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hereby submit this work as part of the requirements for the degree of:
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Between Humans and Nature: Urban Architecture that Engages its Environment

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Between Humans and Nature

Urban Architecture that Engages its Environment

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Abstract

Through the standardized use of high-energy mechanical comfort systems, architecture has lost its connection with the environment. By limiting its dependence on high-energy systems, architecture can promote the well-being of its inhabitants while decreasing its impact on the natural environment. This investigation explores the notion that a building designed to mediate between the occupant and the natural world will inherently respond to the natural world in a way that minimizes energy consumption and resource exploitation.
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1 Introduction

For thousands of years humans lived off the land. They experienced and adapted to the changing seasons. They awoke and slept according to sunrise and sunset. They understood the cycles of nature.

Something has changed. Today we are being held hostage by the buildings we inhabit. Rather than waking up with the sun, we are jolted from sleep by screeching alarm clocks. Rather than adapting our environment to the changing seasons we rely on thermostats and invisible climate control systems. For the first time in the thousands of years of human existence, we are spending the majority of our time indoors, deprived of the natural processes that bring us joy and a sense of being.

This investigation explores the role of architecture as a mediator

“When most people depended directly on the land and lived close to nature, their modes of sheltering reflected centuries of learning how to live in a place. Dwellings were well adapted, sited, and shaped in response to local conditions of weather and climate.”
Knowles, Ritual House, 4.
between man and his surrounding natural environment. Some would argue that the only way to reestablish our connection with nature would be to live off the land in rural environments as our ancestors did. This thesis acknowledges that contemporary cultural expectations would not allow such a return to primitive habitats. Instead, this thesis seeks to understand how architecture can better link mankind with nature in an urban context.

This document is organized into four sections. The first section further defines the problem that is under investigation. The second section proposes four strategies and a series of tactics that work towards a solution to the problem. The third section shows how these four strategies are used in example precedents. The last section documents a design project that uses the four proposed strategies. The design is also analyzed with thermal modeling to quantify the impact of each strategy from an energy-savings point of view.
Architecture has lost its connection to the natural environment because of the standardized use of high-energy, mechanical and electrical comfort systems. The same McMansions under construction in Indiana, Ohio, and Missouri can also be found in Arizona, and Colorado. The same skyscrapers are being constructed in Dubai and Beijing as in Chicago, London, and Tokyo. Trends in architecture over the last century have distanced mankind from his natural surroundings and have had an alarming effect on the environment. Recent efforts in “green building” and “sustainable design” have increased public awareness about the insufficiencies of today’s building practices; however, they disturbingly portray ecologically responsible architecture as an additive process.

“Centralized energy production has allowed the development of countless high-density housing blocks with total indifference to the environment. Every building is pretty much like every other building. No building is oriented, juxtaposed, or otherwise related to its surroundings.”

Knowles, Ritual House, 72.
Human Isolation from the Environment

For the first time in history, humans are able to avoid the natural environment if we choose. Over the last century, architectural solutions have followed society along a path of increasing isolation from fresh air, and daylight. The availability of natural resources is now being taken for granted because of the widespread availability of on-demand water, electricity, and fossil fuels. Modern technology allows us to override nature’s ever-changing climatic conditions. As a species we are being smothered by the monotony of modern-day indoor environments.

NHAPS - Nation, Percentage Time Spent

![Diagram showing percentage of time the average American spends indoors](fig.01)

Society's Departure from Nature

In the introduction to *Urban Place: Reconnecting with the Natural World*, Peggy F. Barlett, a Professor of Anthropology at Emory University, gives a well-cited account of how the separation of humankind and nature came to be.¹ The growth of political empires, specialization of labor, and lives of city-based elites as divorced from rural lands are given as reasons for the separation. Until the Victorian era, Barlett contends that mankind was considered to be

part of the natural world. \(^2\) Margaret I. FitzSimmons, a Professor of Environmental Studies at UC Santa Cruz, says, “Nature as we know it was invented in the differentiation of city and countryside, in the differentiation of mental and manual labor, and in the abstraction of contemporary culture and consciousness from the necessary productive social work of material life.”\(^3\) The accounts of Barlett and FitzSimmons point towards the industrial revolution as the time when humankind became separated from society’s construct of nature. Laborers changed from craftsmen that were connected with their work and environment to factory workers whose role became a set of standardized instructions in a decontextualized factory environment.

