

ABSTRACT

Title of Document: *INFORM: DIDACTIC ECO-CONSCIOUS
ARCHITECTURE.*

Angelo Claudio, M. Arch, 2008

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Architecture Program

Architecture has the potential to reflect the cultural values of a society. Conversely, an expressive and didactic architecture can affect cultural value systems. At the most fundamental level, sustainability is about being aware of our place in a larger whole and respecting the interconnectivity all life shares on this planet. Without a cultural value system that supports this worldview, sustainable architecture will eventually reduce into a style or application. This thesis explores the didactic potential of architecture in regards to sustainability. It focuses on the recognition of unique characteristics in the built and natural environment of a place; the building's response to these environmental factors; and how an expressive architecture may teach the inhabitants of the building and local residents of the surrounding neighborhood about their environment. A secondary school in downtown San Francisco is an opportune typology for this exploration. Form may follow function, but can form inform?

INFORM: DIDACTIC ECO-CONSCIOUS ARCHITECTURE.

By

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Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Masters in Architecture
2008

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Dedication

To

My patient and supportive wife.

Acknowledgements

I would like to thank

Professor Isaac Williams for his advice and enthusiasm for the advancement of education and architecture. He has paved a direction of architecture I did not previously consider pursuing.

Professor Gary Bowden for his patience with me and his insight with urban planning and design. He has emphasized the full ramifications of architecture in the broader urban scale.

Professor Carl Bovill for his support and optimism over the past few years. His passion for environmental design will forever echo in my future career as an architect.

Professor Deborah Oakley for her zeal at teaching and enthusiasm for structure. She has indelibly peaked my interest in expressive structural form.

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Introduction

People concerned for the environment in the 1960's were perceived as unreasonable, tree hugging radicals that most main-stream America felt threatened by, in part, due to their anti-establishment politics. Many segregated themselves in remote compounds to practice a more ecologically friendly life style. Though well intentioned, this marginalized their group and hurt their cause. For the most part they failed to work within the system and cooperate with known channels. Beginning in the 1980's after successive environmental disasters such as nuclear waste leaks, flooded cities and crop failures, public concern became more prevalent. [fig. 1]

With the new millennium, the word sustainability has come into the mainstream. However, inundated by marketing ploys, the public is confused and the true definition of sustainability ambiguous. I fear that the result may make sustainability just a passing fad and sustainable architecture a passing style.



*Chernobyl
Exxon Valdez
Katrina*

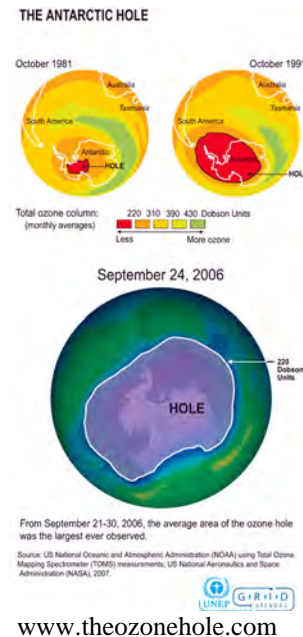


Fig. 1 Non-isolated disasters we face today.

This confusion is due to ecological awareness and environmental concern not being an integral part of the American cultural value system. American Culture extols individuality, self-reliance, independence, innovation and entrepreneurial fortitude. This however favors an anthropocentric perspective of the world.

Past cultures, albeit more agrarian, revered the cosmological and natural. This awareness permeated, in various degrees, all facets of their daily lives. From the Mayan pyramid to the Zen garden [fig. 2, fig 3], societies around the world viewed themselves as a small part of a much larger universe. And their architecture reflected this connection and awareness.

It is time for this young nation to integrate sustainable ideas into its value system. It is time for us to pass on to our children not just a world that is sustainable but pass on the ideologies and values that will keep it sustainable for subsequent generations to come.[fig. 4]

Architecture more than ever can affect rather than just reflect cultural values. Architecture can be a



Cosmological connection imbedded in culture

Fig. 2 ChichinItza



Architecture being a part of something larger

Fig. 3 Traditional Japanese House



passing sustainable values onto the next generation

Fig. 4 Concept Illustration

tangible metaphor. Architecture can be an instrument
for learning. Architecture can inform.

Chapter 1: Why be sustainable?

Section 1: Current State of Affairs

With the exception of solar radiation and meteorites, the earth is a closed system. The air we breathe, the water we drink, and the food we eat, all have existed on earth since its formation. The energy from the sun and the existing matter on earth sustain life on this planet. This matter and energy continually transform and cycle within a delicate ecological balance.

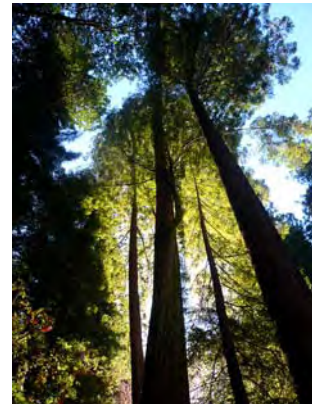
All living species on this planet impact their environment. But Nature enforces ecological balance to insure the continuation of these cycles. Alarming studies and observations conclude that people's impact on the planet is disrupting these cycles.

“At an accelerating rate, we are destroying natural habitats or else converting them to human made habitats, such as cities and villages, farmlands and pastures, roads and golf courses.... Those losses...provide us with so called ecosystem services such as protecting our watersheds, protecting soil



Less diversity and number of species each passing year.

Fig. 5 Kauai, Hawaii



Preserving what is left of natural habitats.

Fig. 6 Muir Woods, California



resource allocation and environmental impact

Fig. 7 Las Vegas, Nevada

against erosion, constituting essential steps such as protecting our watersheds, protecting soil in the water cycle that providing habitat for most terrestrial plant and animal people live on earth and the rate of population growth is expected to increase. However it is not just the number of people but the impact they will have on the environment.[fig. 7] “On average, each citizen of the U.S., western Europe, and Japan consumes 32 times more resources such as fossil fuels, and puts out 32 times more wastes, than do inhabitants of the Third World.”

According to Diamond “...low-impact people are [also] becoming high-impact people,”¹ for two main reasons. Third world people coveting first world life styles begin to live more extravagantly. And Immigration of third world inhabitants into first world countries also propagates this high impact life style.

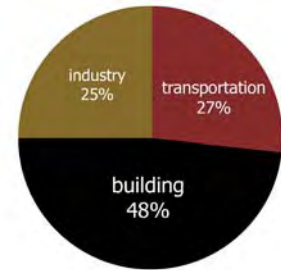
Our current practices of energy consumption will deplete and fully exhaust our resources. The inevitable result is economic and ecological collapse. Historic precedents for anthropogenic problems such as the demise of the Easter Islanders, the Anasazi of the American Southwest, and the Mayans confirm the

¹ Diamond, 494

dependent relationship between a society and its climate, geography and resources.

“The building of shelter consumes one-sixth of the world’s fresh water supply, one quarter of its wood harvest, and two-fifths of its fossil fuels and manufactured materials. As a result architecture has become one of the primary targets of ecological reform.”² [fig. 8] Can we provide quality built environments for people without negatively impacting the natural environment? The answer is yes, if a paradigm shift can be achieved. Permanent change however takes time and may take multiple generations for a populace to fully accept a radically different way of thinking. [fig. 9]

Currently an informed minority, such as McLennan, Diamond, Begley, McDonough and Braungart, are illuminating the public consciousness. These ecological ideologies, arguably begun in the 1960’s and 1970’s by a few forward thinkers such as, Rachel Carson³, Denis Hayes⁴, and E.F. Schumacher⁵,



United States Energy Consumption

Data from the US Energy Information Administration shows that close to half of energy consumption in the US is from buildings.

Fig. 8 US Energy Consumption graph

² Wines, 9

³ author of “Silent Spring”

⁴ president and CEO of the Bullitt Foundation and coordinator of the first Earth Day in 1970

⁵ author of “Small is Beautiful” and “Buddhist Economics”

paved the way for the movement we are experiencing today. The next generation of decision makers, the young adults in schools today, will complete the loop by fully embracing sustainable principles as merely common sense.

1962

Marine biologist Rachel Carson publishes "Silent Spring", calling attention to the threat of toxic chemicals to people and the environment.

1970

First Earth Day

1974

Chemists Sherwood Rowland and Mario Molina publish their landmark findings that chlorofluorocarbons (CFCs) can destroy ozone molecules and may threaten to erode the Earth's protective ozone layer.

1983

The U.S. Environmental Protection Agency and the U.S. National Academy of Sciences release reports concluding that the build-up of carbon dioxide and other "greenhouse gases" in the Earth's atmosphere will likely lead to global warming.

1985

Scientists report the discovery of a "hole" in the Earth's ozone layer.

1992

The Convention on Climate Change sets non-binding carbon dioxide reduction goals for industrial countries (to 1990 levels by 2000). The final treaty calls for avoiding human alteration of the climate, but falls far short of expectations, largely due to lack of support from the United States.

1996

Theo Colborn, Dianne Dumanoski, and Pete Myers publish "Our Stolen Future," which warns of reproductive threats to animals—including humans—due to the release of billions of pounds of synthetic chemicals into the environment, many of which mimic and disrupt natural hormones.

1998

The ozone hole over Antarctica grows to 25 million square kilometers. (The previous record, set in 1993, was 3 million square kilometers.)

2001

U.S. President George W. Bush announces that the United States will not ratify the Kyoto Protocol, saying that the country cannot afford to reduce carbon dioxide emissions.

Fig. 9 disturbing trends

Section 2: Ecology and Economy

Today many people use the words “sustainable” and “green” without fully understanding these terms. The frequent use and misuse confuses their true meaning and reduces their significance into a cliché, a style, or a commodity. As Basset suggests, “Over-commercialization of sustainability will only contribute to the public’s misconception and eventual dismissal of sustainability.”⁶ According to the Merriam Webster Dictionary, sustain means to support, prolong, and keep up. In architecture, “green building and sustainable design are terms that are often used to describe the final result of a building...sustainability is broader in its reach, addressing the long term impacts of the built environment on future generations and demanding an examination of the relationship between ecology, economics and social well-being.”⁷ In this case the term sustainability has grown out of its original definition. Perhaps a more appropriate phrase to use that begins to address the interrelationship between organisms and their

⁶ Basset, 50

⁷ Kwok, 15

environment is ecologically conscious or: “eco-conscious.”⁸ This Thesis focuses on this particular part of sustainability: The conscious awareness of the built and natural environment. By understanding our part in a much larger environmental system is the first step toward an eco-conscious future.

“We in the building professions must bear a large share of the responsibility in redesigning the places and systems that we use to live” eco-consciously “because many of the solutions to our environmental problems are design problems.”⁹ Material use and building design strategies directly relate to lowering the impact on the environment. Strategies such as: day-lighting, indoor air quality, passive solar heating, natural ventilation, energy efficiency, embodied energy, construction waste minimization, water conservation, solid waste management, renewable energy, and xeriscaping/ natural landscaping are the first steps toward a sustainable architecture. [fig. 10]

⁸ eco - concerned with living things in relation to their environment
conscious –1. aware of one’s own existence, sensations, thoughts, surroundings 2. aware of what one is doing 3. deliberate; intentional 4. acutely aware of or concerned about 5. inwardly sensible of wrongdoing

⁹ McLennan, xxvi

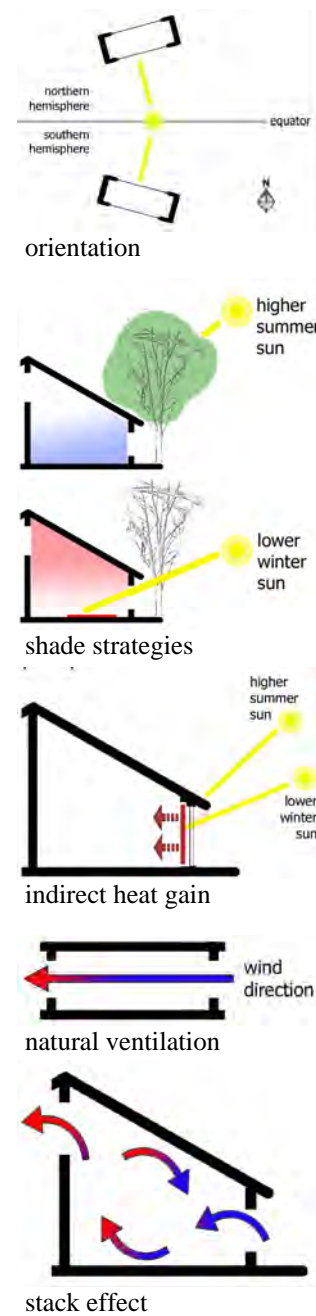


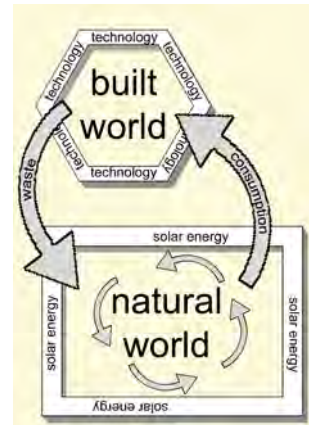
Fig. 10 passive heating/ cooling strategies

However, sustainability is not just an application of design. Fundamentally, sustainability is a worldview, an approach to living, and a philosophy. How we treat each other and our surroundings defines this philosophy. Regardless of how many bamboo floors we build or solar panels we install, our problem will not be solved unless we first examine the cause, ourselves.

