THE INTERRELATIONSHIP BETWEEN HUMAN BEHAVIOR AND SUSTAINABILITY IN THE BUILT ENVIRONMENT

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by

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CHAPTER 1
INTRODUCTION

The study of how both the natural and built environment affects human cognition and behavior is known as environmental psychology. Traditionally, the bulk of research on environmental psychology has been concerned with built environments rather than naturally-occurring settings. However, more attention has been paid recently to how humans and natural environments affect each other (De Young). For example, decisions made in the design of the built environment concerning what materials and building systems are used can have far-reaching effects on the natural environment as well as on the health and wellbeing of the building users. Also, the way a building is planned determines human access to or views of the natural environment while inside the building, which also affects human health and wellbeing. Research for this Thesis will examine the aspect of environmental psychology that deals with this interrelationship between humans, interior spaces, and the natural environment, or more specifically, sustainability. Sustainability is defined as the practice of designing in a way that preserves the natural environment and long term human wellbeing. The primary goal is to gain knowledge that will enable the author to better design interior spaces that address the needs and wellbeing of both humans and the natural environment.

The main questions that shaped the research for this Thesis include the following: do sustainable spaces affect human behavior and wellbeing, and if so, how? For instance, do people feel differently in spaces that include or connect to natural elements? Do
people feel differently in spaces that they know are low-impact or energy-efficient?  
Also, what discrepancies exist among the various sources of information on sustainability of building materials?  In what situations are human needs and sustainability needs at odds with each other, and what can be done to reconcile these differences?  What can be done to improve design for both people and the natural environment?

After determining what questions needed to be answered, determining how best to answer those questions was the next part of the research process. Given the very dynamic and changeable nature of the design profession (due in large part to advances in building materials and other aspects of technology), the decision was made to balance a traditional literature review with information obtained directly from design professionals. This latter category of information was derived from two primary sources: results from a survey distributed electronically to design professionals, and the author’s work experience in the field.

To address the question regarding discrepancies among the sources of sustainability information, an in-depth discussion on carpeting—a widely used product in building interiors—was conducted to illustrate the prominence of discrepancies in the industry. This discussion references information obtained via the literature review as well as phone interviews with carpet sales people.

The Thesis is organized according to the sources of information used, with Chapters 2-4 examining the findings of the literature review, and Chapter 5 focusing on the findings gained from interaction with design professionals.
CHAPTER 2

ENVIRONMENTAL PSYCHOLOGY: AN OVERVIEW

People’s mood and wellbeing are affected by various elements of the built environment including spatial allocations, lighting, access to nature, color, indoor air quality, noise, thermal comfort, user control of space, and preferred environments (i.e., those that are coherent and engaging). After examining the effects of each of these elements, the findings will be compared with the qualities of sustainable design in order to recognize where there can or should be overlaps between the two, where there might potentially be discrepancies, and how any discrepancies can be resolved. The author believes that this knowledge will allow for finding a better way to address the needs and wellbeing of both humans and the natural environment in designs of interior spaces.

SPATIAL ALLOCATIONS

The amount, distribution, and form of interior spaces can have profound effects on the psychological health of people. Some of the main psychological issues at play in regards to spatial allocations include territoriality, personal space, privacy, and crowding.

Inherent in all animal species, territoriality can be defined according to the work of Julian Edney, as stated in Kopec’s Environmental Psychology:

“Territoriality involves the possession and defense of physical space, as well as the exclusiveness of use, marking, personalization, and identity (as a reflection of the self) of that space by the occupant or user. In most civilizations, territories
serve to organize human behaviors so that acts of violence, aggression, and overt domination are reduced.”

Through the use of organizers (such as room signs, partitions and doors, and personal identifiers), mutually acceptable ground rules are established, and social behaviors can be transacted without confusion. People feel more secure when they are on their own turf, and the level of control one feels over that turf is closely associated with the amount and quality of that territory. However, different territories have different needs: the psychological importance of a primary territory (such as a home) is higher than that of a secondary territory (such as a workplace) which is higher than that of a public territory (such as a public park) (Kopec, *Environmental Psychology*, 63-66). Determining the appropriate amount and quality of users’ territories can make or break the success of a design.

Personal space is a three dimensional bubble that surrounds and moves with people (Augustin, 76). It does not exist without interaction between people. The size of the bubble varies depending on personality and stage of development, gender and size of people, cultural and societal norms, the physical environment (e.g., social and spatial density, climate, and familiarity with the environment), and level of familiarity with others. People experience stress when their personal space is violated (Augustin, 77-78) which can limit or prohibit their ability to function in an environment.

Privacy, as defined by Irwin Altman, is the selective control over another’s access to one’s self, one’s group, or one’s environment. Privacy extends beyond just control of physical access and can also include visual, acoustical, olfactory, or informational access.
As with personal space, many interpretations of privacy exist due to differences in personality, life stage, gender, culture and social norms, and experiences. A basic human need, privacy facilitates a sense of control and provides emotional release. Conversely, those who are deprived of adequate privacy may feel lack of control over their environments or their lives which can lead to lack of autonomy, learned dependence on others, and learned helplessness (Kopec, *Environmental Psychology*, 69-70).

Finally, crowding is a subjective term that refers to people feeling physically constrained and that others interfere with them. As with the aforementioned psychological issues of territoriality and personal space, sensations of crowding vary according to individual experiences, circumstances, personalities, and cultures. In some instances (such as on a dance floor or at a ballgame) crowds can create positive energy for some people (Kopec, *Environmental Psychology*, 71-74). However, much of the time people feel stressed when they are crowded (Augustin, 80). Those who are abnormally sensitive to touch (including autistic people or those with Asperger’s Syndrome) may feel particularly ill at ease in crowded situations in which physical contact with others may occur (Kane).

**LIGHTING**

Lighting is another important consideration when designing spaces to enhance the psychological health of the users. Lighting systems include artificial and natural (i.e. daylighting), and the human need and desire for natural sunlight requires a balance of the two sources of illumination. Unlike most types of artificial illumination, daylight
provides full-spectrum light which has been proven to enhance people’s moods and wellbeing. (The types of artificial light sources that have full-spectrum lighting provide some, but not all of the benefits as daylight.)

Numerous studies show the positive effects of daylight on human psychology and health. In the field of healthcare, many of these studies show that patients assigned to sunny rooms recover more quickly, on average, than those assigned to rooms with less daylight. In one such study, the Mackenzie Health Sciences Centre of Edmonton, Alberta reported that half of its patient rooms are bright and sunny, and the rest are not. Patients in the sunny rooms had an average stay of 16.9 days versus those in the darker rooms who had an average stay of 19.5 days (Beauchemin). Another study reports that

“Patients recuperating from spinal surgery in a Pennsylvania hospital were assigned to single rooms in different parts of the hospital that were categorized in terms of sunlight exposure (bright or dim). A questionnaire was administered a day after surgery and before discharge. Those patients who occupied the bright, sunlit rooms experienced less perceived stress and a greater reduction in pain, using 22% less analgesic medication per hour compared with those in dim rooms (Derman).”

Many other studies report similar findings, showing the importance of daylight in healthcare facilities.

Just as access to daylight promotes the health of patients in healthcare settings, access to daylight also promotes the health and wellbeing of students in schools. As reported by Susan Winchip in her book Fundamentals of Lighting.
“The Heschong Group (1999) found that students in classrooms that had significant daylight had higher test scores than students working in classrooms with little or no daylight. (In addition,) the Alberta Department of Education in Canada and schools in Raleigh, North Carolina, reported health and educational benefits for children who were exposed to daylight. Research also found that absenteeism was lower in educational facilities illuminated by daylight.”

Clearly, daylight can have profound, positive effects on people of all ages.

Despite its many positive qualities, daylight must still be controlled as it enters buildings. Glare and heat gain from uncontrolled daylight can create difficult working conditions for users which may cause stress, fatigue, and irritability. The unpredictable nature of daylight (due to variations in the seasons, time of day, weather, and window glazing) necessitates that it be augmented by artificial light in many interior spaces in order to create functional, safe, and pleasant spaces for people (Kopec, *Environmental Psychology*, 191).

ACCESS TO NATURE

Just as with natural lighting, research shows that people are better off when they have access to or views of nature. According to environment and behavior researcher Frances Ming Kwo, as stated in Augustin’s *Place Advantage*,

“Access to nature and green environments yields better cognitive functioning, more self-discipline and impulse control, and greater mental health overall. Less access to nature is linked to exacerbated attention deficit/hyperactivity disorder
symptoms, higher rates of anxiety disorders, and higher rates of clinical depression.”

