Honda dealership site is a former brownfield.\(^3^9\) Cleanup of the oil from cars in the Honda mechanic shop was not considered hazardous by the DEP. And currently, the DEP claims that it is cleaned to the appropriate level.\(^4^0\) The actually reason why it has not been redeveloped is because the current owner values the parcel at much more than its worth and because of this will not sell.\(^4^1\) Because of its location, there is much more uncertainty regarding the architectural identity of the site, which has been discussed by the town (Figure 25).

\(^{39}\) Mass.gov. “Waste Site & Reportable Releases Results.” Energy & Environmental Affairs Data Portal, Commonwealth of Massachusetts, 2018, eeaonline.eea.state.ma.us/portal#!/search/wastesite/results?SearchType=Only%20sites%20with%20Activity%20%26%20Use%20Limitations&TownName=NORTHAMPTON


\(^{41}\) Mass.gov. “Waste Site & Reportable Releases Results.” Energy & Environmental Affairs Data Portal, Commonwealth of Massachusetts, 2018, eeaonline.eea.state.ma.us/portal#!/search/wastesite/results?SearchType=Only%20sites%20with%20Activity%20%26%20Use%20Limitations&TownName=NORTHAMPTON
8.3 Site Analysis

8.3.1 Greater Site Conditions

The greater site conditions of 190-200 King St. that impact future design development lay in the earth composing the site. As one can see from the diagram above, Northampton is composed of various soil types and hydrogeological activity (Figure 27).
According to the data from Historical Northampton’s Aquifer Protection Studies\textsuperscript{42}, soil composition of the site is mainly soils composed of outwash.\textsuperscript{43} Outwash plains are low elevation areas that held a large influx of water from melting glaciers at the time of its inception.\textsuperscript{44} Because of this, the soil is composed of mostly sand and other fine sediments easily carried along by the flow of water. There is a possibility that the soil would have some clay because it is common in Northampton. The site is part of the band of lowest land elevation that runs down into the Connecticut River that runs North to East of the site. Additionally, in terms of hydrogeological activity, the area is of recent alluvium and floodplain. This means that the land is mostly flat, and was formed by the deposition of soil over centuries by waterways coming from high to low points. Alluvial, or eroded, soil forms in these “floodplains” where overflow from rivers or waterways occur.\textsuperscript{45} While the site itself (outlined in red in Figure 26) is particularly flat it is important to account for the high water runoff through the site particularly from the northern Barrett St. Marsh, in addition to its soil/hydrogeological factors.


\textsuperscript{44} Schaetz, Randall. "Outwash Plains.", accessed 1/11/19, \href{http://geo.msu.edu.silk.library.umass.edu/extra/geogmich/outwash_plains.html}{http://geo.msu.edu.silk.library.umass.edu/extra/geogmich/outwash_plains.html}.

Figure 26: Greater Site Conditions Physical Model

Greater Site Conditions

Based off Historical Northampton’s Aquifer Protection Studies

KEY

Soils
- Soils on Outwash
- Soils on Outwash, Terraces and Lakebeds
- Sandy Soils on Glacial Till
- Loamy Soils on Glacial

Hydrogeologic
- Recent Alluvium & Floodplains: low-moderate permeability
- Lakebed Deposits: very low permeability
- Undifferentiated Sand Deposits: low-high permeability
- Deltaic Deposits: moderate-high permeability
- Lakebed Deposits: very low permeability

Site

Waterways

Figure 27: Greater Site Conditions Map
(Based off data from Northampton’s Aquifer Protection Studies)
8.3.2 Direct Site Conditions

Zooming into 190-200 King Street and its direct surroundings, one can see that the site is in a relatively mixed area. There is primarily residential neighborhoods surrounding, however, businesses also line either side of King St. The site is sandwiched between two parallel lines of travel, King St. (Route 5) on its western edge and the AMTRAK rail line/ bike path on its eastern edge. Because of this, noise will be coming from both directions and affecting both Eastern and Western edges of the site. Creating a buffer zone will be essential for noise pollution on site as well as occupant comfort and
safety for pedestrians and bicyclists (Figure 28). The site is assessable from many means of public transportation such as walking, biking, bus and train (Figure 29). This means that many different people in different vehicular circumstances will be able to use this site more readily. However, Northampton is a special town because of its rural and urban characteristics and ignoring vehicular traffic on this site would not be appropriate. Cars pass this site steadily throughout the day (Figure 30) and vehicular use of this site in the form of cars and trucks for loading, etc. must be integrated to make this complex successfully assessable.

Figure 29: Site Traffic A
(Picture and information from Google Maps)
8.4 Plans

8.4.1 Level 1

The work complex I have designed on the King St. site is composed of six buildings. Four of these buildings are more work driven and contain office and workshop...
space for the small businesses that will occupy them. These four buildings line the northern and southern edges of the site (Figure 31). In terms of plan development and orientation, “L”-shaped buildings were the most practical configuration for sustainable practices. Because of their linearity in the workshop/office wings, cross ventilation from opposite window placement is achieved. The ground floor of these four buildings contain first level of work space that branch from a center atrium. Upon entering the atrium, one is confronted with a large greenhouse area that acts as the heart of the building, ascending up through the floors. There is also a café area on all ground levels and a place for seating around it and the greenhouse. Each of these buildings have walkthroughs for pedestrian access to the site.