“One of the most fateful errors of our age is the belief that ‘the problem of production’ has been solved.... The arising error, so egregious and so firmly rooted, is so closely connected with the philosophical...changes during the last three or four centuries in man’s attitude to nature. Modern man does not experience himself as a part of nature but as an outside force destined to dominate and conquer it. He even talks of a battle with nature, forgetting that, if he won the battle, he would find himself on the losing side.”¹⁰ [fig. 11, fig. 12]

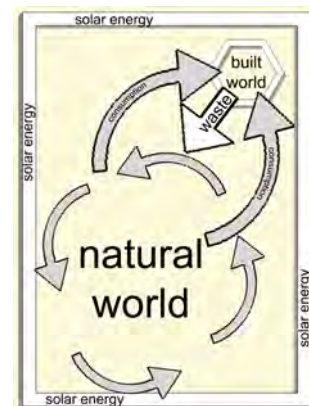
Fundamental to Western culture is the insatiable need for consumption to support a growing economy. Continued growth indicates economic success. But there is one caveat: continual growth in a

¹⁰ Schumacher, 14



Delusion: self-sufficient built world independent of natural world. Modern man believes he is not part or is above nature

Fig. 11 built world not part of natural world?



Fact: built world depends on natural resources to sustain itself

Fig. 12 relationship between built and natural world

finite system cannot be realized indefinitely. Ghandi once said, “Earth provides enough for every man’s need, but not for every man’s greed.” Unless current practices of energy consumption change, the inevitable result is ecological and economic collapse.

Exponential growth can only continue indefinitely if there is an unlimited supply of input material and an infinite supply of sink capacity. This has essentially been the case through most of human history. “Humans were such small part of the ecosphere that resources and sinks were effectively infinite.”¹¹ The dynamics of exponential growth in a finite system may follow three scenarios: the sigmoid growth, overshoot and oscillation, or overshoot and collapse. [fig. 13, fig. 14, fig. 15]

It is unfortunate that we have succumbed to the fiction of inexhaustible resources. And in this built insular world, we blissfully accept the illusion of autonomy that our technology provides. It is our conceit that deludes the truth--we do rely on the natural world to survive. It is imperative that we must accept limits to abate collapse.

¹¹ from lecture by Professor Carl Bovill

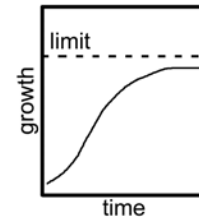


Fig. 13 Sigmoid Growth can happen if environmental limits are understood and acted upon in advance. The consequence is a smooth transition out of exponential growth.

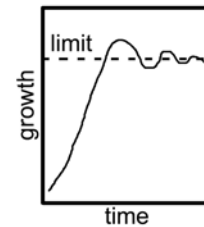


Fig. 14 Overshoot and Oscillation can happen when the signals and responses are delayed and the environmental limits are able to recover quickly.

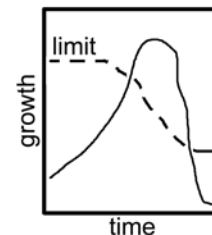


Fig. 15 Overshoot and Collapse can happen when signals and responses are delayed and the environmental limits cannot recover quickly and are damaged beyond recovery by over use

Concepts based from lecture by Prof. Carl Bovill

Section 3: For People

“Most environmentalists are doing what they do for their children and their children’s children, and viewed in this way they should be seen not as mere tree huggers who love owls more than loggers, but as champions of humanity, fighting to protect the very lifeblood that sustains all of us.”¹² This misconception has been applied to early designers who solely focused on energy efficiency and technology. Though this is a practical approach toward architecture, one must not ignore the original purpose of architecture – a place of shelter for people. Early eco-conscious building forms seemed foreign and utilitarian. Others created poor air quality interior environments. Volatile Organic Compounds (VOCs), mold and mildew growth, and elevated carbon dioxide levels threatened the health of inhabitants. Ironically, the older less efficient buildings with leaks and drafts infiltrate to allow these gases to escape. In conclusion, we must remember that eco-conscious architecture is not about efficiency but effectiveness; not about standards of living but quality of life for people as well.

¹² McLennan, 47

Chapter 2: Knowledge is Power

Section 1: Learning from the Past

“The American suburban environment is increasingly recognized as a failed and insufficient archetype of housing and organizing mass populations. It is evident that this environment has been generated by a disregard of the sound design and planning principles that have guided the successful development of cities throughout history, creating ecologically damaging, socially irresponsible, and psychologically harmful human environments. Not only is the suburban environment the antithesis of sustainability, it is also an environment that generates social and mental instability.”¹³ Italian architect Paolo Soleri argues for a “healthier relationship with nature created through density, frugality...” He calls for dense urban structures that accommodate life in all its facets: work, education, culture, leisure...etc.

In the early part of the twentieth century, the International Style through known architects such as Mies van der Rohe, Gropius and Le Corbusier hoped



Fig. 16 Figure ground of nondescript suburban area

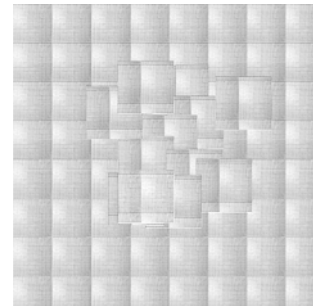


Fig. 17 Conceptual diagram of non-hierarchical and homogenous urban fabric

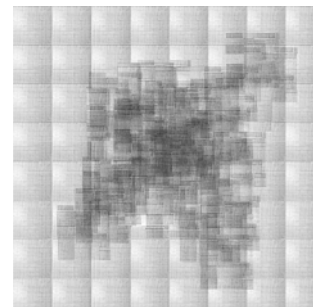


Fig. 18 Conceptual diagram of hierarchical and heterogeneous urban fabric

¹³ Roeth, 38

to offer more egalitarian, affordable, healthy, architecture to people. Sadly, the International Style has been reduced to a cheap, easy and uniform way of building that can be located anywhere. The good intentions of sustainable architecture of today may also be forgotten in the future. Standardization in pursuit of a universal design solution motivated by ease and cost may result in the same ineffective bland architecture. A designer must remain vigilant at critically, rigorously and thoughtfully pursuing specific solutions to specific circumstances. “The specific solutions must grow out of and respond to local circumstances.... local solutions follow, are adopted and adapted elsewhere as appropriate, and are continually revised and refined, effecting a profound process of change...”¹⁴ [fig. 19]

Section 2: Learning from Each Other

The issues of sustainability are complex. They deal with systems and cycles that form an interconnected web or matrix full of redundancies and dependencies. Solutions may not be easily solved by



Fig. 19 Applying a green roof, solar panels, bamboo floors, or large low E windows after designing and building a house is not eco-conscious architecture. Sustainable principles must be considered from the very beginning and in a holistic framework.

¹⁴ McDonough & Braungart, 164

an individual such as the artist/genius/ protagonist of Ayn Rand’s “Fountainhead.” Instead, a collaborative group of experienced experts from various backgrounds and disciplines will most likely solve the issues we are facing today.

“The truth is that we do, in fact, need people who intimately understand the working of very specific subjects, but they need to be taught a different process of thinking. The process is inclusive and respectful of other disciplines...instilled with an understanding of how their field must rely on and contribute to other fields and have a humbleness to know that specialization by its nature means limited knowledge of other areas.”¹⁵ [fig. 20]

Section 3: Keeping an Open Mind

There have been studies in environmental psychology that posit the direct relevance of our surroundings affecting behavior. Theodore Roszak’s research in eco-psychology traces “mental disturbances and even larger scope of societal

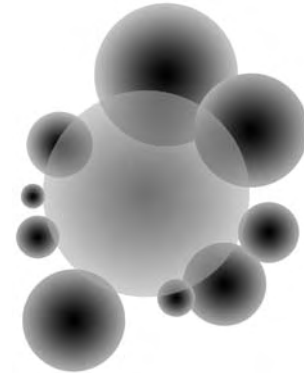


Fig. 20 Conceptual Diagram of various disciplines (some of which are broad while others very focused) in a collaborative relationship.

Specialization means limited knowledge of other areas, while broad disciplines understand only a certain level of many fields.

Mutual respect for people of other fields and an open dialogue among these fields will be necessary to solve our sustainable problems.

¹⁵ McLennan, 89

dysfunction directly to people's loss of contact with the earth. This relatively new focus in psychology has moved away from Freudian psychoanalysis, with its anthropocentric view of the id as a guarded sanctuary and its defense strategies against the hostilities of nature"¹⁶ Eco-psychology concentrates on the relationship between people and the natural environment. It focuses on the hidden yet significant consequences of people's alienation from nature. Rather than solely searching inward for answers within the ego, eco-psychology questions and explores how the dynamic relationship with the environment affects the self.

These ideas echo in philosophies like Zen Buddhism. Its "vision of the entire universe as a system of interrelated parts, translated into architecture as an expression of the relation between inside and outside." This theme "was responsible for some of the most profound relationships between buildings and their sites in human history....In this way, the architecture was seen as conversing with nature."¹⁷ [fig. 21]

Fig. 21 Traditional Japanese House



¹⁶ Wines, 27-28

¹⁷ Wines, 56-57

Contemporary architects, such as Kengo Kuma, link traditional Japanese architecture and contemporary design. He utilizes techniques such as defamiliarization¹⁸ in his regional architecture to reconnect with the regional, climatic and cultural peculiarities of a place. We can also learn to connect with place and nature from a few basic concepts from Zen gardening such as: Kanso: simplicity; Seijaku: stillness, peace, calm; Datsoku: transcend this plane of existence or wonder of the sublime; Yugen: mystery; hide and reveal. Shakkei: borrowed scenery.[fig.22]

Zen gardens also implement techniques such as framing views and creating spatial depth through layering foreground, midground, and background. [fig.23] These traditional techniques and concepts are used to create relationships between the interior and exterior and the built and natural.



Fig. 22 Shakkei



Fig. 23 Layering

¹⁸According to Merriam Webster Dictionary, defamiliarization means “to present or render in an unfamiliar artistic form usually to stimulate fresh perception”

Chapter 3: Education

Section 1: 19th and 20th Century Experiments

The architectural application of this close relationship between built and natural, inside and outside and self and world in conjunction with contemporary psychology gives credence to the profound influence of architecture's didactic potential. Can this latent and powerful aspect of architecture be utilized to communicate a pedagogical intent? And if so, can an environmentally based expressive architecture improve learning in educational facilities?

Looking at the historical emergence of the school typology, we can easily distinguish the prominent pedagogical intentions communicated through the architecture.

Early 1800 schools literally copied domestic and religious precedents such as in the Robson School resembling the Hatfield House. Designers began with existing models that espouse the private domesticity of the home and the public community of the church. The first schools consisted of single large rooms, rows of desks in a lecture hall fashion. As differentiation of

age, grade, and subject arose, compartmentalization occurred.

From the 1850's to the 1890's urban schools were compact two to four story buildings on very small sites with axial plans. A variety of organizational strategies developed at this time.

Comparing schools in Cleveland for example illustrates the wide variation and experimentation in design. For instance Alabama School in Cleveland in the 1850's was a three story building with solely three classrooms per floor. The economic layout only provided vertical circulation via three stairwells..

