THE HIDDEN CURRICULUM:

AN EXPLORATION INTO THE POTENTIAL FOR GREEN BUILDINGS TO SILENTLY COMMUNICATE A PRO-ENVIRONMENTAL MESSAGE

by

AMANDA MITCHELL

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Abstract

This qualitative research study explores whether high caliber green buildings can passively communicate a pro-environmental message to their occupants, and if so, whether some design strategies are more effective than others at communicating this message. The sample consisted of 26 participants (students, staff and faculty) who were occupants of one of the four study buildings: the C.K. Choi Institute for Asian Research and the Liu Institute for Global Issues at the University of British Columbia in Vancouver, BC; Princess Street Campus at Red River College in Winnipeg, MB; and the Computer Science Building at York University in Toronto, ON. Semi-directed interviews of 20 to 80 minutes in duration (the average interview was 43 minutes) were conducted *in situ* by the researcher. This research found that to varying degrees green buildings can passively communicate a pro-environmental message to their occupants. How many "green" design features an occupant could identify appears to form the core message, which is enhanced or diminished by the operational context, occupant experience and comparisons to other buildings. Certain design features were more often associated with a pro-environmental message and are therefore more effective at communicating this message. These emphatically green design solutions, such as salvaged materials and photovoltaics, either utilized strategies that are heavily connected with pro-environmental behaviour (the 3R's, energy conservation and water conservation) or are icons of the environmental movement. These design solutions acted as "triggers" by capturing an occupant's attention and causing them to link the strategy with a pro-environmental construct. Complicating the communication process is that a conclusive definition for "pro-environment" did not exist among occupants. This means that a pro-environmental message may not be communicated unless the building embodies the occupant's specific definition for the term. This research provides direction to designers and building managers on how to increase the potential that a green building will communicate a pro-environmental message to their occupants, and it suggests that green buildings can be heuristic learning tools if they are designed with an aesthetic that challenges existing constructs.

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Except where noted, all photos were taken by the author.

List of Abbreviations

AJLC	Adam Joseph Lewis Center (Oberlin College, Oberlin, OH)
BREEAM	Building Research Establishment Environmental Assessment Method
CaGBC	Canadian Green Building Council
Choi	C.K. Choi Institute for Asian Studies
CIRS	Centre for Interactive Research on Sustainability
CPCS	Centre for Person Computer Studies
CSB	Computer Science Building, York University
CSO	Campus Sustainability Office at the University of British Columbia
DND	Department of National Defence
DSP	Dominant Social Paradigm
ERB	Environmentally Responsible Behaviour
GSHP	Ground Source Heat Pump
HVAC	Heating, Ventilation, and Air Conditioning system
LEED	Leadership in Energy and Environmental Design
Liu	Liu Institute for Global Issues
MEC	Mountain Equipment Co-op
NEP	The New Ecological Paradigm
PDA	Personal Digital Assistant
PV	Photovoltaics
RRC	Red River College
York	York University's Computer Science Building
UBC	The University of British Columbia
USGBC	United States Green Building Council
VITP	Vancouver Island Technical Park
VOCs	Volatile Organic Compounds

For Occupant Quotes

Italicized quotes are from the interviewer

C	C.K. Choi Institute for Asian Studies
L	Liu Institute for Global Issues
R	Red River College's Princess Street Campus
Y	York University's Computer Science Building

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Dedication

With much love, this thesis is dedicated to my father, Kenneth George Mark Mitchell.

"Every school, college, and university has a formal curriculum described in its catalogue. But it also has a hidden curriculum consisting of its buildings, grounds, and operations. Like the infrastructure of the larger society, it structures what students see, how they move, what they eat, their sense of time and space, how they related to each other, how they experience particular places – and it affects their capacity to imagine better alternatives."

(Orr, 1999b, ¶ 7)

Introduction

Chapter 1

"We shape our buildings, and afterwards our buildings shape us."

(Winston Churchill, 1943 as quoted in Brand, 1994, p. 3)

In *Architecture as Pedagogy,* David Orr argues that the "curriculum embedded in any building instructs as fully and as powerfully as any course taught in it" (Orr, 1999a, p. 213). Whether intentionally or not, every building "tells a story." Reading the subtleties of form, materials, relationship to location and design strategies employed, individuals subliminally extract meaning from the built environment. Although this process usually passes unnoticed, there are certain buildings in which the process of extracting meaning is much more pronounced. Take for example the experience of walking into a neo-gothic cathedral such as Montreal's Notre-Dame Basilica. The large scale of the building with its cavernous interior, lavish materials and dramatic lighting creates a rich perceptual experience that evokes feelings of awe, submission and reverence. The heavy stone construction suggests permanence and its soaring towers and prominent location hints at the important role the church held within the community. It has long been argued that neo-gothic and gothic style Christian churches were specifically designed to intimidate people in order to raise the image of the church (Maas, Merici, Villafranca, Furlani, Gaburro, Getrevi, & Masserini, 2000; Tuan, 1977; McAndrew, 1993). Regardless of whether this was the church's intention, the resultant churches are laden with meaning.

A contemporary example of a building with a noticeable story is the new Canadian War Museum in Ottawa (Figure 1.1). Officially opened on the sixtieth anniversary of Victory in Europe Day, the Museum was designed by Raymond Moriyama of Moriyama Teshima Architects and Alex Rankin of Griffiths Rankin Cook. A review of the building by the Toronto Star's architectural critic Christopher Hume, specifically discussed how the building creates a narrative:

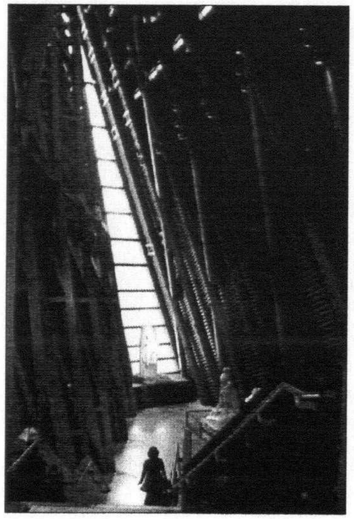


Figure 1.1. Inside the Canadian War Museum (Photo courtesy of Michelle Baker)

> Its job is to tell the story of Canada's military history. But this hardly begins to explain the powerful impact the museum has on anyone who enters it. To walk its corridors is to experience physically the sense of dislocation and disruption that are the inevitable

> results of war. The darkness of certain spaces and the feelings of separation and isolation it leads to are impossible to ignore. The brilliance of this extraordinary building lies in its most basic structural elements — the angles of the walls, the handling of light and materials, the use of emptiness and absence as architectural devices. These are some of the techniques that enabled Moriyama and his team to create a building that itself communicates a narrative, conveys emotion and speaks so eloquently (Hume, 2005, ¶ 8-10).

Thus, through the materials, lighting, colours, furnishings and angular form of the walls the Canadian War Museum communicates the tragedy of war, and sends a message of regeneration and remembrance.

1.1 Meaning from the Built Environment

To understand how meaning is derived from architecture, it is first necessary to explore the method by which people make sense of the world. Personal Construct Theory, devised by George Kelly, postulates that everyone is a scientist engaged in the process of anticipating the world (Crittenden, n.d.). Much like a scientist devises a working hypothesis for an event and then tests that hypothesis through experimentation, this theory states that individuals create constructs of the world based on perception and personal experience. These constructs, schemata or mental maps are then superimposed on everyday experiences and provide the filter by which the world is viewed. When a person's experiential reality matches their construct, these constructs are strengthened. However when the construct system clashes with the lived experience, then the original construct is revised. Constructs enable an individual to form expectations for a given situation, to predict possible outcomes, and guide behaviour (Crittenden, n.d.; CPCS, 2004).

According to Hershberger there are two categories of meaning that can be derived from architecture – representational and responsive (Figure 1.2). Representational meaning refers to the identification of objects, design features or spaces, and the recognition of their function. This involves matching sensory experience with personal constructs. For example, distinguishing a rectangular plank of wood with a circular handle as a door and its purpose of partitioning two separate spaces would be representational meaning. Responsive meaning is a secondary reaction to the identified object. These responses might be "affective, evaluative, or prescriptive in nature: 'tinglings' in our spine, 'feelings' of disgust or contempt, 'thoughts' about the value of the represented environment, or 'ideas' concerning what should be done about it" (Hershberger, 1974, p. 148). Through representational and responsive meaning, an individual can understand the built environment and use that information to direct their behaviour – such as wayfinding – accordingly.

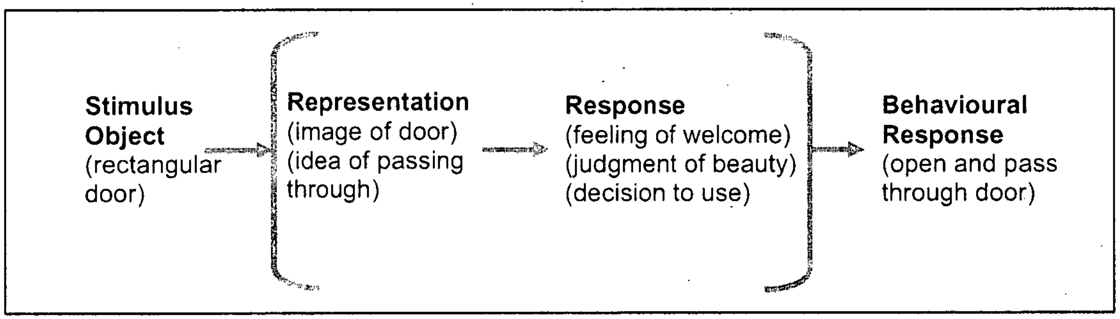


Figure 1.2. An example of Representational and Responsive meaning of architecture (Hershberger, 1974, p. 149)

These two categories of meaning have also been identified by Nasar (1989) although he uses the terms "denotative" and "connotative" meaning instead of Hershberger's representational and responsive meaning. Nasar also defines "symbolic meaning" which results from "a cognitive process whereby an object acquires a connotation beyond its instrumental use" as the connotative aspect of meaning (Lang, 1987 as cited in Nasar, 1989, p. 237). For the purposes of this thesis, and in order to decrease confusion between the different types of meaning, the responsive or connotative meaning derived from architecture will be referred to as "messages".

Research in environmental psychology has explored some of the messages that people derive from specific built environments. Discussed below are results from studies looking at the messages people have derived from house styles, house interiors, restaurant façades and courthouse architecture.

Symbolic meanings of house styles was studied by Nasar (1989) who asked participants from Columbus, Ohio and Los Angeles, California to rate six different house styles (Farm, Tudor, Mediterranean, Saltbox, Colonial, and Contemporary) in terms of desirability and the perceived friendliness and status of the assumed residents. The two participant groups showed consistent responses in their rankings with Farm and Tudor seen as the most desirable. In terms of friendliness of the perceived residents, Farm style houses were seen as the most friendly and Colonial as the least. Colonial and Tudor house styles scored the highest in terms of status.

A study by Sadalla, Vershure and Burroughs (1987) took the exploration of symbolic meaning from the built environment one step further and examined how well the messages observers derived from house decoration matched the homeowner's personality. In this study, upper-middle-class homeowners rated their personality and identity using a questionnaire consisting of

36 personality traits listed in a 9-point, bipolar scale. Bipolar personality traits included cultured-uncultured, nonintellectual-intellectual, foolish-wise, pessimistic-optimistic, conformist-individualistic, tense-relaxed, unpleasant-pleasant, suspicious-trusting, shy-venturesome, impolite-polite, etc. Study participants from Arizona State University were then shown photographs of the exterior of the homeowner's house, their living room or both and asked to assess the homeowner's personality and identity based on the photographs and using the same bipolar scale as the residents. Results showed that the inferences made by the participant about the homeowner did in fact correspond to the homeowner's self descriptions, with the greatest correlations achieved when participants were shown photographs of the living room. Sadalla et al thought that interior spaces may be more informative since homeowners have greater flexibility in manipulating interior spaces. The fact that an individual's character, personality, priorities, values, and interests can be inferred by how they decorate their space is something understood by executives at Home and Garden Television Network who created a dating reality show based on this premise. In *Design for Love*, participants decide who they would like to date by visiting the apartments of three potential matches (Smith, 2003).

Evidence of shared social constructs for restaurants is provided in a study conducted by Cherulnik (1991). Participants were shown photographs of 20 restaurant façades that fell into four different categories: lunch/sandwich shop, family dining, inexpensive dinner restaurant, and expensive dinner restaurant (fast food chain restaurants such as McDonald's and Wendy's, were not included and there was no mention of the restaurant's ethnicity). The restaurants were located in a central Pennsylvania city with approximately 35,000 residents and situated far enough away from the University where the participants were from to reduce the likeliness that participants would be familiar with the area. Participants were asked to record their impressions of conditions within the restaurant, to identify which occasions they would be most likely to visit each restaurant, the physical conditions within the restaurant and to identify the occupations and personality-traits for the most likely clientele all based on photographs of the restaurant's façade. Results showed that the four restaurant types were clearly differentiated, and participants correctly judged the conditions that would be experienced by the patron – from food and prices to ambience and clientele.

An interesting study by Maas, Merici, Villafranca, Furlani, Gaburro, Getrevi, and Masserini (2000) looked at the messages derived from two different courthouse designs in Northern Italy. The older courthouse, which was built in 1345 and used to be a convent, has a residential look with warm colours, large windows and wooden doors. In contrast, the second courthouse was built in 1991 and is a massive, grey, semi-circular "high-style" building with narrow windows and an entrance enclosed between two huge walls. Participants where shown a series of photographs that approximated the experience of approaching the entrance of one of the courthouses and were asked to imagine that they were accompanying a friend to court. They were asked to comment on the aesthetics of the courthouse, how uneasy they felt, and the likelihood of conviction for their friend. Participants found the two courthouses to be equally attractive, but they judged the new courthouse to be more intimidating, and participants estimated that their friend stood a greater likelihood of conviction when the trial took place in the new building. Participants also experienced greater discomfort and stress when imagining themselves entering the new courthouse, but only when they had previous experience with the building. This curious result – that participants who had physically been in the new courthouse experienced greater discomfort and stress when imagining themselves entering the building – was thought to be reflective of the study method chosen. The researchers thought that the photographic representation of the architecture may have reduced the impact that the buildings had in person.

1.2 How Buildings Passively Instruct

As the above studies show, people derive subliminal messages from architecture. In the words of Rapoport (1990) "the environment acts as a form of nonverbal communication" (p. 97) by silently providing cues to occupants on the schemata in which it was designed. According to Rapoport if the observer shares the same schemata as the designers, then it is possible for an occupant to "read" the building, to decode these messages and act accordingly (See Figure 1.3).