The other two buildings that make up the complex are more community driven and sit in the center of the site. The building facing King St. is a community gallery and presentation space for the artisans and makers occupying the workspaces as well as retail space for product sales and a small café area. Within this building there are also greenhouses. The first of which is at the entrance to the gallery, creating a visual draw that can be seen from vehicular travel on King St. This greenhouse on the façade ascends multi-levels as well. The building at the back of the site facing the rail line is a proposal for an additional AMTRAK stop that currently only stops on Pearl St. By adding this feature to my site, the amount of people utilizing the proposed complex would increase because commuters could come in on the line to work as well as people wanting to take the line from the site for travel. The first level of this building contains covered parking and a circulation space up to the primary second level. The community areas also have pedestrian walkthroughs, which present glimpses to the center of the site for passerbys.
Figure 31: Level 1 Plan
8.4.2 Level 2

The second level of the AMTRAK building is the main level containing a large café area, small retail space and ticket office. The other community gallery building facing King St. has a second level of presentation space and a circulation area that flows around the large greenhouse for views in and a filtering of natural light into the gallery through the glass. While the main greenhouse is not assessable from the second level, there is another smaller greenhouse that is assessable and also faces out to King St. Additionally, there is a small balcony on the north façade of the building for outdoor sculpture exhibits.

The second level of the four workshop/office buildings are all laid out similarly. Each contain floors that are all connected, which shelter the pedestrian walkthroughs underneath. The workshop and offices are stacked on top of their same space below, creating opportunity for mezzanines and light penetration as mentioned before. The central greenhouse atrium continues to ascend through this level with access from either wing via balconies. Around the central core there is also space for formal or informal meeting, which can all look out onto the primary (core) and secondary (wing) the greenhouse spaces (Figure 32).
Figure 32: Level 2 Plan
8.4.3 Level 3

Lastly, the third level of the four work buildings contain another floor of workshop space stacked on top of similar spaces underneath. This level is intended to be an open plan and flexible office use area, but can also be more studio space depending on the business’s needs. There are also specific office spaces in the restaurant building facing King St., as well as places for small business operations. Greenhouses continue to grow up through these levels, creating the opportunity for mezzanines and lookdown within the growing spaces, similar to the second floor (Figure 33).

The community buildings in the center of the site follow a similar notion with the greenhouse spaces. Also ascending up, there are many look-downs and mezzanines within the greenhouse space itself. Additional presentation space is housed on the third floor of the gallery with a large balcony the looks out onto King St. for gallery events and exhibition openings. The AMTRAK building on the back of the site has the third floor that contains an indoor hydroponic park which looks down onto the railway and the center green of the site. Upon speaking with several people who utilize a hydroponic park in Easthampton, MA with their children all seasons, many expressed the desire to have another venue similar closer to the downtown Northampton area. Within this scheme, the addition of an indoor park surrounded by greenhouse area is appropriate thinking about a child’s benefit from an exposure to nature as well.
Figure 33: Level 3 Plan
8.5 Site Flow and Function

8.5.1 Establishing the Grid

This complex factors out to be approximately 11.5 acres of site in which 100,000 square feet of condition building exist on. Because this work park is so large and there are a lot of different programmatic elements happening through the site, disorganization and chaos could have ensued. However, utilizing a gridded scheme for this site created necessary order and predictability that helped the large, varying program. By taking each building and aligning their forms to fit within a 25’x25’ grid, the site became more organized for all types of traffic flow.

8.5.2 Site Usage

Traffic utilizing this site is both vehicular and non-vehicular. A lot of time was spent utilizing all of the site data to process how parking would be integrated into the site. The conclusion that traffic proceeding in a counter-clockwise, one-way flow around the perimeter was the most appropriate to keep the desired center of the site pedestrian-only. Parking will line the one-way road composing the perimeter of the site. There are smaller loops, however closer to the buildings with covered spaces for assessable parking, pick-up/drop-off and loading docks for workshops and business spaces. Also, in the center there is a two-way “main drag” for bicycle traffic that redirects the Northampton bike path through the site’s interior, engaging the community even more. In terms of outdoor greenery and landscape, there is a large area in the center of the site for outdoor community events such as small farmers markets or vendor fairs. Trees also line the area outside the parking spaces to create a buffer zone. Lastly, the front sidewalk lining King
St. utilizes trees and greenery to create a buffer zone as well, but also to create a
transitionitory space from street to sidewalk to intermittent green area to building. This
corridor consideration increases safety of site users and considers the zoning setbacks as
opportunities to increase planting and greenery on site.

Figure 34: Site Organization

8.6 Sections and Elevations

Many of the architectural elements discussed previously are most evident in the
sections of these work buildings. The stacking of spaces on one another is broken up with
mezzanines for light penetration that comes from the large windows (Figure 35, Section A-A). By cutting through the greenhouses their accessibility from multiple levels and use by all occupants of the building becomes evident (Figure 35, both). Plants are able to grow up and ascend the tall space, creating interesting views through the layers of glass on the interior of the building. In the meeting space around the green areas, occupants can gather formally or casually and experience a closer exposure to nature (Figure 36).