Now, a century after the industrial revolution, we are as disconnected from the outdoor environment as ever. Research shows that Americans spend 20.9 hours per day indoors, 1.3 hours in a vehicle, and only 1.8 hours outdoors.\(^4\) We find ourselves able to go from a mechanically conditioned house, to a heated or cooled car, and drive into an underground parking garage attached to our final destination without ever experiencing the outdoor environment.\(^5\)

**Commodification of Resources**

Barlett explains that in recent times nature is becoming commodified for resource extraction and recreation.\(^6\) For example, in most of the developed world fresh water is available on-demand in seemingly endless supplies regardless of recent rainfall amounts. Natural resources such as coal and fossil fuels are exploited in the form of on-demand electricity that is invisibly delivered to appliances and devices in our homes. Select places in the world that are too remote or too beautiful to be scavenged for resources are bordered off and exploited as eco-tourism destinations. Natural commodities have become abstracted in

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4 Klepeis et al., “National Human Activity Pattern Survey,” 239.
people’s minds. Their only interaction with the reality of a gallon of water or pound of coal takes place each month when the utility bill shows up in the mail.

William McDonough writes about the topic of resource commodification in the background material for his *Hannover Principles*.

Martin Heidegger placed the roots of our detachment from nature in the moment we began to extract energy from nature, storing it to be consumed at will with no sense of the Earth’s cycles. When energy is seen as “standing-reserve,” the concept of waste is inherent, because energy is regarded as something there to be used up. The world is no longer something to partake in, but supplied for consumption. This approach has fostered progress as opposed to a way of life which understands the limits of nature and seeks to sustain society within it.7

For the first time in the thousands of years of human existence, mankind does not have to gather his own resources to sustain life. These resources are now commodities available on-demand through invisible distribution networks. Furthermore, with an abundance of resources and energy at our disposal, humans have developed technology to automatically modify our built environment, removing us from nature even further.

**Technology**

In the foreward to Shelter: Models of Native Ingenuity, Dolmatch and Wessel write, “Mechanical devices, dependent on cheap and ample energy, have enabled the Western architect to build comfortable homes with little regard for the local environment.”8 Widespread use of such mechanical devices has widened the rift between human beings and the natural environment. Most of these technologies automate or make obsolete tasks that were once performed by humans. For example, humans no longer need to collect firewood in anticipation of the coming winter when we know that our thermostat will automatically kick the

7 McDonough, *Hannover Principles*, 42.
8 Dolmatch and Wessel, *Shelter*, 5.
furnace on when needed. We no longer design buildings with natural cross ventilation when we know that buildings can be cooled to a chilling 72 degrees in the middle of the summer.

In his book *Evolutionary Architecture*, Eugene Tsui writes, “The building is viewed as a closed system with little, if any, exchange and response to other systems—i.e., air currents, sun movement, temperature changes, climatic shifts and the like.” Technology is what has allowed our buildings to become closed off from the natural processes that heated and cooled buildings for thousands of years. The consequence of this disconnection between architecture, humans, and nature is the ever-growing need for energy and natural resources to feed our mechanical and electrical systems.

**Vulnerable Environment**

If the entire history of the earth was condensed into a single day, the period of time from the industrial revolution to the present would last approximately one second. The world has seen a species inflict so much change in such a short amount of time. Mankind is putting an unprecedented amount of stress on the world’s ecosystem through resource extraction and harmful emissions. The world’s population has skyrocketed in the past century and will continue to grow, especially in urban areas, for some time. Energy consumption is also on the rise amidst recent worries of peak oil and global climate change. Research shows that architecture plays a major role in the future outlook of energy consumption and carbon dioxide emissions. An increased awareness and sensitivity to natural processes through architecture is important to sustain the well-being of our earth and all of its inhabitants.

9 Tsui, *Evolutionary Architecture*, 5.
10 assuming the earth is 4.5 billion years old and the industrial revolution began in the mid-19th century
The world’s population is projected to continue growing through 2050 when an estimated 9.2 billion people will live on the planet.\(^\text{11}\) The earth is a finite resource, so as the world population grows over the next half century, the amount of resources consumed per person has to decrease in order to maintain our current impact on the earth—which is arguably too high, already.