How well the message is decoded is dependent on whether the occupant and the designer are using the same schemata. Rapoport states that traditional environments were more legible since there was greater congruence between the schemata of the occupants and that of the designer. Modern environments, however, are harder to read since there are more specialized settings and greater diversity among society. Rapoport also points out that the decoding process occurs on a subliminal level and it only becomes apparent when it ceases to work, when people are placed in a situation that they are not familiar with, when they "do not understand the cues, the rules, the expected behaviour" (Rapoport, 1990, p. 84).

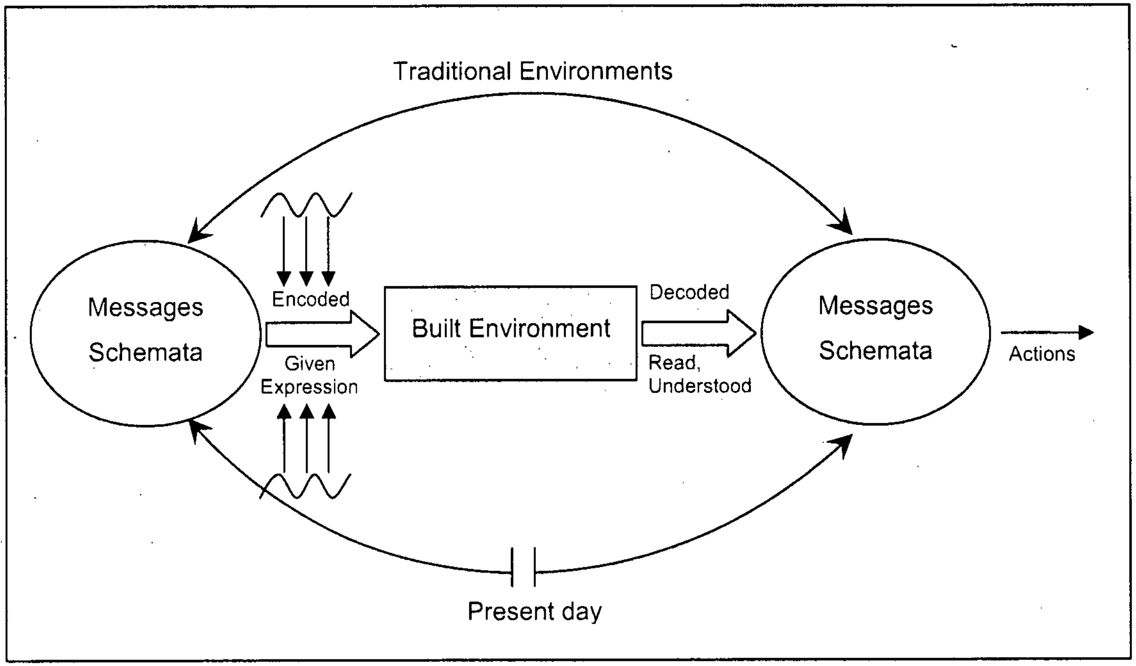


Figure 1.3. Encoding and Decoding of Environmental Information (Rapoport, 1990, p. 82)

Examining the built environment in this way explains why the participants in Sadalla, Vershure and Burroughs' study (1987) were able to correctly infer homeowner personality based on the way they decorated their interior and exterior spaces. Homeowner's decorated their personal space using socially derived 'symbols' that communicated their personality. Since observers share the schema upon which the meaning of these symbols was based, they could read the setting to gain an understanding of the occupants.

Similarly, in Cherulnik's study on restaurant façades, the high degree of correlation between inferred attributes of the restaurant and actual conditions, suggests that restaurant façades are highly legible and that there exists a shared schema for restaurants (Cherulnik, 1991). This is especially the case with chain establishments such as Tim Horton's, where the experience is consistent at each location that patrons know exactly what to expect.

As Van der Ryn and Cowan (1996) state: "Design manifests culture, and culture rests firmly on the foundation of what we believe to be true about the world" (p. 9). In this context, buildings can be considered archeological artifacts that contain "congealed information" on the values, priorities and worldview in which they were designed (Rapoport, 1990). It is this information – this latent meaning – encoded by buildings that can, in varying degrees, be decoded by occupants. As such, buildings are subliminal teaching devices, quietly reinforcing the schemata in which they were produced. In this way, regardless of any intention to be didactic, all buildings instruct.

Buildings can also be actively used to instruct through the integration of the building with an explicit learning curriculum. In some societies buildings have been the "primary text for handing down a tradition, for presenting a view of reality" (Tuan, 1977, p. 112). Churches that relied on stained glass windows and statutes to tell the story of the scriptures to an illiterate congregation provide one example of the active employment of building elements to teach.

1.2.1 Lessons from Mainstream Architecture

If buildings embody the worldview in which they were built, and occupants can derive messages from buildings, then what environmental messages would a building designed in the context of the prevailing western worldview – the Dominant Social Paradigm – teach? The Dominant Social Paradigm (DSP) assumes that humans are separate from the natural world and dominant over nature. Limitless resources, the necessity of continuous growth, and the unfailing faith in science and technology to solve ecological problems are cornerstones of this worldview (Arcury *et al.*1986).

Mainstream architecture embodies this worldview through resource inefficient buildings that have been designed irresponsive of place. Modern buildings in which siting is irrelevant to natural settings, interior environments are isolated from natural conditions, and the use of abstract building forms with no relation to natural geometry project messages to occupants. Orr discusses some of these messages projected to occupants by mainstream architecture:

> The extravagant use of energy in buildings...teaches...that energy is cheap and can be wasted. The use of materials that are toxic to manufacture, install, or discard teaches carelessness about the use of Creation and a kind of mindlessness about where things come from and at what cost. Windowless rooms, or those with windows that do not open, teach that nature is to be kept at arm's length (Orr, 1999b, ¶ 8).

Mainstream architecture that is removed from the natural world teaches occupants the unimportance of place, that ethical, ecological, and aesthetic aspects are not important, nor are environmental and energy costs of buildings. In short, mainstream architecture can teach occupants that disconnection from surroundings is normal. Examining statistics on the amount of materials, water, and energy used by buildings, as well as the greenhouse gas emissions and waste produced by buildings (see Figure 1.4) reinforces these unspoken environmental lessons.

Gaining momentum is an alternative, less environmentally apathetic paradigm – the New Ecological Paradigm (NEP). At the core of the NEP is the assumption that humans are a part of the ecosystem and therefore subject to natural laws. The desirability of restricting growth, protecting the integrity of ecosystems, and working with natural systems to find solutions to environmental problems comprise the fundamental ideas of the NEP (Arcury *et al.* 1986).

1.2.2 Potential Lessons from Green Buildings

Designed to reduce the environmental impact at every stage of a building's lifecycle, green buildings are a manifestation of the New Ecological Paradigm. Green buildings consume less energy, use less water, and produce less waste than conventional buildings. They are constructed using environmentally and socially responsible materials that do not offgas noxious chemicals. The result is a healthier building with a more comfortable interior, lower utility bills and reduced impact to the surrounding environment.

Green buildings are designed using a fundamentally different mindset than their conventional counterparts. The environmental impact of every decision, from the siting of the building to material selection, is considered alongside economic and aesthetic decisions. The result is a much different building with a much different story.

Resource Consumption of Residential and Commercial Buildings

On a Global Scale

· Buildings and construction activities worldwide consume 3 billion tons of raw materials each year or 40% of total global use
· 40% of the world's energy is used by buildings
· 55% of the wood cut for non-fuel uses is for construction
· 30% of newly-built or renovated buildings suffer from "sick building syndrome"

In the GVRD

· 3.6 million tonnes of greenhouse gas emissions emitted by buildings in 2000 (28% of the regional contribution to greenhouse gases)
· 309 million cubic metres of water consumed
· 51 million gigajoules of electricity consumed
· 64 million gigajoules of natural gas consumed
· 1.7 million tonnes of demolition, landclearing, and construction materials generated, of which 67% is recycled

(GVRD *et al*, 2003, p. ii)

Figure 1.4. Environmental Impact of buildings

Returning to the concept that buildings silently transmit messages to their occupants, what potential environmental lessons do green buildings offer? Natural resources are limited and should be valued, the uniqueness of each place should be celebrated, and the earth should be treated with respect. Green buildings that reuse existing structures teach the importance of history and heritage, while sending a strong message of resource conservation. By making the ecological systems that sustain us visible, green buildings show that we are dependent on the natural world. In short, green buildings project a message of hope. Hope that our ecological problems are solvable.

1.2.3 Active verses Passive

What is the difference between design strategies and buildings that are actively instructional and those that are instructional only on a passive basis? Before answering that question, it is useful to review the nomenclature for hand gestures as proposed by Desmond Morris. Morris has made a career out of watching and categorizing human behaviour – including hand gestures. In his book *People Watching, the Desmond Morris Guide to Body Language,* Morris makes the distinction between Primary and Incidental Gestures:

> The hand-wave is a Primary Gesture, because it has no other existence or function. It is a piece of communication from start to finish. The sneeze, by contrast, is a secondary, or Incidental Gesture. Its primary function is mechanical...In its secondary role, however, it cannot help but transmit a message to his companions, warning them that he may have caught a cold (Morris, 2002, p. 21).

Similar to a "Primary Gesture," a design strategy would be "Actively" instructional when it has no other existence or function other than to communicate a message. Design features that are actively instructional would include truth windows, windows exposing mechanical systems, interpretive signage, didactic art and real-time monitoring displays (discussed in Chapter 2).

A "Passive" design strategy is much like an "Incidental Gesture" – where a message is not necessarily intended, but one is communicated nonetheless. These design strategies, such as salvaged materials or the elimination of finishing details, would be present in the building regardless of any intention to teach. This category is explored in greater detail in this thesis.

To determine whether a design strategy is actively or passively instructional, it is again useful to borrow from Morris (2002). As he states: "A convenient way to distinguish between Incidental and Primary Gestures is to ask the question: Would I do it if I were completely alone? If the answer is No, then it is a Primary Gesture" (Morris, 2002, p. 21). Similarly, one can determine if a design strategy is active or passive by asking: Would the strategy be there if there if there was no intention to teach? No audience to communicate to? If the answer is No, then it is an "Active" design strategy.

A building would be actively instructional when there is a clear intention to use it as a tool to teach occupants about environmental issues. This involves the use of various active design strategies and the incorporation of the building within the curriculum. Conversely, a green building would be passively instructional when few, if any, active strategies have been used. Any lessons learned or pro-environmental messages derived by occupants in these buildings are a derivative of the green design strategies incorporated.

1.3 Green Buildings that Actively Instruct

Green buildings are increasingly found in school boards, universities, colleges and outdoor educational centres across North America. Apart from the ecological and economic reasons for this trend, the idea that a green building can silently communicate a pro-environmental message to its occupants has been cited as the primary reason behind the move towards green design in many educational facilities. For example, Brown University in Providence, RI, has started to incorporate green design as a "shadow curriculum that supports or argues with the principles being taught in a building's classrooms" (Fickes, 2002, p. 14). The administration at Stanford University hopes "that fellow students will adopt sustainability through the use and observation of the buildings where they learn" (Knox, 2002, ¶ 19). All campus buildings at IslandWood – the environmental learning centre on Bainbridge Island, WA – were "constructed with sustainable materials and technology that surround a child with lessons for living responsibly within the natural world" (IslandWood, n.d.). As the Superintendent of Seattle Public Schools, Joseph Olchefske stated, "This facility will play a vital role in our effort to teach children to respect the environment" (IslandWood, n.d.).

Instead of restricting the building's influence to the passive realm, some educational institutions are taking things one step further by using green design strategies that actively instruct, and by incorporating green buildings into educational curriculum to create a "building that teaches" (Pearlstein, 2002, ¶ 1). The Adam Joseph Lewis Centre at Oberlin College in Ohio is an integrated building and landscape system and was the first of this concept. Designed specifically as a teaching platform for sustainability, building operation and performance is monitored using

150 data sensors that are embedded throughout the building, with the data being analyzed by students and provide the core content for several courses taught at the Centre.

The new addition to the Frost Campus at Sir Sanford Fleming College in Lindsay, Ontario, which houses the School of Environmental and Natural Resource Sciences, was designed with similar intent. In the words of Jim Madder, Former Principal of Frost Campus, "As the most environmentally sound commercial building in Canada, it is a building that our students will not only learn in but also learn from" (Fleming, n.d., ¶ 12).

Another Canadian example of a green building that teaches is the Integrated Learning Centre, Beamish Munro Hall at Queen's University in Kingston, ON. Designed by B+H Architects, the Integrated Learning Centre received a Royal Architectural Institute of Canada 2005 Award of Excellence ("RAIC Announces," 2005). Described as a "live building," exposed structures and monitoring sensors allow engineering students to gain an in-depth understanding on how a green building is constructed and how it functions over time. Sensors monitor a variety of information including stress, temperature, light levels, water pressure, air quality, heat transfer, energy production from the photovoltaic array, and energy consumed by the building. Data from these sensors is published online and can be used by instructors or for research (Queen's University, n.d.).

There is a growing interest in the use of green buildings as a teaching tool. An indication of this trend is the amount of LEED certified buildings that have received an Innovation Credit for "Sustainability Education" or "Sustainable Building Education." Out of 148 projects certified under Version 2 of the Leadership in Energy and Environmental Design green building rating system, 84 projects (45.7%) have received this Innovation Credit (as of April 8, 2005). On September 24, 2001, the USGBC made a Credit Interpretation Ruling to lay out the requirements that projects must follow to achieve this educational Innovation Credit. The ruling dictated that the approaches should be "Actively" instructional and must incorporate any two of the following three elements:

1) A comprehensive signage program built into the building's spaces to educate the occupants and visitors of the benefits of green buildings. This program may include windows to view energy-saving mechanical equipment or signs to call attention to water-conserving landscape features.

2) The development of a manual, guideline or case study to inform the design of other buildings based on the successes of this project. This manual will be made available to the USGBC for sharing with other projects.

3) An educational outreach program or guided tour could be developed to focus on sustainable living, using the project as an example (USGBC, 2001).