However, this school was still quite simple, lacking secondary spaces such as corridors, toilettes, closets or offices. [fig. 24] Exploring a variety of approaches to corridor and space relationships continued with the Sterling School in the 1860's was also a three story building but with six classrooms per floor with double loaded corridors between all six classrooms. [fig. 25]

The Giddings School in the 1880's expanded the corridor to have an expanded central hall. [fig. 26]

Influenced by Giddings School, the Memphis School in the 1900's incorporated an auditorium. [fig.27]

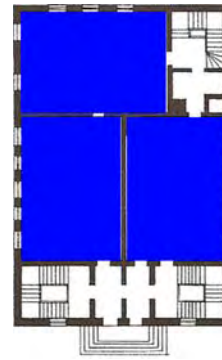


Fig. 24 Alabama School Schematic layout

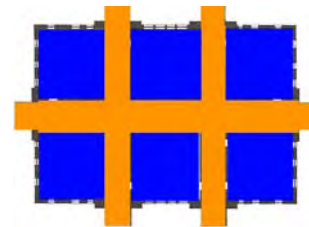


Fig. 25 Sterling School Schematic layout

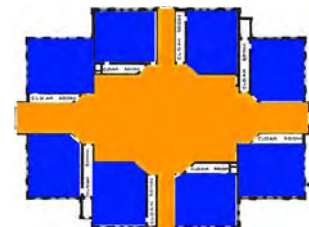


Fig. 26 Giddings School Schematic layout

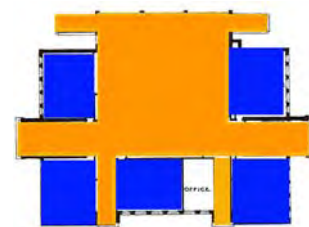


Fig. 27 Memphis School Schematic layout

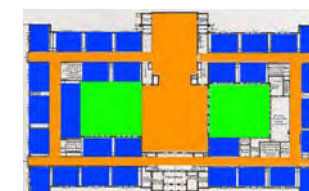


Fig. 28 Skokie School Schematic layout

Twentieth century schools focused less on strictly internal organizational changes and more on light and air issues for a healthier learning environment. For example, the much larger Skokie School in Winnetka, IL built in 1922 utilized two courtyards to introduce more light and air. [fig. 28]

The quality of the environment improved with skylights and views to the outside for each classroom. However, the double loaded corridors and central auditorium space is quite similar to the organization of Memphis and Giddings.



Fig. 29 Crow Island School Schematic layout

Not until the 1940's, however, did the qualitative not the quantitative aspects of the school building begin to be prioritized. A range of solutions to connect the outside with the inside followed. The Crow Island School in Winnetka, IL built in 1940, is a single story building consisting of long wings either with single or double loaded corridor extending from a central spine. The design maximized building envelope exposed to light and air.[fig.29] Built in 1960, Anthony Overton School in Chicago consisted of independent buildings consisting of a cluster of four classrooms connected to each other by corridors.



Fig. 30 Anthony Overton School Schematic layout

[fig.30] Architects introduced the idea of designed flexible spaces in Anthony Overton School, but it was never realized due to opposition from some of the teacher's. The New Trier West Highschool built in 1965 was influenced by college campus designs. The organizational strategies of aggregation of massing, open plan and clusters of classrooms in seven buildings around two courtyards can easily trace their origins from the precedents previously mentioned.

Designers in the 1990;s balanced compartmentalized versus open spaces, programmed versus unprogrammed, and small versus large rooms. Providing simultaneous experience in a single environment, one-on-one conference areas, and small group rooms, begins to combine pedagogical approach of diverse teaching methods with the diverse learning capabilities of students. For example the Anne Frank School built in 1993, not just incorporated elements from past schools, but also began to parallel the architecture with this new pedagogical approach to learning. Features such as: [fig. 31]

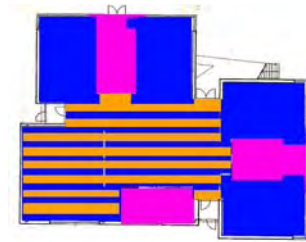


Fig. 31 Anne Frank School Schematic Layout utilizes circulation space as places for learning. Also shared bathroom, sink, and storage areas foster informal dialogue with other class.

- Paired Classrooms with bathroom in between
- Playroom with Staff room above
- Homework room for after school hours
- Open in evenings for parent use
- Open internal volume
- Screen walls flexibly linking classrooms
- Orientation of each classroom optimizes sun penetration

exemplify how architecture may support the

pedagogical intent of an open yet secure school,

flexible spaces that accommodate variety of activities,

as well as, a safe and dynamic learning environment

that fosters exploration and self reliance.

Section 2: Contemporary Theories in Learning

According to the Heschong Mahone Group Study of 1999, students with most daylighting in classrooms- as compared to those with the least daylighting- progressed 20% faster in math test and 26% faster in reading.[fig. 32] “But beyond purely educational objectives, a building can also communicate to children a great many subtle messages about what is important and what is deserving of respect. This is crucial in an age where education is viewed with a certain degree of contempt by many young people in society...”¹⁹ Architecture plays a fundamental role in shaping the values of young people. If the architecture communicates the message of self referential anthropocentrism while teachers and text teach otherwise, the result is a confused and conflicted education. Reading or listening about the environment is not enough for some students. Engaging and experiencing the concepts being taught may impress upon them more profoundly. Architecture may play a fundamental role in this endeavor.

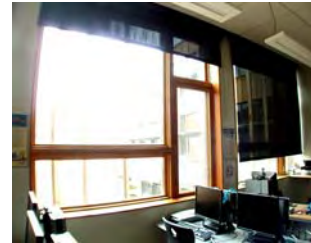


Fig. 32 Daylighting

¹⁹ Dudek, 45

Unfortunately a lack of interest by students is a critical problem in schools today. In *Experience and Education* by John Dewey, Dewey touches on some noteworthy points about learning. He investigates how experience can be educational as long as it promotes positive growth and perpetuates learning. Regrettably some aspects of traditional education fragment and compartmentalize subject matters to the detriment of this continued desire to learn. The value to the individual is lost and with it engagement. Without engagement, learning ceases. This thesis explores how building location, program and form may play a significant role in providing value to the student and perhaps increase interest in learning.

“Whatever significance schooling might once have held for the majority of youngsters in our society, it no longer holds significance for many of them. The reasons cannot be discerned...what is acquired in school will actually be utilized in the future. The real world appears elsewhere: in the media, in the marketplace...[However,] an active and sustained participation...[such as in a mentorship/apprenticeship model] offers a far greater opportunity for

understanding.... novices have the opportunity to witness on a daily basis the reasons for various skills, procedures, concepts and symbolic and notational systems. They observe competent adults moving readily and naturally from one external or internal way of representing knowledge to another.”²⁰ Rooting the concept with application, activity with the goal, and observing first hand the real world practice of their education, will help connect and give meaning to the experience of learning. This thesis looks at how a mixed use development in a downtown metropolitan area may be conducive to bringing meaning to the experience of learning. Perhaps being exposed, on a daily basis, the connection between the subjects they are learning and the prospects of its future relevance, may motivate the student.

Theories in learning conclude that the way people learn also varies. According to Howard Gardner’s Multiple Intelligences theory, all humans possess eight intelligences each in varying degrees of strength:

²⁰ Gardener, 203

1. Linguistic-Word Smart
2. Logical/Mathematical-Numbers Smart
3. Musical-Musical Smart
4. Bodily/Kinesthetic-Sport/Fitness Smart
5. Spatial-Picture/3d Smart
6. Naturalist-Nature Smart
7. Interpersonal-Social Smart
8. Intrapersonal-Self Smart

With this in mind, the form of the architecture may provide an environment conducive for these eight intelligences to occur. A visually expressive architecture may illustrate a structural logic, rhythm, and proportion that may resonate with the spatial and mathematical. Providing direct access to gardens and exterior spaces may appeal to the naturalist and kinesthetic.

Section 3: Contemporary Learning Environments

“We now have abundant evidence from the frontiers of brain-based research that learning is not linear, but holistic, and that it is not uni-dimensional but multi-faceted. Under the new learning paradigm, we are looking at a model where different students (of varying ages) learn different things from different people in different places in different ways and at different times.”²¹ According to “Design Patterns for

²¹ Nair and Fielding, 19

the 21st Century Schools” by Prakash Nair and Randall

Fielding, the physical school must support the

following modalities:

1. Independent study
2. Peer tutoring
3. Team collaborative work in small and mid-sized group (2-6 students)
4. One-on-one learning with the teacher
5. Lecture format with the teacher or outside expert at center stage
6. Project-based learning
7. Technology-based learning with mobile computers
8. Distance learning
9. Research via the Internet with wireless networking
10. Student presentations
11. Performance and music-based learning
12. Seminar-style instruction
13. Community service learning
14. Naturalistic learning
15. Social/emotional learning
16. Art-based learning
17. Storytelling
18. Learning by building-hands on learning

Cognizant of these studies and modalities, conceptual

and schematic design of spaces in a school may begin

to take shape to support these modalities.

Chapter 4: Site

Section 1: Site Location

Site location is the first fundamental step of eco-conscious architecture. Using existing resources, energy and infrastructure reduce the impact of a new development. Therefore, deciding to place a new development on a green field rather than a brown field should be carefully considered. With this proposed multi use program that includes a school, locating the project near public transportation and other shared resources is advantageous. Proposing the roof garden and photovoltaics, makes access to light an important consideration. Reciprocal exchange of resources between the new development and the existing built and natural environment lessens the impact and allows an easier transition. With these concerns in mind, two abandoned buildings at 690 Folsom Street is a suitable choice for the proposed development.

Section 2: History of SoMA

In the 1840's South of Market or SoMA consisted of sand dunes and not much else. A surveyor named Jasper O'Farrel shaped the character of the area by laying out the blocks four times as larger than the blocks North of Market. The area developed into a mixed use district full of factories, warehouses, shops, and rows of wood framed housing for workers. First Street became home to many seaman and industrial workers, Irish saloons, German groceries and workshops. Jack London was born a block or two from the proposed thesis site at the corner of Third Street and Folsom!

By 1900, the South of Market was the second densest part of San Francisco second only to Chinatown. Unfortunately the 1906 earthquake changed everything. The

great fire due to the earthquake destroyed all the wood framed housing and did not leave much else. The housing and industry that naturally sprung up in the area and tightly knit it was replaced with only industrial. The more transient population brought with them a different genre of land use. Lunch counters, thrift shops, pawn shops, employment agencies and church missions began to pop up in the area. The economic downturn in the 1930's took its toll in the area. Relief came with the Second World War that brought shipbuilding jobs into the area. By 1953, however, poverty and crime increased and the area was designated an urban renewal zone. The area near Third Street and Folsom street was completely demolished. Developments such as Yerba Buena Gardens and later the Moscone Center are the result of this redevelopment initiative.

The 1990's drastically reshaped the area as the dot com companies transformed former industrial building into high tech office spaces and high end live/work lofts. Currently, an influx of new residents is transforming this area back into its original mixed-use roots but with contemporary needs comprised of housing, shops, clubs, art galleries, offices and restaurants.

Section 3: Built and Natural Environment

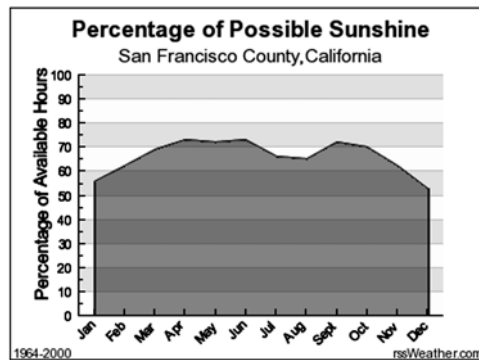
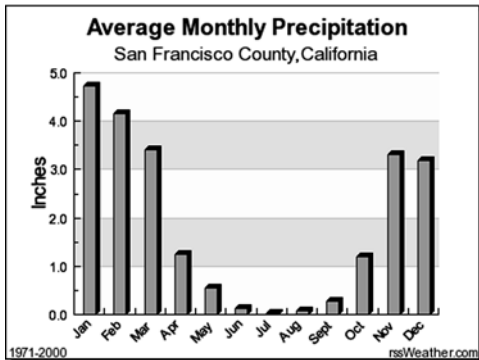
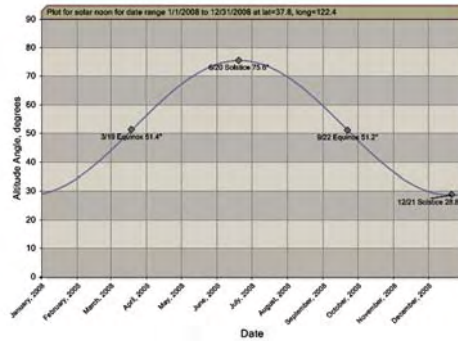
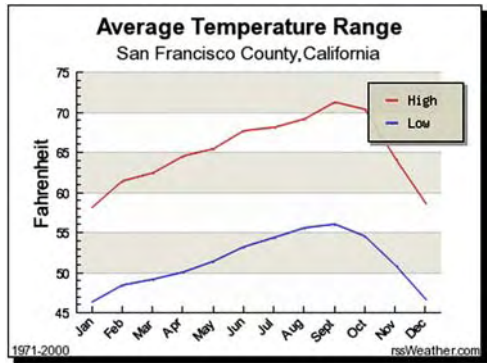
At the heart of eco-conscious architecture is first being aware of the unique characteristics of an environment – both built and natural. The next step is responding accordingly by locating, orienting, and forming the building-keeping in mind the impact it will have to its surrounding, as well as, the impact of the surroundings to the building.