Most of the population growth in the next half-century is going to occur in cities. By 2050 nearly 70% of the world’s population will live in urban areas compared to the 49% that lived in urban areas in 2005. Urban populations will continue to grow over the next 40 years, while rural populations will actually start to decline after 2020. In 2005 1.2 billion people lived in cities of at least a million people. By 2025 this number will grow to 1.8 billion people.\(^\text{12}\) Some cities in Asia are predicted to grow to 20 or even 30 million people. According to urbanists Peter Hall and Ulrich Pfeiffer, “Humanity has not been down this road before; there are no precedents, no guideposts.”\(^\text{13}\)

“Everywhere, cities must confront the need for higher density.

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But how is this to be accomplished without undue reliance on high-energy buildings? How is this to be accomplished without losing contact with nature? Future growth can either carry us further from nature or reconnect us, depending on how we direct it.”

Energy Crisis

With projected increases in energy consumption and worries of depleting natural resources, there is much debate over what will power the world’s future. Will it be oil, coal, nuclear, or renewables? Architects, as well as the mass media, tend to get caught up in the debate over what technology will power our future rather than focusing on the real issue: reducing energy consumption. Rather than focusing on what the next hot technology will be, architects need to worry about what they have the most influence over, minimizing the energy consumed by buildings. Conceptualizing buildings as mediators between people and the natural environment can reduce energy consumption in buildings. Such a methodology encourages low-energy, passive responses to climate control and lighting, the two major consumers of energy in buildings.

In order for mankind to reconnect with nature, the fear of environmental degradation has to be overcome. As Barlett observes, “People resist the possibility of ‘deeper entwinement with the natural world’ out of vulnerability and fear, perhaps anxiety, and sometimes even panic over the environmental destruction we perceive. Compassion can be too painful at this historical moment or too closely connected to self-sacrifice.” In the face of so much evidence suggesting how and why we must change our habits, perhaps Barlett has discovered why many people still choose to do nothing.

“Today, millions of typical builder’s houses in the United States depend almost exclusively on hidden machines for climate control. Subdivision layout determines location and trendy styles drive house form. Every developer knows that prospective owners expect to heat the house in winter and cool it in summer just by fiddling with a thermostat. Why worry about taking care and expense with energy-conserving design when the occupant can be counted on to foot the long-term cost of maintaining comfort?”

Knowles, Ritual House, 62.
Buildings are to Blame

In his 2003 article in Solar Today, Edward Mazria claims that architecture consumes 76% of all electricity and 48% of all energy used in the United States. Buildings are also responsible for 46% of carbon dioxide emissions. Mazria argues that while much attention and criticism has been directed towards SUVs with low fuel efficiency, the entire SUV, mini-van, and light-duty truck fleet in the United States only makes up 6.5% of the country’s total energy consumption. Mazria argues for a fundamental change in the way that we look at the problem. Government policies, professional organizations, and architecture schools all need to come together to enact change on the issue. Buildings that promote interactions between mankind and nature are likely to consume and pollute less than typical buildings of today.

“Green Building” and “Sustainable Design”

Recent efforts in “green building” and “sustainable design” have beneficially increased public awareness about the insufficiencies of today’s building practices; however, they incorrectly portray ecologically responsible architecture as an additive process—one made up of checklists and scorecards. While the primary objective of this investigation is not a critique on “green building” or “sustainable design,” a brief comment on these popular topics is warranted.

The following excerpt from a New York Times article about a “green building” in Chicago depicts a frightening image of what “sustainable design” means to some people (italics added for emphasis):

[Homeowners] Ms. Whitehead and Mr. Elniski shy away from making absolute claims about the comprehensiveness of their house’s energy-saving systems, and declined to say how much they spent. There is always more to be done, they noted, and “between now and Thursday, something new could come out,” Mr. Elniski ventured. But they believe they are living as sustainably as they reasonably can in a world where local commercial availability of such products

is limited, and finding technicians to install and maintain systems is a challenge.

“We do not have black floors,” which hold the sun’s warmth better than light-colored floors, Ms. Whitehead said. “We do not have this new thing called Trombe walls, which soak up heat and release it back into a room like solar space heaters. We do not have gray-water recycling. But we’ve done a lot, while always being careful to balance it with an aesthetic atmosphere that people would actually want to live in.” […]

*Halfway through the design phase,* the couple began researching environmentally sustainable building practices online and came across what appeared to be an exhaustive list of green amenities. They decided they fervently wanted, as Ms. Whitehead put it, “a complete set, a truly encyclopedic wonder cabinet of devices — and that’s when we really started to drive [the architect] crazy.”