The Technology Enterprise Facility III (TEF III) Building at the University of British Columbia is an example of a Certified LEED Silver project that received an innovation project for "Sustainability Education" (Figures 1.6 and 1.7). To attain this credit, interpretive signage placed in the main hallway defines "What is a green building" and explains how the TEF III achieved energy efficiency, high quality indoor air, reduced waste during construction, and incorporated recycled and locally manufactured materials. There are seven different signs in total, and multiple copies of the signs are placed throughout the project. In addition, the TEF III created a case study detailing the building's environmental attributes which is accessible through the US Department of Energy, High Performance Building website and the Canadian Green Building Council's website

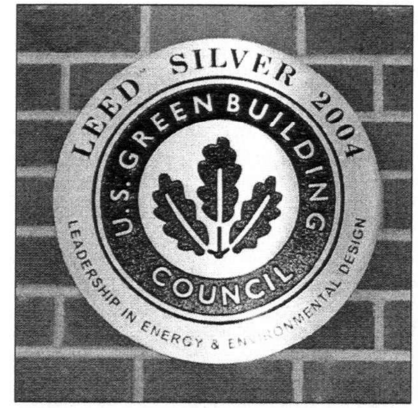


Figure 1.5. Photograph of the LEED Silver plaque awarded to the TEF III building at UBC

Figure 1.6. Close up photograph of one of the three "Sisters of Mercy" statues mounted on the TEF III that was salvaged from the Medical-Dental Building – a Vancouver art deco building that was demolished in 1989.

(http://www.cagbc.org/uploads/Case%20Study%202.pdf). Discovery Parks, the owner of the building, also has agreed to offer tours of the building to interested parties (E. Santos-Brault, personal communication, July 11, 2005).

Another indication of this trend – as seen at the USGBC's 2004 GreenBuild Trade Show – is the emergence of several companies with the sole purpose of supplying educational programming to green buildings. For example, EduTracks™ Green Building + Sustainability Education creates information boards showcasing green building attributes (Figure 1.7). Green Touchscreen Quality Attributes provides information to occupants on green building attributes through the creation of computer kiosks. Taking this one step further is Lucid Design Group, which provides real-time monitoring and feedback of building systems to occupants and the wider public through information kiosks and internet displays.

Chapter two discusses the six main actively instructional methods used in green buildings: Interpretive Signage, Make the Invisible Visible, Integrating Feedback, Didactic Art, Outreach Methods and Building as Curriculum.

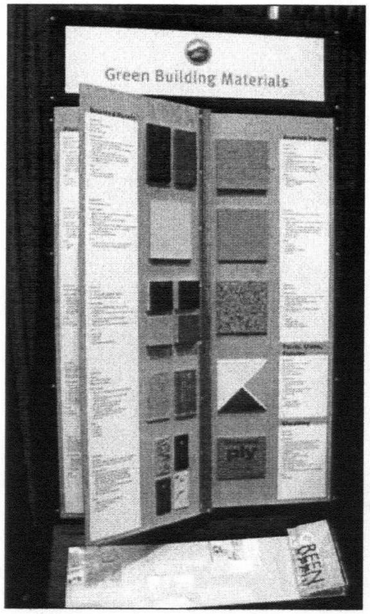


Figure 1.7. An example of the information boards created by EduTracks™

1.4 Research Question

Although the idea that green buildings can silently communicate environmental messages to occupants has been discussed in the literature (Orr, 1994a; Orr, 1997; Orr, 1999a; Orr, 1999b; Van der Ryn & Cowan, 1996; Lister & Stevens, 1996) and it forms the reasoning behind the adoption of green building strategies at many education facilities, to date there has been no comprehensive study conducted to validate these assertions. The notion that occupants of green buildings can passively derive pro-environmental messages embedded within the design is an intriguing concept, however, is it valid? Do high caliber green buildings passively communicate a pro-environmental message to their occupants?[1] And are some design strategies more effective than others in communicating that message? This thesis will explore these questions in greater detail.

1.5 Objectives

This project is an exploratory study with the following objectives:

- To determine if occupants derive pro-environmental messages from green buildings
- To determine which building characteristics or design strategies may be more effective in communicating a pro-environment message

- To develop recommendations for designers, facilities managers and environmental educators on how green buildings can be used as a teaching tool

1.6 Audience

By uncovering which building attributes and green design features lead to a heightened sense of environmental awareness among occupants of green buildings, this research will provide a directive for architects interested in designing a "building that teaches." The results will also be useful to environmental educators and building managers interested in exploring green buildings as tool to teach ecological literacy.

Green Buildings That Teach

Chapter 2

"In an effort to educate a new generation of ecologically literate and responsible citizens, educational facilities must be designed in such a way that pupils learn the art and science of sustainability passively as well as actively. The building and site should facilitate active learning through its features and programming layout, while passive learning should be facilitated through the use and incorporation of natural features, ecological processes and appropriate (visible) technology. In this sense, the building and site should serve as a teaching tool"
(Lister and Stevens, 1996, p. 106).

2.1 Who do Green Buildings Teach?

As pictured in Figure 4.1, there are several different "audiences" that can learn from green buildings: Design and Construction Teams, Building Occupants, the Community, and the Wider Public and Design Community. These audiences learn directly from the completed building, or in the case of the design and construction team, they can learn from the design process.

2.1.1 Design Team and Construction Team

This category not only includes members of the design team, such as architects, engineers, and landscape architects, but also contractors, project managers, specification writers, building commissioners, cost consultants, and construction managers.

During the design and construction of a green building there can be a steep learning curve if the team is inexperienced. Green design strategies – such as composting toilets, high volume flyash concrete, or waterless urinals – often challenge the status quo and existing expectations, which can lead to opposition. A story recounted by Freda Pagani, Director of the Campus Sustainability Office at UBC,and the motivating force behind the vision for the C.K. Choi Building (UBC), demonstrates that the design and construction process can also be a learning process. One of people from UBC who was involved in the project was "dead against" incorporating the reused bricks on the building, because it did not correspond with his value system at the time. However, his experience working on the C.K. Choi project helped to shift his viewpoint and he is now the Associate Dean of Sustainability at a prominent American university (F. Pagani, personal

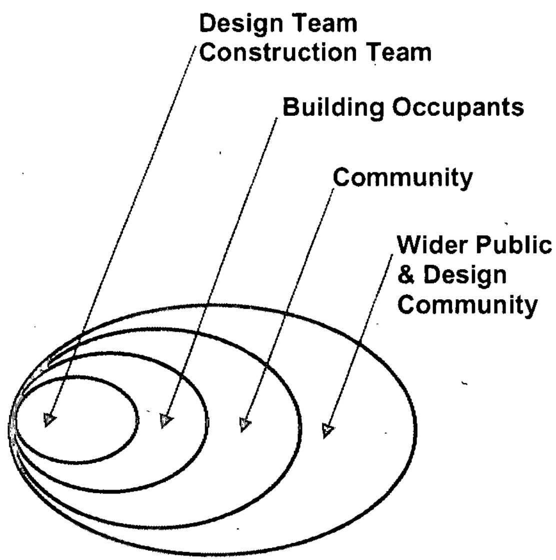


Figure 2.1. Spheres of influence – the different audiences that can learn from green buildings

communication, June 16, 2005). As this example shows, people can be dismissive of technologies that are outside their current operating schemata. Over time, however, as more is learned about the technology and the underlying philosophy for their use, this initial opposition can lead to acceptance.

Walter Bettio reiterated this point, stating that one of the greatest challenges encountered with the design of the Computer Science Building was the "resistance you get initially to do [things differently]" only to have those people recognize later "that it was not such a far flung idea" (W. Bettio, personal communication, October 25, 2005). Bettio found on this project that "anything that was not typical or conventional was a challenge" (W. Bettio, personal communication, October 25, 2005). This was especially true for the construction industry, since green design requires this industry to "stretch itself" (W. Bettio, personal communication, October 25, 2005).

All of the architects interviewed for this study – Eva Matsusaki, Ryan Bragg, Noel Best and Walter Bettio – discussed how much of a learning experience the actual process of designing a green building was and how they have applied the lessons learned from these buildings into subsequent design projects. Similarly, Diana Klein, the structural engineer for the C.K. Choi, credits her experience working on that project for setting her on a career path focused on reducing the environmental impact from buildings (D. Klein, personal communication, August 30, 2005).

2.1.2 Building Occupants

Green buildings can educate their occupants through active design strategies that purposefully encourage learning. This chapter discusses building elements that are actively instructional and designed to teach. The passive use of a building to communicate environmental messages to building occupants will be explored in greater detail in this thesis.

There is some indication that green buildings can encourage pro-environmental behaviour in building occupants. In a post occupancy study of Herman Miller SQA conducted by Eco*Integrations, Inc. they documented how "a lot of the recycling that was showcased in the building lunchroom was being picked up and taken home by employees. This spinoff of environmental consciousness was one of the possible 'ancillary benefits' we noted for green buildings" (J. Wise, personal communication, April 21, 2003). This study did not investigate whether this reaction was a result of the building itself or influence from the building management.

2.1.3 Community

Through methods that invite the community to come and explore, green buildings can help to educate the surrounding community. This can be achieved through tours, hosting public events such as community movie nights, or having an amenity like a café that draws the public in. Of course, depending on whether the building is public or private, it may not be desirable to the building management to extend the building's sphere of influence to the community.

Oberlin, OH resident Nancy Roth provides an example of how a green building can teach the community. When Roth and her husband needed to replace their aging furnace, they decided to install a ground source heat pump, which was something they learned about during a tour of the Adam Joseph Lewis Center. As she recounts: "We knew what geothermal heat and cooling was, because of the Lewis Center. And our own world-views have come more and more to parallel the one expressed in that building" (Roth, 2001, ¶ 23).

2.1.4 Wider Public and Design Community

Green buildings can expand their realm of influence to reach the wider public through outreach programs that extend the experience of the building. Books, publications, web access to performance data and internet databases that present green building case studies are some ways to reach a wider audience.

For the design community, green building case studies are a way to promote knowledge transfer among professionals and can help alleviate concerns regarding the feasibility of alternative building methods and nascent technologies. There is always a certain degree of risk when implementing a new technology. Sharing successes and challenges incurred can help educate the design community and the wider public on the merits and pitfalls expected when incorporating that technology into a building. Monitoring the success of a building over time, through post-occupancy evaluations and performance data, can establish whether a building is performing to design specifications. If the lessons learned from these buildings are publicly available, designers can learn from other projects, which can create a feedback mechanism for the design process.

One example of a green building that has been well documented for use as a case study is the Liu Institute for Global Studies. A 110-page report, *The Liu Institute for Global Studies Post*

Occupancy Environmental Assessment, was compiled by Architectura in order to document the performance of the Liu based on 60 Sustainability Targets established at the project's onset. For each of the 60 targets, this report includes a reference to a LEED™ Version 2.0 credit or perquisite, describes the context of the target and the strategies explored, the results achieved, any comments about the strategies and references for more information. This highly detailed publication provides a solid overview on the decision making process that was used while designing the Liu and the relative success that the strategies achieved. As stated in the document, its purpose was to: "Ensure that many of the challenges and experiences shared by the project team in the development of the Liu Centre can now be extended to a wider audience" (Architectura, n.d.b, p. 3). Although there was initially some concern that Architectura would loose a competitive edge by making this document public, in the end they decided that the case study could help catalyze interest in green design and would therefore be more useful in the public domain (N. Best, personal communication, August 16, 2005). The document has served its purpose and has "generated a lot of interest" (N. Best, personal communication, August 16, 2005).

2.2 Actively Instructional Green Building Strategies

As discussed in the introduction, facilities with an educational mandate (i.e. schools, environmental education centres, museums) are starting to use green buildings as a method to teach students about environmental issues. There are six main methods in which green buildings can be actively used to teach: Interpretive Signage, Make the Invisible Visible, Integrating Feedback, Didactic Art, Outreach Methods and Building as Curriculum[2]. The following section explores these six methods along with examples of buildings that utilize these strategies.

2.2.1 Interpretive Signage

Probably the easiest and most often used method to educate users on the environmental features of the building is to include interpretive signage or displays. This strategy is relatively inexpensive, can be installed with minimal effort at any time in the building's lifecycle, and can be used as a secondary form of communication to augment green design strategies that may not be well understood. To what extent the interpretive signage or displays are effective is dependent on their design. Signage needs to have the appropriate balance between photographs that engage the occupant's attention and text that explains the feature in a succinct way.

Among other buildings, this strategy has been used at the TEF III Building at UBC in Vancouver, BC (Figure 2.2); the Kortright Centre for Sustainable Living in Woodbridge, ON (Figure 2.3); The Jean Vollum Natural Capital Center (EcoTrust Building), Portland, OR (Figure 2.4); Mountain Equipment Co-op in Winnipeg, MB (Figure 2.5); and the Population Health and Wellness Directorate building in Victoria, BC.

Figure 2.2. Interpretive signage at the TEF III Building at UBC, Vancouver, BC.

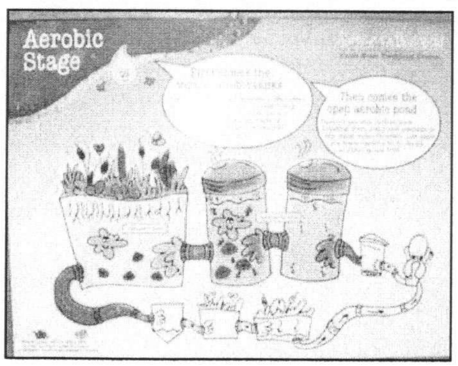


Figure 2.3. Interpretive signage explaining the solar aquatic system at the Kortright Centre for Sustainable Living, Woodbridge, ON.

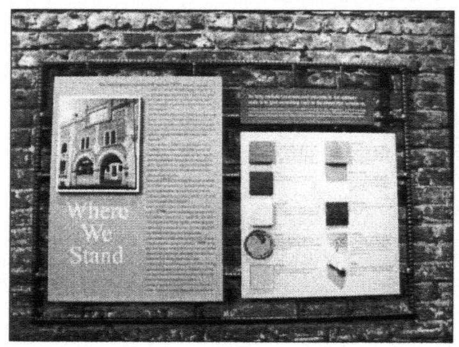


Figure 2.4. Interpretive signage at the Jean Vollum Natural Capital Center, Portland, OR.

