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Concept and Technique: How Traditional Japanese Architecture can contribute to Contemporary Sustainable Design Practices

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INTRODUCTION

In recent years "sustainability" has become a more widely discussed topic among societies seeking to lessen the detrimental effects that wasteful consumption has had on the environment. This increased acknowledgement may have resulted from the "newfound" understanding of the importance ecosystems hold in the balance of the environment; yet it may also simply be out of fear of what the future may bring in terms of global climate change. Contemporary societies have inherently become increasingly detached from nature in a way that is harmful to both the environment and people. In general, this disconnect has mostly developed from our own desire to advance our ways of life. People design and adapt structures and technologies to cope with natural forces beyond our control as a means of gaining some power over them. This power, in turn, allows for a creation of a sense of both physical and emotional *comfort*, from which people feel protected and happy.

Increasingly, people have generally come to understand how man-made features have the capability to negatively affect the immediate environment, and there has developed a general desire to improve. As a result, an acknowledgement of the importance of sustainability has emerged, and one major way in which people have sought to improve the sustainability of our lifestyles is through the most basic of technologies: shelter. Architecture provides an opportunity to reconnect our lifestyles to the natural environment in a way that positively affects our daily lives. Even in searching for a solution, our contemporary societies have a tendency to

create *new* ways to reconnect architecture to the environment in a sustainable manner. Although this method is a viable approach, it is important to recognize that solutions are not always found in something new. Human history offers centuries of case studies for our benefit, but generally there is a propensity to overlook important traditional building methods, even though they have influenced what the global society has developed into. As a result, people realize later than we should that something essential has been lost or forgotten.

The past is a significant part of what has made the present what it is, and, subsequently, what will become of the future. Therefore, examining how traditional cultures interacted with their respective environments in the past can be the most beneficial stage of creating new, sustainable architecture, accepting that this "new" technology can be inspired by the past. This is why vernacular architecture is so relevant when it comes to redesigning our methods of sustainability; where we seek to reconnect to nature, past techniques were based on a strong link with the natural environment. Therefore, traditional architecture provides valuable insight into what works and what may not in terms of sustainability. Yet not all vernacular designs are created equal; after all, natural environments differ depending on location. There are certain traditional designs that demonstrate unique connections, which maintain the potential to inform contemporary architectural techniques. Traditional Japanese architecture is one such example, as in the centuries of adapting building methods to improve the quality of living for the occupants, Japanese builders created numerous sustainable design techniques.

As a country that experiences a wide range of natural disasters, Japan has encountered countless examples of the power and uncontrollable aspects of nature. The dangerous and unpredictable features of the environment are perhaps why Japanese architects have long since acknowledged the importance of naturally occurring features, such as wind, sun, water, and materials. This recognition was then incorporated into building designs as a means of using nature to the occupants' advantage rather than simply as something beyond their control. According to Eiji Maki, author of *Sustainable Architecture in Japan*:

> *…[Japanese] architecture avoids artificial uniformity, creating instead attractive and heterogeneous interior spaces and harmonious special relationships. These structures were designed to last and were built from renewable, locally available materials. We aim to learn the lessons offered by these superbly functional traditional buildings and apply them in our own green designs. (Maki 22)*

Although certain aspects of Japanese traditional architectural design were merely results of available materials and immediate environment, the architecture continues to represent one of the most extensive forms of living sustainably.

The title of "traditional" or "vernacular" does not determine whether or not a design concept is sustainable such that it can be incorporated directly into contemporary lifestyles. Adaptability is key; features of vernacular architecture may not be appropriate for contemporary societies, but the concepts embodied in these

features can lend to the generation of usable criteria for sustainability. Vernacular American architecture does not inform sustainability to the level of traditional Japanese structures; this is due to its limited history, which has left American vernacular design little time to evolve before modernity allowed for the taming of the natural elements through technology. Traditional Japanese architecture provides a valuable template of sustainable methods that are not only aesthetically pleasing but also feel both emotionally and physically comfortable, even in contemporary society. As architecture (and the core concept of shelter) is a keystone of modern lifestyles, it is an ideal method of achieving an improvement of sustainability in terms of the global society as a whole. Therefore, it is important to examine traditional Japanese architecture in order to improve contemporary sustainability and, subsequently, create a style that is not necessarily either historical or new, but is inspired by the past and, thereby, *improved*.

In order to truly understand how vernacular design can inform contemporary architecture, it is essential to bring concrete meaning to the term "sustainability." As a fairly new concept, sustainability encompasses a variety of meanings and connotations, but there is only one purpose: to lesson the detrimental effects of our societies on the environment. Therefore, chapter one will discuss and develop a definition for the broad concept of sustainability. This development is essential to understanding how such vernacular designs as traditional Japanese architecture can lend knowledge and methods to improving contemporary architecture. After a workable definition of sustainable architecture is established, in chapter two an exploration of aspects of Japanese design that maintain sustainable characteristics

will begin. We will analyze how these particular elements of this building tradition may inform sustainability in a contemporary sense. Finally, chapter three will examine *how* traditional Japanese architecture can be incorporated into contemporary designs, acknowledging syntheses of previous architects (both American and Japanese). Methods of incorporation will be explored and, subsequently, we will develop general sustainable criteria inspired by vernacular techniques for use in contemporary designs.

CHAPTER ONE:
Defining Sustainability

INTRODUCTION

"Sustainability," in terms of architectural design, is a word that has received an increasing amount of attention in recent years, yet a clear definition for it is difficult to determine. In their book *Sustainable Design: The Science of Sustainability and Green Engineering*, Daniel Vallero and Chris Brasier state:

> *Green architecture has been defined as the means of allowing people to become more in touch with the environment in which they live. It incorporates natural landscapes in to the building's design, which gives people a better connection to the land. It also takes into account all of the environmental effects which a building will have on a place. (168)*

Green architecture is a means of reconnecting people to the environment in which they live, which in and of itself is a method of sustainability. In many ways, green architecture represents a sort of subsection of sustainable architecture, one in which current design methods are simply less damaging rather than redefining the whole process, which is "sustainability" (McDonough). Sustainability, however, is more difficult to define than "green architecture" because it is used to address a number of different purposes. Because of this ambiguity, before analyzing how to produce a piece of sustainable architecture, one must first understand what

sustainability really *is*. Sustainable architecture implies a specific goal or state based on scientific principles and verifiable data. Sustainability in architecture encompasses a wide variety of elements, which can be organized into the categories of site issues, material selection and construction methods, human interaction, the building's longevity, and long-term performance; and in all this it should be respectful of past designs.

SECTION ONE
Site Issues

Sustainable architecture implies more than merely a tool of environmentalism; it is about creating a connection to nature that brings about a pro-active, integrated, and mutually beneficial relationship to the environment. Sustainable architecture seeks to exist *within* a natural environment, and not as a separate entity. According to Vallero, this is "A building that is not merely placed on a site with no conscious regard to the specifics of the area; the architecture must connect to the nature and atmosphere of its home," (168). This implies that a building does not reject naturally occurring features of the landscape or harm them; instead these structures must connect to nature and exist *with* the environment. In order to accomplish this state, Azby Brown, author of *Just Enough: Lessons in Living Green from Traditional Japan*, theorizes: "…we need to train ourselves to immediately see the interactions upon which natural processes are based, and to better observe how the things we make interact with what is already there," (94). For this reason, the characteristics of a site are essential to analyzing the sustainability of a building. People have always

recognized the importance of location, but only recently has this essential trait been acknowledged as a vital component to sustainability. For example, the United States' LEED Certification program, which assesses a building for its sustainability based on a series of requirements, accounts for a site's previous uses as well as the surrounding community (pubic services, transportation, density, etc.) in its analysis.

Acknowledging how a building affects a site is extremely important, but it is also vital to assess how the building is affected by its location. In addition, it is key to take into account if building a new structure would destroy or damage natural habitat, or if an already devastated site could potentially benefit by the construction of a sustainable design. The design of a sustainable building should illustrate an understanding of the site's characteristics, taking care to avoid or reduce damaging features. According to Vallero, "*Green buildings* incorporate given site characteristics and conditions, such as microclimate, light exposure, vegetation, and urban factors (e.g., noise, amenities) into the design," (168). This means, essentially, that architects understand and take into account various natural features such that their sustainable structures exist in a mutually beneficial relationship with the surrounding environment. As Brown observes, this is an attainable goal: "One way to achieve more efficient and better use of natural resources is by better understanding and utilizing microclimates and ecological niches," (90). This involves understanding and acknowledging how the local ecosystem works, both from natural and artificial resources. Vallero states: "From an integrated, green viewpoint, a design must incorporate an appreciation for the interrelationships of the abiotic (nonliving) and biotic (living) environments," (168). For example, the use

of trees for shading represents a relationship with the biotic, whereas the allowance for passive energy flow via wind is abiotic. A structure can draw attention to these essential natural traits by using them to survive sustainably, and in so doing provide a means for its users to feel a sort of connection to the environment. This understanding of the natural features of the site on which the building sits includes giving special attention to how a building is oriented on a site.

Understanding the environment around a building means knowing exactly how to construct and position the structure on a lot in order to optimize the utilization of natural processes such as wind, sunlight, rain, snow, and temperature ranges. According to Vallero,

> *Many of the key components of green design involve in-depth knowledge about a place. Green buildings must account for sun intensities, temperature variation, precipitation and many other environmentally driven aspects. Without knowledge of local environments, green buildings cannot plan for variations and they will not be as energy efficient. (168)*

Essentially, Vallero asserts that attaining sustainability is not as simple as placing solar panels on a roof; proper orientation and angle are required to maximize efficiency. In order to ensure this happens, one must understand the specific solar intensities and angles that impact the particular site. The same basic environmental understanding is required of other sustainable techniques such as wind power and geothermal energy. Sustainability, as a means of drawing visual as well as ecological

attention to essential natural features, certainly requires an understanding of the local environment, and through the utilization of these characteristics, the building can then teach those interacting with it about the place in which they live.

When a building utilizes the available natural energy without exploiting it (i.e. using natural energy efficiently rather than wastefully), an appreciation for nature is developed, as it no longer seems like mere scenery; it becomes a source of electricity and a means of attaining efficiency. However, contrary to contemporary thought, this concept of designing a building such that it uses naturally occurring environmental conditions to its advantage is not a "modern" one. Brown states:

> *The importance of siting houses to take advantage of the sun, prevailing breezes, and natural drainage was obvious to experienced buildings all over the world until mechanized heating, cooling, and infrastructure systems began to offer what seemed to be a free ride. (103)*

People in the past, in lacking the technology contemporary societies possess, were forced to learn how to take advantage of their environments in a way that we are attempting to remember now. Although we are defining "sustainability" in a contemporary sense, it is important to note that present techniques are not necessarily *new* as much as *rediscovered*.

SECTION TWO

Material Selection and Construction Methods

The site is not the only important feature that requires careful selection; a building will not achieve sustainability if the proper materials are not chosen and the purpose of renewability is not applied to the design. For instance, a building designed such that it serves multiple uses will have far greater value to a community than one that simply houses offices. This concept of allowing a site to support multiple uses is key to sustainability. A multi-use complex (such as a building with housing and retail) allows for more community interaction and benefit, but also has a tendency to allow for future adaptability. Regarding this design concept, Brown suggests:

> *Allowing each element to perform several functions, and each function to be supported by several elements, is a fundamental design principle applicable to everything: interior design, architecture, town planning, agriculture, and ecosystem management. (93)*

Multiple uses in terms of building design and development is the same basic concept as reuse and recycling; the more uses a single building has the more likely it is to be maintained and reused. Mixed-use buildings also allow for more efficient use of resources and reduced site impact. For example, paved parking spaces can be utilized by a business during the day and residential tenants at night, drastically reducing the amount of paving and land required than if the uses were separated.

Material selection is undeniably important to contributing to what it is that makes a building more efficient in energy consumption, waste management, impact on resources, and exposure to toxicity. As societies stand today, building construction and deconstruction is a major source of waste, as well as environmental destruction. Brown observes:

> *Building construction consumes approximately 40 percent of all the raw materials produced globally. Not only does the production and transportation of these materials consume vast quantities of water and energy, but we have given little thought to what happens to the materials after buildings are demolished. (97)*

Construction and deconstruction of a building both have harmful, destructive, and waste producing traits that are increased when toxic and unsustainable materials are used. In addition, they can lead to environmental degradation and destruction both by the waste they produce and the site on which they are built if thought is not given to how the building can work *with* the environment. Materials are key to this, as they affect how a structure will be constructed and deconstructed, as well as determining the quality of the environment within a building. There are a number of ways materials can contribute to the sustainability of a building, and most of these positive attributes are dependent on the manufacture and transportation of the material.

Artificial and manmade materials can harm the environment by producing waste that does not decompose, but they can also be harmful to the occupants of a structure. Within recent history there have been a number of cases in which toxic materials were widely used before their detrimental or harmful affects were known, making it entirely possible that materials still used today may one day reveal their toxic traits. According to Pacheco-Torgal, author of " Toxicity of Building Materials: A Key Issue in Sustainable Construction," buildings today, especially residential ones, often utilize many toxic materials that still remain legal despite their detrimental characteristics to both humans and the environment (Pacheco-Torgal 2012). One such example is asbestos, which was once widely used in construction because its dangerous affects were unknown. Although now it has come to be illegal in the United States due to its toxicity, in many countries such as Canada the incorporation of asbestos in common building materials remains a legal practice. In addition to the harmful effects on people and the environment that these toxic materials have within a building, determining what to do with them post-deconstruction is equally concerning. Toxic materials provide another issue regarding waste reduction and management, as they cannot be reused or recycled.

On the other hand, the use of naturally occurring materials is one way in which waste reduction for both toxic and nontoxic materials can be achieved. Carefully chosen nontoxic natural materials maintain the potential to improve the issue of waste, as they are typically renewable. This characteristic means they can be quickly replaced, presumably as part of a natural process. They can also be beneficial to people as they often avoid the potentially dangerous characteristics that artificially

produced materials sometimes possess. In addition, because humans have used them for centuries to build their homes, any dangerous traits natural materials may have are usually already known (Vallero 180). Another important feature of using natural materials is that they can often be reused as opposed to simply being thrown away. This concept of reusability is an ideal for sustainability, as it reduces waste efficiently. In fact, Brown states that, in terms of sustainability,

> *The goal is to ensure that all materials used in a building can be repeatedly reused or recycled, thereby reducing the amount of energy and raw material production necessary to support new building activity. This entails designing structures that can be easily dismantled. (97)*

A building that is constructed of materials that do not increase the toxic burden on the environment and humans, and that can be dismantled and reused, is an ideal example of sustainability. Yet this has proven to be more difficult than it sounds within today's cultures.

Many contemporary societies are struggling to accept the concept of reuse and recycling in terms of basic goods, making it difficult to apply the strategy of reuse when it comes to something as large as a building. Frequently, simply tearing a structure down and building a new one is much cheaper. People are not always reliable when it comes to sustainable practices following the creation of a building or material (such as recycling). Therefore, instead of relying on the post-consumer waste reduction processes it is more sustainable to incorporate the environmentally

friendly qualities of a product into the production process itself. Relying on the fact that a material will be recycled or reused is, unfortunately, not a necessarily dependable method. According to Brown:

> *The challenge is to replace the throwaway economy with a reduce-reuse-recycle economy. Officials should worry less about what to do with garbage and think more about how to avoid producing it in the first place. (104)*

This concept is a return to the difference between "green" and "sustainable," as it presents the idea that we can utilize the same practices and simply change our post-consumer ways to reduce waste. However, as Brown observes, although this may be a good first step, an ideal solution would be to change our wasteful ways from the start; in other words, change the way materials are made.

This concept of pre-sustainability as opposed to post-sustainability is not limited to bottles and cans; buildings are also faced with a pre/post sustainable issue. In his exploration of material selection based on how things are made, Vallero discusses the important issue of renewable versus nonrenewable resources. Many contemporary civilizations are experiencing the negative consequences of not respecting the natural processes of renewal within the environment (Vallero 180). However, by understanding these processes, a structure can be built of materials that are more sustainable both at construction and over time. Brown proposes: "We should develop building material and construction systems that have easy reuse designed in. People will want to do this only if the building elements are extremely

practical, extremely beautiful, or both," (97). In addition, Maki suggests that a building's longevity is dependant on it ability to be comfortable to its users, the ease with which it can be maintained, and its ability to be adapted and reused (33). People's views and opinions of a building are, thus, another essential feature in its sustainability. Materials maintain an incredibly important role in the sustainability of a building in how it interacts with the environment as well as with the people that use it.