Fig. 33 above: background aerial map from google earth data base

Fig 34 below: Climate information of San Francisco [accessed May 19, 2008]. The site is located in the North/East area of San Francisco known as South of Market.

RssWeather, <http://www.rssweather.com/climate/California/San%20Francisco%20County/>, <http://www.rssweather.com/climate/California/San%20Francisco%20County/#sunshine>.



Fundamental design decision in regards to the envelope, shade devices, type of HVAC, type of roof, structural form and material will be affected by this information. The proposed project, for instance, responds to the seismic issues of the location, the wind direction and velocity, the average temperature, the average precipitation and possible sun days. Orientation and form of the building may directly respond to solar altitude and sun path. Passive strategies for heat gain and maximum daylight, as well as, rejection of light and heat can only be addressed by first recognizing the seasonal and daily cycles of the sun.

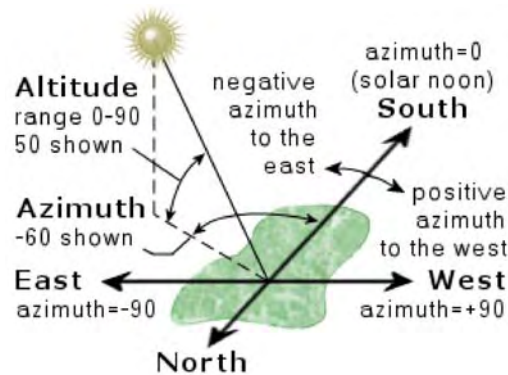


Fig. 35 <http://solarplots.info/Default.aspx> [accessed May 19, 2008]

Solar Angle or Altitude in San Francisco ranges from 28.8 degrees to 75.0 degrees.

Fig. 36 below

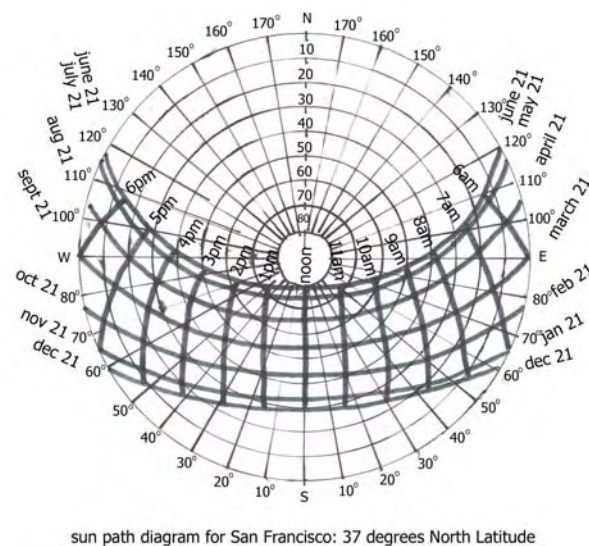




Fig. 37

UC Berkeley Library

<http://www.lib.berkeley.edu/EART/maps/sf-1960.html> [accessed May 19, 2008]

Topographic Map of San Francisco

Call number: G4364.S5 1960 .S3 Case D



- A. Lowell High School
- B. Galileo High School
- C. St. Ignatius College Prep.
- D. Abraham Lincoln High School
- E. Convent of the Sacred Heart H.S.
- F. Jewish Community High School
- G. George Washington High School
- H. School of the Arts Alternative H.S.
- I. Riordan High School
- J. Balboa High School
- K. Gateway Highschool
- L. The Urban School of S.F.
- M. Mission High School
- N. Lick Wilmerding Highschool
- O. Mercy Highschool
- P. S.F. University High School
- Q. Wallenberg Alternative H.S.
- R. Thurgood Marshal High School
- S. International Studies Academy H.S.
- T. S.F. Woldorf High School
- U. Stuart Hall Highschool
- V. Independence High School
- W. Leadership High School
- X. Ida B. Wells Highschool
- Y. John O'Connel HighSchool
- Z. City Arts and Tech High School
- a. Enterprise For High School
- b. Youth Chance High School

Currently, the South of Market area does not have a high school in its immediate area.

Fig. 38 High School Locations in San Francisco

Locating a high school next to a growing residential neighborhood with public transportation nearby and resources that can be reciprocally shared between the school and the community may have positive social, political and natural consequences. Simply encouraging walking and public transportation activates the street, reduces automobile use, and lowers Co2 emissions. The site is located a quarter a mile away from mixed use residential, offices, museums, parks and restaurants. Half a mile away is the main arterial street of downtown – Market Street. Besides being a central commercial area, the Bay Area Rapid Transit or BART trains runs underneath Market Street, connecting San Francisco with the rest of the Bay Area. Three bus routes nearby with two stops conveniently right in front of the site, connect this location with the rest of the city.

background map from <http://maps.live.com/> [accessed May 19, 2008]



Fig. 39 Quarter mile and Half Mile Radius from Site

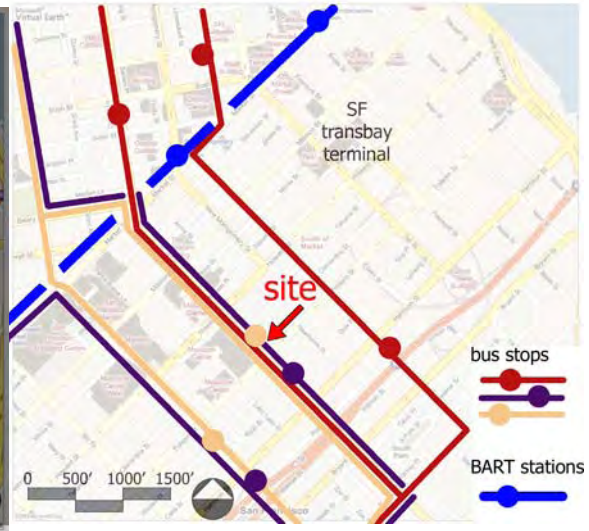


Fig. 40 Public Transportation near site

The location of the thesis site is located between two relatively densely populated residential areas. The site location is a transition area between the Financial District just North of Market St. and the residential and mixed use areas of SOMA.

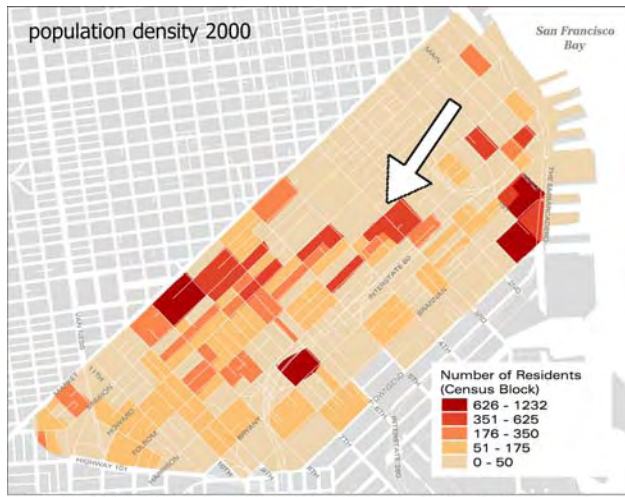


Fig 41. Population Density

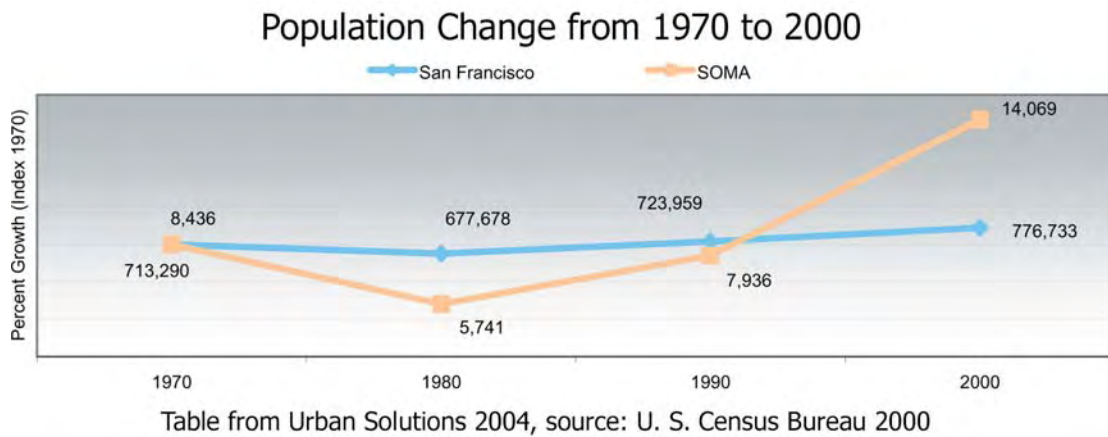
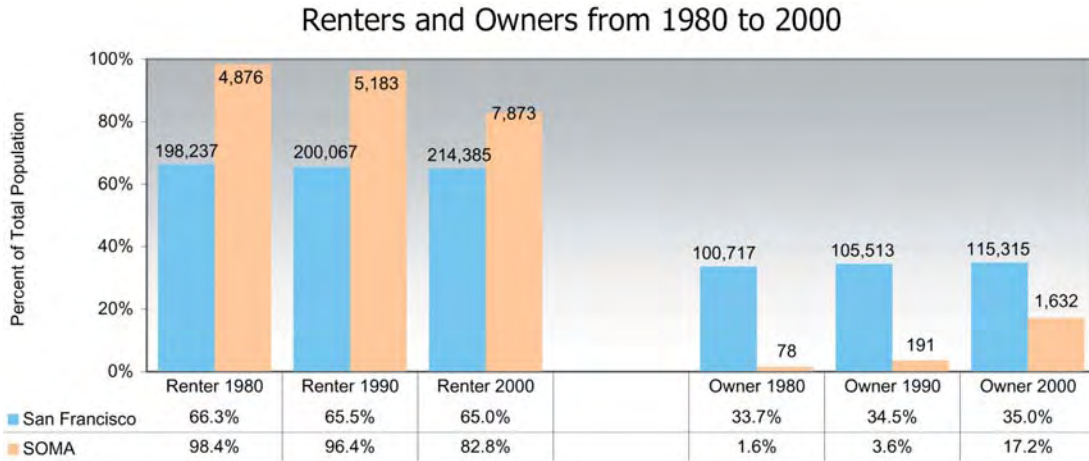


Fig. 42 The table above illustrates the much higher rate of residential population growth in the SoMA area relative to San Francisco as a whole.



Source: GeoLytics, Inc, CensusCD Neighborhood Change Database 1970-2000 Tract Data
Table from Urban Solutions 2004

Fig 43 The table above illustrates the decline of renters and increase in owners in the SOMA area.

By looking at demographics, trends and resources of a specific area, a more informed programmatic and formal design decision could be made. Beginning to incorporate this background at the conceptual stage will not just increase the success of the project but may positively affect the environment. Nature finds the most economic and effective means to satisfy needs. Formal and physiological makeup often responds to its immediate environment. This idea can be applied to the growth of new developments. Responding to solar orientation, prevailing wind direction, seismic issues and precipitation is important. In an urban setting however, it is also important to be attentive to surrounding building massing, bulk, height and proximity.

Locating and orienting an eco-conscious building consisting of a roof garden and photovoltaics South of the tall buildings of the Financial District and being aware of the zoning in the proposed development area should be part of the initial process.

During research of wind speed averages at different elevations in this location ranging from 3-8mph, proposing wind driven turbines as an energy source seems

impractical. But shaping the tower to alleviate wind pressure on the structure may be prudent. Locating the tower on the North side of the site and orienting the tower's vertical façade south, a vertical solar array is feasible. Locating the tower on the North side also allow more light to fall on the proposed roof garden. The amount of glazing and the use of a double envelope system in the tower responds to the average temperature range of the area and low humidity.