Figure 35: Sections A-A and B-B

Figure 36: View of Greenhouse from Central Circulation
Figure 37 shows the front elevations for the King St. site. The facades are a balance of metal insulated panel finished to look like wood, and glass. The presence of views is important for this project so the site’s ability to pull people in needed to be emphasized. The exterior pedestrian walkways through the building’s first floor create partial sightlines into the central green. Catching a glimpse from the sidewalk and driving by, people are intrigued and pulled into the site through this architectural experience.

Figure 37: King St. Elevations and Section C-C

Figure 38: View of King St. Elevations Looking North from Gallery Balcony
8.7 Sustainability Sectional Perspective

All architectural notions mentioned previously about sustainability, incorporation of nature into the workplace and employee health is referenced in Figure 39. First, the building’s linear wings are shaped to encourage cross ventilation (purple arrows) with operable windows on each side. This can be seen also in Figure 40, one of the primary form studies done in the conceptual phase of the project. By tweaking that original idea to fit more on the site, the L-shaped workshop shapes continue to encourage passive airflow through the stacking of space with openings (via mezzanines) through the levels. Air flow into and up by stack effect increases the building’s ability for natural ventilation as well. The building form and materiality also encourages day lighting transparency and light penetration through curtain walls and greenhouses. Solar panels are angled on roofs to increase energy efficiency along with insulated metal panels that mimic the biophilic wood finish. Lastly, phytoncide transfer to adjacent spaces through operable interior greenhouse windows increases workplace health. As discussed before, plants produce phytoncide and negative ions which are proven to lower stress hormones, reduce anxiety and increase pain threshold in humans as a result of improved immune functions.\footnote{Selhub, Eva M., and Alan C. Logan. *Your Brain on Nature: The Science of Nature's Influence on Your Health, Happiness, and Vitality*. Toronto: HarperCollins Publishers, 2014.}

On the exterior of the building, sustainable practices are used to aid in site efficiency (Figure 39). The use of greenery lining the site’s perimeter create a buffer zone increasing pedestrian safety and sound filtering from the busy street. Permeable pavers are used on all pedestrian walkways to control water retention on site as well as runoff from the surrounding areas of higher grade. Finally, sustainable transportation is encouraged though the redirection of the bike path and incorporation of covered storage.
areas adjacent to the covered assessable parking or at the main building entrances on the site.

8.8 A Simple Kit of Parts

In an effort to make this research and project applicable to situations apart from this particular site and work area it was boiled down into a simple kit of parts. The goal is
that creating a healthy workplace is something that could be implemented at different scales. The most basic extraction of key spaces (workshop, greenhouse, office/business, café) are all modules replicated without much change in each of the six buildings on this site (Figure 41). Bathrooms are also all designed with the same dimensions aligned with elevators. Almost every one of these components is stacked upon one another and can be added or subtracted to in other situations for taller or smaller buildings following the same ‘workplace health’ idea. Additionally, returning to the 25’x25’ grid that established the site organization and building form for this project, dimensions can be changed for other circumstances. By changing the grid and building modularity to correspond, design flexibility is increased and a deeper consideration to workplace health can be executed on whatever scale.

Figure 41: Designed Flexibility, A Simple Kit of Parts
8.9 Additional Render Views

Figure 42: View of the Center Green From Workshop Balcony

Figure 43: Third Floor Workshop
Figure 44: View of Center Green from Office
CHAPTER 9
CONCLUSION AND FUTURE WORK

It can be concluded that the impact of nature on a human’s health is something that can be harnessed to effectively change the way we look at the workplace. The main exploration of this project was to integrate nature (greenery, sunlight, air flow and sustainability) and architecture. While though this was achieved, the basis of integration could be seen as a basic application. Further progression would strive to reveal a greater understanding of the most effective way to architecturally harness the ability of plants, light and air perhaps through a NetZero building, where each element coexist in a better synergistic whole.

The next stage of this project will also include a further exploration of integration with the landscape. While the grid was essential for establishing order for a large program and aiding in organization, there are areas in which the grid needed to be broken or voided. By doing this an integration with nature can begin to echo out beyond the architecture. Playing with various grades and including elements like berms, rain gardens and native plantings would help progress the site. Changes in the landscape would also help drive the potential NetZero capability of this scheme by including rainwater collection or site regeneration. Progressing the integration of nature with architecture and landscape, the future can create a new standard for workplace development as healthy and holistic areas of production.
APPENDIX

ORAL DEFENSE PRESENTATION BOARDS

Photosynthesizing the Workplace  

A Study in Healthy + Holistic Production Spaces

Kautili Howard

How can nature be integrated with architecture to positively impact workplace health?

What would this beneficial work environment look like?

How do we create a healthier workplace environment centered on exposure to nature?
Why is Northampton, MA ideal for an integrated workplace?

What are the surrounding conditions affecting this site?

How is this research being practically applied to 195 King St, Northampton?
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