The homeowners in this article talk about the sustainable features of their house as if they are collecting baseball cards. Near the end of the excerpt, the homeowners reveal that they “came across” a list of “green amenities” that they wanted to add to their house.

Architecture that mediates between man and the natural environment has to achieve a deeper level of understanding than is exhibited in the *New York Times* article above. Ecologically responsible design should not be an exercise in adding “sustainable strategies” to an existing scheme, but rather it should be an exercise in harmonizing the relationships between nature, architecture, and mankind.

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Siem Reap, Cambodia. Photo by Author.
When architecture is created as a mediator between man and his natural environment, the need for high-energy comfort systems can be reduced resulting in an architecture that is better for the well-being of its inhabitants and the natural environment. Instead of treating architecture as a collection of “sustainable strategies,” the goal of this investigation is to reestablish a connection between a building’s users and their natural environment. A building that is designed to mediate between its occupants and a natural world will inherently respond to that natural world in way that minimizes energy consumption and resource exploitation.
Strategies for Mediation

The following list of strategies is not meant to be inclusive, but rather it is demonstrative of design strategies that mediate between mankind and nature using the two approaches described above. Actual design processes should be problem-specific, because each problem has its own priorities and natural forces to engage.

Facilitated Interaction

Buildings are inherently static, but many of their components are dynamic. People migrate through buildings. Electricity, water, and air flow through pipes and conduits. Apertures can be opened and closed. These dynamic elements can be designed to take advantage of natural processes for the benefit of an occupant’s awareness of the natural world.

Migration

Building occupants can become aware of natural processes through architecture when moving through spaces that respond to the natural environment in unique ways. A well-ventilated room shaded from the sun may be desirable on a hot and humid day, while an enclosed interior region of a building may be more desirable on a cold day. In *Thermal Delight in Architecture*, Lisa Heschong writes, “Animals have a great thermal advantage over plants because they can move about. Rather than endure the thermal conditions of one place, they can choose the most favorable location”\(^1^9\) Knowles gives a historical account of how migration within a dwelling is imbedded in the traditional housing models of Iraq, Algeria, and India. Throughout the day and throughout the seasons, inhabitants would migrate around the dwelling to seek out the shady, cool spots in the summer heat, and the exposed, upper levels during the cool nights.\(^2^0\)

\(^2^0\) Knowles, *Ritual House*, 37-41.
Manipulation
In addition to moving about a building, the operation and modification of a built environment promotes an understanding of the natural environment. For example, the decision to open or close a window requires one to evaluate the temperature and air quality of the outdoor environment in comparison to the indoor environment. Adjusting which windows are open and closed throughout the day can provide a rich connection to natural processes.

The perception of adaptive, operable environments also leads to an increased level of thermal tolerance. According to Nick Baker, research suggests, “that the existence of adaptive opportunity greatly extends the acceptability of an environment.” Baker cites one study that indicates higher levels of respondent satisfaction in heat stressed environments when freedom to take adaptive actions is perceived, even if it is not acted upon.

Thermal Stimulation
In its most basic function, a building is a shelter from the potential harshness of nature. In the last century, this basic function has been met, and buildings now strive to maintain a steady indoor environment based on a set of optimized conditions known as the comfort zone. This neutralized environment often overrides natural processes and should be challenged by other approaches.

Expanded Comfort Zone
Conceptually, the comfort zone defines a set of conditions in which the majority of people tend to be comfortable. Although we are perfectly capable of surviving in conditions outside of the comfort zone—and had done so for thousands of years—recent practices in heating and cooling use the extents of the comfort zone as universal set points for indoor environments. Climate

control systems in buildings are tuned to the present-day notion of thermal comfort as something fixed and limited. Life in such thermally neutral environments can be boring and uninspiring, while studies have shown that “thermal diversity is tolerated, and in many cases enjoyed.”

Nick Baker points out that two models of thermal comfort exist: one based on a “thermally neutral environment brought about by a steady state heat balance,” and the other based on the premise that “thermal comfort can be achieved within a range of thermal sensations, provided adaptive behavior is possible.” The “kidney-shaped, cross-hatched” comfort zone diagram is still a valuable design tool and reference point, but architecture that seeks to reveal natural processes to its inhabitants should question the accepted standards of the thermally neutral comfort zone.