Fig. 44 Approximate building massing of downtown San Francisco
From Google Earth Database

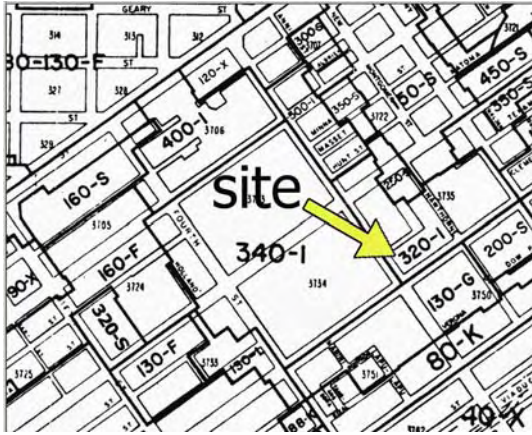


Fig. 45 **Height and Bulk** Districts
 Source: sfgov san francisco municipal code
http://www.sfgov.org/site/planning_index.asp
<http://www.municode.com/Resources/gateway>

BULK LIMITS

Presented below is a summary of the of bulk limits from § 270 of the Planning Code. These limits appear on the Height and Bulk District Maps numbered HT01 through HT13.

TABLE INSET:

Bulk District Symbol on Height and Bulk Maps	Height above Which Maximum Dimensions Apply (in Feet)	Maximum Plan Dimensions (in Feet)	
		Length	Diagonal Dimension
A	40	110	125
B	50	110	125
C	80	110	125
D	40	110	140
E	65	110	140
F	80	110	140
G	80	170	200
H	100	170	200
I	150	170	200
J	40	250	300
K	60	250	300
L	80	250	300
M	100	250	300
N	40	50	100
T	At setback height established pursuant to § 132.2, but no higher than 80 ft.	110	125
V	At setback height established pursuant to § 253.2	110	140
OS	See § 290.		
R	This table not applicable. But see § 270(e).		
S	This table not applicable. But see § 270(d).		
TB	This table not applicable. But see § 263.18.		
X	This table not applicable. But see § 260(a)(3).		

Fig. 46 Bulk Limits Table

Zoning in this area is primarily residential commercial combined (RC-4 Residential - Commercial Combined Districts, High Density) and C-3-S (Downtown Support District commercial)

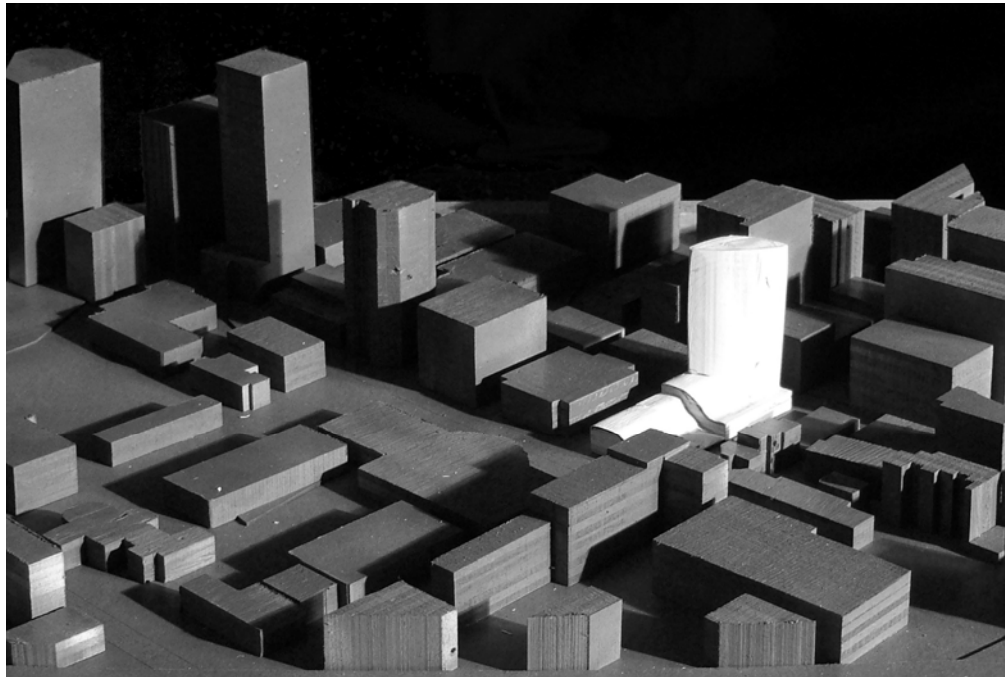


Fig. 47 Massing Model of Yerba Buena and Soma Neighborhoods

Height limit: varies from lot to lot ranging from 80-200ft (RC-4) and up to 350ft on some lots for (C-3-S)

Floor Area Ratio: Basic 4.8 to 1 (RC-4) and 5.0 to 1 (C-3-S)

Proposition K, which prohibits towers from casting new shadows on existing city parks

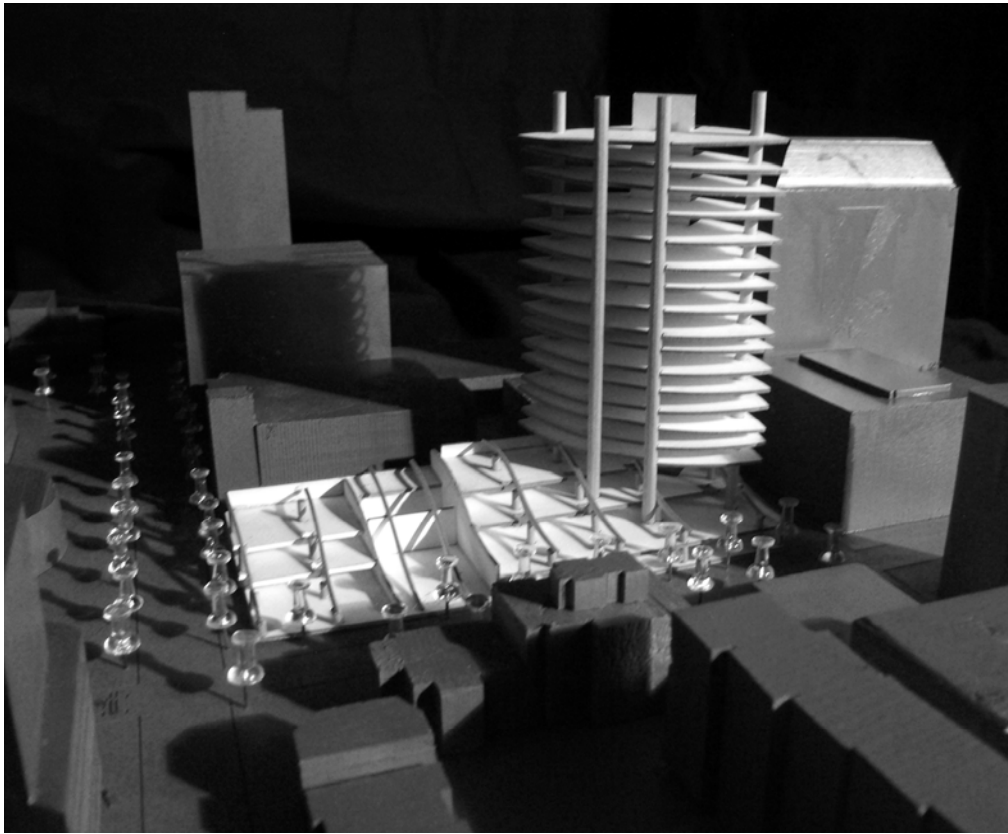


Fig. 48 Concept model of structure and floors

Being aware of zoning, propositions and limits in conjunction with site analysis can formally integrate a new building into an existing urban context. However in other cases, may hinder the initial intention. Challenging the existing zoning restrictions may be necessary to reevaluate a cities priorities toward a more eco-conscious future. Questions such as solar rights, similar to air rights, may become an issue as renewable energy becomes a necessity. In this case, the bulk and height restrictions As illustrated in the following elevation the transition from the taller office buildings and the shorter mixed residential buildings is mitigated with an office tower setback atop a three to four

story plinth. At the street level, continuity of the street wall and dialogue with the surrounding buildings seamlessly integrates the new with the existing.[fig.49]

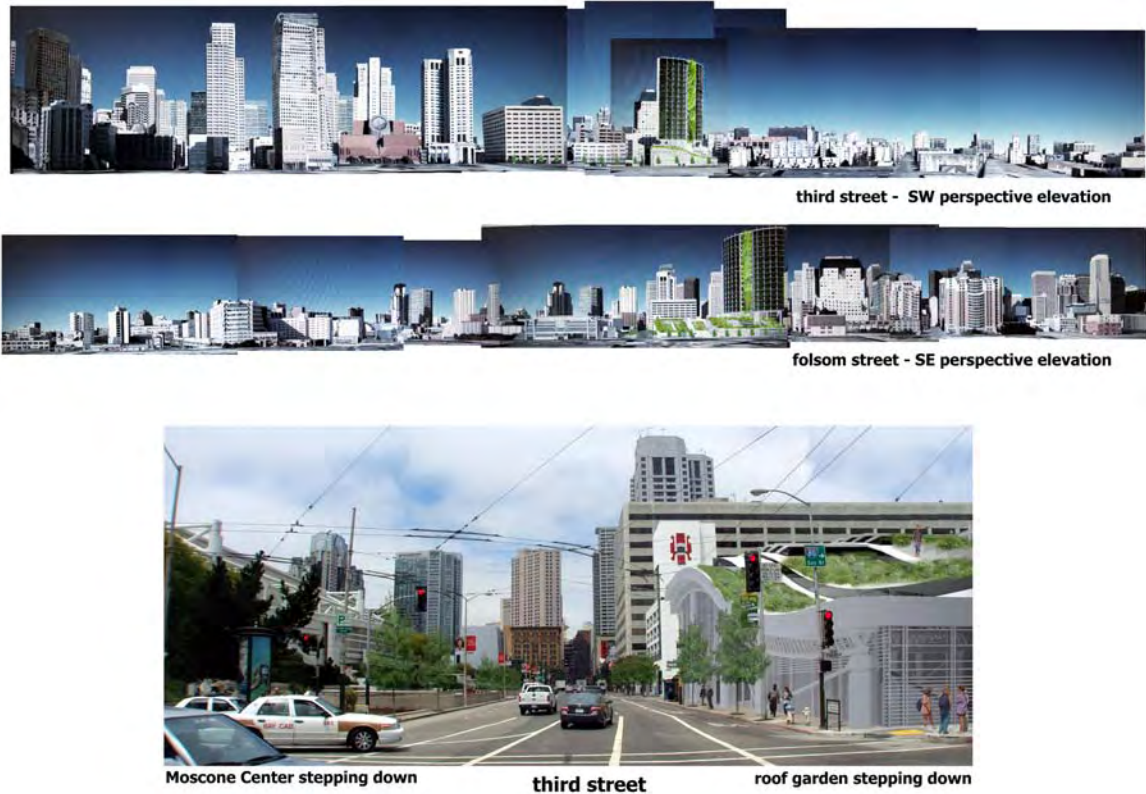
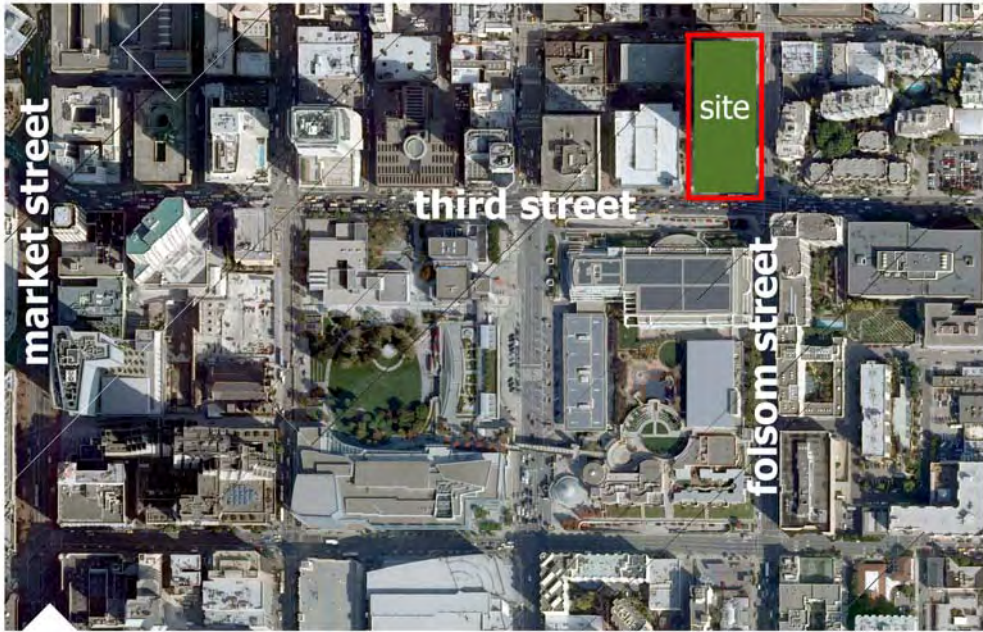