Research conducted by Rachel Kaplan reveals similar findings: when people can see grass and other natural things from their windows (whether in a home or workplace), they are less frustrated, in better physical health, and more satisfied with their lives. The most relaxing nature views are not purely natural but show some signs of human tending; such views have some water, mown fields, and clumps of trees. A moderate number of potted plants in interior environments can reduce stress levels as well, but views of nature through windows provides greater benefits (Augustin, 186-187).

COLOR

Research has demonstrated that color is important to the perception of space, building form, wayfinding, ambiance, and image. In the Western world, people focus more energy on what they see than on any other sense. The manner in which color influences human behavior directly is still being investigated, though experts generally agree on the effects of color as they relate to the three main attributes of a color—hue (the wavelength of a light beam), saturation (how pure a color is), and brightness (how light or dark a color is) (Kopec, Environmental Psychology, 87-89).

These attributes affect color preference in different ways. Colors with warmer hues (longer wavelengths) are more energizing and appear closer in space, as opposed to colors with cooler hues (shorter wavelengths) which are generally more calming and which recede in space. Warmer colors also tend to increase the perceived temperature of
a space, while cool colors decrease the perceived temperature. This effect is strong enough that thermostats can actually be changed about five degrees when the most prominent colors of a space change from warm to cool or cool to warm (Augustin, 55).

Saturation and brightness of colors also have a big influence on how people respond emotionally to color. Colors that are brighter and more saturated are more pleasurable, though the pleasure is influenced more by brightness than by saturation. Energy level increases with color saturation and decreases with increases in brightness, except for very bright colors, which are highly energizing. Brighter spaces are also perceived as being larger and less crowded than darker spaces of the same size and shape (Augustin, 49).

INDOOR AIR QUALITY

Indoor air quality is another factor that greatly affects people’s health and wellbeing. Sick building syndrome (SBS) is a serious health problem that can cause headaches, fatigue, chronic coughing and overactive sinuses, and chronic eye, nose, and throat irritations. Research indicates that carbon dioxide levels in combination with other indoor pollutants—such as volatile organic compounds released by building materials, office machines, cleaning products, equipment, human bioeffluents, formaldehyde, and dust—are responsible for symptoms related to SBS (Kopec, *Environmental Psychology*, 238). When people suffer physically in an environment, their morale is oftentimes negatively affected as well. Natural ventilation as well as reducing or eliminating VOCs from their sources can improve the wellbeing of building users.
NOISE

Noise is an environmental variable that can cause a multitude of detrimental effects. In schools and workplaces noise can be particularly problematic. Some researchers believe that noise in schools causes distraction and interferes with learning. Effects of noise in educational settings can range from impairment of psychomotor performance, language acquisition and understanding, reading skills, to a greater likelihood of having elevated blood pressure (Kopec, *Environmental Psychology*, 192).

According to Sally Augustin, in workplaces

“Too much noise from other workers is often the reason that workers say they need privacy, and more noise is related to less satisfaction with a job. Noise from coworkers has been shown to directly influence stress levels, with more noise being linked to more stress. In general, when workers perceive that they are distracted, they become less satisfied with the physical environment in which they work.”

Even if people do not realize that they are distracted by noise, they can still be affected negatively. A recent study has found that when people are distracted by noisy conditions (55-65 decibels), they are less likely to take simple steps that would aid in concentration, such as adjusting a chair. People working in quiet conditions (40 decibels or less) are more likely to find additional ways to enhance their concentration (Augustin, 192).

Indeed, reducing noise levels in both workplace and learning environment makes for a more efficient and pleasant experience.
THERMAL COMFORT

Thermal comfort is influenced by four environmental conditions that affect the body simultaneously: air temperature, humidity, air movement, and mean radiant temperature. Regarding air temperature, the comfort range for most people (80 percent) extends from 68 degrees Fahrenheit in winter to 78 degrees Fahrenheit in summer in the northern hemisphere. The large range is due mostly to the fact that warmer clothing is worn in the winter. Relative humidity indicates how much moisture air can hold. Dry air can readily absorb moisture from the skin which cools the body, while moist air is less able to cool the body which increases the perceived temperature. Relative humidity comfort levels for most people are between 20 and 60 percent in the summer and 20 and 80 percent in the winter.

Air movement (which provides ventilation) has a pronounced effect on heat loss and is generally an asset in the summer and a liability in the winter. Finally, mean radiant temperature (MRT) must be considered when it differs greatly from air temperature. Radiation from the sun through a window, for instance, can increase the perceived temperature of a space during the day, and decrease it at night after the sun has set (Lechner, 60).

Thermal comfort has a significant effect on people’s wellbeing. For instance, studies of classroom temperature found that when learning environments included air conditioning, the incidences of classroom annoyances were reduced, and attitudes, performance, and student behavior improved (Stuart). One study found that at
temperatures higher or lower than 72 degrees Fahrenheit, students showed decreases in memory, suggesting that the optimum temperature for learning is 72 degrees (Pilman).

Air temperature, humidity, ventilation, and mean radiant temperature are dependent on a number of environmental factors including the configuration and materials in a building, amount of glazing on windows, size of the space, number of occupants and their activity level, and HVAC systems. Flexibility and ease of adjusting these building components and systems is necessary in order to ensure the comfort and wellbeing of the occupants (Kopec, *Environmental Psychology*, 194).

**USER CONTROL OF SPACE**

Control is the ability to change a space or the opportunity to control access to a piece of turf. Personality, sensory differences, and culture determine the general level of control desired at various times, though all people are more comfortable and satisfied in spaces when the control they have matches the control they want. When people do not feel in control of what happens to them in a space, they become stressed, discouraged, and frustrated (Augustin, 29).

The most comforting spaces allow users to exercise the most control over all of the aforementioned elements of the built environment: spatial allocations, lighting, color, indoor air quality, noise, and thermal comfort. Control that establishes privacy is the most important type of control—audio and visual, with audio privacy being slightly more important. This is why noise control in particular is so important: quieter spaces feel more private. Crowding is another critical issue which can be alleviated in part through
space plans and furniture arrangements that allow for a means of escape in crowded situations. Designs that allow for user control of furniture, lighting levels, views, ventilation, and temperature (via adjustable work surfaces and chairs, task lighting, operable windows and window coverings, for example) also go a long way in creating comfortable and healthy spaces for people.

It is important for designers to understand and recognize cultural differences when designing spaces in order to create environments that provide users with an appropriate amount of control. However, even within the same culture personality and sensory differences can abound. Whether a person is introverted or extraverted, is a screener or a non-screener, or has a particular disability gives rise to many of these differences. For instance, introverted and extraverted people need different amounts of stimulation in their environments in order to thrive. Introverts, which make up approximately 50 percent of the population in the United States, have a preference for the inner world of their own mind rather than the outer world of sociability. Depleted by too much external stimulation, introverts do best in quiet environments (Helgoe, 57). Such environments can be achieved not only by minimizing the noise level but also by reducing stimulation in other ways, such as by controlling the amount of access to other people or considering the calming effects of certain colors. Extraverts, on the other hand, crave external stimulation. They typically prefer louder, more active environments and seating arrangements that promote socialization. They may also be more inclined to personalize a space with photos and knickknacks that could prompt conversations.
The ways in which screeners and non-screeners react to environments also have significant implications for designers. People’s ability to screen out unwanted environmental stimuli (e.g., noise, glare, odor, drafts) depends on how they respond to various distractions that arrive in different patterns. People who are less affected by a stimulus are considered to possess greater screening abilities, whereas those who are bothered or annoyed by a stimulus are thought to be non-screeners (Kopec, *Environmental Psychology*, 47). An extreme sensitivity to stimulus may indicate the prevalence of a condition or syndrome such as attention deficit disorder, autism, Asperger’s syndrome, and sound sensitivity syndromes such as hyperacusis and misophonia. High stimulus environments can severely agitate those with ADD, autism, and Asperger’s syndrome, while those with sound sensitivity syndromes are particularly disturbed by noise. Even adults with iron deficiency, hypoglycemia (low blood sugar) or hypothyroidism (underactive thyroid) can have trouble concentrating, which makes them especially sensitive to distractions as well (*10 Medical Conditions*).

Indeed, flexible spaces that allow users to control the amount of stimulation in their environment maximize the functionality and comfort of those environments. When people are comfortable, their wellbeing improves.