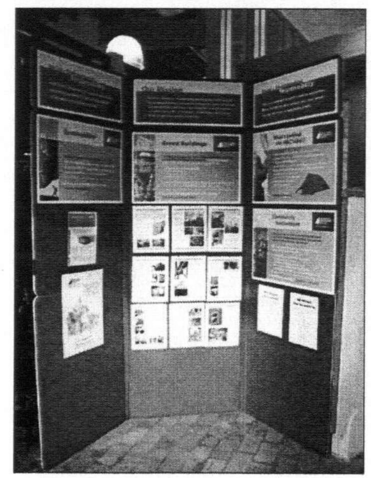


Figure 2.5. Green building display at Mountain Equipment Co-op, Winnipeg, MB.

The Environmental Technology Wing, Sir Sanford Fleming College (Lindsay, ON)

Seven large interpretive signs printed on canvas are hung throughout the Environmental Technology Wing at Fleming. These signs include the following topics: “Exploring our Geology,” “Turning to Wind Turbine Solutions,” “New Directions in Geomatics,” “What are Constructed Wetlands,” “About our Earth Observatory,” “Getting to Know our Forests” and “What’s Happening at the Centre for Alternative Wastewater Treatment?” (Figure 2.6).

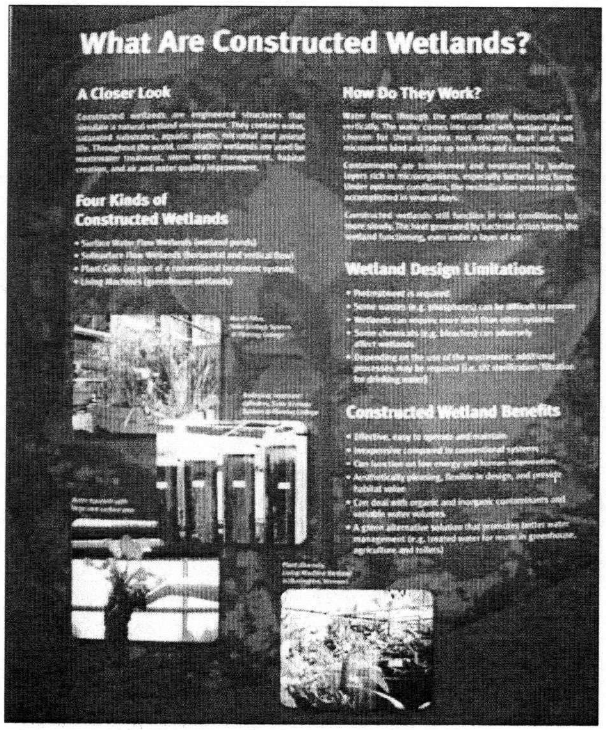


Figure 2.6. Interpretive sign explaining constructed wetlands at the Environmental Technology Wing at Sir Sanford Fleming College

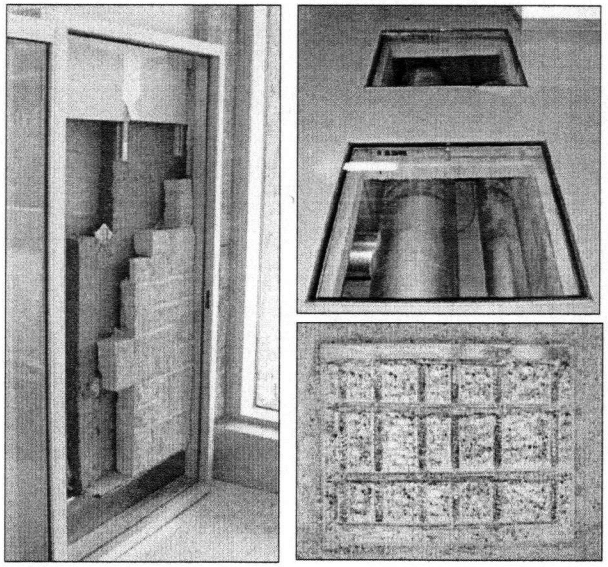
2.2.2 Make the Invisible Visible

There are three different methods to make the invisible visible: exposed building systems, expressed building systems or uncovering hidden cycles.

2.2.2.1 Exposed Building Systems

Exposed building systems are an active strategy that creates opportunities to view the building systems that are normally hidden behind walls. This can be accomplished by eliminating finishing details such as dropped ceilings that usually hide mechanical equipment, and providing windows to view building assemblies and mechanical equipment. The "truth window" often found in strawbale buildings is an example of an exposed building system.

Although exposing building systems creates an opportunity for occupants to literally see what is behind the walls, this strategy may be somewhat ineffective if it is not explained. Without prior knowledge of building science, occupants may not understand what they are looking at. This problem can be avoided through the use of a secondary communication method – such as interpretive signage – that can explain the systems on display.



Figures 2.7, 2.8, 2.9. (Clockwise from left) Exposed wall systems, steam heating pipes and concrete rebar assemblies at the Integrated Learning Centre at Queen's University (Queen's University, n.d.)

Integrated Learning Centre Beamish-Munro Hall, Queen's University (Kingston, ON)
One of the best examples of exposed building systems, the Integrated Learning Centre was designed as a "Live Building" to illustrate green building construction techniques to engineering students. Several sections of concrete have been drilled out to showcase how the structure has

been reinforced, steam heating pipes are visible through glass windows, a floor cut out shows column foundations and strip footings, and a display in the Tea Room exposes the layers in the wall assembly system (Figures 2.7, 2.8, 2.9) (Queen's University, n.d.).

Fred Kaiser Building, University of British Columbia (Vancouver, BC)

Housing the Electrical and Computer Engineering programs, the Fred Kaiser Building was partially designed to facilitate experiential learning. In particular, viewing opportunities are provided for electrical engineering students to learn about DC power, photovoltaics and, if funding comes through, stationary fuel cells (F. Pagani, personal communication, June 16, 2005). In addition, glazing on an exterior wall provides views into the mechanical room from the outside (Figure 2.10).

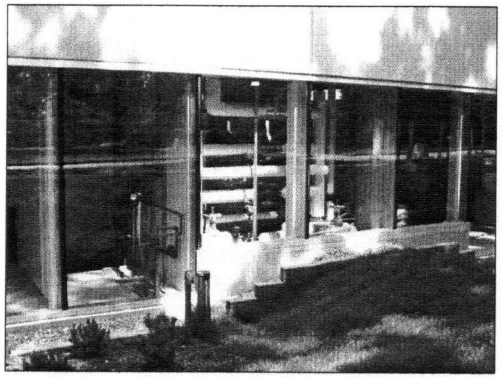


Figure 2.10. External window at the Fred Kaiser Building showing mechanical equipment

The Environmental Technology Wing, Sir Sanford Fleming College (Lindsay, ON)

Throughout the Environmental Technology Wing, dropped ceilings have been eliminated to make mechanical equipment and the pipes for the ground source heat pump (GSHP) visible. Instead of hiding mechanical control rooms in basements, windows link the mechanical control room to the library and the information technology control rooms with the computer lab (Figure 2.11).

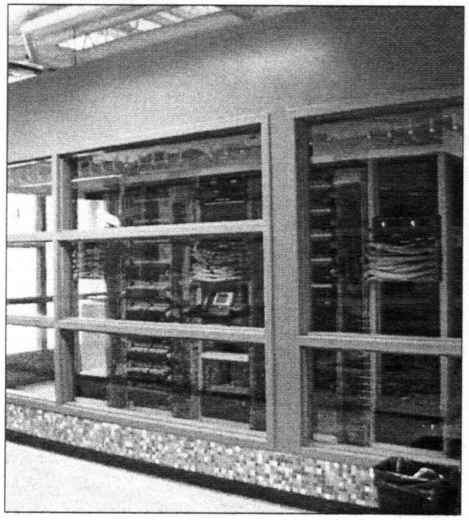


Figure 2.11. Windows provide views into the information technology control room at the Environmental Technology Wing

2.2.2.2 *Experiential Building Systems*

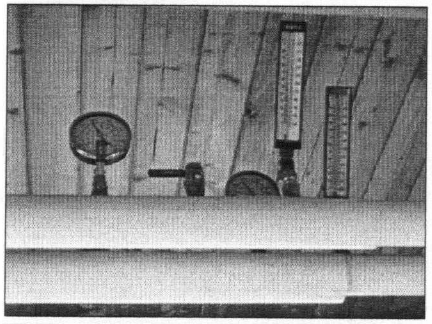
The experiential building system is a variation on the exposed building system. This active strategy involves the creation of opportunities for an occupant to understand experientially the purpose behind the building system. Typically, experiential building systems aim to create a fast, effortless, and automatic learning opportunity through the reliance on sensory experience (M. Murray, Personal Communication, August 13, 2003). With the focus on experiential learning, this strategy is reminiscent of the type of displays found in museums, and therefore may have limited application. Although this strategy would compliment some building programs such as schools and outdoor education centres it may not be appropriate in more professional settings such as office buildings.

Adam Joseph Lewis Center (Oberlin College, Ohio)

Visitors to the Adam Joseph Lewis Center can experience first hand the GSHP by gripping "handles" that are connected to the supply and return pipes of the GSHP to "feel the heat flow" (Figure 2.12). Expressing the building system in this manner creates an experiential learning opportunity as visitors can intuitively deduce the supply and return pipes based on the temperature difference (M. Murray, Personal Communication, August 13, 2003).

The Environmental Technology Wing, Sir Sanford Fleming College (Lindsay, ON)

Exposed ceilings at the Environmental Technology Wing reveal GSHP pipes that are fitted with thermometers and pressure gages to allow students to discern between the intake and return pipes (Figure 2.13). In addition, a truth window on the floor in the main hall shows the GSHP pipes with a built-in dial that illustrates the flow (Figure 2.14).



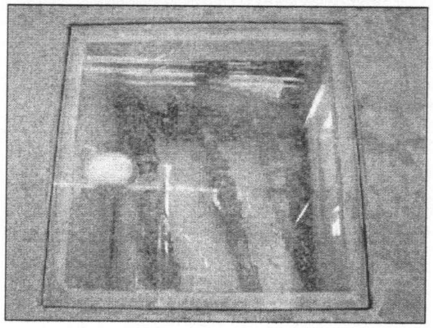


Figure 2.12, 2.13, 2.14. (From top) "Handles" at the Adam Joseph Lewis Center express the GSHP flow (Photo courtesy of Michael Murray); Pressure and temperature gauges on GSHP pipes at Fleming; Truth window at Fleming shows flow in the GSHP pipes

2.2.2.3 *Uncover Hidden Cycles*

As Van der Ryn and Cowan (1996) state: "The designed environment does not reveal to us how technology supports us and how in turn it is interconnected with the natural world" (p. 161). This is the basis of "flush and forget" technology found in contemporary buildings in which the ecological underpinnings of the built environment – including the hydrological cycle, diurnal and seasonal cycles – are hidden from view. Pipes bring water and fuel into a building, cables provide electricity and waste is removed all through unseen processes. Hiding these systems makes it difficult to understand them, and perpetuates the idea that buildings exist in a realm that is separate from the natural world. Green buildings can illuminate hidden cycles through technology that makes these connections visible, which can:

- Help us see and become more aware of the abstractions we superimpose on the land
- Make complex natural processes visible and understandable
- Unmask systems and processes that remain hidden from view
- Emphasize our unrecognized connections to nature (R.L. Thayer Jr. quoted in Van der Ryn & Cowan, 1996, p. 165).

Ways in which green buildings can uncover hidden cycles include: treating wastewater onsite using a solar aquatic system, producing energy from renewable means, capturing rainwater for use within the building and incorporating a composting program that provides nourishment for landscaping. Although there are many green buildings that have employed one or more of these methods, only one will be discussed in more detail.

Walker Elementary School (McKinney, TX)

Walker Elementary School incorporates several design strategies that uncover hidden cycles. A gauge in the front foyer measures how much rainwater is stored in the school's underground cisterns, a photovoltaic array and a wind turbine produce energy which is featured through data displays, and a constructed wetland manages stormwater onsite. The curriculum even requires each student to tend a flower bed. In Principal Deb Beasley's words: "An ecosystem has been structured for students which allows them to experience first hand their interdependence with nature" (Keep, 2002, p. 18).

2.2.3 Integrating Feedback

This strategy involves the incorporation of feedback either through real-time monitoring or annual audits. Literature on the use of feedback to domestic consumers has shown that it is possible to reduce energy consumption by the order of 10% (Darby, n.d.).

2.2.3.1 Real-Time Monitoring with Display Monitors

For this strategy, data sensors record building performance, which is then broadcast in real-time to occupants and visitors using a display monitor mounted in a visible and assessable location.

Adam Joseph Lewis Center, Oberlin College
Over 150 data sensors located throughout the building monitor the performance of a variety of building systems from water quality, air quality, energy consumption and production of energy by the photovoltaics. This information is made available to visitors and occupants through a display monitor located in the front foyer and an interactive website (Figure 2.15)

Fred Kaiser Building, University of British Columbia (Vancouver, BC)
In the central atrium of the Fred Kaiser Building, a data display monitor provides real-time feedback of the energy consumption of the building (Figure 2.16). This strategy "was intended as a teaching tool for the general public and the users of the building. For the general public it is more of an informational thing, but it is the users of the building who we expect will modify their

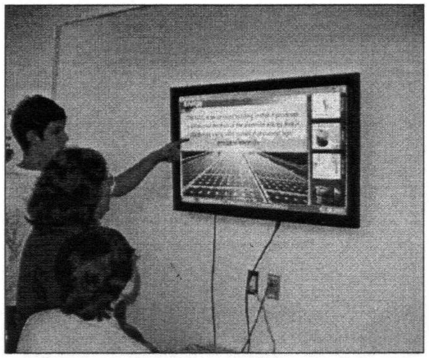


Figure 2.15. The data monitor display at the Adam Joseph Lewis Center (Photo Courtesy of Michael Murray)

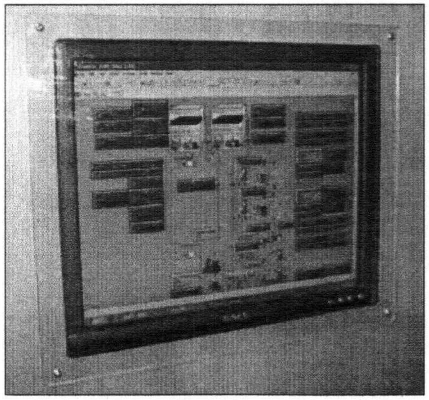


Figure 2.16. Display monitor at the Fred Kaiser Building, UBC

behaviour as a result of seeing the display monitor" (F. Pagani, personal communication, June 16, 2005).

Brunswick High School (Brunswick, ME)

The Brunswick High School in Brunswick, Maine has a monitor in the hallway that allows students "to check oil and electricity use throughout the building" (Sutton, 1996, p. 25).