Wood, for example, is a very commonly used material in building construction, yet not all wood is equally renewable, and thus, sustainable. Vallero suggests, "The tree is a central feature of green design…the choice of wood as a material affects the sustainability of a structure," (292). The particular choice of wood can affect sustainability for a variety of reasons. Shipping costs and fuel use in transport can change how sustainable a particular wood is based on site location and distance from the source. In addition, the regeneration rate of a tree species is key to determining its renewability rating. A tree that regenerates faster will be less harshly affected by logging and will replace itself more rapidly. With this concept in mind, there are a variety of logging techniques that seek to be less environmentally destructive, one of which is known as selective logging, during which a forest is not clear-cut but instead trees are chosen based on age and relative abundance. In his study about forest fragmentation and selective logging, Uster Dana observes:

> *…forest fragmentation affects ecosystem processes indirectly by changes in biodiversity, whereas selective logging influences processes directly by*

> *modifying local environmental conditions and resource distributions. The positive to neutral effects of selective logging on ecosystem processes show that the functionality of tropical forests can be maintained in moderately disturbed forest fragments. (Dana 2012)*

Although selective logging is not a perfect method, it minimizes disturbances to an ecosystem, unlike such detrimental logging practices as slash and burn and clear-cutting.

Another method is top-harvesting, where, as the name suggests, only the top of a tree is harvested. However, regeneration rates and tree species also affects this form of logging, as different species will grow at contrasting rates. For instance: "Many coniferous trees (e.g., pines) cannot survive if they are cut too far down the trunk, whereas many deciduous trees will grow back readily," (Vallero 292). Besides the regeneration of the tree that is harvested, it is important to consider how the particular species acts within the natural flow of atmospheric gases. In studying climate change, scientists have found that, besides creating additional gases, human harvesting of trees has reduced the absorption of these gases by natural processes. Because of this, "Decisions about trees must also consider green house gas balances," (Vallero 292).

In the big picture, material selection for sustainable design must take into account the source and renewability of a material as well as its contribution to essential natural processes and if said systems will suffer if it is removed. Material

selection is thus an important consideration in creating a piece of architecture that claims the title of "sustainable." To summarize these features:

> *…Mendler et al. identify global goals that must be part of green design: waste nothing (a "less is more" approach; reuse, avoiding specification of scarce materials); use "free" resources (renewable energy, renewable materials, locally abundant resources); optimize rather than maximize (synergies, less reliance on active, mechanical systems); create a livable environment (protect sensitive ecosystems, actively restore damaged habitats, look for pedestrian-friendly and mixed-use design options; avoid toxic materials. (Vallero 9-10)*

Sustainability relies heavily on efficiency, and for this the selection of both site and materials are essential and must be considered carefully.

SECTION THREE:
A Building's Longevity

While site and material selection contribute to the structure's sustainability, these traits are rendered irrelevant if the building fails to survive long enough for it to justify the environmental costs of its construction. Although this may seem on the surface to be a simple enough task, the truth of the matter is that humans crave novelty, and it is often witnessed that a building, which is considered "beautiful" one decade, may find itself "obsolete" the next. Unfortunately, if a building fails to maintain its "usefulness" and is demolished, it presents an unfortunate series of

destructive factors. The demolition (destruction) and even deconstruction (disassembling) of a building produces a surplus of environmentally damaging elements, such as acidification, summer smog, nitrification, and other components that contribute to climate change (Coelho 551). In a study conducted by Andrew Coelho and Jorge de Brito, five different deconstruction and demolition methods were analyzed for their impacts on the environment. The first option they explored was complete demolition, wherein all the resulting material would be transported to a landfill. This method not only includes environmental destruction from the growing landfill, but also the energy used in transporting such a large amount of material. The second method they studied was one known as "soft-stripping," for which the non-structural components are selectively demolished, and then the rest is completely demolished (Coelho 545). However, Coelho states:

> *'Soft-stripping', or the removal of non-structural elements for recycling, followed by traditional demolition of all other materials and their removal to a landfill, will generally not imply any environmental impact reduction… (552)*

Even if non-structural elements are recycled, the amount of material remaining to be dealt with (the structural material) is typically great enough that the quantity of waste is not significantly reduced; therefore, a reduction in environmental impact is not guaranteed (Coelho 552).

The third method was to deconstruct the non-structural components followed once again by completely demolishing the remaining elements. Again, this method

does not ensure much reduction in negative environmental impacts. Fourth, they studied the strategy of completely deconstructing the building and then sending all the materials to be recycled. The final method was to fully deconstruct the building once again, but this time only the materials that could not be reused were sent away for recycling (Coelho 545). Despite these methods of waste reduction, Coelho and de Brito found that, even in cases when recycling is practiced, the negative environmental impacts are not necessarily reduced due to the energy costs from the transportation process. This unfortunate reality is related to the fact that, in many cases, local recycling plants are not available, and thus the materials must be transported a distance farther than the landfill might have been. This is only an issue because the primary method of transportation in these situations is diesel truck (Coelho 552). In addition, they found that "…the final impact of the considered life cycle stages including recycling will be 17% and 39% higher for aggregate and steel mass respectively," (Coelho 550). As a result of this study, it is clear that demolition and deconstruction, even when methods of waste reduction are practiced, are major factors when considering the sustainability of a building.

Coelho and de Brito's study illustrates that relying on the sustainability of the deconstruction process as opposed to demolition does not always ensure that the negative environmental impacts of a building will be reduced even if the owner is willing to spend the extra money to recycle and reuse materials. This is the same concept mentioned earlier, where the best method of sustainability is not to rely on post-consumer conditions, but to instead incorporate environmental features into the construction itself. In other words, the sustainability of a building depends

almost entirely on its construction and, consequently, how long it can avoid the environmentally damaging demolition and deconstruction processes. The question is, then, how is this accomplished? Although both features are important, the answer may not lie so much in the aesthetics of a building as it does in the way a structure makes people *feel*, the *comfort* of a building.

Many of today's societies tend to be based on short-term results; the difficulty with this myopic perspective is that, although people tend to want and *like* new things, they typically *love* what is considered old. Steward Brand, author of *How Buildings Learn: What Happens After They're Built*, claims:

> *Loved buildings are the ones that work well, that suit the people in them, and that show their age and history. All it takes is keeping most everything that works, most everything that is enjoyed, much of what doesn't get in the way, and helping the rest evolve. (209)*

This idea presents a difficult paradox; as there is an unfortunate gap between the time at which a building is "novel" and when it becomes old enough to be considered "beautiful." People's sense of beauty is ever-changing and evolving; it is because of this that building a structure that can survive to achieve beauty through age is a difficult task, especially when considering that not *all* old buildings are considered beautiful. This is why sustainable structures must be aesthetically pleasing for their time but also ensure that these qualities remain "beautiful" in the distant future, which typically involves that buildings maintain the ability to be

altered and reused. Buildings must be flexible in order to survive for a long period of time.

However, even if a building is considered beautiful in its own time, this does not *ensure* that age will restore its aesthetic qualities; certain fads never return to style. Yet there are certain aspects of buildings that will always be desirable to the people that use them, such as the availability of natural light and views; in other words, a connection to nature. Perhaps it is for this reason that architect James Wines observed:

> *"People will…never want to keep an aesthetically inferior building around no matter how well stocked…with cutting edge thermal glass, photovoltaic cells, recycled materials, and zero emissions carpeting. The mission [of sustainable design]…is [also] to recover those fragile threads of connectedness with nature." (Quoted in Kellert 94)*

Arguably, nature is something that has remained "beautiful" throughout time within most cultures and societies, and will continue to be considered aesthetically pleasing. This is why acknowledging that aesthetics can come from reconnecting a building to nature is one way to improve its chances of surviving for a long time; the aesthetics of nature are not a "fad" and do not fade with time.

Yet, beauty and aesthetics are not the only contributors to the longevity of a structure, as the people who use the buildings must enjoy being in them. As Simon Unwin, author of *Analysing Architecture*, observes:

> *…architecture is operated by and for people, who have needs and desires, beliefs and aspirations; who have aesthetic sensibilities which are affected by warmth, touch, odour, sound, as well as by visual stimuli; who do things and whose activities have practical requirements; who see meaning and significance in the world around them. (16)*

In other words, a building is an object of human creation, made for them and by them to reach a particular end. Because of this concept, how people interact with a structure, and subsequently how they enjoy the space, is essential to its longevity. Sustainable architecture strives to create a space people love by reconnecting them to nature. As previously mentioned, one of the essential features of sustainable architecture is reconnecting people with the nature around them, and in so doing teaching them about the beauty of the natural environment. Sustainable architecture, then, is an ideal way to create a space that uses a reconnection to nature as a means of creating a comfortable building for people who, by enjoying the structure, continue to use it for an extended period of time.

However, as countless countries have advanced technologically, many people have perceived that they have come to lose touch with the environment and why it is important to respect nature. In his study of sustainability, Rachmawati states:

> *There are two major problems associated with nature problems in the 21st century, i.e. how to create architectural harmony with the environment, and*

> *the maintaining of Natural resources; and how to improve the quality of human life in sustainability. (Rachmawati 2012)*

A building maintains the potential to separate its user from the environment in which it stands, or it can reconnect them to it by existing *with* nature.

However, often this important potential for buildings is overlooked in the design, and the result is that the users feel disconnected from the environment and uncomfortable. Stephen Kellert, author of *Building for Life*, suggests part of the reason behind our detachment from the environment stems from our current and past architecture. He claims:

> *One major cause of alienation from nature has been how we design and develop our built environment…Many contemporary influences have diminished positive contact between people and the natural environment, including forces of destruction and alienation...These and other factors of an increasingly urban culture, at least as conventionally designed and developed, have increased human separation – and even alienation – from the natural world. (Kellert 90)*

This alienation from nature has caused a detachment from the environment that is contrasted to the intimate connection "pre-modern" humans once had. As mentioned earlier, before technological advancement, humans lived as *part* of the environment and this was reflected in their architecture. However, as a species, humans seem to have forgotten the importance of being connected to nature, both

for the sake of the environment and for our own health; and subsequently buildings have become disconnected.

Yet, it has been acknowledged that reestablishing this lost connection would actually improve the mental and physical health of people. For example, a room with natural light and a view can result in a better work environment and productivity than a dark, fluorescently lit room. Kellert states:

> *It has long been stuff of legend and anecdote that parks and gardens exert a beneficial and even restorative and healing impact on people. The many purported benefits of contact with gardens, open space, and park-like settings include rest, relaxation, contemplation, restoration from illness, and spiritual renewal. (13)*

Recently, this concept has been the subject of many studies into the psychology of humans and how interactions with and the accessibility of nature can be extremely beneficial to the mental health of people in the workplace, schools, and even in their own homes. Rachel and Stephen Kaplan, environmental psychologists, suggest: "…the physical and mental benefits of parks, gardens, and open spaces stem from four observed characteristics of these settings: 'coherence, complexity, mystery, and legibility,'" (Quoted in Kellert 15). In other words, these places that embrace nature reconnect people to the environment by creating a place that demonstrates a way of living *with* nature; this is accompanied by an understanding of the complexity of the environment.

Parks and outdoor spaces are more obviously connected to nature as they provide a place outside for people to gather, however, sustainable architecture can also draw both functional and aesthetic inspiration from the natural elements. Nature is the truest example of a system that works; it uses energy efficiently, recycling and reusing when necessary. Within the natural system, there are organisms that occupy specific niches in order to ensure that all nutrients and energy are passed throughout the system repeatedly. As Vallero observes, "Human subtlety will never devise an invention more beautiful, more simple, or more direct than does Nature, because in her inventions, nothing is lacking and nothing is wasted," (25). Similarly, in her book *Biomimicry*, Janine Benyus argues: "…nature presents a workable model for innovation worthy of imitation. The biomimicry model looks to nature as a learning resource rather than merely as a natural resource commodity to be extracted from the Earth," (Vallero 25). To learn from how the environment works sustainably and incorporate these features into architecture helps to reconnect a building to and allow it to exist *within* nature. In addition, this connection and availability of nature to the people working within a building creates in them a sense of comfort and peace; when people like a building, it is more likely to survive.

How a building falls into the spectrum of human emotions is, thus, a significant part of what allows it to survive for a long time. If beauty and aesthetics are such fickle things, the answer to longevity may actually lie in how a building is connected to its environment and, subsequently, how the people who use it feel (in other words, an emotional aesthetic). However, a structure's potential longevity can also

be analyzed based on needs and aesthetics; in other words, how flexible the space is in evolving to fit future needs. As discussed earlier, even in terms of waste reduction, a building's aesthetic, spatial and indoor environmental qualities are significant to its sustainability, for a beautiful and comfortable building is more likely to survive. Sustainability means a building survives and adapts to changing needs and aesthetics. In order to match the shifting lifestyles, it must be flexible and, more importantly, it must create a space that is comfortable for the people using it, while still being connected to the natural environment.

SECTION FOUR
Long-Term Performance

How buildings make people feel may be a more reliable way of ensuring a structure's sustainability than aesthetics alone; but it is still important to acknowledge that "beautiful" buildings also affect a structure's *feel*. Thus, it is essential to also consider a building's aesthetics. However, as mentioned previously, designing an aesthetically pleasing building is not as simple and straightforward a task as one might believe; it is actually quite difficult, as people's perceptions of what is "beautiful" is in a state of near constant fluctuation. Because of this ambiguity, creating a building that lasts is one of the most significant hurdles to sustainable architecture. In order to avoid this obstacle, it is important to examine where past styles have failed. According to Auguste Berque, the author of *Japan's Endemism*, Modernism and Post-Modernism are two textbook examples of "fads" that have come and gone in the world of architectural aesthetics (30). The core idea

between the two styles was the same; the place and environment a structure was in was irrelevant to the design and appearance of the building. Although many people believed that, unlike Modernism, the versatility of Post-Modernism would allow it to continue for ages to come, the reality was that its designs were merely a "fad," and as such, the popularity of the movement dissipated with time. Both the historic preservation movement and New Urbanism grew out of the same rejection of Modernism that generated Post-Modernism; and both movements maintain components that are compatible with sustainable design. Despite what the advocates of the movement believed, the lack of prevalence of them today shows that they did not succeed in moving beyond the realm of Modernism, because in reality space *is* different, as are human cultures and ecological settings; and the sense of space differs depending on location (Berque 30-31). Although these movements maintained popularity and the title of "beauty" for a period of time, they have evolved into a less rigid style that allows for more expression and versatility. This evolution was key to its survival as the previous style of Modernism did not account for evolving human opinions, and something that relies on novelty for beauty will inevitably become obsolete over time.

Although in contemporary societies one tends to be able to find a wide variety of sustainability certification programs for buildings, such as the United States' LEED program, they typically do not analyze buildings for aesthetics. In his book *The Shape of Green*, Lance Hosey argues that in creating sustainable architecture, aesthetics are often sacrificed (3). He compares the importance of aesthetics to the theory of natural selection, where the key is "survival of the fittest." He states:

"…form affects performance, image influences endurance…If it's not beautiful, it's not sustainable," (Hosey 6-7). This idea is the same as the concept that a building can achieve "beauty" again with age; if it is fit enough, it will survive to achieve "aged beauty." Like animals and natural selection, an individual building is not the only deciding factor of its fitness level; this is more or less dependent on the buildings that surround it and its users. Unwin suggests:

> *Architecture always depends on things that are already there; it involves recognizing their potential or the problems they present; it involves, maybe, remembering their associations and significances; it involves choice of site and sharing with others. (44)*

A building must, in order to survive (or be fit) work with the environment in which it sits, which involves being aesthetically pleasing and recognizing the history of a site. In other words, sustainable architecture needs to be connected to nature in more than just its site, materials, and energy efficiency; at its core it must also withstand passing fads and persevere. Like organisms, the perception of "beauty" evolves, and thus architecture must be designed such as to remain pleasing despite the flow of aesthetics. The designs of sustainable architecture, if they are to withstand the ever-changing perception of beauty (and in so doing be considered truly sustainable), they must be more than mere aesthetics; it is as Hosey observes: "Sustainability should *have* style but not become *a* style," (28).

However, the question remains of how this is accomplished. In order to truly understand, one must know what architecture is in its very basic definition, as the practice of designing buildings is not merely a science of engineering. To design a piece of architecture is to create a space in which people will live and interact, work and invent; a building is a place that holds the potential to make people comfortable and happy. Yet, to define what *is* architecture is not as simple a task as one might originally think; much as we strive to define "sustainability," architecture continues to hold new meanings. In fact, Unwin observes: "It is probably fair to say that the matters of the definition and the purpose of architecture have never been settled," (13). At a lecture he gave at the International Design Conference in Aspen, Colorado in 1962, the famous architect Louis Kahn claimed: "Architectural space is a space within which you read how the space is made…" (Kahn 152). In other words, in its very essence, architecture is meant to help you understand what a space is for, not to simply house a specific purpose. In terms of sustainable design, this concept also means that architectural space is one in which people come to understand the environment as well. Rybczynski, author of *The Look of Architecture* (written in 2001), presents the definition provided from the Italian architecture enthusiast Sir Henry Wotton (who was inspired by Vitruvius): "'In Architecture, as in all other Operative Arts, the end must direct the Operation…The end is to build well. Well-building hath three conditions: Commoditie, Firmeness, and Delight,'" (Rybczynski 4). This is the same basic concept presented by Kahn, that architecture is a way to illustrate a structure's purpose.