Unfortunately, designing spaces for those with unseen conditions, syndromes, or sensitivities is often prioritized less than designing spaces that address physical disabilities. The Americans with Disabilities Act (ADA), which is enforceable by law, focuses on making spaces accessible for those who are physically handicapped—such as those who are wheelchair bound, blind, or deaf. No enforceable guidelines exist to
accommodate those who are environmentally sensitive. Thus, it is up to designers, rather than law enforcement professionals, to ensure that designs consider (and hopefully address) the environmental needs of all potential users.

PREFERRED ENVIRONMENTS

The elements of the built environment which have been discussed up to this point all contribute to and affect preferred environments. Such environments are places that people seek out. In these places, people feel competent and confident and are able to make sense of the environment while also being engaged with it. Research in environmental psychology has expanded the theory of preferred environments to include the notion of coherence within a space. Coherence is a term which refers to having a sense that all of the parts in a given environment are contextually appropriate and inherently fit together. In other words, a coherent space is one that psychologically “feels right.” These comprehensive environments are restorative and evidence has shown that people instinctively seek them out. In general, preferred environments are thought to increase health, sense of wellbeing, and behavioral effectiveness in humans (De Young).
SUSTAINABLE DESIGN

In his book *Heating, Cooling, Lighting – Sustainable Design Methods for Architects* Norbert Lechner states that in order to promote the future wellbeing of both humans and the natural world, sustainable design in the long run is not an option but a necessity (Lechner, 14). Scientists continue to argue about some of the specific numbers and rates of resource depletion, pollution, and climate change. However, it is commonly understood that the planet is losing its ability to protect life, regenerate resources, disperse pollution, and provide food for the quickly escalating numbers of humans, let alone other species of life (Koger and Winter, 19). To define sustainability, The World Congress of Architects in Chicago in June 1993, said:

> Sustainability means meeting the needs of the current generation without compromising the ability of future generations to meet their own needs. A sustainable society restores, preserves, and enhances nature and culture for the benefit of all life present and future; a diverse and healthy environment is intrinsically valuable and essential to a healthy society; today’s society is seriously degrading the environment and is not sustainable (Lechner, 14).
Many ways exist to describe sustainable design. One approach urges using the four Rs: reduce, reuse, recycle, and regenerate. In the building industry these measures can be carried out in a variety of ways, such as by reducing the size and energy appetite of buildings; renovating (rather than demolishing) old buildings; repurposing or recycling old materials that would otherwise be discarded; and designing buildings and communities in a way that allow the surrounding landscape to regenerate (Lechner, 15-16).

EFFECTS OF SUSTAINABLE DESIGN ON ENVIRONMENTAL PSYCHOLOGY

By examining various elements of the built environment that affect human psychology, it has been shown that a successful design necessitates making design choices which promote the wellbeing of people. At the same time, the future wellbeing of the planet (and thus of people) is dependent on the choice to design sustainably. While these two needs can work together in some situations, they become competing forces in others. The following section will examine how sustainable design can both positively and negatively impact human psychology. In addition, possible solutions to lessen the negative effects will be offered.

One of the main ways in which the environmental impact of buildings can be minimized is by decreasing the size, and thus the energy and material needs of buildings. Taking this approach to sustainability has many ramifications, particularly for office workplaces. Due in great part to economic forces, workplaces are becoming smaller. The National Research Council of Canada (2004), Construction Division, determined that
in 2002 the average clerical worker’s workspace had an area of 71 square feet, professional/technical staff members had 88 square feet, and managers had 178 square feet, on average (down from 79, 103, and 205, respectively, in 1997) (Augustin, 196). According to Nigel Scott-Williams in a 2011 report, this trend is expected to continue so much so that many office buildings will become empty within the next five to ten years as the real estate of many companies contracts (Scott-Williams).

While this trend may seem like a positive one in terms of saving energy and building materials/furnishings, it can be more difficult to meet human needs in higher density workplaces. The main reason for this is that it is harder for people to establish and maintain privacy in smaller spaces, particularly since many of these spaces are open. A survey conducted in 26 different offices in the Stockholm, Sweden area provides an example. Out of several different workspace types—including private offices, shared offices (for two or three people), small, medium, and large open plan offices, flex offices (which allow for people to work in the office or remotely), and combi-offices (in which employees share common workspaces with no assigned desk)—employees in medium and large open plan offices were the least satisfied with their work environment, primarily due to the prevalence of noise and lack of privacy (Danielsson and Boden).

Considering that 80 to 90 percent of a company’s expenses each year are on payroll while typically less than two percent of the expenses each year are building related, it is not surprising to find that the 80 to 90 percent figure for salaries is what eats away the most at a company’s profits (Scott-Williams). Indeed, the success of a company (and thus the success of the office design) is dependent upon keeping the
company profitable; thus it is very important that employees are satisfied with their work environment.

Finding a way to provide necessary space and privacy for people within a smaller office footprint takes careful planning. In many offices it is neither practical nor desirable to provide private offices for every employee, so other sorts of private spaces must be provided within an open office setting. Several sources indicate that many highly successful open plan offices include a variety of unassigned workspaces that support different kinds of tasks, such as quiet focus rooms for tasks that demand concentration; cafes and team rooms for collaborative work; and enclaves for private conversations. This approach can work particularly well in flex offices in which some of the employees work remotely some of the time and do not have assigned workspaces. Flex offices with carefully designed unassigned work areas certainly allow companies to keep the square footage of the office down while providing opportunities for privacy.

The prevalence of noise has been noted as one of the reasons that occupants in workplaces may feel that they lack needed privacy. This can become a problem in green buildings that utilize minimal finishes since such environments can be acoustically challenging. For instance, some approaches that minimize applied finishes in order to maximize daylight and conserve resources include using concrete slab floors (without any additional floor finish above the slab); using open ceilings (which typically include a concrete or metal deck with exposed ductwork); and minimizing walls (which correspondingly creates more open space). Aside from actual sources of sound, the acoustical environment of a building is determined by both the materials which make up
the building and the configuration of the space (Moeller, 3). Acoustical properties of materials are demonstrated by their noise reduction coefficient (NRC) rating which shows the ability of materials to reflect or absorb sound, with full reflection equal to zero and full absorption equal to one. Looking at the aforementioned materials, concrete slabs have an NRC rating of zero and offer no noise control. A metal deck can provide a good deal of sound control but only if the deck is perforated and backed by a highly absorptive material such as fiberglass. Adding other materials to a space, such as carpeting (with an NRC rating of 0.29 to 0.50) or acoustic ceiling tiles (with an NRC rating of 0.50 to 0.95) can add a great deal more sound control (Grondzik, et. al., 769). In certain spaces such as lobbies which do not necessitate quiet environments, using minimal, often more reflective building materials does not present a problem. However, areas in which focused work is done (as well as in spaces adjacent to those work areas) necessitate that sound-absorbing materials be used in order to minimize aural distractions. For instance, one source suggests that performance criteria for open plan offices includes an NRC rating of 0.75 or higher for ceilings; 0.70 or higher for partitions; 0.80 or higher for walls; and 0.15 or higher for floors (Acoustics).

The configuration of a building also affects acoustics, with open spaces and higher ceilings offering less noise control than spaces that are more enclosed. In spaces with minimal walls such as open plan offices, conversations are often intelligible from up to 50 feet away (Sound Masking). Compared with suspended ceilings, higher ceilings (such as those with exposed ductwork) also allow for greater sound reflections which produce a noisier environment (Ferut).
Achieving a design solution that uses building materials and energy in a sustainable way and meets human needs often involves compromises. Using sustainable materials (such as those made from rapidly renewable resources or those with high recycled content) that also have sound absorbing properties can be one such compromise. Utilizing a sound masking system is another tactic that can improve the acoustic environment by covering, and thus limiting the bad effects of noise. Particularly effective in environments such as open offices, a sound masking system makes conversation and other noise difficult to hear, thus reducing distractions and providing speech privacy. Variations in the volume of sound over time and across the space are reduced, so the environment feels quieter, and movements are less disruptive. While using a sound masking system adds to the energy requirements of a building, the added energy is minimal. For instance, running a Logison installation of approximately 13,500 square feet uses about the same amount of energy as a light bulb. Also, when a sound masking system is included in a facility design, the need for extra insulation or layers of drywall, plenum barriers, and permanent walls around private offices may be reduced or eliminated (Sound Masking). In regards to sustainability, the energy it takes to run a sound masking system is likely more than compensated for by the potential reduction of other building materials as well as by the increase in users’ wellbeing.