Enjoyment of Extremes

Beyond the acceptance of slight thermal deviations, people can also enjoy thermal extremes. Take, for example, the Finns, who jump from a steamy sauna into the snow, or skiers that spend an entire day in freezing conditions before retreating to an open-air hot tub in the evening. The availability of hot and cold extremes provides the thermal balance to safely enjoy both extremes.

In a study of comfort in office buildings, Schiller concludes that, “even people [with extreme thermal] sensations are not necessarily dissatisfied.” Architects can use these examples of thermal deviation to liberate themselves from the notion that every space has to be between 68 and 74 degrees Fahrenheit at all times. Variety in thermal conditions, and even temperature extremes can enhance one’s satisfaction level and enhance one’s perception of the surrounding environment.

25 Knowles, Ritual House, 175.
26 Heschong, Thermal Delight in Architecture, 21.
27 Schiller, “Comfort in Office Buildings,” ###.
Sensual Connection

Architecture changes the way that people sense their surroundings. Buildings can reveal and emphasize aspects of nature that are not apparent in everyday life.

Archetypal Spaces

In *Inward Garden* Julie Moir Messervy describes seven archetypal places for garden design that are also applicable to architectural design. The archetypes recall particular settings in nature and evoke particular emotional states. In the “sea” one feels immersed and surrounded by peaceful solitude. The “cave” is an enclosure to feel alone with one opening to the outside world. The “harbor” is a u-shaped enclosure that defines a refuge and a view out. The “promontory” is an edge or cliff that provides an exhilarating point of view. The “island” allows a 360 degree view of the world. The “mountain” is a high vantage with a familiar landscape below. Finally, the “sky” is a departure from the known landscape. 28 Using these archetypes to conceptualize space can lead to architecture that has great control over how humans experience nature.

Between Humans and Nature

Cosmos

Experiencing the night sky, sunrise, sunset, the North Star, the solstices and equinoxes, and the phases of the moon are all delightful experiences that enhance one’s connection to nature. Architecture has a rich history of connections with the cosmos in sites such as Stonehenge, and Chaco Canyon; however, present day architecture rarely makes reference to astronomical bodies. Reestablishing the dialogue between the cosmos and architecture can improve mankind’s connection with the environment.

Formal Expression

Sculptural building forms or building elements are often inspired by natural forces and how the building interacts with such natural forces. In addition to the aerodynamic or structural advantages of these moves, a building’s form can also reveal natural elements to people.

Energy Optimization

Architecture is one of the few designed things that does not move. It has a constant size and orientation with relatively few moving parts. Because of its stationary quality, a building’s form and materials can be optimized to its natural environment. When humans perceive this optimization they gain a level of understanding of their own natural context.
Passive Energy Flows

The principles of passive heating and cooling are based on the principles of nature; therefore buildings that strive to reduce active heating and cooling loads in favor of passive strategies are often designed in concert with natural forces. A buildings’ occupants are able to understand their natural environment by understanding how architecture engages the natural environment.

Form / Orientation
For every site and program, decisions about form can be made that will improve or degrade building performance. While there is not one ideal design process, or one ideal form for a given site, design decisions can be informed by thermal modeling calculations and other technical analyses. Modern software packages such as ECOTECT and EnergyPlus can facilitate quick technical calculations in an iterative process. In his “Blueprint for a Revolution,” Edward Mazria highlights the importance of computer simulation software to understand the principles involved in how natural processes affect a building.

A set of buildings designed to optimize performance for a given location and climate should start to reveal similarities in form. The logic and natural processes driving these forms should become exposed, consciously or subconsciously, to building occupants.

29 for an extensive list of building energy software tools, see http://www.eere.energy.gov/buildings/tools_directory/
and people that pass by. In turn these people will enhance their understanding of the natural environment by understanding why buildings are formed the way that they are.

**Two Outcomes**

The strategies and tactics listed above are by no means exhaustive, but they do identify a number of ways that architecture can mediate between humans and the natural environment. The goal of these strategies is to improve the well being of humans and the ecology through architectural design.

**Human Well-being**

Contact with the natural world is beneficial to one’s health. 31 Ever since the industrial revolution, mankind has lost much of his awareness of the natural world. This reverses thousands of years of evolutionary patterns in which humans had frequent contact with nature and a wide range of environmental conditions. Using architecture as a means to re-establish connections between humans and their natural environment will re-introduce the delightful nature into everyday life.