Mary Ann Cofrin Hall, University of Wisconsin-Green Bay (Green Bay, WI)

Mary Ann Cofrin hall is a demonstration project for solar technologies. It features a 2,256 square foot solarwall system, extensive daylighting and two different Building Integrated Photovoltaic (BIPV) sections – a roofing product and a thin-film vision glass product. Over 4,300 square feet of BIPV were installed with an annual generation of approximately 27,500 kWh (Wisconsin Public Service Corporation, 2002b). An interactive electronic information kiosk located at Mary Ann Cofrin Hall "brings the building to life" by enabling visitors and occupants to learn more about daylighting design, the environmental features of the building, and obtain continuous real-time data on the BIPV systems (Figure 2.17) (Wisconsin Public Service Corporation, 2002a).

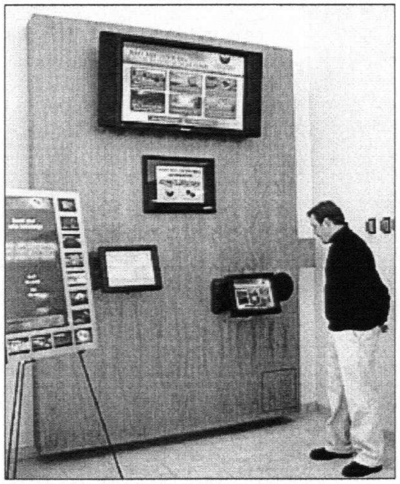


Figure 2.17. An electronic information kiosk at Mary Ann Cofrin Hall (Wisconsin Public Service Corporation, 2002a).

2.2.3.2 Resource Consumption Audits

Annual audits provide a way for data to be collected on energy consumption, waste production, recycling initiatives, and the like. Audits can be an indispensable method to measure the performance of various programs geared at reducing a building's impact on the natural environment.

Upper Canada College (Toronto, ON)

Through its "Green School Initiative," Upper Canada College has initiated an annual audit on natural resource consumption to provide benchmark data for reduction targets. Results of the audit – which examines waste production, electricity and water consumption, and the amount of waste diverted through composting – are published in the bimonthly online newsletter "Green Times" (http://www.ucc.on.ca/GreenSchool/GreenTimes/). This publication also communicates methods that UCC is taking to reduce its ecological footprint and provides suggestions to staff and students how they can help by adopting pro-environmental behaviour.

2.2.4 Didactic Art

This strategy aims to evoke connections to the natural environment through art or structural design that tells a story of place. This can be as simple as painting a mural on the wall or can be more substantial with a design that blends the indoors with the outdoors. Depending on the extent to which this idea is expressed, didactic art can be incorporated during design or post occupancy.

The Jean Vollum Natural Capital Center, EcoTrust Building (Portland, OR)
A painting of the local watershed is located directly above the drinking fountains to remind thirsty visitors that "Mount Hood and Bull Run Watershed – Portland's Water Supply" (Figure 2.18).

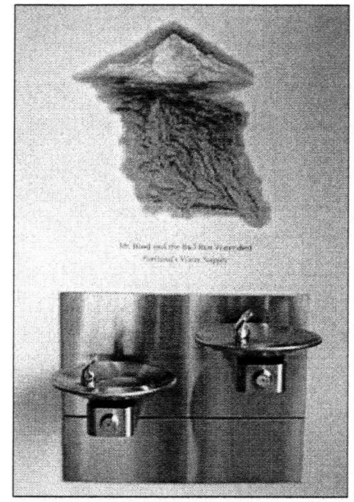


Figure 2.18. The painting of the local watershed above the drinking fountains at the Jean Vollum Natural Capital Center

Islandwood (Bainbridge Island, WA)
Each of five stone fireplaces teach a geologic lesson. Sinks in the dining hall depict a swimming salmon to remind visitors that water going down the drains ends up salmon habitat (Figure 2.19). Light fixtures in lodge rooms each have a unique constellation, teaching about the night sky.

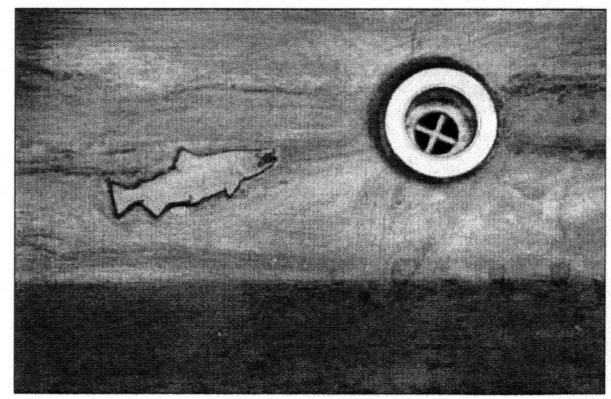


Figure 2.19. Sink detail at Islandwood showing a swimming salmon (Islandwood, n.d.)

The Adam Joseph Lewis Centre, Oberlin College (Oberlin, OH)
The front courtyard of the Adam Joseph Lewis Centre features a sundial plaza. In the center of the plaza is a tall pole whose shadow maps the solar year.

Brunswick High School (Brunswick, ME)
The central lobby "features four supporting columns painted to look like birch trees" (Sutton, 1996, p. 23).

Conserve School (Land O' Lakes, WI)

The central stairwell in the residence building at Conserve School uses a design that mimics tree branches with skylights and wood strips, which "suggests a forest canopy with sun filtering through the trees" (Figure 2.20) (Conserve School, n.d., ¶ 1).

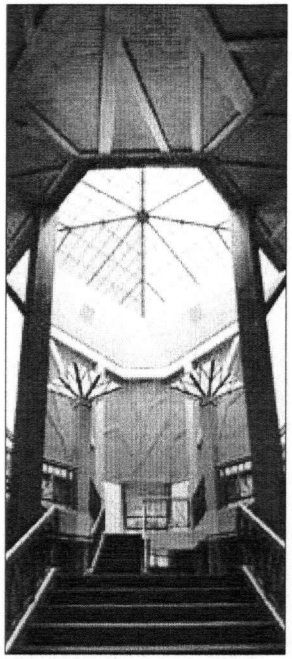
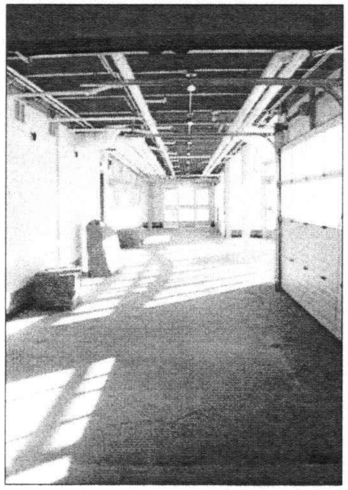
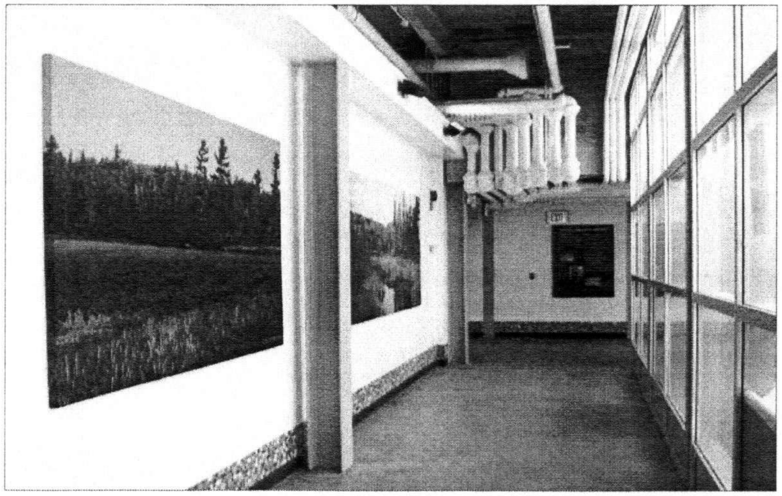


Figure 2.20. The central staircase at Conserve School (Conserve, n.d.)

The Environmental Technology Wing, Sir Sanford Fleming College (Lindsay, ON)

The main circulation space is known as the "Discovery Walk" and includes a section of the Trans Canada Trail (Figure 2.21). Designed as a tribute to local biotic conditions, this walkway uses large operable glass doors to blend the distinction between indoors and outdoors. Impressions of plant leaves endemic to the area can be found in the rough concrete floor, stone boulders serve as make shift benches telling the geological heritage of the area and a "Woods of Ontario" finishing detail found throughout the addition all quietly expresses the uniqueness of place. Six large-scale photographs of various Ontario ecosystems (i.e. bog, eastern deciduous forest, marsh) line the walls of the Discovery Walk, creating connections between the programs at the School of Environmental and Natural Resource Sciences (Figure 2.22).





Figures 2.21, 2.22. (Left to right) Discovery Walk at the Environmental Technology Wing; Large scale photographs of a Bog in Thunder Bay District and a Northern Marsh in Temagami hang opposite the Centre for Alternative Wastewater Treatment at Fleming

2.2.5 Outreach Methods

The purpose of outreach methods is to communicate greening goals to a wider audience. This method includes tours, books, and websites.

2.2.5.1 Green Building Tours

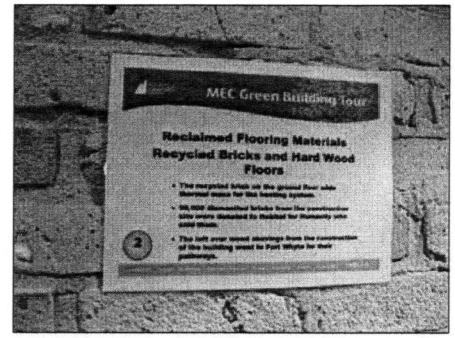
Although tours can be offered for any green building, the creation of a self-guided tour extends the fleeting nature of this strategy through the creation of a more permanent teaching device.

Echo Leahy Center for Lake Champlain (Burlington, VT)

As the first LEED Certified project in Vermont, and the first LEED Certified aquarium in North America, Echo has created a ten question scavenger hunt – E^2 Quest – that doubles as a self-guided tour. As an incentive to encourage visitors to participate, visitors that complete the scavenger hunt get $1 off their next visit (http://www.echovermont.org/images/photos/e2Quest.pdf).

Mountain Equipment Co-op (Winnipeg, MB)

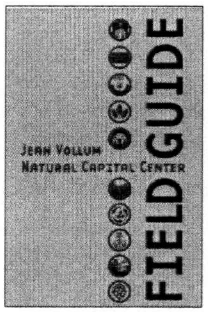
Customers to the Winnipeg Mountain Equipment Co-op (MEC) – a LEED Gold Certified Project – can take a self guided "Green Building Tour," which consists of information signs located throughout the building (Figure 2.23), and a "Green Building Fact Sheet" (Figure 2.24).

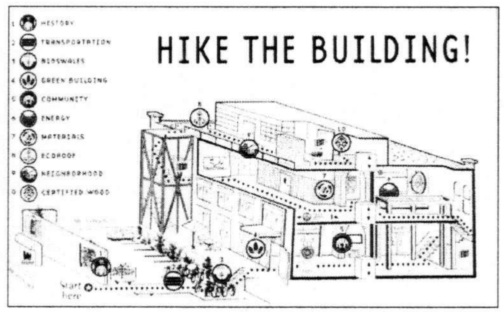


Figures 2.23, 2.24. The fact sheet and an example of the signage posted throughout Mountain Equipment Co-op's Winnipeg store which forms the basis of the self-guided tour

The Jean Vollum Natural Capital Center, EcoTrust Building (Portland, OR)

The EcoTrust Building in Portland includes a self-guided tour that is reminiscent of a scavenger hunt. At the entrance of the building is a display of "Field Guides" which invite visitors to "Hike the Building" (Figures 2.25, 2.26). The Field Guide includes a map of the building (Figure 2.7) and information on what makes the building green (Figure 2.8). Symbols located throughout the building denote stops on the tour (Figure 2.9) (von Hagen, Kellogg & Frerichs, 2003).





Figures 2.25, 2.26, 2.27, 2.28, 2.29. Elements of the "Hike the Building" self-guided tour at the Jean Vollum Natural Capital Center in Portland, OR. From left to right: Visitors pick up a field guide at the entrance display that includes a map of the building with the stops on the tour. Visitors can read about the green design strategies used within the building at each stop, which is denoted by a metal plaque.

The Sustainable Condo (Vancouver, BC)

Designed as a travelling display, the Sustainable Condo project takes an unique approach to green building outreach – by bringing the building to the people. Unveiled in Vancouver at the international environmental forum and tradeshow GLOBE 2004, the Sustainable Condo showcases currently available products, systems and technologies that can help reduce the ecological footprint of buildings. Using interpretive signage, brochures, and tour guides, the condo educates visitors on the environmental, economic and social benefits of the Sustainable Condo in 5 themes: energy, water, materials, land, and health and well being. This EcoSmart™ project was designed by Busby + Associates Architects, built by Ledcor Construction and supported by over 40 partners and sponsors (Sustainable Condo, n.d.).

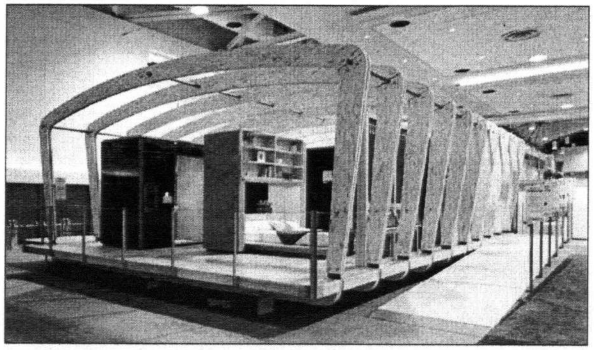


Figure 2.30. The Sustainable Condo at GLOBE 2004 (Sustainable Condo, n.d.)

2.2.5.2 *Books and Publications*

Books and other publications offer a way to extend the realm of influence of the building. They are useful communication tools, and can be purchased as souvenirs by visitors to the building.

The Jean Vollum Natural Capital Center, EcoTrust Building (Portland, OR)
Written by members of the design team, "Rebuilt Green" narrates the transformation of the Natural Capital Center from a century-old warehouse into a LEED Gold project (Figure 2.30). The book details the environmental reasoning behind EcoTrust's decision to design a green building, as well as an in-depth explanation on how the building optimizes energy, materials and water. On the social side of things, the book also discusses how the building has helped establish ties to the community through community involvement during the design process and by hosting social events such as neighbourhood movie nights (von Hagen, Kellogg & Frerichs, 2003).