The issues of territory, personal space, and crowding must also be carefully considered in the planning phases of a sustainable building. While minimizing the space requirements of a building is desirable from a sustainable perspective, doing so can make it more difficult to prevent crowding or to provide people with the amount of territory
and personal space they need to feel comfortable. Thus, to satisfy both sustainability and human needs, measures must be taken to maximize the perceived amount of space without actually adding square footage. For instance, providing well defined spaces—whether through walls, partitions, or changes in color, flooring, or ceiling height—can make it easier for people to maintain territories. Designing spaces with higher ceiling heights and rooms with walls at angles of 90 or more degrees reduces feelings of crowding by helping people feel comfortable with less personal space. Providing interesting views can also make crowded situations less awkward. In addition, lighter, brighter spaces are perceived as less crowded—whether those higher illumination levels are produced by artificial lighting, daylighting, or the use of bright colors on the walls (Augustin, 70, 81). Through the use of such measures, thoughtful design can help bring together and satisfy the potentially opposing needs of people and the environment.

Another way in which the environmental impact of buildings can be minimized is by providing ample natural lighting and reducing the amount of artificial lighting. However, it is important to balance the need for natural light with the need to prevent unnecessary heat gain or loss in buildings. This means that larger windows (which provide greater quantities of natural lighting) are not always better. In fact, windows that exceed 30-40 percent of wall space do not provide significantly more daylight than do windows within the 30-40 percent range, though heat gain or loss increases significantly beyond that range. Windows on the east and west sides of a building in particular can emit intense heat and glare into buildings which is oftentimes undesirable. Windows on the north side of a building can present problems as well due to heat loss in the cooler
months of the year. In terms of the environmental benefits, the best place for large windows is on the south side of a building. Windows on all sides of a building, but particularly the east, west, and north sides must have appropriate shading devices in order for environmental benefits to be reaped (Ferut).

These specific guidelines for the positioning of windows can make for a complex building planning process. For instance, if offices, classrooms, apartments, patient rooms, or other spaces that would benefit from natural light and views of nature line the entire perimeter of a building, this may present a problem in terms of being able to provide sustainable thermal control. Ideally, such a conflict should be carefully addressed during the initial planning phases of a building, when building siting and preliminary space planning are being considered.

Color choices can also have significant effects on the sustainability of buildings for two reasons. One reason is due to the fact that brighter colors reflect more light while darker colors absorb more light. Thus, in order to enhance the sustainability of an environment through color, brighter colored surfaces that reflect more light should be specified in order to reduce the need for artificial illumination. Specifying bright colors on the ceiling has the most effect, followed by the back wall of a space (opposite windows), followed by walls adjacent to windows, followed by the floor plane, followed by furnishings, which have the least effect (Ferut). However, these specific guidelines for color distribution do not always coincide with human needs. Compromises may need to be made when determining which colors would help provide a sustainable environment
versus which colors would offer the most appropriate level of stimulation or create the desired atmosphere for the space.

Another way in which color determines the sustainability of buildings is through the effect of color on perceived temperature of a space. As previously stated, warmer colors tend to increase the perceived temperature of a space, while cooler colors decrease the perceived temperature. A sustainable choice involves using cooler colors in buildings that benefit from being cooled most of the year. Doing so would decrease the perceived temperature and reduce the energy required to keep the building at a comfortable temperature. Buildings that could be made more sustainable through the use of a cool color palette include those located in hot climates or those that are internal load dominated buildings (i.e., taller, thicker buildings with more space away from climate influences. Being electrically lit rather than daylit, these buildings generate heat and need cooling all year.) The opposite would be true of warmer colors: a warmer color palette would make for a more sustainable building in skin load dominated buildings located in cold climates. (Skin load dominated buildings are those in which nearly all spaces have an exterior wall, necessitating the need for heating in cold weather and cooling in warm weather) (Grondzik, et. al., 216). Again, the best color palette in terms of its sustainable value may not necessarily be the best color palette for the users of the space. In this situation, compromises must be made.

Achieving satisfactory indoor air quality and thermal comfort in buildings while minimizing energy needs takes careful planning throughout the design process. Perhaps the most effective way to achieve both a comfortable and sustainable indoor climate is
through the use of passive systems. Passive systems may be used for climate control, fire protection, lighting, acoustics, circulation, and/or sanitation. (In contrast, active systems may also be used for the same purposes as well as for electrical distribution.) In the case of climate control, passive systems may utilize natural ventilation, daylight, insulation, and other means to regulate the interior environment, rather than relying on mechanical control of HVAC (Grondzik, et. al., 11). However, in order to be fully effective, buildings must be properly positioned on a site in order to use elements such as daylight and wind in the most advantageous way. Implementing passive systems in an existing building that has not been properly sited will not provide maximum sustainable benefits. Furthermore, designing passive buildings requires particular expertise, and in some cases the up-front expenses of passive buildings may exceed those of standard buildings (Ferut). Thus, the success of the passive building industry is dependent on designers’ willingness to both embrace it and advocate its benefits. The benefits, fortunately, are clear: thoughtful passive design and planning allows for both human and sustainability needs to be met.

Many green buildings, particularly those that utilize passive systems, require user participation in order for sustainable measures to be fully realized. For instance, operable windows and shades provide natural ventilation and shading which can improve indoor air quality and thermal comfort while reducing energy usage—but only if properly managed by people. Luckily, users typically appreciate having such control over their space.
In some situations providing people with information or reminders is an effective way to get the most compliance with sustainable initiatives. Reminders known as prompts let people know that a particular behavior is called for, and they are ideally located both physically and temporally close to the behavior that is prompted. Examples of prompts include a label on a light switch reminding people to turn it off, or a sign on a recycling bin that says “please recycle.” If people are positively disposed toward performing such a behavior and the effort is minimal, a reminder may be all that is needed. However, if a reminder is perceived as being rude or demanding, it may not be effective. Instead, people may deliberately ignore a prompt in order to demonstrate their independence (Clayton and Myers, 150). Indeed, people tend to be the most satisfied and cooperative when they feel that they have control over their space as opposed to when they feel that they are being ordered to do something.

In other situations it is beneficial to provide users with a means to see the effects of sustainable actions so that people know their behaviors have been effective. For example, individual water meters provide the feedback people need to monitor their own effect. Being cognizant of this effect tends to result in lower water usage than when people pay a flat rate—saving both water and money for the client. Sometimes, feedback itself may be enough reward to motivate the behavior. Recycling programs often provide continuously updated information about how many trees have been saved by the amount of paper recycled. A target or goal along with feedback about the progress towards it can be both informative and motivational to people (Clayton and Myers, 151). Thus,
providing people with the means to control their space is typically helpful, if not necessary, when implementing sustainable measures in that space.

Depending on the context, creating preferred environments can either enhance a sustainable design or pose challenges. In general, people desire coherent spaces, or those which are contextually appropriate. Much of the time, sustainable designs can be adapted to a variety of contexts. In some situations, however, such as in certain high end spaces, there is an expectation for specific (high end) finishes which may or may not be sustainable. Granite countertops provide a classic example of a finish that has come to be expected in luxury (and even some semi-luxury) housing markets, but which is not sustainable due to its high amount of embodied energy (i.e., the amount of energy it takes to produce, transport, and construct with a material) (Lechner, 53). Extreme amounts of energy are needed not only for mining granite, but also for shipping it to distant locations.

According to natural stone installer Jay Irwin, it is often cheaper for American stone companies to get granite in South America, ship it to China to be polished, and then ship it across the world again to be installed in the United States. Still, according to real estate agents in residential markets, the popularity and desirability of granite goes unmatched by any other countertop material. In fact, leading stone counter industry professionals estimate that since the 1990s when the granite phase began, Americans have spent upwards of $12 billion on granite countertops—a figure which is higher than the cost of the first Gulf War. Another leading industry professional estimates that the amount might be closer to $60 billion (Fitch, 1-2).
In the case of granite, selecting salvaged stone or that which has been locally mined and fabricated (within 500 miles of the design site) can lessen the environmental footprint. Specifying a comparable material with low embodied energy (such as recycled quartz) is another positive solution. By suggesting reasonable alternatives to unsustainable materials, designers can create preferred environments in a more sustainable way.

Finally, something should be said for the value of green buildings, simply for the fact that they are green. This information alone can have positive effects on people’s wellbeing. Sally Augustin provides an example of the benefits green buildings can have on those in workplace environments:

“Green buildings signal to workers that an organization values its employees’ long-term welfare, which has positive repercussions. They also signal a concern for the public welfare to the general population, which has significant public relations values if the concerns seem legitimate. People working in green buildings are more likely to feel that their workplace meets their needs than people working in other buildings, and they are also less likely to be negative when there is a problem with building operations (e.g., temperature, lighting, noise)” (Augustin, 183).