**Ecological Well-being**

As humans and buildings become more sensitive to nature, energy consumption and resource exploitation should be reduced, improving the ecological well-being of the earth. A growing awareness of our planet’s environmental strain is inspiring many people and organizations to take action. Architecture is arguably the single biggest consumer of energy in addition to having the largest room for improvement. Rather than trying to find ways of producing even more energy, architecture should first attempt to lower consumption by returning to its historical roots in harmony with nature.

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31 see Frumkin, *Urban Place*, 256-9.
Overview

Many built projects employ the strategies and tactics described in the previous section. A study of these built projects is helpful in understanding how the strategies work together and how they sometimes overlap each other in. Precedents in the following matrix were initially chosen for having at least two similarities with the design project in chapter 5 of this document in the categories of scale, program, climate, and context. Two additional projects (Thermal Baths at Vals, and Fallingwater) were added to the matrix in order to fill out some of the tactics that were scarce on examples. The University Park Apartments is a residential-over-retail development that was recently completed near the site for the project in the following chapter. It is included in the matrix
to suggest it as the antithesis of what this investigation is trying to accomplish, but no detailed analysis is made on the project. Three projects are analyzed in more detail: the Global Ecology Center, the Institute for Forestry, and the GSW Headquarters.

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<th>FACILITATED INTERACTION</th>
<th>Global Ecology Center</th>
<th>Colorado Court Affordable Housing</th>
<th>Hawaii Gateway Energy Center</th>
<th>Institute for Forestry</th>
<th>GSW Headquarters</th>
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**fig.15** Matrix evaluating strategies and tactics with precedents
Global Ecology Center

EHDD, completed 2004
Stanford, California | 37.4288°N 122.1794°W | el. 116 ft
The Global Ecology Center has an upper office level, a lower laboratory level, and an indoor / outdoor lobby and collaboration space. The controlled laboratory environment requires the lower level to be actively cooled while the rest of the building relies solely on natural ventilation for cooling.32

Facilitated Interaction - - - - - - - - STRATEGY
Manipulation - - - - - - - - - - - TACTIC
The lobby area of the Global Ecology Center is able to transform from an enclosed space to an open-air space with the opening of large bifold doors. This presumably daily ritual of opening or not opening the doors informs the building’s users of the outdoor environmental conditions. The presence or absence of the lobby enclosure reinforces an awareness of the environmental conditions to passers-by

Thermal Stimulation - - - - - - - - STRATEGY
Availability of Extremes - - - - - - - - TACTIC
When the lobby is in its open-air state, misters inside the ventilation tower can be activated to cool the outdoor air through evaporative cooling. The cool moist air travels down the ventilation tower through convection and tempers the lobby space. While the overall temperature in the lobby might be higher than is usually considered comfortable, the availability of a localized source of cool-moist air makes the space comfortable.
Sensual Connection - - - - - - - - - - - - STRATEGY

Formal Expression - - - - - - - - - - - - TACTIC

The ventilation tower serves as a focal point of the formal composition of the Global Ecology Center. From the exterior, the butterfly-shaped wind scoop at the top of the tower signifies its function as a one for moving air into or out of the building. From the lobby space, the bottom of the tower is left open so the building’s users can experience the cool air moving down the ventilation shaft.
Energy Optimization - - - - - - - - - - STRATEGY

Passive Energy Flow - - - - - - - - - - - - - TACTIC

The laboratory zone in the Global Energy Center—the one zone that is mechanically cooled—uses an innovative, passive method for chilling water to cool the space. At night, water is sprayed onto the roof and chilled through deep-space radiation. The chilled water is stored in a large, insulated tank for use during the warmer daytime hours. This method of cooling is much more connected to natural processes than a typical air conditioning compressor, and the system uses far less energy to cool the space than a typical system would.

Institute for Forestry

Behnisch, Behnisch & Partners, completed 1998
Wageningen, Netherlands | 51.9877°N, 5.6673°E | el. 40 ft

The Institute for Forestry is a composed of an east-west running spine on the north end of the complex, and three double loaded office corridors protruding to the south. Indoor gardens occupy the space between the office blocks. These gardens provide circulation, and informal meeting spaces in a space that is tempered only with natural ventilation and passive solar gain. The garden zones act as a buffer to the office blocks. Experimental vegetation growing in the gardens also provides scenery to the offices and serves thermal functions.