Fig. 49 Perspective Elevations original images from Google Earth Database

The site location is a junction between an established commercial area, a growing residential neighborhood and a developing art district. .A multi-use development comprised of offices, school, gallery, restaurants and retail reflects the existing uses of the area. The program locations on the site directly respond to the land use context. A possible connection of the two existing roof gardens above the Moscone Center and the proposed roof garden on the site, can strengthen the urban fabric. [fig. 50]



legend

- roof garden
- office
- gallery, restaurant, hotel
- residential



Fig. 50 Vicinity Map and Use Map
 Aerial photo from <http://maps.live.com/> [accessed Nov. 2008]

Chapter 5: Multi-Use Development

Section 1: Program and Context, Program and Pedagogy

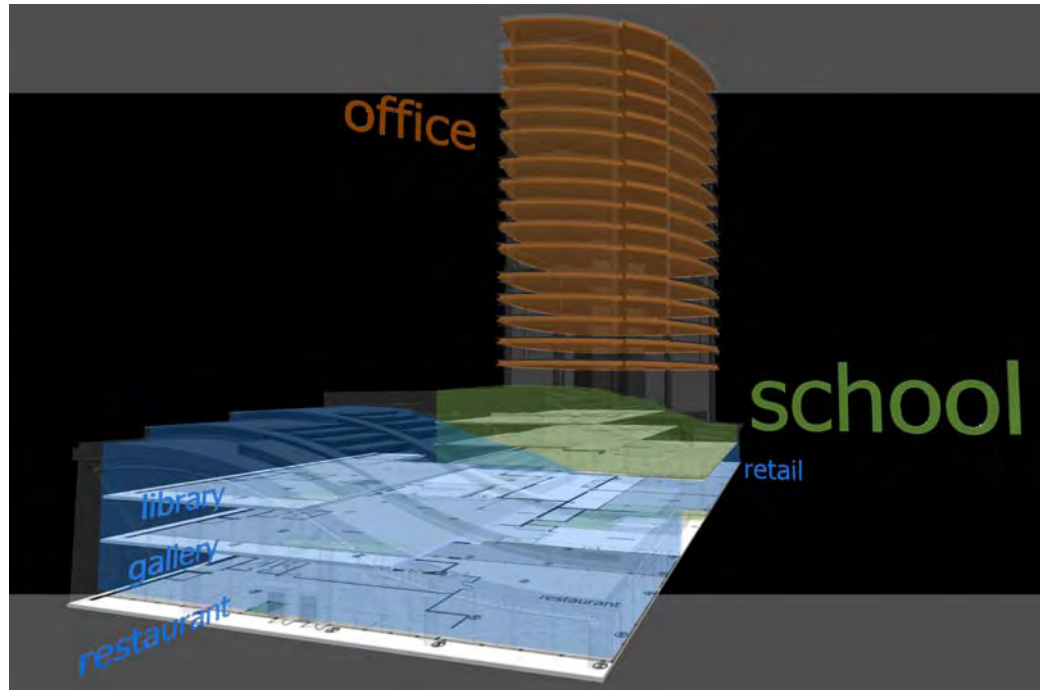


Fig. 51 Program

This multi-use development in downtown San Francisco weaves education, work and recreation into the existing fabric of this urban location. It is an opportunity for these seemingly disparate activities to crossover and enhance the learning experience. Leaving the linear 20th Century Ford model consisting of 45 minute increments of learning and 15 minute breaks from learning separated by the sound of a bell, this thesis begins to explore continuity in the learning process incorporating the city itself as an extension of the classroom.

The urban location situated next to gyms, public parks, galleries, museums, offices and public transportation allows the school to make use of these existing amenities. But it goes beyond sharing resources. By introducing mentorships, role

models, and substantial examples of academic subjects, students disheartened and uninterested in school may begin to see continuity.

A mixed use building with eco-conscious local start up companies such as Tesla Motors may inspire a young man or woman to look into engineering or industrial design. The student may place more effort in mathematics and science after meeting a designer a few floors up during an internship that is currently working on the Tesla Roadster.[fig.52]



Fig. 52 Tesla Roadster, one of the first commercially sold electric sports cars
image from www.tesla.motors

In turn, the residential community and commuting professionals may take advantage of the schools resources while being exposed to environmental concerns. The library may be a resource of environmental information and data. The gallery may display ecological themed artwork. Just as Marcell Duchamp challenged us to reconsider what was art, perhaps we can today challenge people to reconsider what daily living is or should be. [fig53]



“Fountain 1917” Marcell Duchamp
photographed in 1917 by Alfred Steiglitz
Fig. 53



Compost Toilet at Chesapeake
Bay Foundation

The restaurant may serve organic locally grown dishes while the retail stores may sell products less harmful to the environment. The school auditorium may dual as a lecture hall or theater where people may learn more about environmental issues. Workshops and tours may be conducted for parents, local residents or commuting professionals to showcase the more expressive and didactic aspects of the architecture that can teach them about their local environment.

Section 2: Eco-concious and Responsive

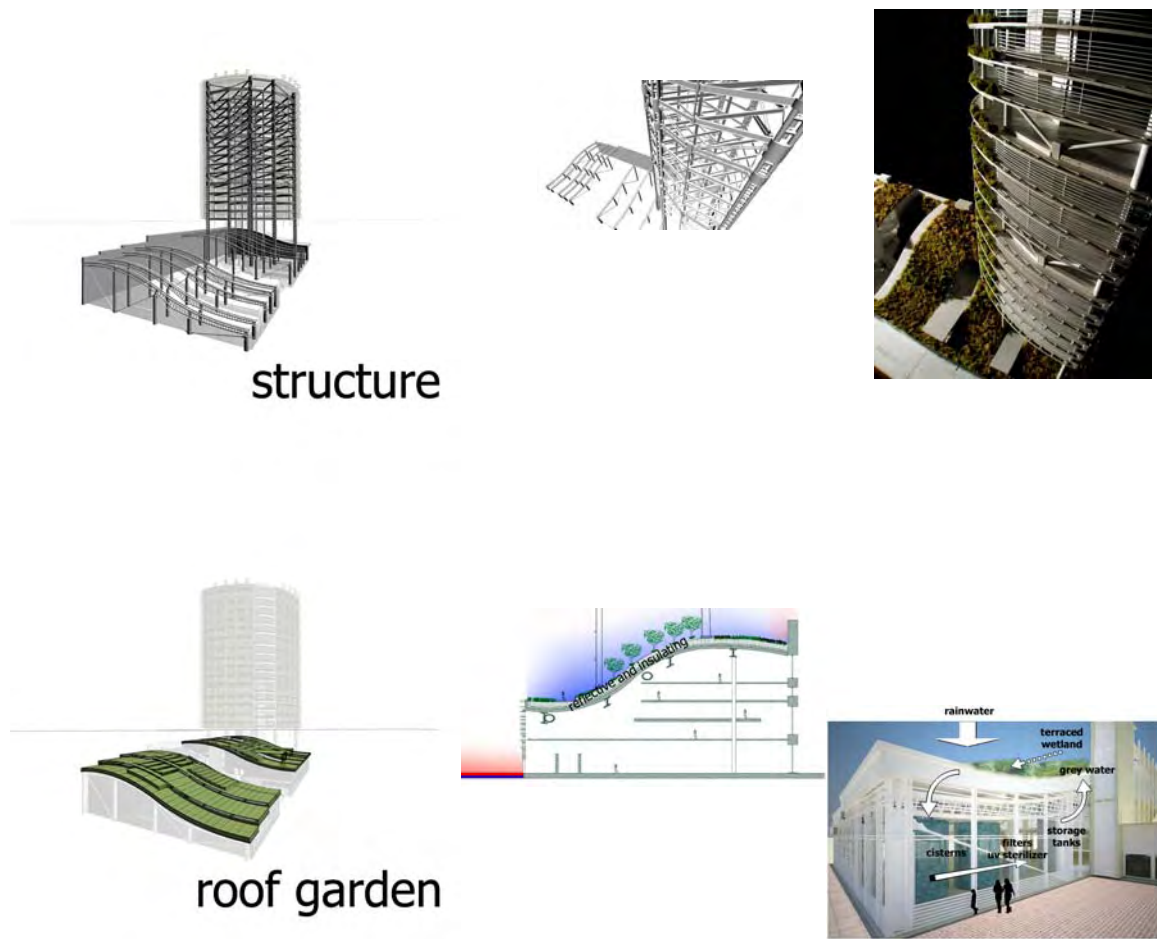


Fig. 54 Structure responding to Seismic; Roof responding to runoff and heat island effect

Directly responding to the seismic issues of the San Francisco Bay Area with an expressive architecture may be a tangible illustration of applied physics and mathematics to students. Residents and pedestrians may wonder about the cables and chevron shapes. Curiosity, I believe, is one of the first steps toward learning. Prominently displaying the water cycle process of how rainwater and grey water is reused for irrigation and toilet flushing is a straightforward illustration of an effective solution for runoff and water conservation. A portion of the roof garden is open to the public to see first hand the terraced wetland that begins to filter the water, local native plants that may need little if any irrigation, and vegetable gardens that are appropriate for the local climate. Being introduced to viable solutions may enable some to adjust their own life style. The roof garden also alleviates the heat island effect and may reduce CO2 levels. [fig. 54]

The double envelope, narrow floor plate and aerodynamic form of the tower is similar to the Federal Building a few blocks South of the site by Thom Mayne - Morphosis. The prevailing winds coming from the North/West are utilized in naturally ventilating and cooling the office tower. The outer envelope on the North/West façade acts as a group of small wind scoops while the inner envelope allows, when wanted, cool air to enter via operable windows. On the South facade, the air between the double envelope gains radiant heat. [fig. 55] The pressure difference moves the air through the interior space cooling it. The variable-air-valve HVAC system independently shut off on each floor when the windows are open.

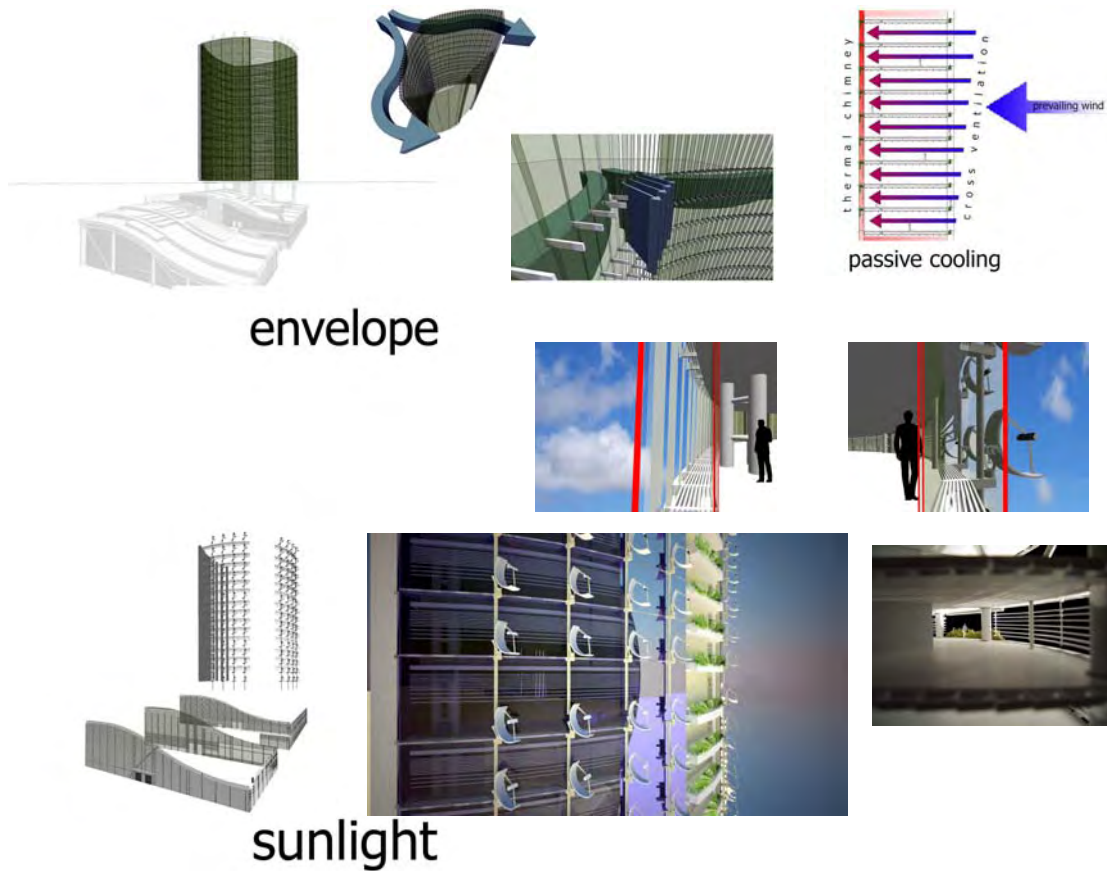


Fig. 55 Envelope responding to microclimate; orientation, louvers, solar array responding to seasonal light/shade studies