On the other hand, Unwin believes: "…*identification of place* lies at the generative core of architecture…*Place is to architecture*, it may be said, *as meaning is to language*," (14-15). Architecture is meant to represent its site; it must understand the environment in which it stands and exist within it, not next to it. A structure in and of itself must both protect its users from their environment (as is the essential meaning behind a shelter), while at the same time connecting them to nature. In many ways, architecture is a separate sphere of an environment, one that exists within it but as an observer; it is both subject to elements of nature and protected from them. This is a complicated situation, as sustainable architecture is meant to reconnect people to the environment, yet it must continue to protect them from it at the same time. In this way, "Architecture creates a feeling of a world within a world," (Kahn 227). This concept is typically what allows people to fall in love with particular buildings; if the space creates a feeling of being one with nature in a comfortable way, it often results in peace of mind.

In addition, architecture requires you to "…reconsider the requirements for the nature of the environment which inspires the activity of that institution of man," (Kahn 172). Simply put, a piece of architecture must reflect its purpose, connect to the natural environment, and protect its users. Thus, architecture is, essentially, the creation of an existence that defines a space otherwise undefined; and as such it must be loyal to all its purposes, both to nature and to people. In order to be loyal to the purpose, Hosey claims:

What designers need isn't an ecological aesthetic – it's an aesthetic of ecology, a set of principles and mechanics for making design more responsive and responsible, environmentally, socially, and economically…[there are] three principles that drive the aesthetics of ecology: shape for efficiency, shape for pleasure, and shape for place. These three values – conservation, attraction, and connection – can guide designers to make things more environmentally intelligent, humane, and elegant all at once. (28)

Nature maintains the potential to teach, all people have to do is listen; the purpose of sustainable architecture is, in a way, a demonstration of what is learned when listening has been accomplished.

SECTION FIVE
Hindsight

As discussed earlier, nature provides the perfect template for a system of survivability and reuse. Just as with organisms, buildings are more likely to survive if they work within their particular environment. Like Unwin, Brand also presents a connection to natural processes in a concept he calls "evolutionary design." He states:

There is no 'climax' in ecological communities; irregular oscillation drives the continued self-tuning of the system…The Darwinian mechanism of vary-and-select, vary-and-select has one enormous difference from the process of design.

> *It operates by hindsight rather than foresight. Evolution is always away from known problems rather than toward imagined goals. It doesn't seek to maximize theoretical fitness; it minimizes experienced unfitness. Hindsight is better than foresight. That's why evolutionary forms such as vernacular building types always work better than visionary design such as geodesic domes. They grow from experience rather than from somebody's foresight. (Brand 188)*

Vernacular architecture is an ideal for understanding how sustainability can be accomplished as it often demonstrates intimate connections between nature and buildings, and it also represents the best solutions to past failures. Unwin suggests: "So called 'traditional' architecture is full of places which, through familiarity and use, accord well with users' perceptions and expectations," (15). Traditional architectural works can be models for contemporary sustainable designs if the right ones are examined, as they maintain the potential to provide hindsight into future designs. As Brand observed, hindsight is better than foresight, making it essential to acknowledge and understand the mistakes and successes of the past (188).

In essence, traditional architectural designs are full-scale models that demonstrate ideas that worked and those that did not; therefore why not utilize this past knowledge. In describing important features of their famous sustainable designs, the architects of the Japanese firm Nikken Sekkei (a firm which embraces vernacular design) observe that sustainable architecture in the contemporary world has begun to shift into designing a building such that it brings nature in; a design

technique that is also found in the traditional structures of Japanese architecture (Maki 10). Although it may seem that this firm looks to traditional Japanese architecture specifically because the it is based in Japan, in actuality, vernacular designs of Japan are excellent case studies of sustainability. All vernacular designs are specific to the environments in which they developed because ancestral humans were in far less control of the elements than we are today. However, in Japanese traditional architecture in particular there are numerous examples of sustainable features and construction methods that could be adapted and used in contemporary designs. Traditional Japanese designs, therefore, provide valuable insight into vernacular sustainable techniques and are subsequently worth acknowledging and exploring.

In traditional Japanese architecture, a connection to the environment was demonstrated through the designs, which were also loyal to their purpose (in other words, the design and space reveal to the user the building's purpose). With regards to their residential architecture, author Kevin Nute states: "Whether the Japanese house is right or wrong in its plan and construction, it answers admirably to the purpose for which it was intended…the Japanese dwelling is in every bone and fibre of its structure honest," (37). In other words, there is little ornamentation for the sake of ornamentation; the house represents its purpose, which is to be someone's home and shelter. Traditional Japanese buildings have certain desirable qualities in common that can help us evolve a modern sustainable approach to architecture. Maki states:

> *Traditional Japanese buildings offer superb examples of what we are trying to achieve in our buildings for the new century and the future. Their underlying principle is amity with the environment. They are close to nature and tailored to local conditions in ways that provide comfort with minimal energy consumption. (22)*

As a country of limited resources and one that was, at points during its history, closed to outside influences, Japanese craftsmen were able to produce a design template that worked sustainably. Although in many contemporary civilizations we rely mostly on technological features to provide comfort indoors, traditional designs accomplished similar effects through natural means. In accordance with the view that hindsight is essential to successful sustainable designs, it makes sense that exploring the design methods of traditional designs such as those found in Japan offers the potential to improve contemporary architecture.

CONCLUSION

Sustainability is not merely defined by a word or a sentence; it encompasses a process of thought and construction, a consideration of site, environmental features, human interaction, and how this all affects the longevity of the building. A "sustainable" building is, then, one that utilizes the natural features of a site without exploiting them, as well as incorporating materials that are healthy for both the local ecosystems and humans. The building must also demonstrate a respect for the

people that will interact with it, allowing them to feel comfortable and happy within the space. Lastly, and perhaps most importantly, the building must be able to survive long enough for its carefully considered sustainable characteristics to make a difference in energy consumption, resource conservation, and waste reduction. The longevity of a building is also dependant on how difficult or easy it is to adapt to future changes. According the core concepts of LEED building design:

> *Flexibility and adaptability are increasingly important attributes of green projects…Green Projects must be prepared to adapt to future changes and be designed and operated to stand the test of time…Designing a project to meet both current and evolving needs is one key to sustainability. (Green Building 11)*

Hindsight can inform how a building will interact with its environment and is the best method for which to create a sustainable structure. Thus, a sustainable building is one that exists harmoniously within its environment while still allowing its users to feel comfortably connected to and protected from naturally occurring features; it is also flexible enough to survive for an extended period of time, and in so doing reduce waste and increase reusability.

CHAPTER TWO:
The Sustainability of Traditional Japanese Architecture

INTRODUCTION

The previously established definition of "sustainability" revolves around a connection to nature and local environments, which, subsequently, entails that people must then be able to *feel* this relationship through the architecture itself. Although the concept of sustainable architecture has only recently begun to gain momentum, Japanese architecture has historically demonstrated an understanding of this important environmental connection. In Japan, the sustainability of traditional architecture either resulted from climatic and topographic conditions (such as the use of certain materials), or from specific cultural preferences (such as particular forms). Regardless, the techniques and designs of traditional Japanese architecture demonstrate a relationship with the environment that is different from those seen in other vernacular styles. According to the French author Auguste Burque, the Japanese have developed a unique and organic relationship with the land on which they live, a term often referred to as *fūdo* (風土). Fūdo is a direct result of topographic conditions, as Japan is a small mountainous country of islands, and land is therefore limited. In addition, the borders of Japan were closed to foreign countries for two and a half centuries, isolating it from outside influences. Burque claims that it is this understanding of the limits of space that have allowed the Japanese to, traditionally, maintain a connection to the environment (Burque 25). Whether it is for cultural or environmental reasons, Japanese traditional

architecture demonstrates a respect for and connectedness to naturally occurring features of the environment.

Yet, it is evident in specific traditional Japanese garden designs (such as tea gardens and courtyard gardens), that although there is a connection to the environment, what the people desire is not untamed nature. What is seen, especially within city homes, is a manipulated, manmade representation of what occurs naturally in the environment. This is the "nature" that is seen throughout many aspect of traditional Japanese design, and although it is a manipulated form of untamed nature, the style still demonstrates an acknowledgement of the importance of accessing the idealized qualities of the outdoors, even in a busy city. Traditional Japanese architectural forms and designs are representative of both cultural preferences and their distinctive relationship with the natural environment. This unique relationship is illustrated through various aspects of traditional design, such as the use of natural light, their representation of nature in gardens, natural ventilation, flexibility of space, and material selection.

SECTION ONE
Natural Light

Natural light is essential to the mental health of people as it often creates a feeling of peace within an architectural space, if presented correctly. According to the architect Louis Kahn: "The lighting of the room must stem from its very structure,'" (343), which essentially implies that in the design process itself, an architect must understand how light will play inside a space. How light is presented

in a room, or the availability of light, is essential to the comfort a space allows its users. In terms of sustainability, sunlight plays an important role in not only in the disposition of those utilizing the building, but also in energy efficiency and the structure's internal climate control system. Brown presents the concept of "good" light, which he claims "…means having an interesting continuum from light to dark, that lends the brighter spaces a special presence and beauty," (212). People, as discussed earlier, are drawn to light; they will always choose a well-lit room over a dark, windowless one because it affects their demeanor in a positive way. Christopher Alexander, author of *A Pattern Language*, observes:

> *People are by nature phototrophic – they move toward light, and, when stationary, they orient themselves toward the light. As a result the much loved and much used places in buildings, where the most things happen, are places like window seats, verandas, fireside corners, trellised arbors; all of them defined by non-uniformities in light, and all of them allowing the people who are in them to orient themselves toward the light. (645)*

Natural light positively changes the demeanor of a room and its users, and its availability within a space often causes people to be drawn there. The sun is thus an essential feature to the feeling created by a room, and the subsequent comfort it provides.

However, providing the appropriate amount of light in the changing seasons as well as differing times of the day is something that requires specific design

techniques, especially in vernacular design where technological climate control systems were not available. In traditional Japanese architecture, this hurdle was overcome in various ways by providing the ability to filter out the sun when necessary, and allowing people within a room to sit anywhere depending on the amount of light (Figure 1). In a typical tatami-mat room, there were minimal furnishings and people simply knelt or sat on the floor. This design feature made it easy to move according to the time and season in order to feel the appropriate amount of sunlight and subsequent heat. In addition, sliding doors allowed a room's users to block the sun completely if it were to be too hot within the space. In many cases, there was more than one sliding door within a tatami room, which could be opened to allow for the entrance of light; this feature also provided the option of having the room lit from either one or two sides. This is a valuable design feature, as lighting a room from two sides is essential for further increasing the comfort of the people within. Alexander states: "When they have a choice, people will always gravitate to those rooms which have light on two sides, and leave the rooms which are lit only from one side unused and empty," (747).

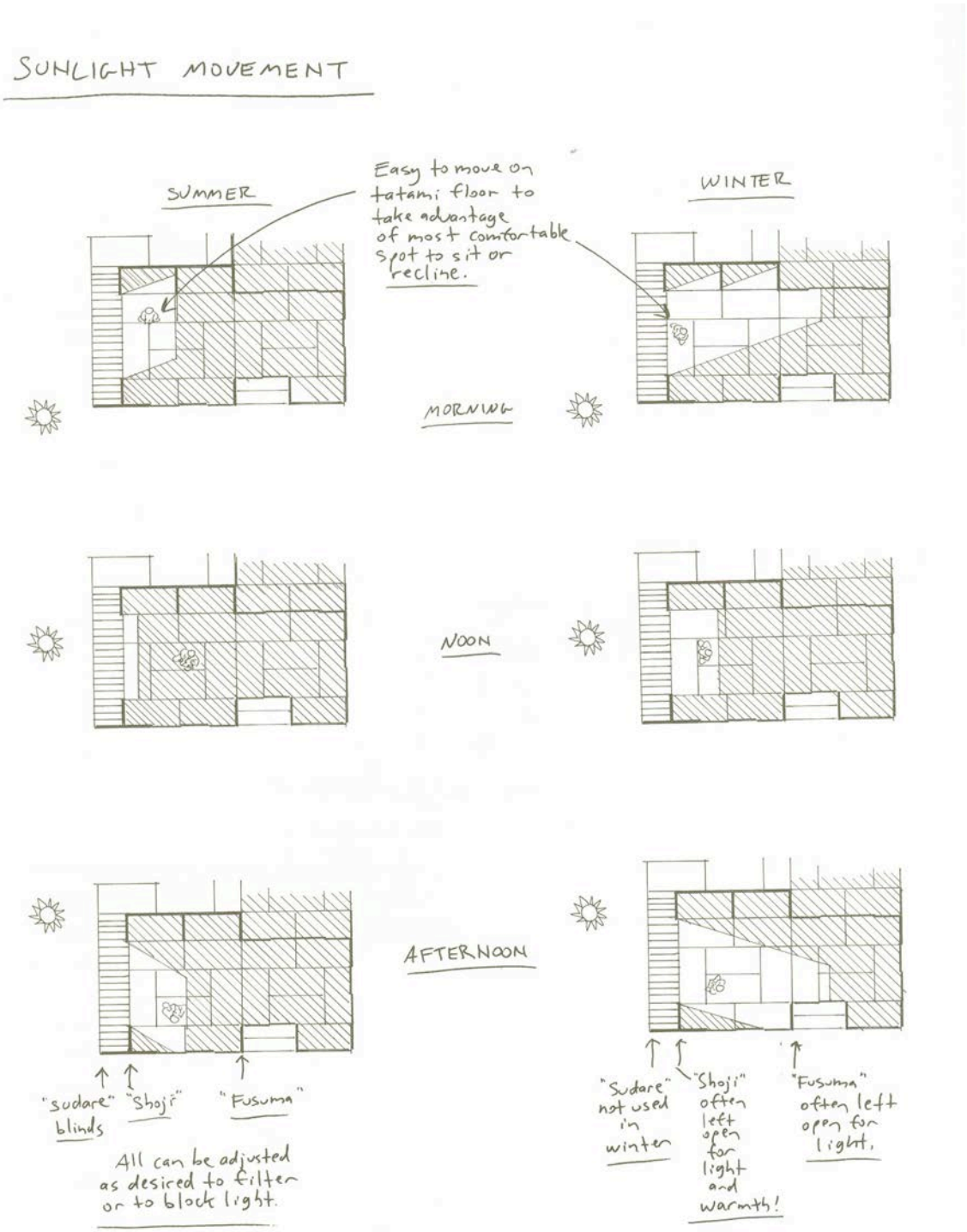

Figure 1
Different lighting conditions within a traditional tatami-covered Japanese room as the sun moves throughout the day (Harada 194)

However, in Japanese climates, especially in the summer, heat gain is not desirable, and allowing excessive sunlight to enter an already hot and humid room is not ideal. When too much light is allowed to enter a room, there is the potential for overheating. The presence of sunlight in a room contributes to the comfort of its users not only through the beneficial qualities of natural lighting, but also through climate control, or more specifically, heat. Maki claims:

> *The first step towards creating buildings that use natural energy is to prevent heat entering and to block sunlight…Japanese traditional buildings tend to emphasize sunlight blocking, while allowing air to pass through the structure. (23)*

In the flexibility built into the very forms of traditional designs, Japanese architects utilized numerous passive methods of modulating the amount of sun and heat that could enter a room and, subsequently, controlled the comfort of a space (Figure 2). The flexibility of the space in these traditional Japanese designs allowed the users to choose; a room could be lit from two sides, one, or not at all. This preference for the amount of light entering a room was most often a result of the current season, as in the absence of technologically controlled climate systems the availability of solar radiation was the main method of climate control and interior light.