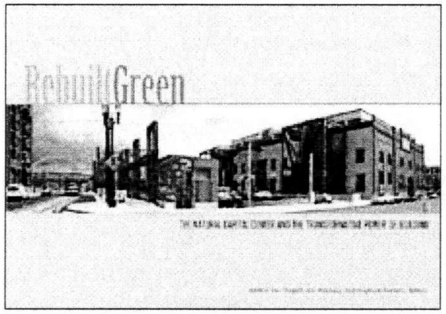
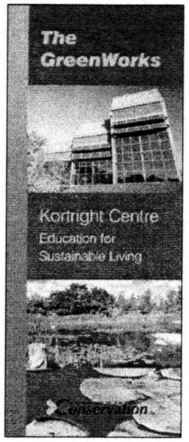
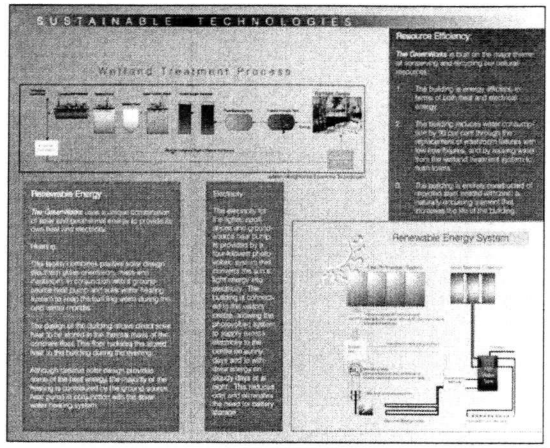


Figure 2.31. The cover of "Rebuilt Green," a book explaining the environmental features of the Jean Vollum Natural Capital Center

Kortright Centre for Sustainable Living (Woodbridge, ON)
A publication entitled "The GreenWorks" explains the environmental features of the Kortright Centre, including the solar aquatic wastewater treatment facility, renewable energy strategy and material selection (Figures 2.31, 2.32). The publication is available through the Toronto and Region Conservation Authority.





Figures 2.32, 2.33. The GreenWorks publication explaining the environmental features at the Kortright Centre.

2.2.5.3 Websites

Websites can offer virtual tours of buildings, explain green design strategies and list performance data. Website tools approximate the experience of visiting the building, and extend a building's sphere of influence into the wider public.

Beamish-Munro Hall, Integrated Learning Centre, Queen's University (Kingston, ON)
Visitors to the Integrated Learning Centre "Live Building" website (http://appsci.queensu.ca/ilc/) can view the current use of electric lighting levels throughout the building, see how much energy is being produced by the 20kW photovoltaic array, or see how much energy is being consumed by the building. The website even includes current temperature measurements from a series of sensors embedded in the different layers of the wall assembly system that demonstrate the effectiveness of insulation and show how buildings lose and retain heat. Alongside performance

data, the website features a detailed description of the environmental features used, tutorials on these features and links to additional information (Queen's University, n.d.).

The Adam Joseph Lewis Center, Oberlin College (Oberlin, OH)

Data collected by the 150 sensors located throughout the Adam Joseph Lewis Center is broadcast in real-time on their website (www.oberlin.edu/ajlc/). Visitors to the website can see how the Living Machine is functioning, how much energy is being produced by the photovoltaics, or how much energy is being consumed by the building overall at that minute. The website even includes local weather conditions, trend data, live shots of the AJLC, tutorials on the design features and explanations for current conditions or data (Figure 2.33).

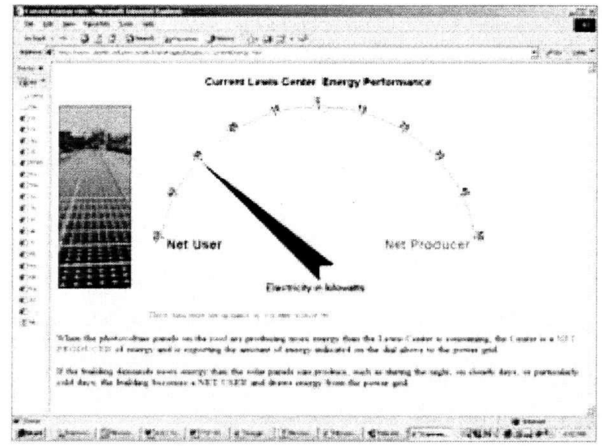


Figure 2.34. Screen shot of the Adam Joseph Lewis Centre's webpage detailing the production of energy by the photovoltaics and the consumption of energy by the building in real-time.

Hartley Nature Center (Duluth, MN)

The Hartley Nature Center features two photovoltaic systems – a 72 panel, 11.88 kW roof-mounted system, and a 8-panel, 1.33 kW array mounted on a pole. Electricity generated by the photovoltaics and electricity consumed by the building are monitored and available for viewing on their website (http://www.hartleynature.org/buildingload.htm).

Leslie Shao-ming Sun Field Station, Jasper Ridge Biological Preserve, Stanford University (Stanford, CA)

The Leslie Shao-ming Sun Field Station at Stanford University's Jasper Ridge Biological Preserve was designed with a goal of zero net carbon emissions for its annual energy budget. To achieve this goal, the building relies on daylight and passive solar heating with electricity produced by a 22kW grid-connected photovoltaic system (Jasper Ridge Biological Preserve, 1998-2005). Data on energy production and consumption is continuously measured and broadcast in real-time on its website (http://jr-solar.stanford.edu/).

2.2.6 The Building as Curriculum

This strategy is mainly associated with buildings that have an educational mandate. Green building can be used as curriculum during both the design and operation phases.

2.2.6.1 Design

Actively involving students in the design process as part of an academic course provides an opportunity for students to learn about sustainable building practices first hand. Although this method provides individual students with tangible experience of the green design process, it is limited to students who are participating in the course during the time of design.

The Environmental Technology Wing, Sir Sanford Fleming College (Lindsay, ON)
During the design of the Environmental Technology Wing at Sir Sanford Fleming, students from the School of Environmental and Natural Resource Sciences were responsible for siting and drilling the ground source heat pumps, as well as siting the wind turbine (J. Madder, personal communication, January 9, 2004).

South Rim Maintenance & Warehouse Facility, National Park Service (Grand Canyon, AZ)
Cornell University students taking "Ecological Literacy and Design" in the Department of Design and Environmental Analysis, teamed with the National Park Service to help the project earn LEED certification. Through their involvement, students gained an in depth understanding of the LEED Green Building Rating System and the green design process (Elliott, 2004).

Art Stretch Program, Delta School District (Vancouver, BC)

This project, spearheaded by structural engineer Diana Klein, illustrates another way in which green buildings can be used to teach about sustainability – by challenging elementary students to design a sustainable school. With a vision to "inspire within these students a passion to improve the built environment" (Klein, 2005, p. 5), this project commenced in the fall of 2004 with a visit to the Vancouver Art Gallery for the exhibition *Massive Change.* Afterwards, the students explored what sustainability would look like in a building and learned how to design using 'The Natural Step' (Klein, 2005). In small groups, students created designs for sustainable schools with attention to setting, energy use, water harvesting, and transportation. What was discovered from this process was that the student's design process was not restricted by the cost constrains and status quo practices that often impedes professionals. Results from six of the groups were presented in drawings and descriptions at the Central Library as a part of EFest 2005 during National Engineering Week (Figure 2.34).

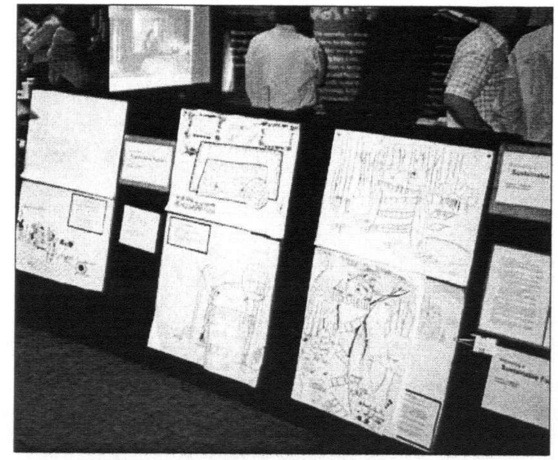


Figure 2.35. Display of sustainable schools designed by elementary students through the Art Stretch Program (Photo courtesy of Diana Klein)

2.2.6.2 Operation

During operation, green buildings can create opportunities for hands on learning through the integration of a building into the school's curriculum. Taking this one a step further, green buildings can act as a substrate for research through the manipulation of building systems in order to study green technologies. In this context, the building can be a "living laboratory" for learning and research. The following examples illustrate methods in which the operation of a green building can be integrated into a learning curriculum.

The Adam Joseph Lewis Centre, Oberlin College (Oberlin, OH)

Every aspect of the building and landscape is seen as an opportunity for experiential learning. Students tend the gardens, monitor the building systems, and use the building to gain an in-depth understanding of ecological design. Several courses taught at Oberlin are based on the AJLC including Practicum in Ecological Design of the Adam Joseph Lewis Center and Practicum in Green Building Technologies: Education and Display. Students can also examine the performance, impact or evolution of the AJLC through an Independent Study. There has even been an Art and Environment course to improve the aesthesis of the building while enhancing its ecological messages (AJLC, n.d.).

Third Creek Elementary (Statesville, NC)

Third Creek Elementary is a certified LEED Gold project that earned an innovation credit for "educational outreach program." One of the green building features integrated is a natural storm water management system with a constructed wetland that has proven to have more than one function. According to the construction manager Rob Jackson, "The teachers are just amazed. They are integrating [the wetland] into the standard course of study for ecology issues, recycling issues, or garden issues" ("Educational Buildings," 2003, ¶ 3).

Samson Environmental Center, Darrow School (New Lebanon, New York)

Similar to the experience at Third Creek Elementary, the installation of a solar aquatic system at the Samson Environmental Center at Darrow School serves an educational tool for a variety of classes (Figure 2.33). As Alex Wilson describes:

> Science classes at all the school's levels, from 9th grade through 12th, use the facility extensively. The lower-level science classes learn to monitor water flows, graph the results, and analyze them statistically. Biology classes study the food web in the system. A stream ecology class studies the water in the system with the same tools they use to study the health of a natural stream – and are surprised to find that the effluent from the Living Machine is cleaner than the stream water!...An added, unexpected, benefit involves the art classes. For example, in February, the greenhouse provides an opportunity for a watercolour class to paint tropical plants! (Wilson, 2002, p. 12).

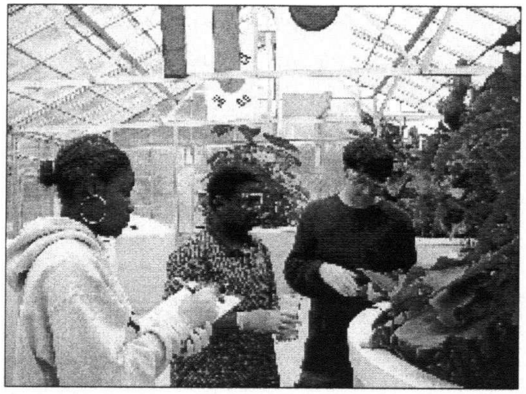


Figure 2.36. Students studying the living machine at Darrow School

Walker Elementary School (McKinney, TX)

Named one of the AIA Committee on the Environment's Top Ten green buildings for 1999, Walker Elementary School was specifically designed as a teaching tool (Wilson, 2002, EBN). The school harvests rainwater for irrigation, manages stormwater onsite with a constructed wetland, and generates electricity with a wind turbine and photovoltaic array. The school also includes a weather station, a sun dial, an energy management system, and a cut-away air conditioning unit. These green design features are not a backdrop, but a key component in the educational programming of the school. Consider the following description:

> Fifth graders huddle atop their elementary school measuring the square footage of the roof. They multiply their findings by the amount of precipitation that fell the night before to determine how many gallons of rainwater are stored in the water tanks on the school grounds. They rush to check their answers against the tall glass tube at the entrance of the building – a gauge telling how many gallons of rainwater are currently stored in the cisterns (Keep, 2002, p. 18)

Including the building into the lesson plan in this way makes the school so much more than a physical building, but a "splendid three-dimensional environmental textbook" (Sims, 2001, ¶ 16).

Centre for Interactive Research on Sustainability (Vancouver, BC)

The proposed Centre for Interactive Research on Sustainability (CIRS) will be designed to be completely off the grid and will be a net energy producer using renewable technologies (Figure 2.33). Potable water will be provided from captured rainwater, wastewater will be cleaned onsite, and the building will be assembled using materials that can easily be reused or recycled once its lifecycle is over. All workspaces will be lit with daylight, and the building is a proposed node for the Hydrogen Highway (Why CIRS?, 2005).

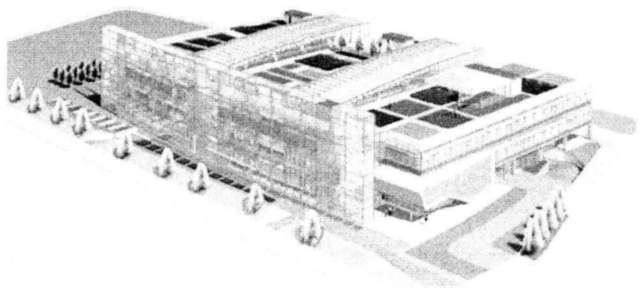


Figure 2.37. Rendering of the proposed Centre for Interactive Research on Sustainability (Source: "Why CIRS?" 2005)

Located at the Great Northern Way Campus, Vancouver, BC, construction on CIRS is anticipated to be finished in 2007. It will house research groups focused on sustainability from its four institutional owners – the University of British Columbia, Simon Fraser University, British Columbia Institute of Technology, and Emily Carr Institute of Art & Design – as well as members from the public, private and non-profit realms.

A distinctive feature of the building will be its focus on research into sustainable building practices. Envisioned as a "globally unique state-of-the-art living laboratory, in which researchers and building industry partners can research and assess current and future sustainable building systems and technologies" (Why CIRS?, 2005, ¶ 3). The building will be a testing bed for sustainability – a substrate upon which new technologies can be installed and their effectiveness can be monitored. Results from these active experimentations will then be communicated to educate the wider public, academics and design professionals alike. In this way, CIRS will advance the understanding of sustainable design practices in order to accelerate their adoption.