The Solar array is composed of a reflective concave dish that focuses light to a concentrated point where high efficiency photovoltaic cells are located. The solar energy reflected by the area of the dish is equivalent to the amount of energy captured by photovoltaics of equal area. However, by reflecting and focusing that equivalent energy onto a much smaller high efficiency photovoltaic cell cluster, the cost dramatically decreases due to less silicon being used. [fig.55]

Location and orientation of the tower, plant species, solar array and louvers are based on winter and summer shadow studies.[fig.56] Facades and

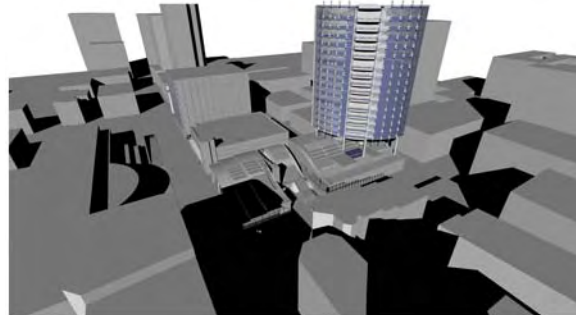


Fig. 56 Screen shot of Shade Study of existing context during Winter Season

horizontal louvers on South vertical fins on West and East Facades prevent glare and unwanted heat gain. Locations of glazing take advantage of winter solar gain while rejecting summer solar gain. Coordinating skylights and monitors with atrium spaces and courtyards maximizes the amount of daylighting for the interior. [fig. 57]



Fig. 57 Longitudinal section

Transverse section

Section 3:21st Century School Models

Some of the theories discussed in Chapter Three are beginning to be implemented in new schools. Three examples that parallel the learning environment proposed are: Hellerup School in Copenhagen, Denmark, Voorn Children's Cluster, Utrecht, Netherlands and Comprehensive School, Zurich, Switzerland. The Hellerup School focuses on developing the cognitive, social and personal skills of the students. The pedagogy of an open landscape of learning is evident in the layout of the building. A central open stair case connects three open floors of workspaces. [fig. 58] The Voorn Cluster is designed with flexibility and adaptability in mind. Most of the interior walls are non-load bearing for ease of future spatial changes. The layout of the school is simple and straightforward. Transparent walls between classrooms and corridors provide visual continuity as well as security. [fig. 59] The Comprehensive School allows ample daylight into the interior while a central landscaped courtyard connects the students with the outside and nature. [fig. 60]

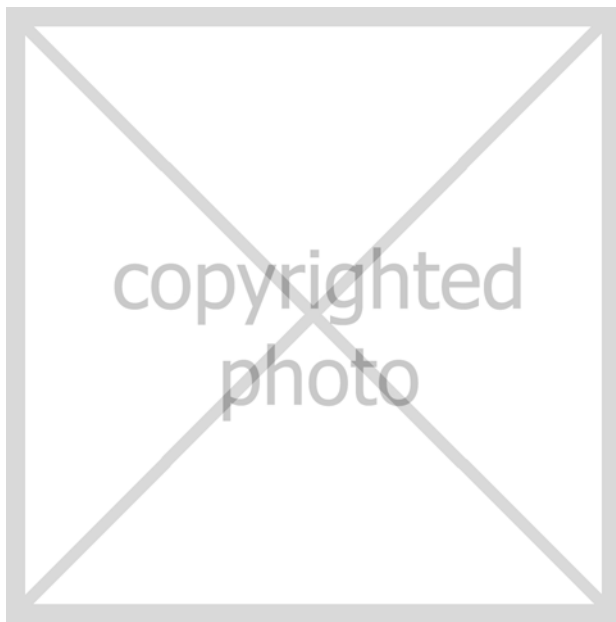


Fig. 58 Hellerup School Central Open Stair



Fig. 59 Voorn Children's Cluster



Fig. 60 Comprehensive School Courtyard

Section 4: Thinking outside the classroom

The school is comprised of 450 students from grades 9 through 12. Each of the three floors houses a small learning community of 150 students. Each small learning community or SLC is team taught by six teachers. Each floor is organized to provide spaces for large group activities [fig.61], mid to small sized groups [fig.62] and individual or one on one study. [fig.63] These spaces vary from completely enclosed acoustically private rooms to open common areas.

The design of the building allows daylight into most of the interior spaces of the school and visual connection to the roof garden and sky are ubiquitously pronounced in varying degrees throughout the school. Specialized classrooms such as the labs directly access the roof garden. [fig.64] Experiments, projects and class may extend beyond the lab walls onto the exterior, open roof. Classes that are nature based may be held on the terraced roof garden during the almost year round temperate days of San Francisco. The structural column grid allows for the flexibility to move all the non-bearing interior walls into new configurations if future needs call for it.



Fig. 61 Common Area for large group activities



Fig. 62 Enclosed and open rooms for mid and small group activities



Fig. 63 Individual Niches, Individual Bays, and One on One activities



Fig. 64 Lab room with direct access to roof

The layout supports a pedagogical departure from the traditional programmatic spaces such as a cafeteria, gym, and school library. The curriculum may include culinary classes where students are taught how to prepare healthy lunches and may be exposed to ideas such as organic, free-range, pesticide free, and hormone free food. Common project areas may at certain times dual as places for students to eat, socialize and display their culinary achievement. [fig.66] Two local gyms, one across the street and the other three blocks away, may welcome these junior members during off peak hours. [fig.65] The roof of the parking structure next door may be utilized as a playing field by simply retrofitting the roof with synthetic turf and a basketball court. [fig.68] A library focusing on eco-conscious awareness is open to both the public and the students. [fig.66] The gallery as well may have an environmental theme and perhaps may include student work as well. [fig.67]

The roof garden [fig.68] will play an integral part in the student's. The students will care for the North roof. Teaching responsibility and stewardship at this age can encourage the teenage student to look beyond oneself. An edible garden, a flowering garden, and possibly dwarf fruit trees can be tangible accomplishments of time and effort given. Providing and contributing to the culinary class mentioned earlier with produce and fruit may strengthen a feeling of self-worth and belonging to the small learning community. Simultaneously, a better understanding of the natural cycle from the solar energy, photosynthesis, food as sustenance, and waste reentering the cycle as compost may teach the student of continuity, balance and ecological interdependence. According to the State Education and Environment Roundtable Study, "Students exposed to a nature base curriculum score higher than students taught out of a textbook"