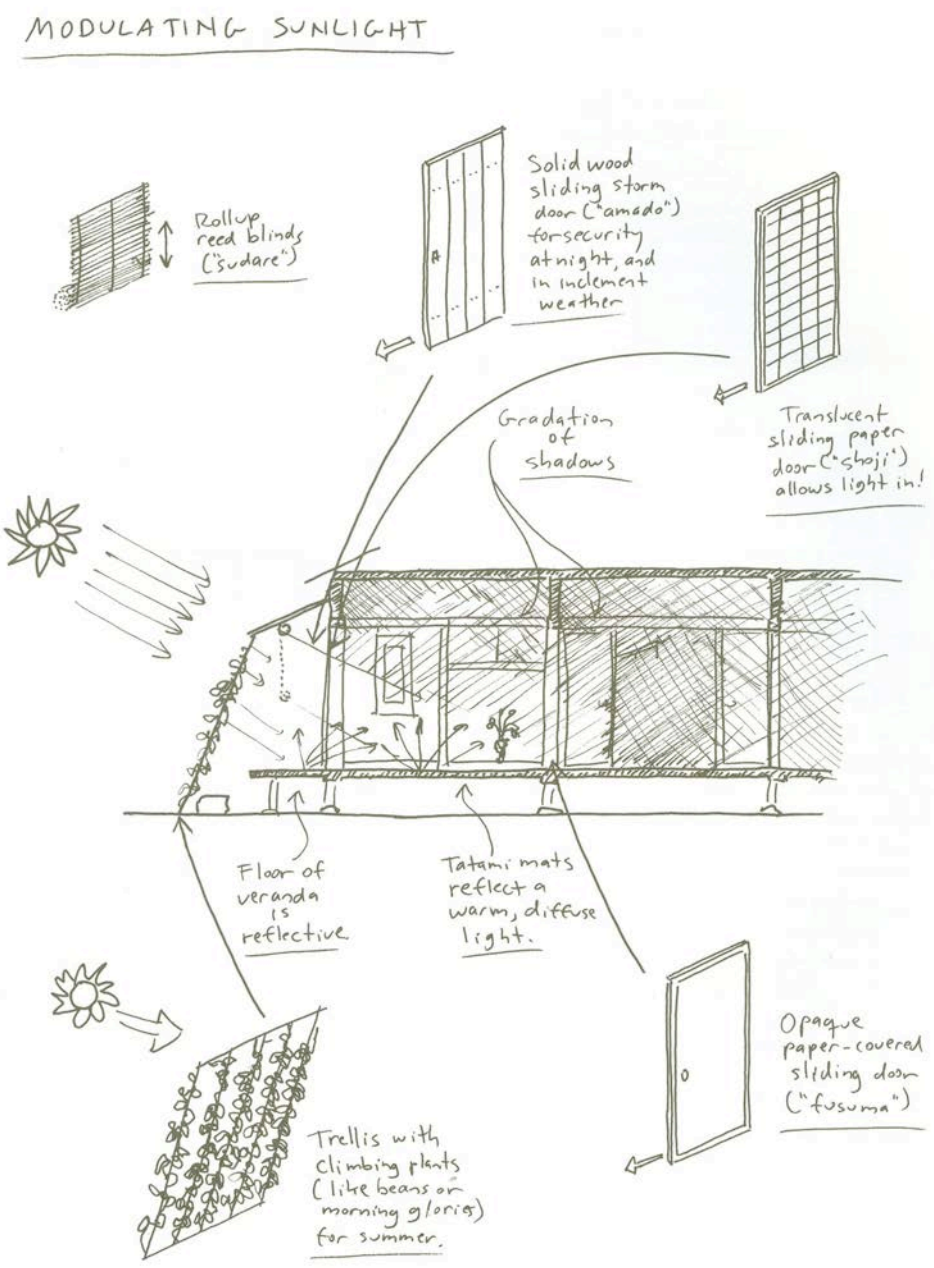

Figure 2
Traditional Japanese architectural techniques to modulate the amount of sunlight allowed to enter a room (Harada 193)

Sliding doors that could be opened and closed were not the only method used in traditional Japanese design to control the climate of a room. In order to accurately modulate sunlight, Japanese designers used an assortment of techniques to ensure that the ideal level of comfort was reached. Natural shading features such as deciduous trees, bushes and vines were common elements seen in traditional design. These features were useful as, after being planted around the building, they would block sunlight while they maintained leaves in the summer, and allow more to enter after their leaves had fallen in the winter (Maki 23). This allowed for more heat energy to enter the rooms at the appropriate seasons in a passive design that utilized natural features. In addition, such features as rolled up reed blinds called *sudare* (簾), sliding doors (either opaque or translucent), and latticed shutters known as *shitomi* (蔀) were utilized (Maki 23). The blinds were made of natural materials and they were used both for privacy and for protection against the elements. Architects also utilized deep eaves that would keep sunlight out of the room in the summer due to the angle of the sun at such times. This is a method seen in sustainable architectural designs today in the form of roof overhangs, shading louvers, and awnings. In order to use this method properly such that it blocks the proper amount of light during the warmer seasons and times of the day, intricate knowledge of a location's solar angles is required. Today, various technologies and solar angle calculators exist to determine the calibrations, however, Japanese designers understood the solar angles of their environment enough to design deep eaves for solar shading.

Traditional Japanese architects had a wide array of techniques they utilized as a means of properly lighting rooms as well as controlling the climates within. This demonstrates, as previously stated, a way of living with one's environment that requires knowledge of how it works and how it can be used to benefit the comfort of people using a building. The combination of these various techniques created a comfortable environment within which natural light was available without overwhelming the interior with heat. In Japanese traditional architecture, designers demonstrated an understanding of the importance of natural lighting and how to use various passive techniques to benefit from both the light and heat provided by the sun. This further supports the argument that Japanese traditional designs maintained an intimate relationship with their surroundings and demonstrated an understanding of the natural environment around them such that they could exist *with* nature.

SECTION TWO
Nature and Gardens

In their traditional architecture, Japanese carpenters often found ways to connect a building to nature either in a subtle way, such as with natural ventilation and material selection, or more visually with certain architectural features such as garden designs. One such feature the Japanese used to connect their buildings to the outdoor elements was the *engawa* (縁側), which was essentially a kind of veranda (Figure 3). This feature was wrapped around a building and was open to the

elements, while still maintaining a view of the surrounding nature or garden. Kuma defines the engawa as follows: “In the traditional Japanese house, this is a board-floored area projecting from the perimeter of the house, also serving as an entrance,” (Kuma 49). Through the engawa, one is able to appreciate the outdoors, even if the natural features they are viewing have been put in place by man.

Figure 3
Example of an *engawa* (veranda) at Shusui-Tei in Kyoto City, Kyoto.

Perhaps more widely appreciated elements of the Japanese connection to nature are the traditional garden designs, mostly those of the aristocratic class such as tea gardens, and more common-use courtyard gardens. Japanese gardens are particularly unique, as they maintain features that are representative of naturally occurring elements of the environment, but tend not to feature untamed wilderness. This concept is not entirely different from Western gardens, which are characterized by perfectly manicured flowers, bushes, and trees. However, where Western gardens often feature exotic plants, traditional Japanese gardens are representative of what exists naturally, only on a smaller, more controlled level. This is the concept of a "mini world," which represents characteristics that naturally occur within the physical environment. Instead of altering the nature around them, Japanese garden designers created features that mimicked their country's beauty. These traits were often found in places where they did not occur, such as cities, where architects sought to recreate a miniature version of the beauty that occurred naturally in their country. For example, a rock within a Japanese garden does not merely represent a rock; it is an allusion to the grand mountains that prevail over the majority of Japan. As an island country, it is not surprising, then, that in Japanese traditional design a key component to most gardens was water, often in the form of ponds. These ponds, although controlled and manmade, were representative of the oceans that surround the country. Just as in life, water was an indispensible element in Japanese gardens and lifestyles, and therefore was typically included in the designs.

Traditional gardens in Japan maintained a unique relationship with wild nature and what people desired from the outdoors. As Japan is prone to numerous

dangerous natural disasters, it is not surprising that they acknowledged the unpredictable qualities of the natural environment. However, this understanding did not prevent them from embracing the positive characteristics of their country or stop them from seeing the beauty in natural features. Despite its strength and destructive power, nature is undeniably beautiful and systematic; there is, in other words, order in the chaos. Bring states: "The Japanese garden is a vision of ideal nature, one that intentionally gives an impression of order, harmony, and balance," (Bring 183). This harmony is translated into a sense of peace and comfort to those who experience it. The history of tea culture plays a significant role in traditional garden design. As the tearoom gradually transformed into a room detached from the main building, tea gardens found their place in Japan (Tanaka 15). These gardens provided a backdrop for the path that ran through nature on which people could "detach" themselves from "civilization" as they made their way to the secluded tearoom. Because of this purpose, Japanese traditional gardens create a certain sense of being *in* nature, while still walking through something that is artificially made. This dual character was what created the juxtaposition that defined the design of tea gardens, and subsequently is seen in a variety of Japanese garden designs.

This concept of a juxtaposition to create a feeling of comfort is reminiscent of *wabi*, an aesthetic originally developed through tea culture. *Wabi* is an aesthetic based in the wisdom of Zen, with the philosophy that everyday activities serve as training opportunities to achieve enlightenment (an ideal stage in which one can live fully and peacefully, while being unaffected by worldly matters). *Wabi*

architecture, then, is a proper design of space for everyday activity while still being attached to a more meaningful purpose (Tanaka 25). The conditions of *Wabi* architectural space (compact, dimly lit rooms surrounded by basic natural materials and construction) allow for detachment from worldly matters, reflection, and attainment of inner peace (Tanaka 28). An example of *Wabi* architecture is Tai-an by Sen no Rikyū (千利休), one of the great tea masters of Japan, which was a 2 tatami mat tearoom (Figure 4). In Tai-an's construction, Rikyū included both raw earth (wall covering) and raw fire (hearth), thus creating a psychological return to the primitive shelters of man, which were no architectural masterpieces. His quest was to create a space that could return to the origin of human dwellings; the miniscule space did this consciously, the fire and earth did so unconsciously. This was the creation of an appreciation for the basic needs of man, which developed into an aesthetic. Rikyū's *Wabi* Tea was meant to share a moment of one's life and understanding of something with guests by means of tea. This style illustrated a design that was loyal to its purpose and remained free from the constraints of the architectural rules and styles that existed at the time.

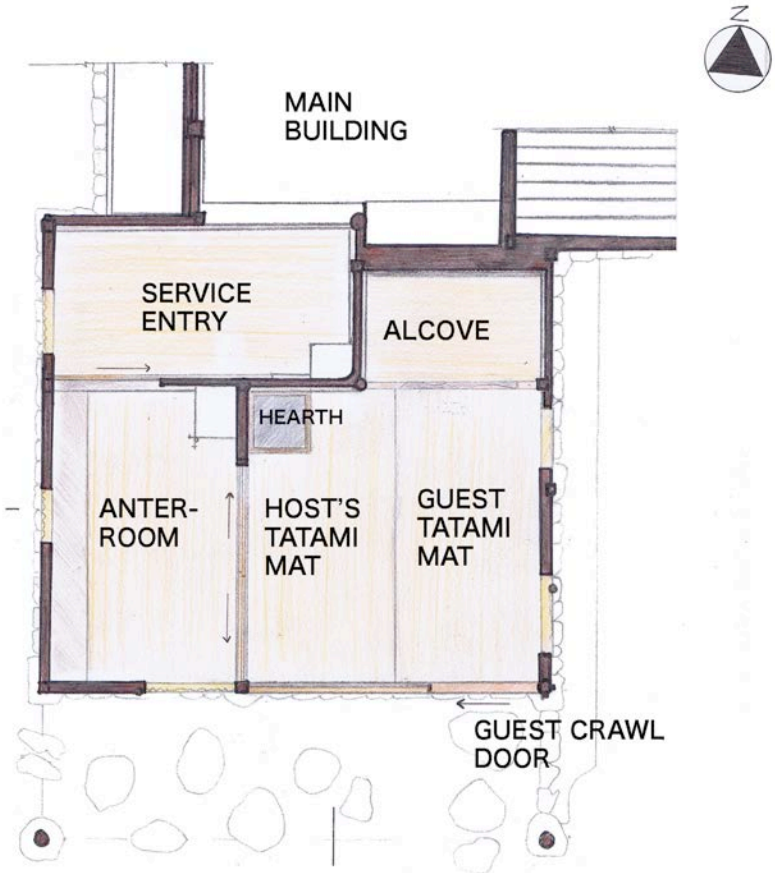

Figure 4
Exterior photo and floor plan of Tai-an (待庵), a small *wabi* tearoom by Sen no Rikyū (千利休) built in the Azuchi-Momoyama (安土桃山時代) Period (1573-1603)

Wabi is, thus, a juxtapositional aesthetic that works as both a connection to nature, and a reminder of the origin of humans, which in turn allows one to *truly* appreciate the beauty in ordinariness. Glynis Berry, author of "Nature and Architecture in Japan," claims that within Japanese culture,

> *Juxtapositions of artificial and natural objects are not abhorred, but are considered natural…the Japanese look to the sensual, visual, and spatial symbolism of their gardens as a reminder of the ideal life in nature and as a mental refuge from the pettiness of normal living. (1)*

This is where *wabi*, the aesthetic and the architectural style, found its way into the design of gardens.

As a means of guiding one from "civilization" to the secluded teahouse, Japanese gardens were typically enclosed and featured stepping-stones, known as *tobi-ishi* (飛び石), as the choice of path marker (Figure 5). In addition to creating a sense of mystery, they also minimized the environmental damage to the surrounding mosses. Kuma observes: "Stepping from stone to stone. When your progress is defined by the spatial rhythm of the stones, you are naturally led into a separate realm," (Kuma 86).

Figure 5
Example of the stepping-stones in the garden at Koto-in, Daitoku-ji in Kyoto City, Japan

However, Japanese gardens were not always enclosed settings meant to represent the larger aspects of the country's landscape; they also evolved with time. During the Heian (平安時代) Period (794-1185), a new (to Japan) technique of garden design emerged called *shakkei* (借景), or borrowed landscape. This method was just as it sounds: the gardens utilized the already in place beauty of the surrounding landscape to bring more to the design. Kuma states: "Shakkei is a method of garden design that brings the surrounding scenery into the garden as if it were a part of the design," (Kuma 118). Just as sky and light are essential features of a garden, shakkei maintained the belief that "Japanese gardens are not complete in themselves. They

tell us that all the mountains, sky, and the universe as a whole are an extension of the garden," (Kuma 118). This is especially clear in the shakkei garden of Shūgakuin Imperial Villa in Kyoto City, Japan (Figure 6). Shūgakuin Villa utilized water, plants, stepping-stones, mountains, rice fields, and of course the sky to create an extensive shakkei garden. Although these features are mostly "borrowed," they still *feel* as if they are a part of the garden itself.

Figure 6
Example of a *shakkei* (borrowed landscape) garden at Shūgakuin Villa in Kyoto City, Japan

While it might seem odd to include rice fields among the otherwise naturally occurring features of the surrounding landscape, they were considered to be part of the "picturesque" landscape sought by aristocrats who did not view them as "work" as much as "quaint" (Berque 69). The design of the garden at Shūgakuin demonstrates not only a respect and understanding of the natural beauty of the landscape, but also the cultivated, man-made landscape. The fact that rice fields were accepted as part of nature in the borrowed landscape designs is but another indicator that, in traditional Japanese architecture, manipulated and manmade environments were also considered nature and beautiful. This feature of the shakkei gardens essentially defines the style of garden design as more of a cultural preference for a particular form than a sustainable feature. However, the appreciation for elements of the landscape that are naturally occurring illustrates their understanding of the wonders provided to them by said environment.

Many Japanese traditional gardens drew inspiration from the concept of Chinese geomancy, which is an "aesthetic science dealing with positive management of the landscape in accordance with hidden forces within the earth," (Bring 3). As mentioned earlier, the gardens allowed for a connection to the naturally occurring landscape, regarding which Brown observes: "The Japanese garden is a selective model of nature, in which the primary elements of natural systems are integrated and allowed to interact with the surrounding environment," (207). The interpretation, representation, and recreation of nature in a miniaturized, manipulated form are key parts of many traditional Japanese designs. Gardens are, as Brown observed, an undeniable model of how traditional Japanese architects

appreciated and incorporated controlled representations of the features that occur naturally in the environment into their designs.

SECTION THREE
Natural Ventilation

Traditional Japanese architects also designed their buildings such as to take advantage of the natural flow of energy. In other words, buildings were designed such that air was allowed to flow through them naturally to help control the climate within. Many traditional architectural techniques demonstrate this knowledge of natural ventilation through a building, however, one particularly good example of this design is the typical townhouse, or *machiya* (町家), of Kyoto during the Meiji Era (1868-1912). These homes were designed to allow for air to flow through the entire first floor. This characteristic, subsequently, helped to keep the building cooler during the hot, humid summers experienced by Kyoto. Regarding this style of building, Brown states: "…these townhouses are models of natural climate control for high density urban areas," (125). For the purpose of air flow through these typically long buildings, Japanese carpenters developed a corridor stretching from the front to the rear of the townhouses called a *tōriniwa* (通り庭). The tōriniwa was a feature that was not quite of the interior, but also not exterior, as it was on the ground level and ran from the front to the back of the house, typically constructed of dirt or stone (Figure 7).