Methodology

Chapter 3

"I'm not trying to prove anything, by the way. I'm a scientist and I know what constitutes proof. But the reason I call myself by my childhood name is to remind myself that a scientist must also be absolutely like a child. If he sees a thing, he must say that he sees it, whether it was what he thought he was going to see or not. See first, think later, then test. But always see first. Otherwise you will only see what you were expecting. Most scientists forget that... So the other reason I call myself Wonko the Sane is so that people will think I am a fool. That allows me to say what I see when I see it. You can't possibly be a scientist if you mind people thinking that you're a fool."

(Adams, 1984, pg. 157)

3.1 Introduction to Qualitative Research

This study is an exploratory investigation into whether green buildings passively communicate a pro-environmental message to their occupants. As such, a qualitative research method that relied on semi-directed interviews and indirect projective techniques was used.

To determine the messages that occupants derive from green buildings, staff, faculty and students from four high caliber green buildings at three Canadian post-secondary educational institutions were interviewed: the Liu Institute for Global Issues and the C.K. Choi Institute for Asian Research at UBC, Red River College's Princess Street Campus in Winnipeg, and the Computer Science Building at York University in Toronto.

As opposed to a linear process associated with quantitative research that includes "theory, hypotheses, operationalization, sampling, collecting data, interpreting data, validation" (Flick, 1998, p. 43), qualitative research follows a circular research model (see Figure 3.1). The process starts with a set of pre-assumptions however, preference is given to the data collected in the field rather than models derived before research begins. Data is collected and interpreted to create a "case" that serves to inform the line of questioning and the sampling procedure for the next case. Likewise, data obtained from that case study will inform the next case. Each successive case helps to refine the working theory to explain the question under investigation. This circuitous process builds a layer of reflection into the theory as it is developed (Flick, 1998).

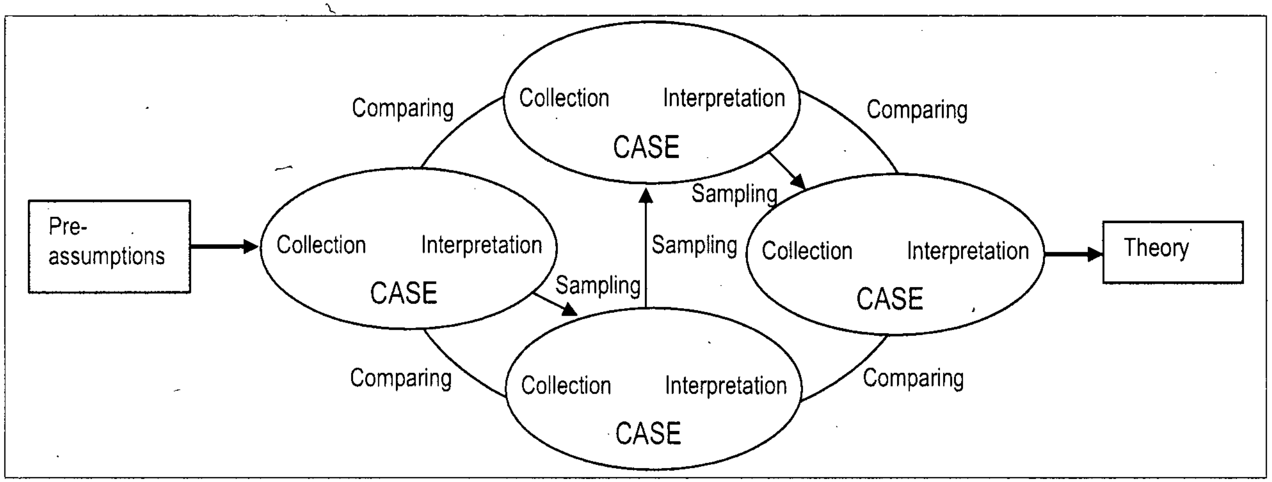


Figure 3.1. Circular model of Qualitative Research process (Flick, 1995, p. 45)

Applying this process to the study at hand, each of the four study buildings represent a case and were compared to develop the final theory (Figure 3.2). Over the course of the investigation, questions were refined, added or removed as the emerging theory dictated.

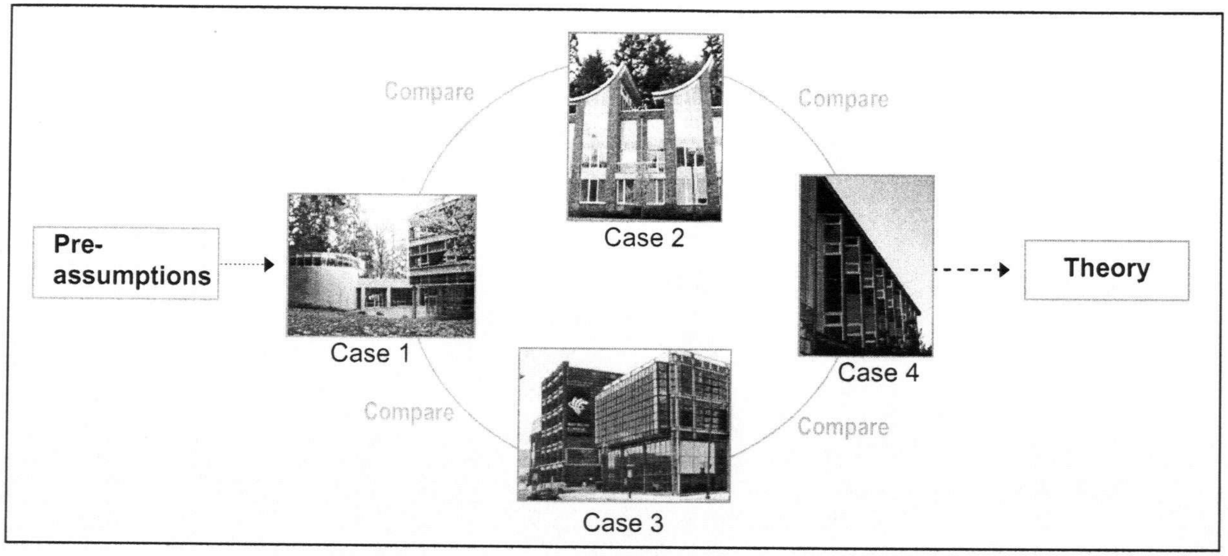


Figure 3.2. Schematic of the Research Model

Interview sessions included four parts: introduction and consent, sketching exercise, semi-directed interview, and collection of background information such as age, length of time in the building, and how many hours the occupant spends in the building in a typical week. The particulars of this research method are discussed in the following sections:

3.2 Study Buildings
3.3 Test Subjects
3.4 Interview Strategy
3.5 Analysis Method
3.6 Encountered Difficulties

3.1.1 Researcher Biases

Wapner, Demick, Yamamoto and Minami (2000) assert that:

> There is a need for researchers to acknowledge that inquiry and knowledge are always biased and that there is no process of 'neutral' observation, inquiry, or conclusion in any science...any object, event, or phenomenon is always mentally viewed from a particular standpoint, or worldview that is capable of definition (p. 289).

Although every effort was made to view the data, and the study as a whole, through objective eyes, it is only natural that the researcher's biases influenced this process. In order to gain an understanding of this position it is necessary to divulge these biases. With that in mind, the researcher views the world according to the New Ecological Paradigm which asserts that humans are components of the natural ecosystem and must work within natural limits. From this position, the researcher fully supports ecological design and believes that the wide-scale application of these practices is necessary for us to live within these means.

The researcher also has a history with the buildings chosen for study – in particular the Computer Science Building at York University. In 2002, while working at the Department of National Defence (DND) the researcher coordinated a sustainability conference for Army Engineers that included a talk by York University's Project Manager for the Computer Science Building and a tour of the building. At another DND conference, project architect Walter Bettio from Architects Alliance was asked to speak about this building.

3.1.2 Limitations

Given the relatively small sample size, and the lack of a randomized sample, the results obtained from the respondents cannot be taken as representative of the sampling frame and therefore cannot be extrapolated as representative of the wider population. However, generalizing the results is not the intent of this research. Rather, the intent is to investigate if buildings can communication a pro-environmental message to their occupants in order to identify areas for further research. As such, this study is considered an exploratory study.

3.2 Study Buildings

Four academic buildings were chosen for this study: the Liu Institute for Global Issues and the C.K. Choi Institute for Asian Research at UBC, Red River College's Princess Street Campus in Winnipeg, and the Computer Science Building at York University in Toronto. Chapter 4 presents a more detailed overview of these buildings.

The underlying motive of this study is to investigate whether green buildings can passively communicate a pro-environmental message to occupants. Can green buildings help disseminate awareness of ecological design to occupants who may not normally embrace that message? Therefore, can the wide scale adoption of green buildings help to catalyze the wide scale adoption of the New Ecological Paradigm? With that intention, occupants of residential green buildings were excluded from this study as it was assumed that they voluntarily chose to live in a green building because they share similar values to those expressed by the building. Occupants of commercial and academic buildings have less control over the buildings in which they work or study and would therefore provide a better reflection on how the general public may view green buildings.

This motive was also the reason why building occupants were chosen over visitors. Although it would be an interesting study to document the messages that green buildings communicate to visitors, it was felt that visitors have a voyeuristic relationship to a building. That is, they experience a building at one particular moment in time either as an academic exercise or as entertainment. Visitors have no investment in the space. They cannot manipulate the building or gain a sense of how the building would behave over time. In addition, most building visitors would be on a guided tour, and the information presented in the tour would inevitably shape their impressions of the space and therefore the messages that it communicates.

Academic buildings were chosen over commercial buildings for several reasons, including:

- Research is a primary focus of academic institutions, therefore it was assumed that academic institutions would be more sympathetic to participate in a research project, and it would be easier to gain access to occupants of academic buildings.

- Academic institutions have been early adopters of green design. The US Green Building Council has stated that the number of colleges and universities seeking LEED certification is increasing (2005, Gonzalez). In 2002 approximately 28% of LEED registered projects were identified as being educational (Cole, 2003b).

- Participants in this study were asked both directly and indirectly to compare the green building to others that they have been in. University campuses typically have a diverse building stock developed over the years. UBC alone has buildings from 1916 to 2005, ranging from ivy clad stone buildings to 40-year old "temporary" buildings. This diversity in buildings presumably enables participants to make readily available comparisons between different types of buildings.

- It was assumed that there would be less variation in the culture between different academic institutions than the expected variation in culture between different corporations.

- Finally, academic buildings were chosen because they are the primary focus in David Orr's essay on *Architecture as Pedagogy.*

3.2.1 Criteria for Building Selection

Alongside practical considerations such as whether it was possible to gain access, buildings were selected based on the following criteria: how green the building is, range of green design features employed, and building program.

3.2.1.1 How Green is Green?

This study aimed to investigate opinions of occupants at high caliber green buildings. In order to define what constitutes a high caliber green building, the Leadership in Energy and Environmental Design (LEED) Green Building Rating Tool developed by the US Green Building Council (USGBC) was used. Only buildings that were the equivalent of LEED Silver or more were considered for this study. Although none of the study buildings were actually LEED certified, their LEED Classification was estimated. Using this tool as a benchmark indication of environmental performance helps to reduce the debate surrounding degree of greenness. In particular, using this tool sets the standard so buildings with nominal green features (i.e. a building with recycled carpets) are not in the same category as a green building that uses a diversity of strategies. A further indication of how green the study buildings are can be determined from the awards and recognition that they have achieved. Table 3.1 provides an overview of the estimated LEED certification level and the awards that the building has been recognized with.

An interesting note is that the C.K. Choi, a building that has been awarded with numerous honours in recognition of its environmental design, was estimated as only receiving a LEED Silver certification. This moderate certification level questions how well a single LEED score can capture the uniqueness of solutions for each building, and whether a single score can be used for universal comparison.

Table 3.1. Estimated LEED Classification, Awards & Recognition for each study building

Building	Awards & Recognition	Estimated LEED Classification[3]
The Liu Institute for Global Issues	• 2001 Lieutenant Governor's Medal for Excellence in Architecture, Architectural Institute of British Columbia • 2001 AIBC Innovation Award. • 2001 Award of Merit, Consulting Engineers of British Columbia. • 2000 Canadian Green Building Challenge Submission • 1999 Environmental Award Winner, Association of Professional Engineers and Geoscientists of British Columbia.	Silver
C.K. Choi Institute for Asian Research	• 2000 Earth Day Top Ten Award, American Institute of Architects Committee on the Environment • 2000 Millennium Celebration of Canadian Architecture, Royal Architecture Institute of Canada • 1998 Award for Innovation Excellence, Architectural Institute of British Columbia • 1998 "Lieutenant Governor of B.C." Award of Excellence, Architectural Institute of British Columbia (Matsuzaki Wright Architects) • 1997 Building Award of Excellence, Consulting Engineers of British Columbia • 1997 "Best Building," International Resource Award (awarded in Seattle) • 1996 British Columbia Earth Award, Building Owners and Managers Association • 1996 Power Smart Award of Excellence, New Institutional Building, BC Hydro	Silver
Princess Street Campus	• 2004 Society for College and University Planning and the AIA Committee on Architecture for Education (SCUP/AIA-CAE) Excellence in Planning Honour Award • 2003 Canadian Urban Institute Brownie Award in the Best Overall Project category for a brownfield redevelopment • 2002 Canadian Green Building Challenge Submission	Gold
Computer Science Building	• 2002 Governor General of Canada, Award for Architecture • 2002 Lieutenant Governor of BC, Medal for Excellence • 2002 World Architecture, International Green Building Award • 2000 Canadian Green Building Challenge Submission	Gold

3.2.1.2 *Building Program*

Green buildings that housed an environmentally focused academic department – such as the Environmental Technology Wing at Sir Sanford Fleming College's Frost Campus which is home to the School of Environmental and Natural Resource Sciences – were not considered for this study. It was assumed that occupants of these buildings would have a highly developed understanding of environmental issues and would therefore be more aware of any environmental messages that the building might be communicating. This knowledge could bias participants and potentially sway results.

Since this study aims to discern if green buildings can passively communicate a pro-environmental message to their occupants, buildings that were specifically designed as a teaching tool – such as the Integrated Learning Centre at Queen's University – were also excluded from this study. That being said, there are some actively instructional design strategies employed in the four study buildings that include:

- Tours are conducted in all of the study buildings. None of the study buildings, however, feature a permanent, self guided tour. The Campus Sustainability Office at UBC frequently conducts tours of the Liu and the Choi to participants from all over the world. Between 2003 and 2004, the Campus Sustainability Office gave over 50 tours of the C.K. Choi and the Liu to over 680 people. Groups were from as far away as Hawaii, Japan, Australia, Brazil, China and Peterborough, ON. (Campus Sustainability Office [CSO], 2004; CSO, 2005).