This last statement regarding building operations does not negate the importance of balancing sustainability needs with human needs. A truly sustainable building is one that endures, which means that it must be a place where people want to be—a place that is healthy, nurturing, and delightful to its occupants. As Christine Evan, president and CEO
of USGBC, says, “The best sustainable designs are not just environmentally responsible. They also produce buildings where employees can thrive and productivity can soar. We call those high-performance green buildings (Architects Honored).”
CHAPTER 4
DISCREPANCIES WITHIN THE SUBJECT OF SUSTAINABILITY: AN EXAMINATION OF CARPETING

Not only do design professionals sometimes find the needs of humans and of sustainability to be at odds with each other, but conflicts also exist within the subject of sustainability. For instance, regarding the sustainability of certain building materials, multiple viewpoints exist, each at least somewhat biased by their own background and interests. While virtually all building products have both positive and negative attributes in terms of their sustainability, a discussion which encompasses a wide range of products is beyond the scope of this thesis. Therefore, one product which is widely used in building interiors—carpeting—will be examined in depth to illustrate the prominence of discrepancies in the industry. In order to discover the most accurate information possible, the chronology and reliability of different sources will be compared.

Carpeting accounts for nearly 70 percent of residential flooring and over 70 percent of workplace flooring in the Western world (Campbell). Due in part to its prominence, the carpeting industry was one of the first targeted by environmental groups, which cited the industry’s negative environmental impacts in the areas of materials usage, poor indoor air quality, and disposability—most especially the billions of pounds of carpeting that has been going into landfills. Overall the industry responded quickly to these concerns and has devoted much effort during the past twenty years to not only address but also help solve the environmental problems associated with the use of their
products (Bonda and Sosnowchik, 122). However, due to conflicting sources of information the question still remains: have these efforts been enough to provide truly sustainable and health-promoting products? A variety of sources will now be examined that provide information on carpet and how it affects human health and sustainability.

According to Dak Kopec in the 2009 publication of Health, Sustainability, and the Built Environment, many healthy-home proponents believe carpeting to be an unhealthy choice for flooring. One of the reasons for this opinion is that carpeting has a high chemical content, including the carcinogens formaldehyde, benzene, styrene, toluene, and xylene. A source from 2001 that Kopec cited stated that although the Carpet and Rug Institute (CRI) has worked with the US Consumer Product Safety Commission (CPSC) to conduct tests for respiratory irritants and set investigation standards, controversy still exists as to how carpet affects indoor air quality. One of the problems that was stated is that offgassing may result from a combination of chemicals, so identifying the specific culprit and then finding carpeting without that particular combination is difficult, if not impossible (Kopec, Health, Sustainability, 103-104).

Another serious problem described by Kopec is that it can be difficult to keep carpet clean, which means that small particles, food crumbs, and skin cells that are shed can easily provide a breeding ground for contaminants such as spores, bacteria, and dust mites. Due to its negative effects on indoor air quality, a number of health problems have been attributed to carpet, including eye irritation, asthma, and neurological problems. Some people suffer a wide variety of symptoms, including headaches, muscle and joint pain, fatigue, and inability to concentrate. Cases of severe seizures have even been
reported. Kopec suggests that chemically sensitive clients should seriously consider flooring other than carpeting, such as hardwood or cork (Kopec, Health, Sustainability, 104).

The information on carpeting in the 2007 publication of Susan Winchip’s Sustainable Design for Interior Environments closely supports Kopec’s findings regarding carpet’s effects on indoor air quality. However, Winchip does state that designers can promote healthy indoor air quality by specifying carpet systems certified by the CRI Green Label program or by California’s Indoor Air Emission Standard 1350. Regarding other aspects of sustainability, Winchip adds that the carpet production process is toxic—emitting poisonous pollutants into the air and harmful dyes into waterways. Also, most of the carpet that is removed from buildings is not salvaged and is transported to landfills, resulting in millions of pounds of non-biodegradable carpet in landfills each year. Similar to Kopec, Winchip states that sustainable solutions emphasize using hard flooring with area rugs rather than wall-to-wall carpet (Winchip, Sustainable Design, 211).

While the Kopec and Winchip sources on sustainable design present carpet in a negative light, other sources with the same focus are more positive and in some instances, directly contradict the Kopec and Winchip books. For instance, the 2007 publication of Sustainable Commercial Interiors by Penny Bonda and Katie Sosnowchik thoroughly discusses the actions taken by a variety of carpet manufacturers to be sustainable. The authors demonstrate that across the board, life cycle impacts of the production, use and disposal of carpet have lessened. End-of-life strategies including reclamation, recycling,
and reuse are noted as being the most significant aspects of sustainable progress, and hence are discussed in the most detail (Bonda and Sosnowchik, 121-126).

The issue of indoor air quality is not included in the section of the book that discusses carpeting but is discussed later in its own section. Reasons attributed to poor indoor air quality include lack of proper ventilation and filtration, as well as VOC emissions. The authors suggest specifying low or no VOC products, including carpeting that is certified by the CRI’s Green Label Plus program (Bonda and Sosnowchik, 151-158).

A source that directly contradicts some of the information in Kopec’s Health, Sustainability, and the Built Environment is Foster, Stelmack, and Hindman’s Sustainable Residential Interiors. According to Kopec, formaldehyde is one of the toxic carcinogens found in carpeting, but Foster, Stelmack, and Hindman state that formaldehyde is no longer used in carpet manufacturing. These authors note that the formaldehyde that offgases from old carpet may come from other sources—for example, when home and garden chemicals come in on the soles of shoes (Foster, Stelmack, Hindman, 220). Interestingly enough, the Kopec book was published in 2009 and the book by Foster, Stelmack, and Hindman was published in 2007.

Other sources that present carpeting in a positive light, not surprisingly, are carpet manufacturers. As stated in Sustainable Commercial Interiors several carpet manufacturers have taken significant environmental initiatives regarding the ways that their products are made. InterfaceFLOR was one of the first companies to implement sustainable measures, and a vast amount of sustainability information is provided on the
interfaceflor website. for instance, huega, which is now an interfaceflor brand in europe, invented the carpet tile in 1955; today, carpet tile is all that interfaceflor sells. in terms of sustainability, carpet tile is preferred over broadloom because of the minimal waste produced in installation as well as the ease of replacing sections of soiled carpet.
in 1994 interfaceflor launched one of the carpet industry’s most aggressive, responsible, and successful carpet reclamation programs, allowing 94 million pounds of carpet to be diverted from landfills to this date. more recently interfaceflor set a new goal to be “off oil by 2020”. use of renewable energy and extensive recycling is helping the company to make this goal a reality. while not standard with all installations, designers have the option to specify carpet to be installed with interfaceflor tac tiles which are used instead of adhesive and which emit 90 percent less vocs than traditional adhesive. interfaceflor carpet is cri green label plus certified and is currently more than 85 percent of the way towards meeting its goal of having all products receive third party verified environmental product declaration by the end of 2012 (interfaceflor).

while interfaceflor is one of the leaders in sustainable initiatives, several other carpet manufacturers have implemented significant positive change as well. shaw contract group is noted for offering cradle to cradle products, which can be infinitely recycled, never going to a landfill. milliken contract also offers a no carpet to landfill contract and is carbon negative, meaning that the company captures and offsets more carbon dioxide than it emits—by planting trees, using alternative fuels, and reducing energy usage. all the products of both shaw contract group and milliken contract are green label plus certified by the carpet and rug institute.
A manufacturer that uses another approach to sustainability is Signature Crypton Carpet, whose carpet is protected by an eco-friendly finish that keeps dirt, liquid, odors, mold, and mildew from adhering to the fibers. This stain free and antimicrobial carpet is designed to be cleaned—not to hide dirt—and it cleans easily, requiring 30% less vacuuming than standard carpets. The high level of product performance not only prolongs the life of the carpet but also improves indoor air quality (if regularly cleaned) since it does not harbor contaminants (Crypton Fabric). This information represents just a small fraction of the sustainable initiatives these companies have implemented.

Reviewing the information in the sources by the various authors as well as that provided by the carpet manufacturers, it is easy to see that conflicts abound. The main issues at hand include the prevalence of carpet recycling; indoor air quality (which is affected by chemicals and offgassing as well as by the harboring of pollutants); and the carpet manufacturing process. The issue of recycling will be examined first.