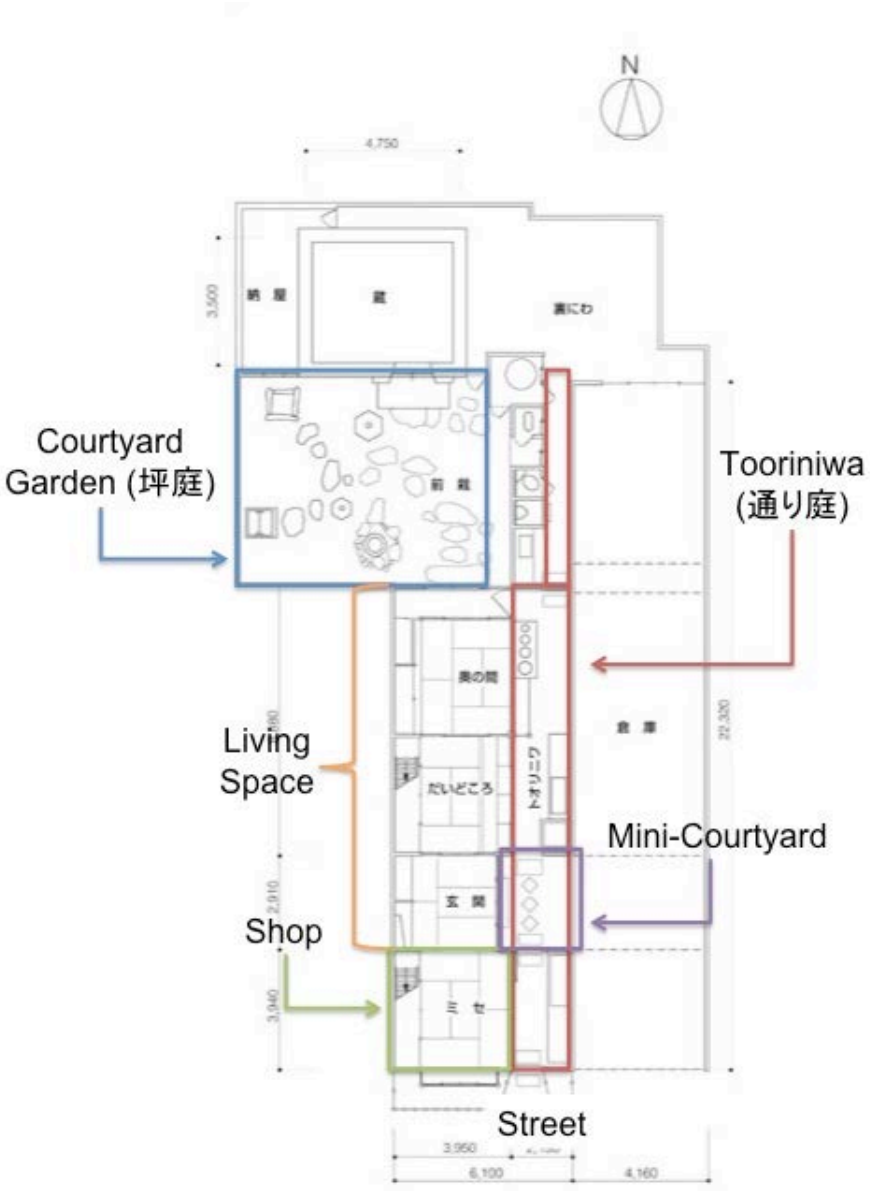

Figure 7
Sample floor plan of a typical Kyoto Townhouse. This is a plan of a *machiya* called *Shijo Kyomachiya* in Kyoto City, Japan

Kuma defines the tōriniwa as follows:

> *The tori-niwa is an earthen-floored corridor that leads from the front to the rear entrance of the home in the urban residential architecture known as machiya. It has skylights and high ceilings. The tori-niwa creates cross ventilation and, because it is roofed over, it helps keep the house cool in the summer. (47)*

In order for this long hallway to circulate cooler air, it was customary to spray the street in front of the house with water, thus lowering the temperature of the air around it, which could then enter the home (Maki 23). This practice is known as *uchimizu* (打ち水), and is still used by some homeowners today in Japan. This is a traditional example of the contemporary sustainable technique of evaporative cooling, which is considered to be a very energy efficient form of air conditioning.

In addition to the tōriniwa, the townhouses maintained an inner courtyard that would allow the air to escape, thus completing the energy flow loop. This inner garden and courtyard was known as the *tsuboniwa* (坪庭), and it not only completed the flow of energy through the house, but it also brought nature to the typical city home (Figure 8). According to Brown, tsuboniwa "…perform a critical environmental control function, providing a continuous supply of naturally cooled air that is drawn through the rest of the house with the slightest breeze," (125).

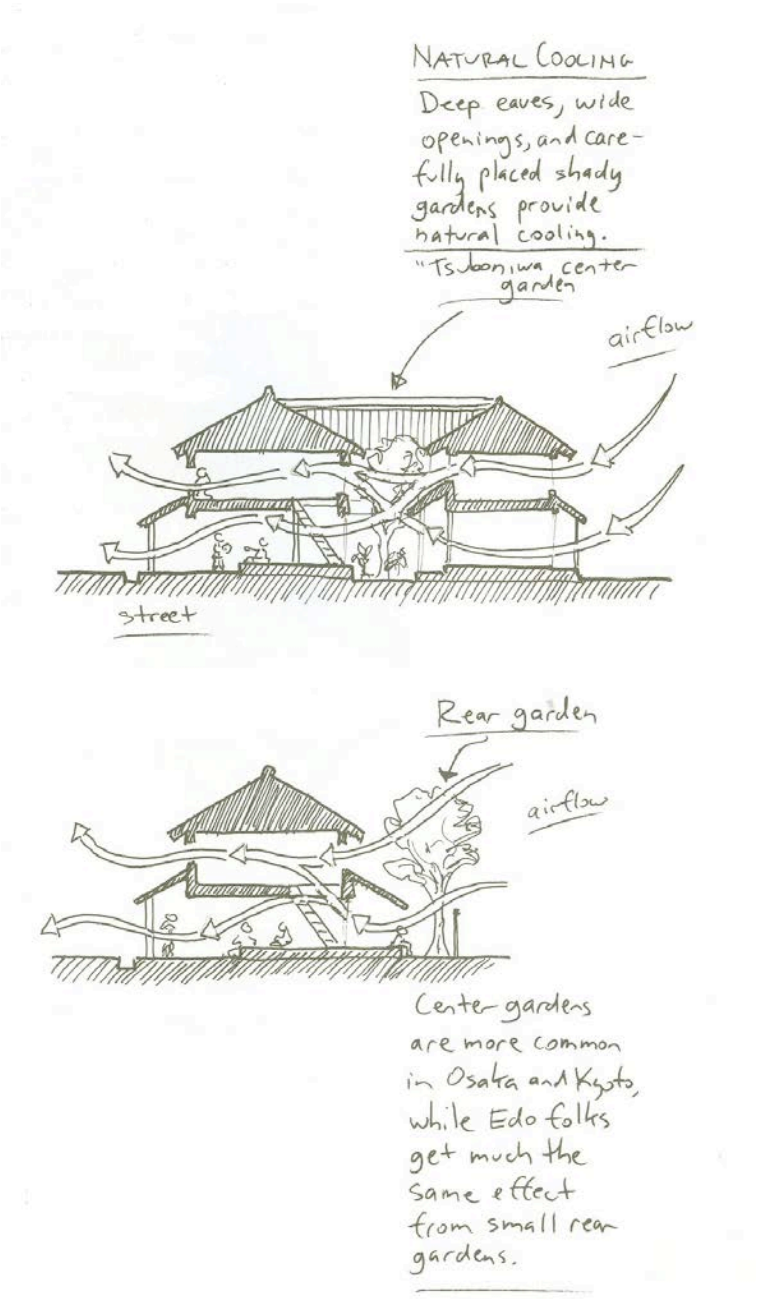

Figure 8
The natural cooling system of the typical traditional machiya (townhouse) designed to allow for the passive flow of energy (Harada 114) - "Edo" refers to modern-day Tokyo

Brown goes on to say: "The tsuboniwa also links the living space on the second floor into the overall air circulation scheme, so that with the deft use of sliding doors and shutters it becomes a highly controllable bi-level cross-ventilation system," (125). Even when utilizing such unpredictable natural features as wind, Japanese architects in their traditional townhouse designs mastered a way to control how the air flowed through their homes.

The tsuboniwa itself, as mentioned earlier, is also a means of bringing natural features of the landscape to the crowded lives of the city dwellers (Figure 9). Kuma describes the tsuboniwa as "A world in miniature," (116), as the garden it maintained was a significant feature of the machiya design. As Teiji Itō, author of *The Elegant Japanese House*, observes: the tsuboniwa is "…an extension of the interior spaces that open upon it," (140). If this is indeed the case, then the tsuboniwa would be what Alexander would classify as an outdoor room, which he suggests is needed everywhere: "It is hardly too much to say that every building needs an outdoor room attached to it…" (765). Although people have come to live mostly indoors, we still crave fresh air and nature, in any form. Alexander is correct in his assumption then that to bring nature in any form to people is a desirable feature. Although an outdoor room or tsuboniwa are rather manipulated environments (and perhaps do not represent the unpredictable qualities of untamed nature), they do accomplish the goal of bringing something more than what merely having windows can bring: fresh air, vegetation, sunlight, and a *feeling* of being outside.

Figure 9
Tsuboniwa (inner courtyard/garden) at *Shijo Kyomachiya*, Kyoto City, Japan

The tsuboniwa represents a smaller, slightly more enclosed version of the typical Japanese garden design. In its layout, the importance of natural light is also taken into consideration, as in its composition it takes into account both seasons and light availability. Itō claims: "To prevent obstruction of light and air, planting in garden spaces like these is generally limited to a few deciduous trees and smaller flowing plants and shrubs,"(140). However, more than anything, the tsuboniwa is a demonstration of how Japanese architects came to understand the calming features

of nature, and thus designed a townhouse in the midst of a busy city that can bring nature to the inhabitants. As Itō expresses:

> *The cooling shade of summer foliage, the bright colors of flowers, and the splendor of autumn leaves bring to the surrounding rooms something of the annual pageant of nature. In winter the shadows of bare tree trunks and branches falling on the translucent white paper of the shōji have a quiet charm of their own. (140)*

Even as the seasons change, the tsuboniwa brings the beauty of nature to a machiya, which in turn creates a feeling of comfort within the home. This demonstrates not only an understanding of the importance of allowing the natural flow of energy to cool a home, but also represents a connection to nature and the environment itself.

SECTION FOUR
Flexible Space

Traditional Japanese rooms have a tendency to feel empty to Westerners who are accustomed to relying on the contents to reveal the function of a space. For instance, when someone walks into a kitchen, they know it is a kitchen from the utensils and equipment; when they walk into a living room, they know it is a living room from its décor. However, with traditional Japanese rooms, there was typically limited furniture, if any, and it would mostly consist of a low table and possibly some kneeling pillows. These tatami mat rooms were ones in which the users would

simply sit on the floor around a table. Even the beds, or *futons* (布団) would be taken out when the time was right for sleep and placed on the floor. Although this custom may seem odd and perhaps even inconvenient to Westerners, this building technique is the epitome of a flexible space.

In many cases, these spaces would be very large, and could be further divided into smaller rooms via *shōji* (障子) screens, which are essentially sliding doors made of bamboo and rice paper (Figure 10).

Figure 10
Shōji sliding doors at Shūgakuin Villa in Kyoto City, Japan

However, shōji screens did not just separate the space, they also, with their semi-translucence, controlled the light within a room. In addition, shōji screens allowed a room to easily be either open or closed to the outside environment. Maki states: "Shōji screens are a traditional way of drawing light in and dispersing it throughout a room. The appearance of the screens varies with changing patterns of daylight and shadow, creating a sense of connection between interior and exterior," (23). Shōji screens truly exemplify the Japanese traditional understanding of the importance of a connection to nature as well as space flexibility, as they are also removable. Maki observes: "By removing the shōji screen in summer, we can enjoy an open air atmosphere. When the shōji screen is in place, we can appreciate the soft sunlight it provides," (23). This is the concept known as *ireko*, and it entails that a particular special zoning connects the interior more readily to the exterior and, subsequently, the natural elements (Maki 23).

The ability to separate and open space within a building is what truly makes these traditional structures uniquely flexible. Alexander observes that other such separations can be accomplished via changes in ceiling or floor heights, as well as through the physical separation (such as shōji). He goes on to say: "A building in which the ceiling heights are all the same is virtually incapable of making people comfortable," (Alexander 877). This idea is true for floor heights as well, as both are essentially two means to the same end. Alexander reduces this technique to a theory that the height "…should be related to the length and breadth of the room" because this creates the proportions that result in a feeling of comfort (877). With regards to Japanese architecture, he observes:

> *In traditional Japanese architecture, this idea is captured by a simple rule of thumb. The ceiling height of a room is 6 feet 3 inches + (3.7 X the number of tatami in the room) inches. This creates a direct relationship between floor area and ceiling height. A very small room (3 mats) has a ceiling height of 7 feet 2 inches. A large room (12 mats) has a ceiling height of 9 feet 11 inches. (Alexander 878)*

This relationship to the floor area is what creates the proportions Alexander observes as being those that allow people to feel comfortable.

In addition to the variation in ceiling height to separate space, traditional Japanese architecture (and even some Japanese homes today) feature changes in floor height, which are often accompanied by shōji or *fusuma* (襖), opaque sliding doors. A particularly good example of such space separation is the previously mentioned machiya (townhouse), where the interior included both public and private space as well as an interior courtyard. As discussed earlier, the tōriniwa (long hallway) in the machiya was considered to be partially exterior and interior, and was as such a fairly public feature. In order to represent the public nature of the tōriniwa, it featured a double height ceiling, whereas the store and living space had lower ceilings. In addition to changes in ceiling height, machiya featured variations in floor height. The tōriniwa was on the ground level and, as it was typically composed of dirt or rock, one was expected to wear shoes while using it. However, the shop and living areas were raised about one-to-two feet off the ground and

included a small space between the tōriniwa and fusuma on which one could remove their shoes and put on slippers. This transition existed mostly because one is never to wear shoes on tatami mats, as they may potentially damage them.

There are a number of reasons as to why the living space would be raised above the level of the tōriniwa, other than to serve as a means of dividing the space. One such incentive is that, within a tatami room, people are expected to kneel or sit on the floor; there are no chairs. Due to this custom, it might be uncomfortable to have a person enter a room in which one is kneeling, as they would be standing and peering over one in a domineering manner. This is also why, in Japanese tradition, one must kneel as they open a fusuma (opaque sliding door) and enter a room. Another reason behind the raised floor system is for climate control; having space for air to move under the floor can help keep a room warmer in the winter.

Variations in ceiling and floor height not only provide further division within a building without the use of doors and walls, they also, in the case of Japanese tradition, represent both cultural preferences for form as well as a natural method of climate control. These various methods of enclosing and separating space are in some ways cultural, but they are also practical, as they evolved as a result of environmental features. Whether for cultural preference or practicality, traditional Japanese space has proven to be flexible and comfortable by using methods of dividing space other than simply installing walls. Yet, for the sake of contemporary sustainable architecture, acknowledging how this design system developed is perhaps equally as important as understanding it existed. Perceiving *why* a style developed demonstrates how contemporary design may evolve similarly.

In the history of Japanese aristocratic architecture that arose in the 10th century, there originated a style known as *shinden-zukuri* (寝殿造). The style itself drew inspiration from the prehistoric Yayoi raised-floor structures that were based on Chinese farming houses located near the Yangtze River (Tanaka 4-6). The shinden style consisted of a variety of "luxury" features that, not surprisingly, were found to be inadequate at providing a comfortable living space. The shinden style sought an intimate connection to the elements; however, its particular design features were not suited to providing a comfortable living environment. For example, instead of walls, the shinden style maintained wooden awnings that left gaps allowing wind to enter the building, causing it to be too warm in the summer and too cold in the winter. In addition, the style featured wooden floors and no ceilings, which, like the lack of walls, allowed for undesirable wind intrusion. The use of cylindrical columns prevented the accurate match-ups of sides seen in the Japanese joinery system of later styles, and this too allowed for intrusion of wind. Finally, the interior lacked proper dividing features, as typical techniques included bamboo or cloth screens. These features, of course, did little to provide the users with privacy in the typically expansive interior of the structures.