33 AIA Top Ten Green Buildings Website
Facilitated Interaction - Strategy

Migration - Tactic
The Institute for Forestry has two circulation systems: the official one enclosed within the office wings, and the one that exists within the semi-enclosed gardens. Descriptions of the project show that most people circulate through the gardens. The semi-enclosed, tempered garden zones provide the building’s users a way to connect with the daily and seasonal cycles of the natural world. In an *Architectural Record* article about the Institute of Forestry, Tracy Metz explains, “The gardens are not just to be admired, but to be treated as an extension of the workplace: for lunch, for meetings, or simply for reading.” The building’s users have to make a conscious choices about where they want to be throughout the day.

Thermal Stimulation - Strategy

Expanded Comfort Zone - Tactic
Like the Global Ecology Center, the office wings in the Institute for Forestry do not have any mechanical ventilation. Stefan Benisch, partner-in-charge for the Institute for Forestry, explains his strategy for achieving thermal comfort in the Institute for Forestry:

I don’t want to change our lives or go back to the Stone Age, but if we are prepared to accept that it’s warmer in the summer and cooler in the winter, I am convinced that we can attain an acceptable degree of comfort by following the rules of nature.

The Institute of Forestry embraces the notion that its occupants can tolerate and even enjoy temperature swings outside the set-points of most mechanical conditioning systems.

Sensual Connection - - - - - - - - - - STRATEGY

Archetypal Spaces - - - - - - - - - - - TACTIC
The gardens take on the presence of an oasis in the Institute for Forestry. Each office unit acts as a harbor looking out onto the oasis. The elevated circulation paths that cut across the garden zones provide interesting vantage points to the surrounding offices and the gardens below. All of these sensations provide the buildings users a connection to the sensations found in the natural landscape.

GSW Headquarters

Sauerbruch Hutton, completed 1999
Berlin, Germany | 52.5064°N 13.3931°E | el. 145 ft
Sauerbruch Hutton’s GSW Headquarters tower is an addition to a 1960s tower in a historically tragic area of Berlin. The new tower is one of the first in a wave of ecologically-minded projects to be completed in Europe in the last decade. Sauerbruch Hutton’s design is characterized by very narrow floor plates that take advantage of daylighting, solar gain, and natural ventilation. On the west face of the building, a double facade creates a “solar flue” that pulls air from each floor up to the roof. Within the layers of the double facade, colorful shading devices can be open or closed to permit or block sunlight from entering each floor. The building’s occupants have a large amount of input in changing how their floor takes advantage of all of the passive strategies that have been designed into the project.37

Facilitated Interaction - STRATEGY

Manipulation - TACTIC
Within the layers of the double facade, colorful shading devices can be open or closed to permit or block sunlight from entering each floor. Occupants also have control over the operable windows on the east and west facades that manipulate the characteristics of the cross-ventilation that occurs on their floor. When adjusting the shading and ventilation elements, building occupants are establishing a connection and understanding of what is happening in the natural environment around them. They get to feel the immediate effects of a cool breeze passing by their skin or the warm sun hitting their desk.

Thermal Stimulation - STRATEGY

Expanded Comfort Zone - TACTIC
During the summer months, temperatures are designed to swing from as low as 60 degrees Fahrenheit at night to around 80 degrees in the afternoon. Since occupants have so much perceived control over their environment, these temperature swings are within their levels of comfort. According to Arup’s thermal analysis, the temperature of the “solar flue,” or space between the double-skin, west facade varies from 93 degrees Fahrenheit on a summer afternoon to 50 degrees on a winter day, even colder at night. The perception of these extremes in the “solar flue” could increase the tolerance of the building’s occupants even more, allowing less mechanical energy to be used to maintain thermal comfort within the building.
Sensual Connection

Formal Expression
A large, upside-down airfoil is positioned on the top of the GSW Headquarters. The proximity of the airfoil above the double-skin west facade creates a low pressure zone at the top of the facade that helps pull air through the “solar flue.” This functional building element is also very beautiful in the overall composition of the tower. The wing atop the GSW Headquarters is an excellent example of a formal gesture that informs building occupants and passers-by about how the building is integrated with natural processes.