In Sustainable Design for Interior Environments Winchip states that most of the carpet that is removed from buildings is not salvaged and is transported to landfills, resulting in millions of pounds of non-biodegradable carpet in landfills each year. While this statement may be true, Winchip does not quantify “most,” and thus there is no way to determine from what the author said what percentage of used carpeting ends up in landfills versus being recycled or repurposed. Furthermore, the author provides no insight into whether this quantity is changing over time. Looking at the information provided by the previously discussed carpet manufacturers, it is readily apparent that these companies have made considerable strides with waste prevention by introducing
reclamation programs and by reducing reliance on virgin resources. Also, some of the most significant sustainability measures these companies have undertaken have occurred within the past five years—after the 2007 publication date of Winchip’s book.

Information from the Carpet and Rug Institute reflects this trend: in 2002 just under 4 percent of waste carpeting was diverted from landfills, compared to 10 percent in 2005, 19 percent in 2008, and 23 percent in 2010. 27 to 34 percent of waste carpeting is projected to be diverted from landfills in 2012 (Carpet America Recovery Effort).

Indeed, from this data it is clear that steady progress is being made. So while Winchip’s statement regarding the amount of carpet that is landfilled each year is correct, the positive trend of increasing carpet reclamation is not accounted for, perhaps due in part to the publication date of Winchip’s book. Thus, looking at Winchip’s source alone does not provide the full picture.

In spite of this it is important to note that the trend of increasing carpet reclamation is likely more accelerated for commercial carpeting than for residential. The main reason for this is that several of the high profile commercial carpet manufacturers offer reclamation services, compared to proportionally fewer residential carpet dealers that offer such services. For instance, out of a random sampling of six residential carpet dealers in the greater Cleveland, Ohio area, it was discovered that only one of those companies offers carpet reclamation for recycling free of charge—so long as new carpeting is purchased from that company. Additionally, nylon 6 is the only fiber type accepted for recycling by this company (Frederick’s Floor Coverings). Another company offers reclamation for recycling but at a price of 50 cents per square foot (The Floor
The other four companies do not offer reclamation services. Recycling residential carpeting without going through a dealer is possible, but only at two locations in Ohio—Brookpark and Cincinnati—and both locations charge fees according to the weight of the carpet that is to be recycled. In essence, recycling or repurposing residential carpeting is not economically viable for most consumers unless time is taken to find a dealer that does not charge for this service. Thus, Susan Winchip’s statement regarding limited carpet reclamation may still very much apply to residential environments.

The effect of carpeting on indoor air quality is another issue that brings rise to much debate. As stated by Kopec, the high chemical content of carpeting leads to offgassing and poor indoor air quality. However, Kopec does not mention that other aspects of the built environment (such as the availability and quality of ventilation) have a big impact on indoor air quality as well. Additionally, every other source that has been examined states that carpeting which is Green Label Plus certified does not create harmful levels of offgassing. While not all carpeting has this certification, it is becoming more standard (The Carpet and Rug Institute). Though Kopec cites The Carpet and Rug Institute for other information, it seems that a description of the Green Label Plus program was deliberately left out of the discussion. Even sources that were published before Kopec’s book discuss the benefits of the Green Label Plus program.

The presence of formaldehyde in carpeting is another aspect of indoor air quality made controversial by the writing of Kopec versus that of Foster, Stelmack, and Hindman. Further investigation reveals that authors of both books present factual
information, but Kopec presents the information in a biased way, describing carpet as having a high chemical content which includes formaldehyde (Kopec, *Health, Sustainability*, 103). This does not mean, as is evidenced by a variety of other sources, that carpeting has high levels of formaldehyde. In fact, the opposite is true. For instance, the Carpet and Rug Institute states that

> “Formaldehyde is common in the air and is a part of many products, even our clothes. Referral to formaldehyde as a component of carpet is incorrect because it is not used in modern carpet manufacturing. The CRI testing programs assure that only extremely low levels may be present in carpets, adhesives, or cushions ([Carpet and Indoor Air Quality]).”

Numerous scientific research studies, including those done by the EPA and independent testing agencies confirm that carpeting is one of the lowest emitting building products and that VOC emissions from new carpet typically fall to very low levels within 48 to 72 hours after installation when accompanied by good ventilation ([Greening Your Purchase](IAQ Problems)). Thus, Kopec’s choice of wording is potentially misleading.

Conflicting views also abound regarding the environmental ramifications of carpet’s ability to harbor pollutants. Again, Kopec states that carpeting contributes to poor indoor air quality because it traps contaminants and is difficult to clean (Kopec, *Health, Sustainability*, 104). Though this issue is not typically addressed by carpet manufacturers other than Crypton, many additional sources claim that the opposite is true: carpet’s ability to trap contaminants is actually beneficial for indoor air quality because the amount of airborne microorganisms is reduced (Lorenzi). This claim is
supported by Swedish data which cited the banning of carpet in schools in the late 1980s only to result in skyrocketing asthma rates in children ever since—an unexpected result (Shishoo and Borjesson). However, in order to ensure that good indoor air quality is maintained, it is recommended that carpet is vacuumed frequently (daily in high traffic commercial settings) and that high efficiency microfiltration vacuum bags are used (The Carpet and Rug Institute). Unfortunately, both the economic and environmental cost of cleaning is one of the largest components in the lifecycle of carpeting, running from $7.77 to $14.17 a yard over the course of 22 years (Bigger). When evaluating carpeting for its environmental benefits, it is thus very appropriate to consider indoor air quality and maintenance as they relate to each other.

Finally, conflicting information regarding the carpet manufacturing process will be examined. In keeping with her relatively negative discussion of carpeting, Winchip states that the carpet production process is toxic—emitting poisonous pollutants into the air and harmful dyes into waterways. However, she does not provide any further data which makes it difficult to determine the full extent of harm. Presenting quite a different picture, carpet manufacturers such as Shaw Contract Group describe their ever-improving efforts to provide a sustainable manufacturing environment. Shaw for instance uses a Reclaim-To-Energy program which reduces the need for oil by using steam energy generated from carpet and wood product waste. According to Shaw, this method improves plant emissions. Shaw also monitors its manufacturing processes by modeling its system after the requirements of ISO 14001, which assists organizations of any type
by providing a strategic approach to setting environmental objectives (Shaw Contract Group) (ISO 14000 Essentials).

Another source, Environmental Building News, offers specific information on the carpet dyeing and treatment process. This source describes how carpet dyeing has traditionally been one of the most polluting stages in the carpet manufacturing process as large amounts of contaminated water are dumped from used dye baths. However, solution dyeing of nylon is the most environmentally responsible method due to the fact that dye pigments are added to the polymer solution as fibers are extruded, minimizing waste water (Carpeting, Indoor Air Quality, and the Environment). Although most carpet manufacturers do not provide this quality of detail regarding the dyeing process, specifying solution dyed carpeting helps reduce environmental impact.

Recognizing that conflicting sources of information abound, it is crucial to consider the chronology and motivations of each source when selecting building products such as carpeting. Regarding chronology, the rapid change that has recently occurred in industries such as the carpet industry warrants particular attention. Even within the last five years new technologies and processes have helped carpet manufacturers improve their environmental footprints, which earlier sources do not reflect. However, the most current sources are not always the most reliable—motivations must also be examined. For instance, certain environmental sources may be inclined to use scare tactics in order to spur readers to action more quickly, while manufacturers are motivated to sell their product. Thus, consulting more neutral sources or looking for products that are certified by independent programs such as the Green Label Plus program provides credibility.
Despite the differences between sources, all that have been examined agree that carpeting adds comfort and warmth to a space and that its acoustic benefits reduce stress and promote wellbeing. Carpeting also promotes safety because it helps prevent injuries from falls (Lorenzi). Still, in order to promote human health and sustainability to the fullest extent possible, carpet decisions should be based on careful research and analysis. Though this approach can involve a significant amount of time and effort, it is necessary in order to determine the most accurate, relevant information possible.
CHAPTER 5

SUSTAINABILITY FINDINGS FROM DESIGN PROFESSIONALS

As has been shown, a plethora of viewpoints exist regarding sustainable design. The changeable nature of the design profession further contributes to the complexity of available information on sustainability. To balance the findings of the literature review, attention will now be turned towards the perspectives of design professionals, who offer very relevant, timely information on the subject. Via an electronic survey, results were obtained from 83 design professionals who work or have worked in the Northeast Ohio area regarding their approach to sustainability. The information obtained in this survey is not intended to capture the views of the average design professional since it is likely that those who are already more inclined to design sustainably are the ones who took the time to complete the survey. Rather, it is understood that the majority of survey responses represent the thoughts of those who typically incorporate or consider various aspects of sustainable design in their work. With the exception of written responses to open-ended questions Table 1 shows the survey in full; highlights (including written comments) are summarized in the following section.