Fig. 65 Ground Level Plan



Fig. 66 Second Level



Fig. 67 Third Level

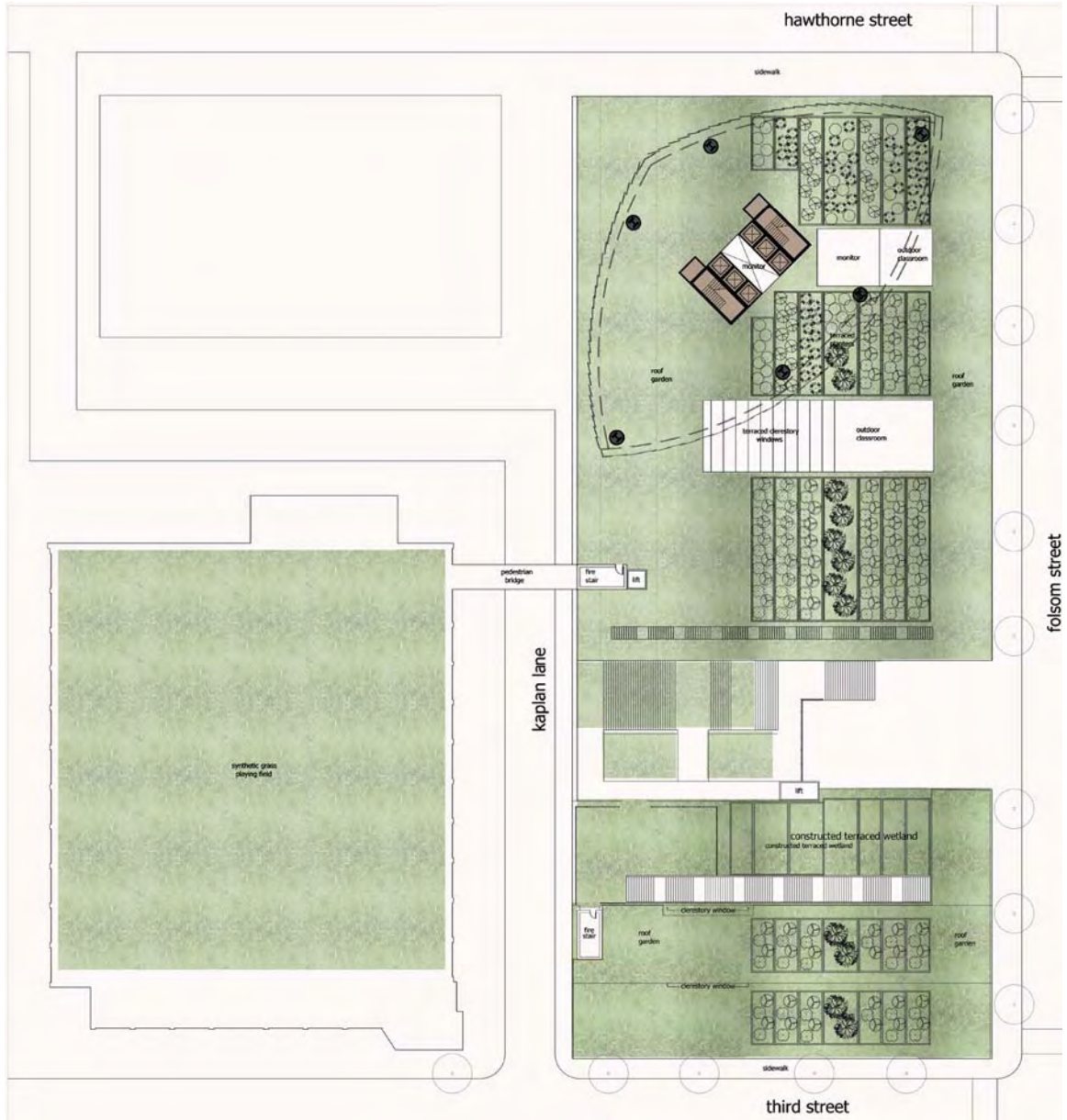


Fig. 68 Playing Field on Parking Structure Roof, Roof Garden Level

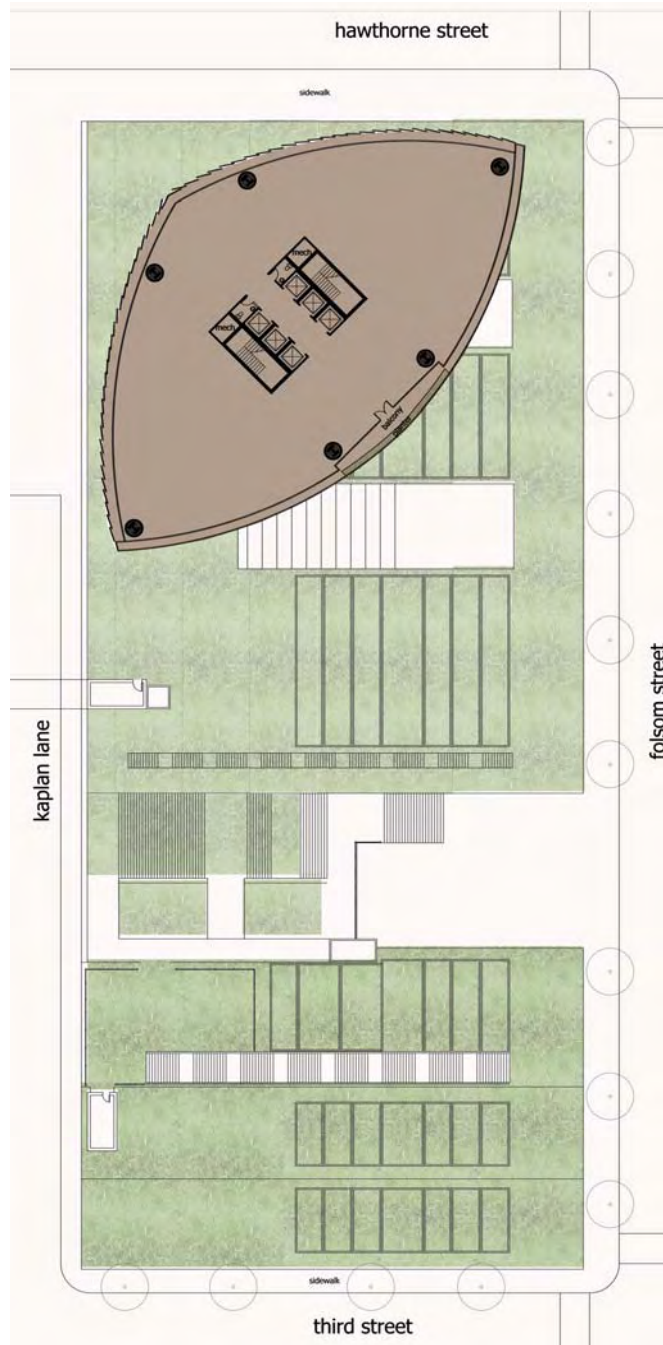


Fig. 69 Typical Office Level

Section 5: In is Out, Out is In

According to the Environmental Protection Agency (EPA), in 2001, less than 15% of students between the ages of 5-15 in the U.S. walked or biked to or from school, down from 48% of students in 1969. These travel choices “influenced by school siting and development patterns, impact air emissions.” In the 1990’s “one out of five schools in the U.S. reported unsatisfactory indoor air quality and one in four schools reported ventilation unsatisfactory. Generally, indoor levels of pollutants may be two to five times higher than outdoor levels.” Concurrently, “on average, Americans spend about 90% of their time indoors” according to EPA studies. In addition, the U.S. Energy Information Administration stated that “the architecture and building community is responsible for almost half of all U.S. greenhouse gas emissions annually.”

Providing adequate fresh air into the interior environment via the HVAC system will not alleviate these problems. Developing quality outdoor areas and spaces that are easily accessible from the indoors in conjunction with dematerializing the perceptual barrier of interior versus exterior may begin to influence people’s choices. Introducing certain plant material into the interior can reduce airborne toxins, reduce CO₂ levels and replenish O₂ levels.[fig.70] Tree species, such as Cinnamomum Camphora, Platanus Acerifolia and Liquidambar Styraciflua, may be used to sequester carbon at the urban scale. Using deciduous trees as shade devices can reduce unwanted summer heat gain while allowing daylight penetration during the winter thereby providing comfortable interior spaces while saving energy. [fig71]



Fig. 70 Roof Garden conceptually rotating into interior space



Fig. 71 Facades with Southern Exposure

Chapter 6: Process

Section 1: Paralleling the Pedagogy

Designing a building conducive to learning requires first understanding how and when learning may take place. Chapter three introduced a few studies, conclusions and theories. Designing spaces that provide experiences to support more of the modalities of learning is the ideal case. A teacher has the most difficult task of identifying and utilizing the student's strongest modalities while cultivating the weaker ones.

Part of this research explores ways to incorporate these modalities into the design process. Research began with independent study. Discussing with classmate clarified what my thesis was not while small group discussions created more questions and possible directions. Conversing faculty focused my efforts and I began to make models, sketches and drawings. Visiting Swiss experts' lectures [fig. 73] provided successful built examples. With reliable resources, the internet became an effective tool. And experiencing the site first hand supplement the data gathered. Taking tours of sustainable buildings and schools complement the research on the building prior. [fig.74] During a series of iterations, I refined my story each time I told it. As the thesis coalesced, discussing with peers, faculty and undergraduates [fig.72]who helped me with the model gave the thesis new dimension. By methodically cycling through the modalities during my thesis process, I became a more informed designer.



Fig. 72 Cross Grade Learning



Spatial/kinesthetic Learning



Fig 73 Swiss School Design Lecture at UMD



Fig 74 Tour of Sidewell Friends School



Fig 75 Model



Fig. 76 Model

Chapter 6: Public Review

Section 1: Improvements and Suggestions

Thesis is a process of research, learning, iteration and refinement. A part of this process is the public review. This thesis emphasizes the interrelationship between the built and natural, exterior and interior, the building and its context and the synergy among the various program elements. With this in mind the panel's constructive comments focused on two issues:

1. Can there be a more meaningful terminus at the top of the stairs? And upon completing this ascension, provide a better view than the neighboring parking garage?
2. Can the building form and space reinforce the intended synergy among the office, the public and the students? The abrupt detachment of the office tower from the roof garden does not support the intention of integration.

Section 2: Modifications and Possibilities

The courtyard stair does end abruptly at the top. The final destination is the public roof garden to the left hand side. However the point of some significant terminus at the top especially after traversing many steps may be expected. One solution ties in with the informative aspects of the project. A small pavilion [fig. 77] at the top to receive visitors into an enclosed space may act as a destination. Video screens imbedded in the wall can inform the viewer of the environmental aspects of the building, the curriculum of the school and the type of work the companies in the office tower participate in. In addition, to the informative video, the pavilion may also be a small café with an elevated view of the city and the roof garden.

The second possibility is a green wall with a row of apertures. Vines or a mural painted by the students may be applied to it. But the openings that frame the proposed roof garden/playing field above the neighboring parking structure may only be noticeable as one reaches the top. [fig. 78]

Or perhaps, taking cues from the Spanish Steps in Rome, the point of the grand stair is not a feature at the top, but the journey to the top. Spaces to rest, gather, enter the building, or just stand and look at the view at various elevations may offer more choices to the pedestrian.

The abrupt terminus of the tower into the roof garden does not support intended synergy among the school, public and office. The ambiguous space between the roof garden and bottom of the tower is an opportunity for an exchange of ideas to occur.

One possibility is a dining level. A cafeteria for the students and a place to eat for the employees. Spontaneous and informal learning may occur in this area. [fig. 79] A second possibility is an arboretum where students give tours educating the public and employees of the native local plant species of the Bay Area. [fig. 80] And a third concept is an exhibition/lecture level where both student and designer/employee have the opportunity to show their latest project or talk about their latest concepts. Consistent with the pedagogy of exploring new learning places, the excitement of a current project an engineer is working on may inspire and motivate students. In turn, enthusiasm from the students may fuel the engineer/designer. Exhibiting tangible examples of these concepts may resonate more with spatial learners. [fig. 81]

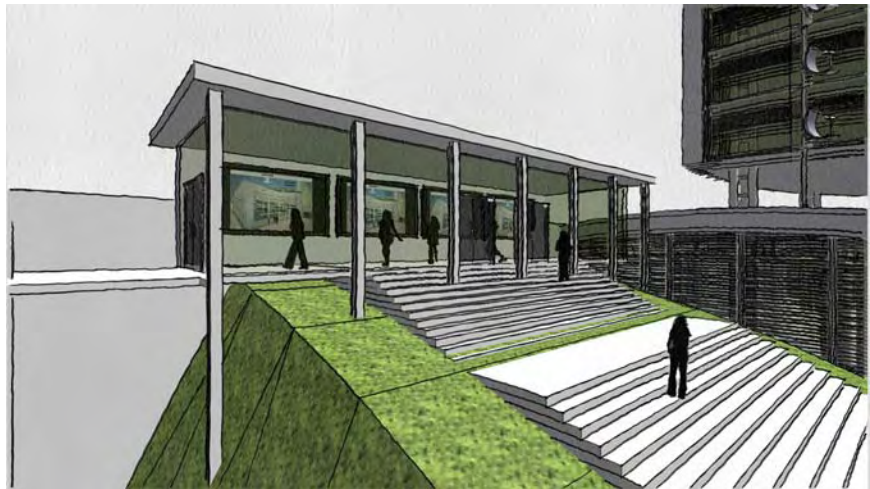
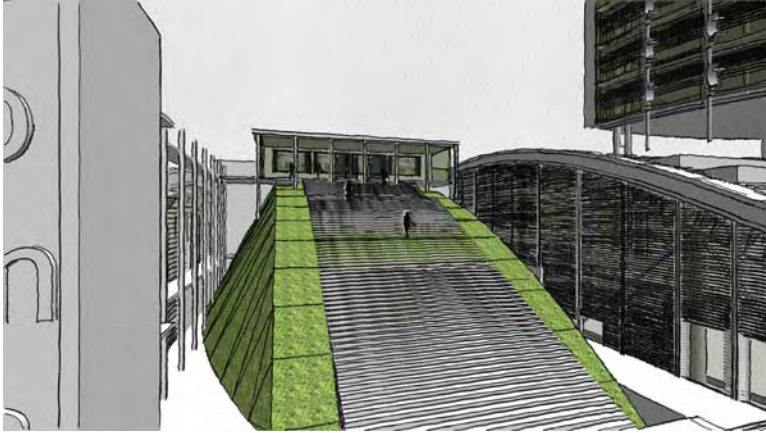


Fig. 77 Pavilion – Conceptual Response to Suggestions at the Public Review



Fig. 78 Green Wall- Conceptual Response to Suggestions at the Public Review



Fig 79 Dining Level- Conceptual Response to Suggestions at the Public Review



Fig. 80 Arboretum- Conceptual Response to Suggestions at the Public Review

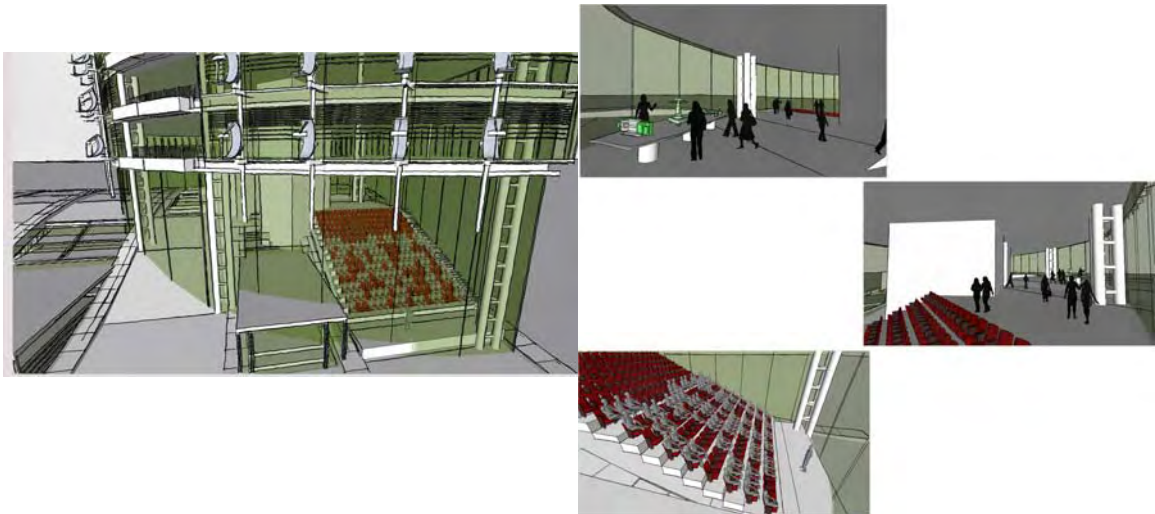


Fig. 81 Exhibition/ Lecture Space- Conceptual Response to Suggestions at the Public Review

Conclusion

Studies discussed in this paper support the physiological, psychological and ecological benefits of environmentally sound design. To insure an ecologically sound future and the continued pursuit of eco-conscious architecture in the United States, these environmental ideals must be integrated into the American culture. Raising awareness of local environmental aspects and issues that communities can identify with is the first step toward affecting cultural ideologies. Drawing on the didactic potential of an expressive and responsive architecture can challenge traditional value systems and introduce a more environmental public consciousness.

Based on studies and precedents, this thesis explores the tangible application of these ideas. Part of the research not only implemented the theories of learning into the design of the project but also into the process of the thesis. Experiencing first hand the varied modes of learning such as independent study, peer tutoring, lecture format, social learning...etc., as part of the research, deepened the understanding of the type of spaces needed to support these modalities.

The research introduced in this thesis supports the theory of better performance by students in flexible and varied environments. Also, architecture that supports pedagogical intent reinforces learning. . The responsive and responsible architecture of the proposed development in this thesis communicates the respectful relationships between the built and natural environments, while the intended programmatic synergy promotes learning through social collaboration. Both cases emphasize and remind us of the interdependent relationship we have with each other and with our environment.



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