The shinden style, however, was not the typical architecture used for the average person, it was a luxury style for the aristocratic class. Therefore, as generally shinden was used for the vacation homes of aristocrats, issues with the designs were not necessarily significant. The concerns of the elite were often symbolic; it was not necessarily about comfort as much as it was about showing off one's power and prestige. In addition, as an architecture style influenced by Chinese

models, the shinden style did not necessarily complement Japanese needs. Regardless, even in a vacation home one desires to be comfortable within a space, and it is because of this that the design of shinden gradually evolved into another as its issues began to find solutions in small steps. This new style that developed was known as *shoin-zukuri* (書院), which subsequently remedied most of the issues of its predecessor while still maintaining a connection to nature (Tanaka 55-63). These altered features included shōji screens in place of the wooden awnings, tatami to insulate the floors, and thin wooden ceilings. In addition, the shoin style maintained square or rectangular columns as a means of reducing the gaps that resulted from the use of cylindrical ones. Finally, as a means of properly dividing interior space, the shoin style utilized the opaque sliding doors known as fusuma, which came to become pieces of art themselves.

The development and evolution of the traditional features that allow for separation and flexibility of space as well as natural insulation not only act to connect a building to the environment, but also represent a path of learning; or hindsight. Although these styles were only used for the aristocratic class and not for the average citizen, the evolution of the styles demonstrates an example of how the architects learned from mistakes made in shinden. Even if remedies did not immediately follow the mistakes, eventually solutions were formed and those that worked stayed a part of traditional design. In their traditional understanding of how to control natural light within a building, Japanese carpenters demonstrated astuteness to nature and responded by connecting their architecture to the

elements; they thus demonstrated features of sustainability, such as a connection to nature and flexibility of space. As Maki observes:

> *Space in Japanese traditional houses is not simply divided between interior and exterior. Instead, a variety of spaces exist in the interstices, creating a pleasantly heterogeneous environment that has real depth while remaining close to nature. (23)*

This "layering" and attention to aesthetics work together to allow some features of Japanese traditional architecture to not only connect to nature, but also to survive for a long period of time because they allow for ease of future adaption and evolution of the space.

SECTION FIVE
Material Selection

Although in the past the use of natural materials was inevitable, what allows much of traditional Japanese architecture to stand out from other styles is the way the natural materials were appreciated and how they continued to be used. Yet, it is not simply the use of natural materials that is admirable in traditional Japanese designs, it is the *way* they were used. Perhaps one of the most beneficial traits of the natural materials that are seen in traditional Japanese architecture is that they are more easily reused and recycled, which is an essential feature of sustainability. Wood is a particularly sustainable material as it typically has a long life cycle

(lasting often for centuries) as well as the capability to be easily reused and recycled (Brown 154). Wood is also very durable, and "can be reused, reshaped many times; eventually useful as fuel and source of ash," (Brown 87). Due to their complex joinery system, traditional Japanese buildings were constructed without using nails or adhesives of any kind, thus allowing them to be easily dismantled and the materials reused. Regarding this particular system, brown states:

> *The Japanese were fortunate to have inherited a wood-frame building system based upon easily dismantled wooden joints, and to have been foresighted enough to refine it to a peak of beauty and efficiency over the centuries. Their architectural aesthetic was based on articulated, jointed frames, and the possibility of removal, reuse, and recycling was always kept in mind during the design and construction process. (97)*

Because of this complex joinery system, the most abundantly utilized natural material in traditional Japanese architecture was wood. David Young, author of *Introduction to Japanese Architecture*, observes that, in addition to being abundant, wood was especially suited for architecture in Japan because it "…absorbs humidity in the wet months and releases moisture when the air is dry," (6), therefore assisting in creating a comfortable interior environment. Perhaps it is because of these beneficial characteristics that the versatile use of wood became one of the defining features of traditional Japanese architecture instead of grasses, animal skin, or mud, which were widely used in many vernacular designs in the Americas.

In addition to understanding how wood could benefit interior climates, traditional Japanese carpenters also appreciated the aesthetic qualities of the natural material, as they typically left the surface exposed instead of covering it with paint or paper. Jiro Harada, author of *The Lesson of Japanese Architecture*, claims: "This attitude toward the plain surface of wood is a manifestation of the love of nature so strong in the Japanese," (47). This appreciation is thought to have originated with *wabi*, which, as discussed, is essentially a juxtapositional aesthetic that works as both a connection to nature and a reminder of the origin of humans. This, in turn, allows one to *truly* appreciate the beauty in ordinariness (Tanaka 26).

Wood, although most abundant, was not the only natural material featured in traditional Japanese architecture; earth was also a commonly used resource. Just as wood was chosen for its climate assisting abilities, earth and other wall materials were selected for their abilities to help maintain a comfortable environment within the building. Earth was featured both literally in walls made of earth known as *tsuchikabe* (土壁), as well as in the use of clay and plaster. Earth was found to be an ideal construction material (in combination with tatami mat floors) because it was particularly suited to the specific climate conditions of Japan (which typically includes very humid summers). Much like the characteristics of wood, earth would absorb moisture during times of high humidity, and release it when conditions were dry (Figure 11).

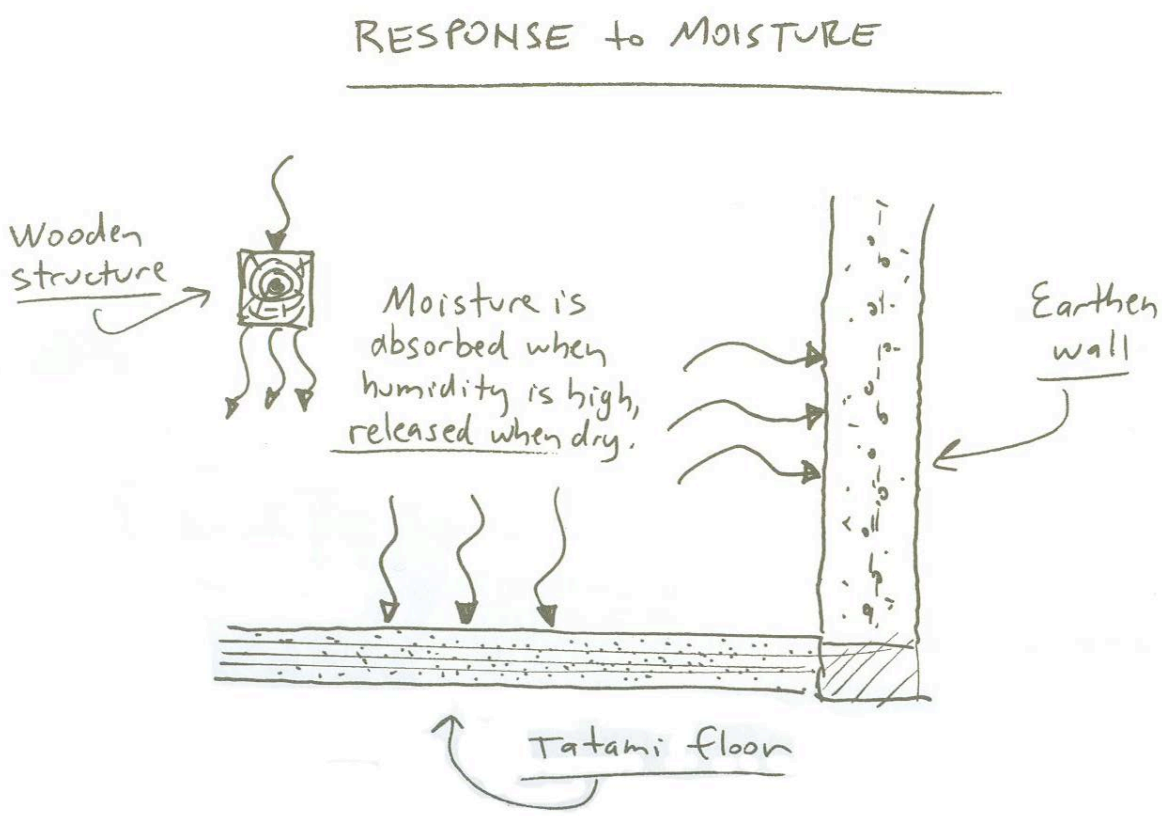

Figure 11
Earth wood, and tatami: traditional building materials suited to the specific climate of Japan (Harada 191)

Japanese traditional architecture is the model illustration of the sustainable qualities of earth, and how earthen wall can successfully make a space feel comfortable through climate and moisture control. These materials were also chosen for their reusable and recyclable characteristics, as earth in particular is characterized by its longevity and recyclability.

Earth wall was also found in a more complex construction of walls that consisted of an intricately woven together grouping of natural materials (Figure 12).

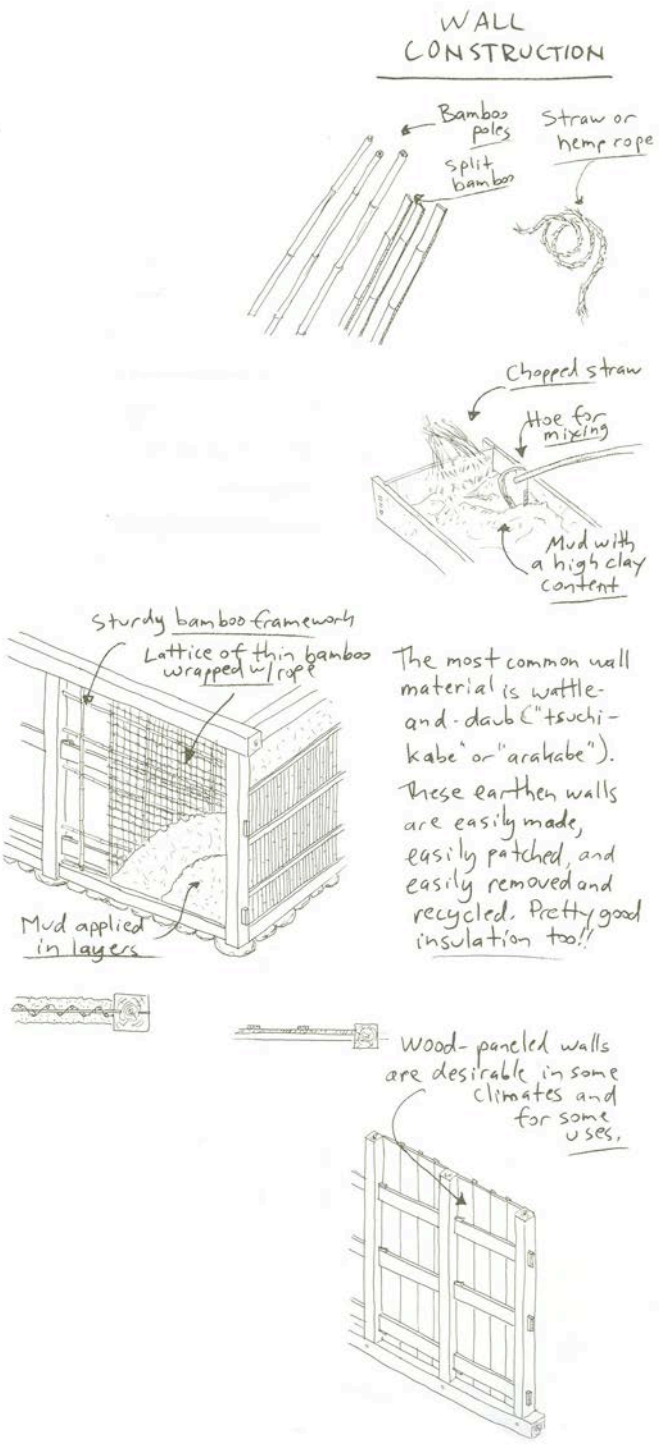

Figure 12
Traditional wall construction of wood, earth wall, bamboo framing, and straw or hemp (Harada 33)

As an example, Brown states: “The lower walls…are usually covered in crytomeria bark, giving them a moisture-resistant and easily replaceable surface,” (33). This demonstrates not only an understanding and embracement of the climate and environment of Japan, but also an intimate knowledge of particular admirable features of the available natural materials that existed there. Instead of merely relying on a single material to create walls fit for the environment, Japanese traditional design most commonly featured a mixture of clay and straw “…that is applied between half-timbers as wattle and daub…” (Brown 33). There were also a wide variety of earth walls that were used in traditional designs, and the level of comfort they created depended on the earth used. The large eaves typically utilized for sunlight control were often reinforced with split bamboo panels. Brown claims that the addition of this third material created “…a wonderful harmony of earthen hues,” (33) thus further adding to the aesthetic qualities of the design. Much like the appreciation for the beauty of wood, the Japanese discovered and utilized a method for expressing the aesthetics of earth and other natural materials.

CONCLUSION

Traditional Japanese architecture demonstrates a certain level of appreciation for naturally occurring features, and how a building can take advantage of said characteristics. The traditional understanding of how to alter buildings in order to ensure that the proper amount of light enters (taking into

consideration season and time of day) illustrates an undeniable connection to nature and appreciation of features of the natural environment. Although the architects may not have intended it, by including ponds in gardens, traditional Japanese designs demonstrate the potential for passive cooling. The appreciation for nature was also evident in garden designs, which both mimicked naturally occurring features as well as utilized them in the views a garden maintained. The carefully selected natural materials that represented the environment confirmed their intimate understanding of not only the beauty of nature, but also its potential.

Even in traditional designs Japanese architects incorporated such sustainable features as natural ventilation, which also demonstrates an appreciation for how naturally occurring features can be used to benefit the comfort of the people within a structure. One of the previously established essential features to ensuring a building thrive for a sustainable amount of time is its ability to be adapted and reused, a trait demonstrated expertly in traditional Japanese designs. Finally the careful selection of materials in the designs of traditional Japanese homes allowed for reuse and recycling of any wastes when a building was dismantled. These are undeniable features of sustainability evident in the traditional designs of Japanese architecture, and they maintain the potential to assist in contemporary structures. As Brown observes:

> *We are now in a position to appreciate the 'invisible' features of Japanese architecture, such as its sophistication in terms of material and energy use, in enabling a zero-waste lifestyle and in supporting human habitation without excessive negative influence on the natural environment. (96)*

These sustainable features of traditional Japanese architecture maintain the potential to benefit contemporary society's desire to create a more environmentally friendly system of construction. Without a doubt, certain aspects of traditional Japanese architecture provide the hindsight that can be incorporated into contemporary sustainable architectural designs.

CHAPTER THREE:
Learning from the Past: Allowing Traditional Architecture to Inform Contemporary Sustainable Design

INTRODUCTION

In improving contemporary sustainable architectural designs, a key step lies in understanding what worked and what did not from vernacular techniques. We have thus far explored the definition of "sustainability" as well as features of traditional Japanese architecture that maintain the potential to assist in contemporary designs around the world. Now it is essential to explore how these traditional design methods may benefit contemporary architecture, as it is not practical to return to the exact methods of architecture from the past. Yet it is essential to acknowledge past failures and successes and learn from them to improve contemporary building performance. In addition, it must be acknowledged that the incorporation of vernacular techniques into contemporary architecture is not a simple task.

One of the most significant roadblocks to adopting vernacular architectural techniques into contemporary designs is people's opinions and perception of what is *comfortable*. "Comfort" generally implies a space that people are drawn to and find they enjoy spending time in as well as a building that establishes a sense of peace of mind. Although the concept of comfort is not necessarily universal, there are physical and emotional aspects of comfort that are shared across cultures. However, comfort is, in many ways, a luxury and not a necessity, which has caused the concept to evolve with the availability of technology that allows for the creation of a physically comfortable space. Yet the right temperature, for instance, is not the

only quality people look for in a space; they also crave aesthetics (physical and emotional) that allow them to *feel* comfortable. Unlike the bodily comfort, these aesthetics are often culturally ingrained, based in history and taste. The variable nature of comfort in its totality thus presents challenges in translating sustainable architectural practices across cultures.

Comfort is, therefore, an important aspect of how aspects of traditional design may be successfully incorporated into contemporary architecture. In other words, to truly understand how traditional Japanese architecture can inform contemporary sustainable design, it is essential to first explore modern interpretations of such vernacular techniques. These case studies must be examined for their level of success with regards to incorporating traditional methods without losing the essential quality of *comfort*, both emotionally and physically. Only after this analysis is completed can the discussion of how these traditional features can be conceptually incorporated into contemporary architecture in a comfortable manner begin. Then and only then can design criteria based on Japanese traditional techniques be established.