SURVEY FINDINGS

83 people started the survey, and 78 completed it, with different numbers of people providing answers for various questions. A little more than half (approximately 56 percent) of respondents were female, and most respondents (approximately 63 percent,
male and female) fell within the age range of 20-39. Approximately 40 percent were architects and 42 percent were designers, with the remaining in the professions of manufacturer’s representative, sales person, teacher, or other design professional. A minority of respondents (about 38 percent) were members of the most common design organizations—International Interior Design Association (IIDA), American Society of Interior Designers (ASID), and American Institute of Architects (AIA). Another minority (also about 38 percent) were LEED (Leadership in Energy and Environmental Design) accredited professionals. LEED professional credentials demonstrate current knowledge of green building technologies, best practices, and the rapidly evolving LEED rating system. At this time the LEED rating system is the only industry standard for green building (LEED Professional Credentials).

Regarding appropriate times to discuss the subject of sustainability, most respondents educate their clients or students on the benefits and importance of sustainable design about two thirds of the time. Nearly three-quarters of the respondents select sustainable methods and materials for their work. Virtually all of the respondents keep informed about new developments with sustainability; the majority (84 percent) of respondents does so by talking with friends, coworkers, reps, and other professionals in the industry. Reading magazines, online articles, and visiting product websites are also very popular methods of education, with about three quarters of respondents using these methods. Many respondents (about 61 percent) also obtain sustainability information by attending lectures.
Two questions asked design professionals what sustainable issues they incorporated most of the time in their designs or their lectures. The first question focused on issues related to conserving resources, and the second focused on issues related to the health/wellness of occupants and workers. For the sake of simplicity, findings from both of these questions are summarized together. The biggest majority of respondents (about 78 percent) indicated that they used or discussed the incorporation of daylighting in buildings. The same percentage of respondents indicated their use of materials with recycled content and/or those that promote good indoor air quality. Use of high efficiency systems (such as lighting, plumbing, and HVAC), scored second highest with about 72 percent. Other aspects that scored between 50 and 65 percent included materials that can be recycled, materials made with renewable resources, efficient use of materials and space, durable materials that have a long life span, and timelessness of design (15+ years). Issues that scored between 45 and 50 percent included materials being reused in another form; design that encourages users to recycle or conserve resources; materials/systems that can be maintained in a sustainable way; and materials that have been manufactured in a way that protects human health. The lowest scoring issue was materials that require minimal energy or resources to be made or installed, at 32 percent.

Seven respondents out of the 78 who answered these two questions left specific comments. Three of those comments were very similar in nature, stating that true sustainability is dependent on looking at the building design as a whole and using design itself to reduce energy. Ways to accomplish this (as stated by the respondents and
verified in the literature review) include designing a building appropriate to the location and climate in which it’s located; determining how the size, shape, and orientation of a building can work together to minimize energy usage; facilitating the right amount of daylighting; and incorporating passive design features such as heating and cooling.

Next, design professionals were asked what concerns they had with sustainability. Again, information was divided into two questions, with the first question focusing on the preferences of clients and designers, and the second focusing on product performance and availability. The primary concern respondents had (71 percent) was that “greenwashing” often takes the place of true sustainability. As stated by Bonda and Sosnowchik, greenwashing is best described as “the deliberate dissemination of misleading information or the implementation of token ecofriendly initiatives in an effort to conceal larger abuse of the environment and present a positive public image” (Bonda and Sosnowchik, 9). Other big concerns (53-63 percent) included clients not being interested in taking sustainable measures if there is no economic benefit to them; the difficulty in reeducating clients who are used to doing things one way; and the budget not allowing for sustainable methods or materials. Issues that are less of a concern (8-19 percent) included designers or clients falling in love with products that are not sustainable; certain high end spaces being designed most effectively with materials or methods that use a lot of resources; finding or creating sustainable solutions takes too much time; and the selection of sustainable choices is too limited. It should also be noted that six percent of respondents did not have concerns regarding the effects of clients’ and designers’
preferences on sustainability, and that 17 percent did not have concerns regarding the product performance and availability of sustainable materials.

Ten respondents provided specific feedback to these questions. Common threads between many of the responses included issues of cost and time constraints. Regarding cost, one respondent stated that clients prefer green methods/materials so long as it does not cost them any more money. Another clarified that the administrative expenses associated with the documentation of green design, sustainable materials, and LEED can be an issue. A third person mentioned that being sustainable is not cost effective in the beginning—that is, the upfront costs of sustainable design are often more than what clients are willing to pay, even if sustainable features pay for themselves in the long run. Regarding issues of time constraints, one respondent described that she is under time pressure to produce and please clients and for this reason she won’t specify products that are not readily available. She also elaborated that the aesthetic and performance qualities of products are more important to her than sustainable qualities. Another respondent stated that finding sustainable products takes more time during the bidding process when three equal competitors are needed.

Additional issues were described by other respondents to this question. One respondent stated that sustainability is compromised when the design staff does not consider building siting and form at the beginning of a project. This issue can be particularly problematic when the design team does not take an integrated approach, and professionals such as interior designers and engineers are not consulted until the building orientation and form are already set. Another person elaborated on greenwashing in that
some products (such as fluorescent light bulbs with mercury in them) trade one environmentally friendly attribute (human health) for another (energy efficiency). A third person stated that many sustainable products have not been in the market for very long and that it is difficult to predict their durability and appeal over a period of time, perhaps 30 years.

An open-ended question asked design professionals for their general comments regarding their thoughts on or approach to sustainability. 12 people provided feedback, with half of the responses elaborating on previously discussed issues, namely cost constraints and the need for an integrated design team. Additionally, three responses expressed concern that the green movement has become harmfully commercialized. One person stated their opinion that the green movement has become too complicated and exclusionary and that many of the design professionals who seek LEED accreditation do so for status purposes, rather than to really make a difference. Another person expressed the concern that LEED certification has become big business and is losing some of its original impact. A third person stated that agencies that charge substantial fees to certify a product is green can be cost prohibitive. For example, a small manufacturer may be very environmentally friendly but may not have the thousands of dollars to get their products certified. Thus, it becomes more difficult for designers to evaluate and compare the true sustainability of different products.

Despite the various concerns addressed by the design professionals, the average respondent indicated that they are confident that their concerns regarding sustainability will become less of an issue in the future. (On a scale from one to ten, with ten being
very confident, the average rating was just under seven.) Seven people provided specific comments on ways in which they work to overcome their concerns. All of the comments focused on the need for continuing education and discussion about sustainability and collectively addressed both the need for design professionals to educate themselves and the need to educate their clients.

SURVEY ANALYSIS
Overall, the survey results are supported by information gained via work experience in the design industry and a literature review. The commercialization of sustainability, greenwashing, and time and cost constraints are some of the main concerns indicated by survey respondents, and these concerns will now be examined in more detail as they relate to findings from work experience and the literature review.

As was previously discussed, the impact of LEED is a matter that was questioned by a few of the survey respondents, with the commercialization of LEED being the overarching concern. Work experience with LEED documentation has revealed that commercialization of the system is a valid concern. Because the LEED rating system is currently the only industry standard for green building, LEED certification carries a lot of weight. For instance, LEED certified commercial buildings have higher occupancy rates and are able to charge higher rents than comparable buildings that are not LEED certified (Eichholtz, et. al., 3). For this reason, it is often desirable to seek as many LEED credits as possible in order to achieve a higher level of certification, even if some of the credits may not have significant impact for the project at hand. As an example, pursuing an
alternative transportation credit (which could involve showing a bus stop within one quarter mile of a workplace, or providing bike racks and shower facilities within a workplace) may not affect the true sustainability of a building in some cities or areas. Providing the proximity or the amenities for alternative transportation is all that is required to obtain the credit—whether or not people actually use these alternative forms of transportation is not relevant for LEED purposes. If it is known that all of the employees at a certain workplace drive to work, gaining this credit can make a building appear more sustainable than it actually is. Thus, it is more meaningful to obtain credits that pertain more closely to the project at hand.