Energy Optimization

Passive Energy Flows
The GSW Headquarters has a series of diagrams that show how passive energy flows through the building during daily and seasonal cycles. The passive energy flows describe how various building elements react to varying conditions.
Siem Reap, Cambodia. Photo by Author.
The goal of this design project was to test the four strategies and series of tactics that were proposed in a previous section of this document. A mixed-use development just south of the University of Cincinnati in Cincinnati, OH was selected as the testing ground. Once each design conjecture was made, a thermal analysis was performed in an attempt to evaluate the strategies’ effects on energy consumption and resource exploitation. The findings of this process suggest that strategies intended to connect people to their natural environments can reduce energy usage significantly.

“Given human evolutionary history, an urban environment devoid of connections to the natural world is detrimental to mental and physical functioning”
Barlett, Urban Place, 26.
Assumptions

Location

Cincinnati, OH | 39.1277°N  84.5134°W | elev. 860 ft

Program

fig.31 Context Map

fig.32 Site Context

fig.33 Program Diagram

Commercial [9,000 sf] over Retail [2,500 sf]
Row Houses [(4) 2-bedroom Units]
Commercial [3,000 sf] over Parking [39 spaces]
Apartments [(8) 1-bedroom Units]
Diagram showing the angles at which the sun should be shaded in the spring and fall.

Diagram showing times when shading is desirable compared to the summer solstice.

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**Wind**

![Wind Diagram](image)

**fig. 36** *Diagram showing wind frequency by direction and temperature*

**Topography**

![Topography Diagram](image)

**fig. 37** *Diagram of topography around the site*
Design

fig.38 Site Plan Diagram

fig.39 View from the courtyard looking southeast
fig.40 Section perspective of the southern residential block looking east

fig.41 Diagrams of the strategies and tactics used in the southern housing block showing corresponding thermal load reductions

A. FACILITATED INTERACTION
Migration
load reduction 38%

B. THERMAL STIMULATION
Expanded Comfort Zone
load reduction 21%

C. SENSUAL CONNECTION
Archetypal Spaces
load reduction n/a

D. ENERGY OPTIMIZATION
Form / Orientation
load reduction ~ 3%
**fig. 42** Section perspective of the eastern residential block looking south

**fig. 43** Diagrams of the strategies and tactics used in the eastern housing block showing corresponding thermal load reductions:

- **A** FACILITATED INTERACTION
  - Migration
  - Load reduction: 34%

- **B** THERMAL STIMULATION
  - Expanded Comfort Zone
  - Load reduction: 10%

- **C** SENSUAL CONNECTION
  - Cosmos
  - Load reduction: n/a

- **D** ENERGY OPTIMIZATION
  - Passive Energy Flow
  - Load reduction: ~2%
**Analysis**

**Thermal analysis of the southern housing block**

**Fig. 44** Thermal analysis of the southern housing block

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<td>41,620</td>
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<td>33,234</td>
<td>32,632</td>
<td>51,686</td>
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**Annual Thermal Load** (in BTU/ft²)

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**Note:** The diagram shows the monthly heating and cooling loads, with breakdowns of gains and losses due to conduction, solar, ventilation, and internal gains/losses. The annual thermal load is also presented with specific values for each month.
Thermal analysis of the eastern housing block

**fig.45** Thermal analysis of the eastern housing block
Sources
Illustration Credits

fig.01 Klepeis et al., “National Human Activity Pattern Survey,” 239.
fig.02 http://www.flickr.com/photos/jugbo/1868066763.
fig.04 adapted by author from Mazria, "Architecture, Stupid," 51.
fig.05 Knowles, Ritual House, 40-41.
fig.06 http://www.worldarchitecturenews.com/news_images/1012_1_MJ%20MHouse%201.jpg.
fig.07 http://www.worldarchitecturenews.com/news_images/1012_5_MJ%20MHouse%205.jpg.
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fig.10 source unknown.
fig.13 photo by author.
fig.14 photo by author.
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fig.20 http://globalecology.stanford.edu/DGE/CIWDGE/about/building/radiant.jpg.
fig.21 Metz, “IBN-DLO,” 96.
fig.23 Metz, “IBN-DLO,” 100.
fig.24 Metz, “IBN-DLO,” 103.
fig.26 image by author.
fig.27 image by author.
fig.28 Sauerbruch Hutton, GSW, 109.
fig.29 image by author.
fig.30 Sauerbruch Hutton, GSW, 195-204.
fig.31 image by author.
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