SECTION ONE
Modern Interpretations

The beauty and usefulness of particular features of Japanese traditional architecture has by no means gone unnoticed by the West. There have been a number of "modern" examples of interpretations of Japanese architecture in

combination with Western materials and techniques. Chochikukyo (聴竹居), a private residence, is especially interesting in the realm of sustainability. The home's environmental traits are what have caused it to be considered a "modern" piece of Japanese architecture, influenced both by traditional Japanese techniques and modern Western ones. Chochikukyo was built in 1928 by the architect Fujii Kōji (藤井厚二) and was thought to be a "masterpiece of modern architecture." Kōji incorporated in the design a combination of spatial structure that included aspects of Western lifestyles and environmental engineering responded to the climate of Japan (Chochikuyo – Fujii Kōji). Chochikukyo is, therefore, "modern" in the sense that it was radical for the time and place (Kyoto Prefecture, Japan) in which it was built. Although Kōji drew inspiration from traditional Japanese techniques, what made them "modern" was that they were consciously modified to suit twentieth century lifestyles and building technology. One example of his improved traditional techniques is the shōji window screens, which contained glass rather than rice paper thereby allowing for improved insulation without losing the *feel* of traditional designs (as the glass was sometimes frosted to resemble rice paper) (Figure 13).

Figure 13
Windows of wood and glass that resemble traditional Japanese shōji in the dining room of Chochikukyo

In addition, Chochikukyo features a unique natural ventilation system designed such as to take advantage of all the natural elements in the immediate area. At one end of the house, there is a large shaft cut through the floor, which opens into the main area of the building. The shaft is purposefully opened to the west in order to take advantage of the mountain breeze. The air is then allowed to circulate the many rooms in the main part of the house, which includes a guest room, study, sunroom, and dining room. The air flows naturally to all the rooms either through the doorways when the sliding doors are open, or through the opening above the doors when they are closed (Figure 14).

Figure 14
View of the sunroom and study from the guest room at Chochikukyo

To complete the flow of air through the house, the ceiling in the sun room maintains small shafts that allow the warm air, which naturally rises, to escape and return to the outside, thus keeping the home comfortably cool. Chochikukyo is much like an evolution from the passive sustainable features of traditional designs to the more active traits of western architecture; and it successfully demonstrates the combination of traditional and contemporary architecture.

Chochikukyo is an unusual combination of East and West, modern and traditional architecture (for its time), but it was successful in that it allowed for a harmonious union of the two. The house appears Japanese and *feels* Japanese, although it also demonstrates an evolution of sustainability. According to Jordan Sand, Associate Professor of Japanese History and Culture at Georgetown University:

> *The appearance was still unmistakably "Japanese," yet distinct from everything around it…[it demonstrates] the scientific validity of an abstractly conceived native tradition, and an exploration of the possibilities of sukiya aesthetics as a suitable concrete embodiment of that tradition. (315)*

Although he focuses on Chochikukyo's relation to the architectural style of *sukiya*, which followed the shoin style, Sand observed the successful combination within the home. Because of the time and place, it was more logical for Kōji to design his home in a way that still read as Japanese rather than Western. Although our goal in combining vernacular with contemporary is *not* to create a building that reads as traditional, it is relevant to note that Chochikukyo represents a *comfortable* combination of not only East and West, but of tradition and modernity.

Japanese architects have not been the only ones to unite traditional Japanese techniques and styles with modern Western materials and methods; architects in America have also found inspiration in this combination. This attention to Japanese architecture arguably saw the greatest surge following the Philadelphia Centennial Exposition in 1876, which included a Japanese exhibit (Nute "FLW and Japanese Architecture" 170). This exhibit is thought to have influenced numerous architects who would go on to demonstrate aspects of traditional Japanese architecture in their designs; one such example is the famous American architect Frank Lloyd Wright. Wright created a new style of architecture known as the Prairie House through which he fashioned comfortable spaces that were inspired by Japanese

designs. Kevin Nute, an architecture professor at the University of Oregon: states: "Wright…saw the ordinary Japanese home as a supreme study in elimination – not only of dirt but the elimination, too, of the insignificant," (39). In his architecture, Wright demonstrated an understanding of how to create a comfortable space within a building based on the division and size of space.

Wright also provided a method of disconnecting the building from the rest of "civilization" as a means of providing a level of comfortable privacy; this was mainly accomplished by hiding the front door from the street. Although concealing an entrance from the street is not a method of traditional Japanese architecture, the perception that a disconnect from busy city life creates a comfortable home is reminiscent of tea culture. Wright acknowledged the importance of the natural as well as the manmade environment surrounding a building in maintaining the way a structure makes people *feel*. Subsequently, he was attracted to the way traditional Japanese architecture demonstrated this concept. Regarding styles of traditional Japan, Wright said:

> *"No more valuable object lesson was ever afforded civilization than this instance of a people who have made of their land and the buildings upon it, of their gardens…a single consistent whole, inspired by a living sympathy with Nature as spontaneous as it was inevitable." (Quoted in Riley 22)*

For Wright, Japanese art and architecture represented a series of case studies that followed his own personal beliefs in design, and in turn, he was influenced and

inspired by them in a way that caused his space to often read as Japanese while still maintaining a level of comfort for people used to contemporary *American* architecture.

In addition, Wright's Prairie houses typically maintained a version of a *genkan*, which is an entry way inside the house where the floor level changes. In typical American architecture, this sort of entry step would usually be an exterior element, and not found within the front door. However, in his Prairie Houses, Frank Lloyd Wright moved the step indoors, as it was within traditional (and modern) Japanese architecture. Wright also occasionally incorporated long hallways that, although interior elements, resembled the tōriniwa of traditional townhouses (Figure 15), which also included a change in floor height through a step up to living space. As Alexander observed and as was explored earlier, changes in ceiling and floor height are excellent ways to provide a separation of space and in so doing make a room feel comfortable, regardless of where a building is located.

Figure 15
A long hallway resembling a tōriniwa in Yodoko Guest House designed by Frank Lloyd Wright, Ashiya, Japan

The Prairie House and Wright's other designs were considered to be unique and new forms of architecture, as people usually did not realize that many of the distinctive traits of these homes were actually inspired by traditional Japanese residential designs. Wright claimed, with regards to traditional Japanese architecture, "'…strangely enough, I found this ancient Japanese dwelling to be a perfect example of the modern standardizing I had myself been working with,'" (Quoted in Nute 43). Wright's architecture demonstrated an inspiration from traditional Japan, where he basically removed specific techniques and incorporated them into modern designs in a way that allowed the users to feel comfortable.

Wright's spaces were universally comfortable, and the qualities that allowed them to be such were what he linked to traditional Japanese architecture.

Another architect who worked in America in the early 1900s and was influenced by Japanese traditions was Rudolf Schindler. He was a man who had previously worked under Frank Lloyd Wright, and when Wright had to travel to Japan in order to construct his design for the Imperial Hotel in Tokyo, Schindler took over his American work. People often speculate that it is because he worked so closely for Wright that Schindler too seemed to have been inspired by Japanese architecture techniques (Steele 76). However, unlike his predecessor, Schindler was more enthralled by the relationship between inside and outside features as well as natural ventilation systems found in Japanese architecture (Steele 77). Schindler believed in a direct connection between interior and exterior elements, especially during the warmer seasons, much like traditional Japanese architecture. An interesting example of Schindler's interpretation of this subtle connection was the home he designed for himself: The Kings Road House (1922) (Figure 16). As previously discussed, traditional Japanese carpenters mastered a complex wooden joinery system that allowed for minimal waste and the ability to dismantle and reuse the structure of a building; Schindler found inspiration in this acquired knowledge in the design of The Kings Road House. According to James Steele, a professor of architecture at the University of Southern California, Schindler kept in mind waste management inspired by the Japanese joinery system when he designed The Kings Road House. Steele states: "The building was planned using standard timber sizes as a fundamental unit of measurement. This meant less cutting, and

reduced waste to almost zero, in contrast to much timber construction where waste levels can be around twenty percent," (Steele 78).

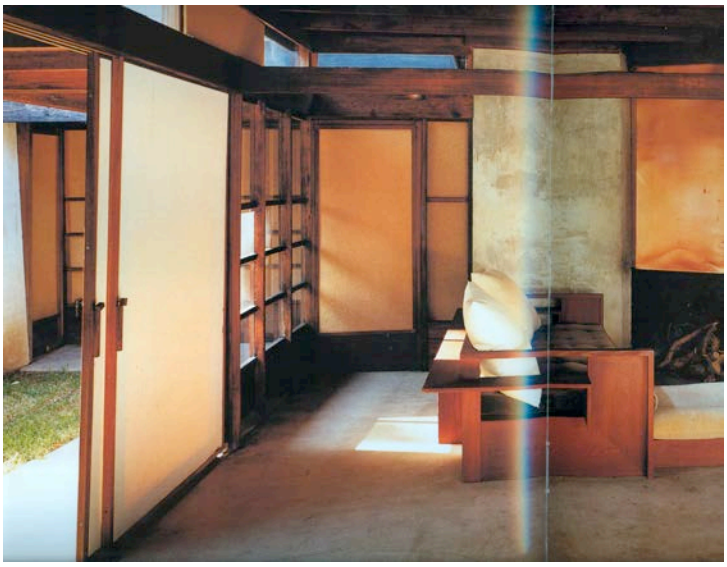

Figure 16
House for Rudolf M. Schindler and Clyde Chace, otherwise known as Kings Road House clearly inspired by Japanese architectural techniques and aesthetics in West Hollywood, California
Image from Steele *Rudolf Michael Schindler* 56-57

Schindler not only incorporated aspects of traditional Japan into his own home, he also designed many L-shaped pinwheel buildings, where each L maintained its own interior courtyard, much like the tsuboniwa (courtyard gardens found in the machiya (or townhouses) of Japan). These courtyards, like the tsuboniwa, played significant roles in the connection to the outdoors that Schindler strived for. In addition, Schindler utilized sliding glass doors to represent a more contemporary version of shōji sliding doors found in traditional Japanese design. This feature was much like Chochikukyo's glass-filled shōji-like windows. With regards to this inspired courtyard design, Steele observes:

> *Each garden is treated as a natural extension of its interior counterpart when the shōji-like walls are pushed open to join them…The sliding glass walls facing each interior garden, which are obviously influenced by traditional Japanese domestic architecture and the idea of shakkei (borrowed landscape) are also based on a modular system like their Japanese counterparts… (80)*

Where Frank Lloyd Wright drew more concrete inspiration from traditional Japan, Schindler embraced specific features of designs that he found to be adaptable to modern lifestyles, such as wood framing, interior courtyard gardens, and even shōji. However, unlike Wright's designs, Schindler's adaption of these techniques to make them "acceptable" in his modern society made them less overtly Japanese, where one could be in the space without necessarily realizing that it was inspired by Japanese traditions. "Acceptability" in this case refers to the fact that these structures were built in America and not Japan. Therefore, people did not look for Japanese houses as much as they wanted something closer to what they were accustomed to: American homes.

The previously discussed architects and buildings were unique in that they drew more literal inspiration from the forms and techniques of traditional architecture. However, in the more recent past (1973-present), the Japanese architect Tadao Ando has provided examples of an architecture that reveals the intimate connection to nature that traditional designs maintained, while at the same time utilizing modern materials. Ando's designs are characterized by his creation of

clean, ordered lines and spaces using concrete, a material often considered cold and uncomfortable. His style is sometimes referred to as a way in which nature is "perfected," as he utilizes modern materials to represent Japanese traditions. Steele observes: "Ando's approach to placing architecture in nature, which perhaps is the characteristic he shares most with Japanese tradition, is not only to show respect for the environment in which he is building, but to amplify its essential quality by showing restraint in what he does…" (245). Much like the previously discussed architects, Ando's designs demonstrate an inherent appreciation for the combination of Western materials and Japanese techniques.

Ando is a strong believer in the combination of Western architecture and the concept of the Japanese tea garden path, on which one was meant to feel a sense of separation from "civilization" on their way to the teahouse. Inspired by this concept, Ando believes that the purpose of architecture is not to be viewed but to be *experienced* (*Making the Modern* 2003). Like tea gardens and *wabi*, a key component in Ando's designs tends to be juxtaposition and contrast, typically seen in the materials he uses. Often, his designs feature smooth, concrete structures surrounding or bordering manmade water bodies (Figure 17).

Figure 17
Tadao Ando's Dreambox at the Asahi Beer Oyamazaki Villa Museum of Art in Kyoto Prefecture, Japan

Certainly this unusual combination of aesthetics is an example of what would not be typically expected in architecture, and is subsequently representative of the concept of juxtaposition found in *wabi* aesthetics. Yet the water seems to add to the calming traits of the perfectly smoothed concrete structures, and in so doing creates a feeling of serenity or comfort. Even the ancient and philosophical design technique of *wabi* has therefore found its way into modern architectural styles. As Ando himself has said: "I believe three elements are necessary for the crystallization of architecture. The first is authentic materials…The second is pure geometry…The last element is

nature. I do not mean raw nature but rather domesticated nature," (Ando 13). This concept of "domesticated nature" is the same seen in such traditional representations of nature as the tsuboniwa; where a controlled environment is desired over the more dangerous untamed nature. Certainly Ando's designs, being made of concrete, do not *read* as Japanese, but it can be argued that one can *experience* them as they would traditional Japanese architecture. Therefore, it is fair to say that, unlike Chochikukyo's creator (a Japanese architect that incorporated Western sustainable features into a building that *felt* Japanese) Ando creates space that looks modern due to the materials and clean geometry, but creates a feeling that *resembles* Japanese tradition.

The incorporation of valuable features of vernacular architecture is not a new concept; many "new" architectural styles were actually influenced by such traditional designs. Japanese traditional architecture has also found a place, whether subtly or more visibly, in modern American and Japanese designs. Japanese architects have found ways to create space that is both modern in materials and traditional in the *feeling* they instill. Similarly, American architects have acknowledged the benefits certain traits of traditional Japanese architectural designs maintain in reaching a specific goal: comfort and sustainability. The combination of old and new as well as East and West, with regards to architecture, is a useful and accepted design approach. Examples of traditional Japanese design techniques being adopted into modern architecture are beneficial to acknowledge as they provide evidence that such a concept can be (if executed properly) accepted as "comfortable" in modern times and a popular aesthetic.

SECTION TWO

Conceptually Incorporating Traditional Features of Sustainability

What is important to understand is how to successfully incorporate traditional concepts into contemporary designs, as our goal in creating a "new" type of sustainable, global architecture inspired by techniques of the past is *not* to design a space that looks like it belongs solely in Japan. As discussed earlier, location is key; different environments and settings call for a variety of architecture. A single style is not guaranteed to be appropriate for every environment, which is why the aim is not to create a "Japanese building." Instead it is more to establish buildings informed by sustainable qualities seen and tested in traditional Japanese architecture, but modified to suit a given environment and cultural setting. What we seek in exploring vernacular sustainable techniques is not a replication of ancient architecture, but an upgraded form of sustainability inspired by the knowledge of the environment acquired from the past.

The largest barrier to the combination of old and new, considering the previously discussed methods of incorporation, becomes establishing an accepted contemporary sustainable architecture inspired by traditional Japanese techniques. What makes adopting vernacular designs often difficult is people's opinions and desire for "new" and "improved" goods rather than "obsolete" and "primitive" designs of the past. The issue, then, is changing people's opinions: vernacular architecture as a template for contemporary sustainability and not as something to simply be disregarded. However, Steele believes this transitional understanding has already taken place:

> *Sustainability has led to a revision of the way we view traditional or vernacular architecture. Rather than veiling it as 'quaint' or picturesque, retrograde or primitive, we now understand that it has something to teach us, that 'local' architecture grew out of many trail-and-error attempts to deal with natural phenomena, and should be respected as a repository of wisdom. (7)*

Yet, if this is the case, the question remains as to what is preventing vernacular techniques from being widely accepted. People may have come to acknowledge that there are features of sustainability and beauty to be found in vernacular designs, but this does not mean they necessarily want them in their own homes.

Although traditional Japanese building materials were renewable, coming straight from the environment and being used in such a way as to express their natural traits, in contemporary society, many people consider using earth and straw to be both "dirty" and "primitive." Cudden states: "Unfortunately, many believe that building with clay means regression to an ancient troglodytic way of living," (9). This rejection of seemingly "primitive" techniques and materials is representative of the modern concept of both physical and emotional comfort, which tends to entail a certain level of financial stability that subsequently is demonstrated through architecture. In other words, the general mindset is that people who have the financial means to invest in the "new" luxurious architectural aesthetics and technology do so. However, according to Brown, if we are to become a sustainable society, we must learn to adjust this specific definition of what is comfortable and what is desirable (Brown 104). People have become accustomed to having the

climate controlled for them in a way that allows the space to be constantly physically comfortable, however, this does not ensure emotional comfort; rather than mere comfort, as Brown suggests, technological climate control is more of a desired luxury. With the integration of a sustainable system that relies on naturally occurring features of the environment to control the climate of a space, there is potential for a structure to instill both physical and emotional comfort in its users. People can be more secure emotionally in feeling the connection to nature and knowing that they are acting as good stewards of the planet. Therefore, the transition between our changing definition of "what is comfortable" that Brown suggests may require "…integrating our homes more closely with the natural environment in a manner that became instinctual for the Japanese in pre-modern times, and allowing the outside in," (Brown 95). This integration can be accomplished through material use as well as creating buildings to be more open to the environment.