Greenwashing, a significant concern as indicated by a majority of survey respondents, may or may not be easy to identify, depending on the situation. While unsubstantiated, vague, irrelevant, or false claims are common indications that greenwashing is occurring, significant research is often required to determine the true sustainability of products, as has been shown by the previously discussed literature review. In their book *The Psychology of Environmental Problems*, authors Susan Koger and Deborah Du Nann Winter offer specific strategies to help combat problems such as greenwashing: asking the difficult questions about environmental issues; pursuing answers, even when they are not forthcoming; learning more about the environmental consequences of various actions; and expressing preferences to those such as product manufacturers and legislatures (Koger and Winter, 215).

Time and cost constraints in the design process are other significant issues that will now be explored further. In many cases time pressure to complete projects as well as
the desire to reduce up-front costs may be due to deeply rooted cultural forces. One source reports that American consumers’ eco-consciousness fades during times of economic recession. While consumer research has revealed that many people are interested in helping the environment, the average person is not willing to pay even a few cents more for green products if there is fear about the state of the economy (Clifford and Martin). Undoubtedly this mindset carries over into the field of design and explains why some clients resist a sustainable approach to a project, even if the long-term financial and health benefits outweigh the initial cost.

Another source states that contemporary fast food culture accounts for feelings of being time-stressed and impatient and leads to a preference for short-term financial gain. This source reveals the findings of Toronto researchers who discovered that exposure to fast food symbols make people feel impatient in settings far outside the eating domain. One of the most striking discoveries was that just a glimpse of McDonald’s golden arches changes people’s psychology so that they become impatient about financial decisions—they wind up unwilling to postpone immediate gain for future rewards, so they sacrifice savings, against their own economic interest (Marano, 45). As has been shown in the sustainability survey, the ramifications of a culture that emphasizes immediate gratification can be prohibitive for sustainable building design in many cases: many clients would rather not pay for sustainable elements due to the increased up-front costs even though doing so typically more than pays for itself in the long run.

CONCLUSIONS
While it is difficult, if not impossible, to change the fast-pace quality of our culture, designers must continue to discuss with clients the need for sustainable design. As has been shown by the survey, talking to people is often an effective approach: survey findings revealed that the highest percentage of respondents (83 percent) indicated that talking to others is the primary way they gain information about new developments with sustainability. Using this tactic to educate clients will ensure that clients are making informed decisions.

When educating clients about sustainability a question that arises is how to make a case for sustainable design in the most impactful way. Authors Koger and Winter suggest that attention be paid to the way that environmental statements are framed. Framing effects are induced when the same information is structured in different ways. For instance, customers are more likely to invest in a water heater wrap if it was presented as a way to avoid losing money, rather than as a way to save money. Another assessment of framing effects revealed that speaking more specifically about “the air we breathe, or the water our children drink” is more widely engaging than the phrase “the environment” (Koger and Winter, 214).

This last statement makes an excellent case for using environmental psychology to effectively promote sustainable design. When it is not enough to make a case for sustainable design due to its long-term financial benefits and positive effects on the wellbeing of the planet, the benefits sustainable design can have on human health, comfort, and productivity may make for a more influential argument. Research shows that people feel better in spaces that include or connect to natural elements and that
people have higher morale in spaces that they know were designed in a sustainable way. But, educating clients is not the only aspect of moving towards a more sustainable society. As has been shown, designers must continually educate themselves on developments with sustainability, weigh the validity of sources against each other, and ask questions when information is not at hand. Incorporating accurate, timely research into projects allows for a more positive, meaningful impact on both the environment and human health.

As was previously stated by Lechner, a healthy environment is essential for a long-term healthy society. Recognizing the interrelationship of the health of humans and the natural world may be the best way to promote the wellbeing of both causes.
WORKS CITED


Frederick’s Carpet Corp. employee. Personal phone interview. 4 Jan. 2012.


WORKS CONSULTED


APPENDIX

SURVEY: HOW DO YOU APPROACH SUSTAINABILITY?

83 total people started the survey; 78 completed it (94%).

Sex: Response count 81

Male 44.4% (36)  Female 55.6% (45)

Age: Response count 81

20-29 30.9% (25)  30-39 32.1% (26)  40-49 25.9% (21)  50-59 8.6% (7)  60+ 2.5% (2)

I work primarily as a(n) (select all that apply): Response count 81

-architect 39.5% (32)  
designer 42.0% (34)  
rep 6.2% (5)  
sales person 3.7% (3)  
teacher 1.2% (1)  
other 7.4% (6)

I have secondary work as a(n) (select all that apply): Response count 73

-architect 9.6% (7)  
designer 15.1% (11)  
rep 0% (0)  
sales person 1.4% (1)  
teacher 11.0% (8)  
other 13.7% (10)  
none 49.3% (36)

I am a member of: Response count 79

-IIDA 16.5% (13)  
ASID 10.1% (8)
- AIA 11.4% (9)  
- none of these 62% (49)

Are you a LEED AP?  **Response count 80**

Yes 37.5% (30)  
No 62.5% (50)

I educate my clients/students on the benefits and importance of sustainable methods and materials. **Response count 83**

1 2 3 4 5 6 7 8 9 10 N/A  
Total average rating = 6.66

1 = I do not usually do this.  
10 = I make it a top priority to bring up the issue whenever appropriate.  
N/A = I do not generally meet with clients

I select sustainable methods and materials for my projects:  **Response count 83**

1 2 3 4 5 6 7 8 9 10 N/A  
Total average rating = 7.38

1 = hardly ever  
10 = every time  
N/A = does not apply to my work

I keep myself informed about new developments with sustainability by (select all that apply):  **Response count 80**

- reading magazines 76.3% (61)  
- reading articles online or visiting product websites 71.3% (57)  
- reading books 22.5% (18)  
- talking to friends/coworkers/reps/other professionals in the industry 83.8% (67)  
- attending trade shows 35.0% (28)  
- attending lectures/CEUs 61.3% (49)  
- none of these 1.3% (1)  
- other: 5.2% (4)
When creating a sustainable design (or presenting a lecture about it), the issues I incorporate most of the time related to conserving resources are (select all that apply):  
**Response count 78**

- materials that are being reused in another form 47.4% (37)
- materials with recycled content 78.2% (61)
- materials that can be recycled 65.4% (51)
- materials made with renewable resources 51.3% (40)
- materials that require minimal energy/resources to be made and installed 32.1% (25)
- use of high efficiency systems (lighting, plumbing, HVAC, etc.) 71.8% (56)
- design that encourages building users to recycle and/or conserve resources 44.9% (35)
- efficient use of materials/space 64.1% (50)
- durable materials that have a long life span 53.8% (42)
- timelessness of design (15+ years) 50.0% (39)
- none of these 2.6% (2)
- other: 7.8% (6)

When creating a sustainable design (or presenting a lecture about it), the issues I incorporate most of the time related to health/wellness of occupants and workers are (select all that apply):  
**Response count 78**

- materials/methods that preserve air quality 76.9% (60)
- materials/systems that can be maintained in a sustainable way 47.4% (37)
- materials that have been manufactured in a way that protects human health 44.9% (35)
- incorporation of ample daylighting and/or views of nature 79.5 (62%)
- none of these 2.6% (2)
- other: 1.3% (1)

My main concern(s) with sustainable design in my projects and how it is affected by preferences of clients and designers are that (select all that apply):  
**Response count 78**

- clients are not interested in taking sustainable measures if there is no economic benefit to them 61.5% (48)
- it is difficult to reeducate clients who are used to doing things one way 52.6% (41)
- the budget does not allow for many sustainable methods/materials 62.8% (49)
- I or my clients often fall in love with products that are not the most sustainable choices 19.2% (15)
- certain high end spaces are designed most effectively with materials/methods that use a lot of resources 7.7% (6)
- none of these 6.4% (5)
- other: 3.9% (3)
My main concern(s) with sustainable design and how it is affected by product performance and availability are that (select all that apply): Response count 76

- many higher impact products that I consider for my projects function/perform better than more sustainable options 23.7% (18)
- finding/creating sustainable solutions takes too much time 17.1% (13)
- the selection of sustainable choices is too limited 18.4% (14)
- “greenwashing” may often take the place of true sustainability 71.1% (54)
- none of these 17.1% (13)
- other: 7.8% (6)

I am confident that the concerns stated in the previous questions will become less of an issue in the future: Response count 78

1 2 3 4 5 6 7 8 9 10 N/A
Total average rating: 6.86

1 = not confident at all N/A = I was not concerned to begin with
10 = very confident

Is there anything you do personally to overcome these concerns? If so, please explain. Response count 7

Other general comments regarding your thoughts on or approach to sustainable design: Response count 12

Note:
Summarized in the body of the thesis are comments from respondents who indicated “other” as a choice as well as comments from those who provided answers to the last two (open-ended) questions of the survey.