Current lifestyles and civilizations are creating a need for people to think more sustainably, which requires a change that in turn necessitates the sacrifice of certain luxuries. Yet, this alteration is not something that can happen overnight; something that requires a change as significant as the concept of "comfort" must be attained over time. People tend to be more comfortable with what they are familiar with, whether in reality or in media representations, and therefore change is sometimes regarded as something existing in a realm outside what is comfortable. Therefore, in order to understand how to accomplish a successful synthesis of past and present, it is essential to comprehend how to incorporate the valuable sustainable features

without creating a space that does not suit its environment. In addition, it is important to prevent a sustainable building that is inspired by vernacular design from being considered a change large enough to feel *uncomfortable*; for this purpose, it may be necessary to start subtly. In other words, certain sustainable features of vernacular architecture must be less apparent when they are incorporated into contemporary design in order to maintain what is perceived as a modern, comfortable environment. This concept raises the vital point of how sustainable features are incorporated: visibly or invisibly.

There are essentially two methods of incorporating sustainable elements into the design of a building: visible and invisible. Hosey defines the two methods as follows: "INVISIBLE *green* – consideration such as embodied energy, material sources, chemical content, and so forth…VISIBLE *green* – form, shape, and image – can have an even greater impact on both conservation and comfort," (6). In other words, sustainable techniques can either actively demonstrate their environmental traits (visible), or they can do so subtly (invisible) in such a way that a person may not know the qualities have even been considered. In Japanese traditional architecture, whether or not it was intentional, both methods were utilized. For example, a form of invisible green would be the natural ventilation that occurred in the designs for the machiya (townhomes). Visible green examples within traditional Japanese designs could be considered the materials used as well as the particular *shapes* of the buildings that allowed for natural ventilation. This concept can also be applied to the incorporation of traditional design elements: they can either be present in a way that people will recognize them, or they can be altered and adapted

to blend into the architecture. In contemporary designs, the objective is not to create something that resembles traditional Japanese styles so much as it is to adopt features with the potential to be upgraded into usable modern elements. In other words, these methods do not need to be *visibly* Japanese; although this does not mean that they *must* be invisible either.

The largest difference between traditional methods of sustainability and contemporary ones is the presence of complex technology. Where our ancestors had no choice but to use certain materials and environmental features to create a comfortable space, we have invented ways to use to provide physical comfort: "Before the widespread availability of inexpensive fossil fuels for energy use and transportation, builders understood the principles of passive design, capturing sunlight and wind for natural lighting, heating, and cooling," (*Green Building* 7). However, Hosey suggests that technology and tradition do not necessarily entail two drastically different sides of the spectrum; they can build upon each other (18). In certain situations, the seemingly undeniable division between the two concepts can become one, where the new ways of thinking are inspired by the traditional. Steele observes:

> *…tradition essentially represents the accumulated knowledge of past generations in relation to effective ways of dealing with the environment and place-specific techniques that historically have been used to control microclimates by the people that live in them. (12)*

Here is where traditional Japanese architectural theories and methods could be incorporated into contemporary sustainable designs. According to the US Green Building Council's LEED Core Concepts: "In many ways, green building represents a return to simpler, low-tech solutions. At the same time, there are now many high-tech strategies available to improve the performance of the built environment," (*Green Building* 7). People have a tendency to associate tradition with being obsolete, increasingly so due to rapidly advancing technology. However, the two are not necessarily opposites, as Steele states: "To set tradition and technology against each other is to establish a false dialectic; a more accurate approach may be to try to discover where they concur or overlap and how this may be applied to environmental problems," (15). Contemporary architecture maintains the potential to be informed by traditions, in a combination of past techniques and modern technologies to improve sustainability.

The concept of "comfort" is perhaps the largest barrier to not only the incorporation of traditional design techniques but also sustainability. However, the immediate answer may lie in how these features are presented within the design of a building; in other words, if they do not *read* as traditional (i.e. old-fashioned) methods then people may be more willing to accept them. Similar to aspects of sustainability, features borrowed from or informed by traditional techniques can either be incorporated into contemporary designs visibly or invisibly. In addition, technology can work *with* these traditional features to create a system that is not new but *improved*.

SECTION THREE

Establishing New and Inspired Principles for Sustainability

Whether or not people will accept an improved model for sustainability inspired by traditional techniques is, more or less, dependant on the previously discussed concept of what feels and seems *comfortable*. However, whether the sustainable traditional features of a building are visible or not, the facts that they improve the quality of life of the structure's users as well as reduce negative environmental impact are what is important. After all, sustainability itself is not about what is seen and what is not, its purpose lies in the effects of a building on people and the environment. Brown states:

> *We should learn to see beauty less as the result of visible features than of things that are invisible. What something does can be a source of greater beauty than its surface appearance…Perhaps a new 'environmental functionalism' can show us the beauty in buildings and other designs that help maintain and restore environmental equilibrium…And perhaps our changing understanding and appreciation of the essential characteristics of Japanese architecture can serve as a model. (95)*

In other words, a building's "aesthetic qualities" can be a result of how a building makes people *feel* (the emotional aesthetic), and this is often dependent on the features of a structure, such as those that connect it to the environment. As a model, traditional Japanese design provides a number of principles that maintain the

potential to improve contemporary sustainable architecture, regardless of how they are incorporated.

The visibility of the features of traditional design incorporated into contemporary architecture is therefore *not* the purpose of their adoption. The goal is to improve sustainability without losing the level of comfort. However, considering that flexibility is a key component to sustainability, it does not then logically follow that rigid and overly specific design rules should be established. Instead, it is more beneficial to allow for adaption and subtle integration of less prescriptive design criteria that can inform an improved style of sustainable architecture. Essentially, in evaluating traditional Japanese design techniques, there are five principle elements from which an improved, informed sustainable design can be established: wind, light availability, flexible space, natural landscape views and water, and, when possible, natural materials (which lends to waste reduction).

A building's form is essential to its sustainable qualities, as it is within the form that such environmental traits as natural ventilation and solar gain become possible. Designing a building such that it properly utilizes naturally occurring wind patterns is an important way to allow for fresh air as well as to reduce air conditioning costs. However, buildings themselves affect the flow of air, especially within a city where the dense accumulation of structures can either kill wind patterns or increase them. Buildings can therefore be designed with the understanding of wind patterns in mind such that they are properly used to the structure's advantage.

Similarly, when considering the availability of natural light and solar radiation, a building's form is key. How a structure is placed on a site determines where (in

what rooms) there will be the most light and, subsequently, where there should be the most windows. However, it is also important to consider the changing seasons and subsequently utilizing passive methods for blocking the appropriate amount of sunlight when it is desired. Japanese traditional architecture utilized a number of methods that could be easily incorporated into contemporary design, such as deciduous trees, overhangs, and sliding doors or windows. Although exterior elements such as trees, bushes, and vines may not appear to be aspects of a building's form, they work together to improve sustainability. A building's form can be inspired by traditional Japanese architecture in order to increase its passive design potential; techniques that control ventilation and solar radiation can instigate an informed contemporary style that maintains the potential to decrease air conditioning costs and, subsequently, increase energy efficiency.

Form also informs purpose; the available space within a room and variations in floor and ceiling heights provide a guide for how a room can be used. Traditional Japanese architecture provides a unique template for a flexible room that can either be divided or opened up such that a single space maintains the potential for multiple purposes. This allows space to be both flexible and adaptable to future changes and uses. As discussed earlier, a building's ability to adapt to new uses helps to assist it in surviving for an extended period of time. Traditional Japanese carpenters mastered flexibility by creating spaces that were meant to have multiple purposes and by allowing movable features to change the way a space performed. Sliding doors and variations in ceiling and floor heights provide for a division of space that keeps the design open and therefore allows for ease of adaptability. These features

are easily applicable to contemporary architecture, although in some cases a substitution of materials may perform better and be more widely accepted. Regardless of the materials and architectural style that may be used, the traditional Japanese methods of space flexibility are entirely compatible with contemporary sustainable design.

Compatibility with contemporary architectural design does not ensure acceptance from people; therefore, one of the most essential principles that can be established based on the techniques of traditional Japanese design is the necessity of aesthetics both visual and emotional that often stem from materials. A building must be aesthetically pleasing enough on the outside that people like it and *want* to see it and go inside. As discussed, how a building makes people feel is essential to its survival, and to accomplish this it must be both comfortable and beautiful from within as well as from the outside. The materials used in a space as well as the availability of a view of nature (whether naturally occurring or manmade) affect aesthetics, and the feeling of comfort a space creates is often increased when natural materials are utilized. In addition, the traditional use of materials in Japanese designs allowed for ease of reuse and disassembly, thereby reducing waste. However, in contemporary society not all of the natural materials used in traditional designs would be as widely accepted due to the previously discussed mindset of "primitive" techniques. Therefore, in designing contemporary sustainable buildings it would be beneficial for the architect to utilize natural materials when possible to improve the feeling and sense of comfort created by the structure.

Traditional Japanese architecture also demonstrates how providing views and accessible natural environments are key features that increase the comfort and aesthetic qualities of a space. Although in traditional Japanese design, gardens were often a manmade representation of an interpreted environment, they still accomplished the purpose of providing a comforting space. Water especially is a beneficial feature to be included in natural landscape design as it not only provides a feeling of comfort and peace, but it also maintains the potential for climate control through such traits as evaporative cooling. In addition, running water can often improve the relaxing traits of a space as it reduces unwanted sounds and replaces them with the gentle bubbling of a stream. A natural landscape and water maintain the potential not only to increase the comforting and aesthetic qualities of a space, but they can also play a variety of sustainable roles. Providing not only views of nature but also the availability to *experience* it creates a feeling of being connected to nature and the environment in a controlled and comfortable space that is at the same time protected. This idea is, essentially, the traditional Japanese concept of a "world within a world."

Concrete, prescriptive design techniques and regulations are not ideal ways to establish an informed and improved style of sustainability as they lack the flexibility that is at the concept's very core. Therefore, instead of looking for guidelines in vernacular design, we can establish principles based on what has been successful in traditional Japanese design. This way, too, a style can be discovered that does not necessarily resemble a structure that belongs solely in Japan or the United States;

these principles maintain the potential to be adapted to specific environments and cultures.

CONCLUSION

Sustainability, despite what many may believe, is in fact not a new concept. Although today it has come to be considered a tool of environmentalism and perhaps even part of the "green movement," it is important to recognize that in human history it was simply a way of life. Before technology was developed that could consistently control indoor lighting, temperature, and humidity, the best way to achieve a comfortable, livable environment was through architecture. The lack of complex technologies meant that vernacular designs were often sustainable, as they emphasized key features of what we have defined as sustainability. Whether features of sustainability were intentional or not, they existed both visibly and invisibly within traditional Japanese architecture. According to Brown:

> *We are now in a position to appreciate the 'invisible' features of Japanese architecture, such as its sophistication in terms of material and energy use, in enabling a zero-waste lifestyle and in supporting human habitation without negative influence on the natural environment. (96)*

We can look to the sophistication in traditional Japanese design that Brown refers to as a means of achieving improved sustainable techniques to better our societies and

ways of life. Past architects have shown that contemporary techniques and materials can be used in combination with traditional ones successfully without losing aesthetics or comfort; now we must use them to improve sustainability.

CONCLUSION

There are essentially three accepted steps to conservation: Reduce, Reuse, Recycle; but "…design needs new strategies for reduction prior to the consumer stage. The first step is a fourth "R" – *Rethink,*" (Hosey 33). Yet, if people want what is *new*, by definition to become obsolete, then the goal of sustainability seems like a lost cause. This concept is much like the contemporary choice of convenience over sustainability. Although Hosey may be correct in that a change at the pre-consumption stage of products is required, in the case of architecture, *rethink* may imply a return to a time when sustainability was a core part of life. For example, contemporary Japan has developed into a nation of building new and improved structures, rather than renovating the old. However, in the past Japanese carpenters were masters of maintenance and repair; so much so that the Japanologist and American writer Alex Kerr observed: "…managing things properly is what traditional Japan did in a way that put virtually every other culture of the world to shame," (162). This concept is what makes traditional Japanese architecture so beneficial as a case study for contemporary design, as a template for not only practices that are environmentally friendly, but also the process of sustainable thought.

Sustainability is a complicated subject as it encompasses such a wide assortment of ideas. However, sustainability within the realm of architecture provides its own particular variety of hurdles, as the process of constructing buildings is both a necessity as well as a large source of waste. Yet this does not

mean that architectural sustainability is unachievable. Architecture and construction will always require materials, however, we can choose them more carefully and use them more intelligently in order to reduce the negative impact a structure will have on the environment. According to William McDonough:

> *Just about every process has side effects. But they can be deliberate and sustaining instead of unintended and pernicious. We can be humbled by the complexity and intelligence of nature's activity, and we can also be inspired by it to design some positive side effects to our own enterprises instead of focusing exclusively on a single end. (81)*

The same can be said about vernacular design: we can ignore it or be inspired by it; our ancestors learned how to live *with* the natural environment because they lacked the technology to control it.

In exploring various design techniques within traditional Japanese architectural styles, we have discovered that these models maintain numerous beneficial characteristics concerning visual and emotional aesthetics as well as sustainability. Whether traits of these traditional designs were a result of cultural preference, comfort, or simply because of the immediate environment, the methods explored in this thesis undeniably maintain qualities of sustainability that can inform contemporary design. However, there are far more Japanese traditional architectural styles and philosophies that were, unfortunately, unable to be covered in this paper. As a country with a long history, Japan has seen countless styles come

and go, each with its own purpose; and many of these demonstrate enlightening characteristics. Therefore, if further study was to be done within the realm of sustainable qualities of traditional Japanese architectural techniques, it may be valuable to give greater attention to the long history and evolution of tea culture as well as the extended spectrum of aristocratic styles.

Although today we look at traditional Japanese designs as a specific style, in actuality there are numerous ones, each inspired by another, absorbing and passing down the traits deemed desirable for their context. In other words, Japanese traditional architecture, in its evolution, is an excellent template for contemporary sustainable design as it demonstrates an ability to absorb beneficial methods. In creating an improved sustainable design concept that is inspired by past techniques, the ability to adopt these characteristics without losing the *feeling* of a specific culture's architecture is key. This merging of styles and techniques was not only limited to traditional design; Japanese architects have, even in this rapidly evolving modern world, succeeded in maintaining the spirit of their traditions. Itō observes: "…in their absorption of modern architectural ideology…the Japanese found…a means for carrying on their traditions in new forms," (103). Instead of allowing a *new* style to take over what already exists, Japanese architecture has absorbed and evolved, much like the previously discussed change from the shinden style to the shoin. This adoption is also similar to how American architects such as Frank Lloyd Wright and Rudolph Schindler incorporated Japanese styles into their own designs.

The ability of Japanese architecture to supplement rather than replace means that it maintains the potential to inform contemporary designs; people can learn

from tradition to allow sustainable architecture to evolve into an improved style, rather than a completely *new* one. As Unwin states: "So called 'traditional' architecture is full of places which, through familiarity and use, accord well with users' perceptions and expectations," (15). Traditional Japanese architecture is an excellent template to use when understanding how to improve contemporary sustainability; in its conception and methodology there is an underlying understanding of the environment and the importance of creating a connection to nature that dates back to a time when we had less control over the elements. The previously established design principles, therefore, are not meant to be concrete rules to create a "new" style of sustainable architecture. The criteria are simply intended to provide a template for creating a space that is not only environmentally friendly, but *comfortable* such that it survives and lends to the emotional aesthetic as well as the visual. Perhaps these principles could inform the creation of more specific, original examples of how to apply them to an architectural design, however, that would be a topic for another paper.

In designing contemporary sustainable structures, it is fair to say we are, in a way, reconnecting ourselves with tradition. Therefore, acknowledging successes and failures of vernacular designs, such as traditional Japanese architecture, is an essential step in creating this improved sustainable architecture that we seek in our contemporary, global society. People can learn from the past and base our "new" and improved ideas on hindsight rather than foresight. We can look to the past to improve our lifestyles as well as the futures of our ecosystems and natural environments. Traditional design techniques are not something to avoid because

they have become “obsolete” in this “advanced” society. In actuality, methods of the past maintain the potential to assist in improving contemporary architecture and therefore deserve to be respected and explored. Traditional Japanese architecture is an excellent template for this type of informed sustainable design; however, it is by no means the only one. In future studies, people may benefit from examining vernacular designs of many other countries with intricate histories, and perhaps even those of America.

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