- The C.K. Choi has a publication available entitled *Design for the Next Millennium: The C.K. Choi Building for the Institute of Asian Research* (Laquian, 1996). According to one of the study participants, this book is mainly purchased by visitors as a souvenir of the tour.

- A static interpretive display is located in the atrium space of the C.K. Choi. This display is mainly comprised of articles found in Laquian's book (see Figure 3.3).

- When constructed, the Computer Science Building at York University had an energy feedback display monitor located on the main floor. However, at the time of the interviews, the monitor was no longer functional and it was boarded up after someone had stolen it (see Figure 3.4) (T. Mohammed, personal communication, October 27, 2005).

- The Sustainable Technologies Consortium is monitoring the performance of the green roof at the Computer Science Building to quantify the benefits of this technology. Climate and hydrology data collected is publicly available through the internet (www.greenroofsystems.org "Members Access").

- The Liu Institute produced a substantial "User's Manual" for building occupants, that explains the green features of the building and how they operated. This was a conscious effort to make sure that the occupants were educated on the guiding principles for the design of the building, as well as how to use the different features. This manual was commissioned after occupants had complained about the lack of acoustical privacy that was experienced, and is common with designs that rely on natural ventilation (N. Best, personal communication, August 16, 2005).

Figure 3.3. Interpretive display at the C.K. Choi

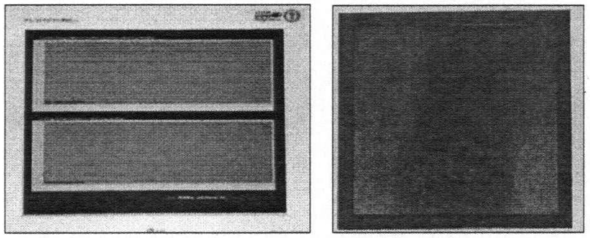


Figure 3.4. Energy display monitor at the Computer Science Building in September 2003 (left) and September 2004 (right)

- The green roof at Princess Street Campus was designed, planted and maintained by students of Red River College's Greenspace Management Program. The roof also serves as a demonstration project for this program's ecology courses (R. Bob, personal communication, October 28, 2005).

3.2.1.3 *Range of Features*

An objective of this study was to determine if certain green design strategies were more effective than others at communicating a pro-environmental message to their occupants. As such, it was necessary that the study buildings selected utilized a range of green design features.

Of particular interest were the high-profile, highly visible green design strategies that are relatively new and challenge existing norms. These strategies include composting toilets, photovoltatics, green roofs, planted atriums, and the reuse of a historical building. Certain design strategies, such as the inclusion of salvaged materials, were found in more than one study building, whereas other strategies, such as composting toilets, were only found in one of the buildings. Table 3.2 outlines the design strategies used by the four different study buildings.

Given the diversity among green buildings it was not possible to choose buildings that had an identical set of green design features. However, some degree of overlap of design features among different buildings was desirable in order to compare the reactions to similar strategies in different buildings.

Table 3.2. Comparison of green design features among the four study buildings

Design Strategy	Liu	Choi	RRC	York
Site Selection				
Minimized site disturbance	Y	Y		
Urban infill development			Y	Y
Brownfield redevelopment			Y	
Access to public transportation	Y	Y	Y	Y
Bicycle storage and changing rooms	Y	Y	Y	
Natural stormwater management	Y	Y		Y
Green roof			Y	Y
Water Reduction				
Natural landscaping	Y	Y		Y
Low flow toilets	Y		Y	Y
Composting toilets		Y		
Low flow water fixtures	Y	Y	Y	Y
Biofilters for greywater		Y		
Rainwater cistern		Y		
Energy Efficiency				
Daylight	Y	Y	Y	Y
Occupancy sensors	Y		Y	
Photosensors	Y			
Building integrated photovoltaic			Y	
Operates using green power		Y		
Material Selection				
Recycling bins	Y	Y	Y	Y
Reused building			Y	
Salvaged materials	Y	Y	Y	
EcoSmart Concrete	Y			Y
Recycled materials	Y	Y	Y	Y
Efficient Detailing	Y	Y	Y	Y
Indoor Environmental Quality				
Low-emitting materials	Y	Y	Y	Y
Views	Y	Y	Y	Y
Natural ventilation	Y	Y	Y	Y
Internal biophilic elements (i.e. planted atrium)			Y	Y
Operable windows	Y	Y	Y	Y
Trickle vents	Y	Y		
Electronically operated windows				Y

3.2.1.4 *Permission and Ethical Review*

Prior to the finalization of building section, permission was sought from the Head of the Department with major tenancy within the building. Department Heads were sent a letter from the Director of the School of Architecture at UBC that outlined the research objectives, methodology, and the role that the resident department would play in assisting with recruitment.

As with all studies that involve human test subjects, it was necessary for each institution to approve the research protocol to ensure that it adheres to the Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans. Approval was granted from the Behavioural Research Ethics Board at UBC, Red River College's Research Approval Committee, and the Human Participants Review Sub-Committee in the Office of Research Administration at York University.

3.3 Test Subjects

3.3.1 Selection of Respondents

Originally this study was to be limited to students who had been in the building for over a year. However, imposing these restrictions on participant selection would eliminate much of the building population – especially at the C.K. Choi and the Liu which do not have a large population of students. Eliminating the requirement for occupants to have been a resident of the building for one year permitted a greater diversity of views to be presented. In fact, some of the most illuminating comments came from occupants at the Liu who had been at the building for less than a year. If this length of residency requirement was kept, then these valuable insights would have been missed.

The only sampling criteria used in participant selection was that occupants must be over the legal age of majority (so they could sign their own consent forms), be available during the scheduled interview time, be willing to be recorded and they must have volunteered to be interviewed.

As with Gustafson's 2000 study into the meanings of place, the objective of this study is not to obtain a statistically representative sample. Instead, it was desirable to capture a diversity of responses by interviewing occupants with a variety of experiences. With that objective in mind, the diversity in participants is acceptable. In total, 26 occupants were interviewed in the 4 buildings. Of those, 11 participants were women, 15 were men, 9 were staff, 9 were faculty and 8 were students, and ages ranged from between 18-25 to over 65.

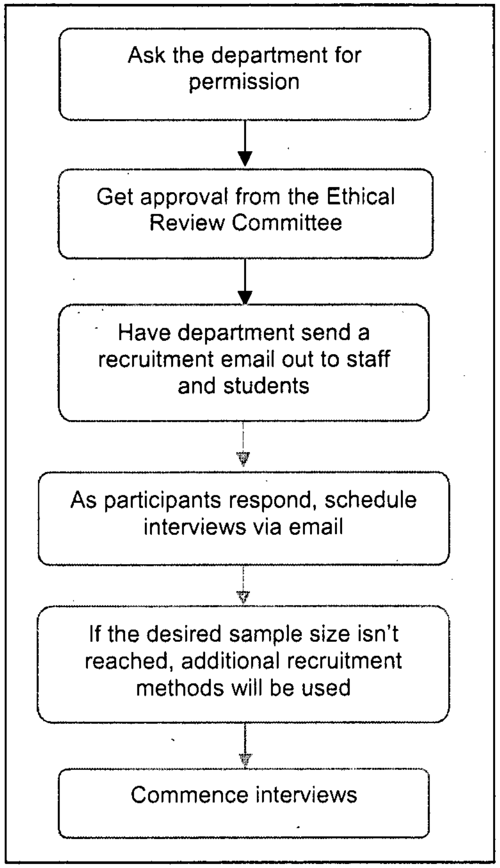


Figure 3.5. Flow chart of recruitment strategy

Morse (1994) has outlined the general criteria for a 'good informant' as one who:

- Should have the necessary knowledge and experience of the issue or object at their disposal for answering the question
- Should have the capability to reflect and articulate
- Should have the time to be asked
- Should be ready to participate (cited in Flick, 1998, p. 70)

According to these criteria, all of the study participants chosen were 'good informants.'

3.3.2 Absence of a Control Group

As it is not the intent of this study to compare messages communicated by green buildings to their occupants with those communicated by grey buildings, a control group is not required. Instead, this study explores whether green buildings can send a pro-environmental message by relying on self-referential experiences occupants have had with different buildings. That is, during the course of the interview, participants were directly asked how the building differs from others they have occupied. Occupants also compared their experiences with other buildings through indirect questions that asked what the most striking features of the building are, what messages the building projects, and what attributes they would miss if they had to leave.

3.3.3 Recruitment Strategy

This study mainly used the criterion of *convenience* as described by Patton when selecting participants, which refers to the "selection of those cases which are the easiest to access under given conditions" (Patton, quoted in Flick, 1998, p. 70). This method is one way to deal with the challenges presented with limited time or people. Since the results obtained with semi-direct interviews are dependent on how comfortable the participant is sharing their experiences, only willing participants were interviewed for this study. As such, no effort was made to select participants in a randomized manner, which is an acceptable practice in qualitative research, and an acceptable practice for an exploratory study (Babie, 2002).

Participants from the C.K. Choi, Liu and Computer Science Building, were recruited via email with the aid of the resident academic department. This involved having the department forward a recruitment email that outlined the aim of the study, the length of time the interviews would take, incentives for participating, and the dates, times and location for the interviews (Appendix B). Interested occupants then scheduled an interview through email. This recruitment method was modeled after one used extensively by Dr. Steven Sheppard, a professor in the Faculty of Forestry and Landscape Architecture at UBC who conducts research in landscape perception. In his experience, this recruitment strategy has worked well to obtain the desired level of participation (S. Sheppard, personal communication, March 19, 2004).

Initial response was low for the Choi, Liu and Computer Science Building. In order to increase participation recruitment emails were resent and a snow-balling sampling method was used. With snow-balling sampling, occupants who already agreed to participate were asked to approach their friends in the building who may be willing to volunteer. The benefit of this approach is that it generates more participants. However the disadvantage is that the new participants recruited will most likely come from the same social circle as the people already interviewed. This can decrease the diversity in viewpoints expressed as the new participants will most likely have similar opinions to people who were already interviewed. This was seen at the Computer Science Building where two of the occupants interviewed had encouraged their partners to participate, who gave answers that were similar to those of their partner.

At Red River College a different recruitment strategy was required since a building wide listserv for Princess Street Campus did not exist. In this case, the administration at Princess Street Campus scheduled interviews with staff and faculty volunteers during a staff meeting. These volunteers then solicited student participants from their classes. Given the challenges associated with email recruitment at the other buildings, this method proved to be far superior. The administration at Princess Street Campus also took care to choose participants that represented staff, faculty and students from each of the major programs within the building. Consequently, the results obtained from Princess Street Campus present a balanced overview of opinions expressed by occupants in the building.

As an incentive and a thank you, occupants who volunteered to participate in this study were given a gift certificate for a complementary tea or coffee redeemable at the campus coffee house. Offering a larger incentive may have enticed more occupants to participate.

3.3.4 Sample Size

With qualitative research methods, interviews are not conducted until a predetermined sample size is reached. Rather, interviews are conducted until each successive interview produces no new information, or until the saturation point is reached (Flick, 1998). The saturation point was only reached at Red River College and to a lesser extent, the Computer Science Building. Although only three occupants at the C.K. Choi were interviewed, their answers showed a remarkable degree of congruence. Ideally, this study would have benefited from more participants from the C.K. Choi, Liu and the Computer Science Building. Collectively, however, there was enough data to proceed with analysis of the cases and to develop a theory based on the responses.

3.4 Interview Strategy

3.4.1 Interview Format

A one-on-one interview format was used for this study. Although more time intensive, individual interviews were chosen over a focus group approach for several reasons. With focus groups there is the potential that some individuals may feel intimidated to express their opinions, sessions may be dominated by the most vocal member of the group leading to a "group think" situation and conversations may be more difficult to control. Most importantly, one-on-one interviews were chosen because it was assumed participants would be more comfortable sharing their thoughts on the building without a peer audience (Babbie, 2002; Groat & Wang, 2002.). Figure 3.6 shows the pros and cons of focus group and individual approach.

In retrospect, individual interviews were a wise choice, as the low participation rate would have made it difficult to find enough people to fill focus group interviews.

	Focus Groups	Individual
Pros	• Answers from one individual can probe thinking in another • Easier to carry a conversation • Respondents will likely feel more comfortable and less exposed • Reduce interviewer bias • Requires less time	• More control over the discussion • Allows for individual one-on-one attention • Individuals may feel more willing to share their feelings
Cons	• May lead to "group think" where the group takes the opinion of the most vocal member • Individuals may be more easily influenced • Individuals may be overshadowed • Potential to lose control of the discussion	• Higher interviewer bias • More time intensive • Respondents can feel exposed and uncomfortable

Figure 3.6. Pros and Cons of Focus Groups verses Individual Individuals

3.4.2 Setting

Interviews were conducted *in situ.* This was convenient for participants who did not have to leave the building and it was assumed that occupants would be more comfortable in a familiar setting. During the interviews, occupants used the setting as inspiration for their answers, drawing upon the location to help them formulate their responses. Locations used varied from the participant's office, a meeting room or a quiet area within the building, and in two instances at the Liu Institute just outside the building. There was one interview for the Liu Institute that took place in the Forestry Building at UBC where that occupant currently worked. This interview was mainly conducted to see what lasting perceptions the occupant had about working in a green building.

Of all the locations used, the meeting rooms were most effective in that they provided a quiet meeting area free from distractions. Unfortunately, it was not financially possible to book a private meeting room at the Liu for the interviews – hence the variety of ad hoc settings used for that study building. The one interview at the Liu that was conducted in the common lounge area was subjected to several interruptions as other building occupants came into the lounge to use the vending machine. These interruptions disrupted the flow of the interview, and made the participant feel exposed. Actually, the two interviews conducted in the outdoor space directly beside the Liu were much more private. At the Choi, two interviews were conducted in the participant's office. These locations were also not ideal as phone calls and visitors interrupted the interview, and it was difficult to find a desk area clear enough of clutter for the participant to sketch on.

3.4.3 Interview Structure

The interview was comprised of four parts: introduction and consent, sketching exercise, a semi-directed interview and collection of background information (as illustrated in Figure 3.7). Interviews lasted from 20 minutes to 80 minutes, with the average interview being 43 minutes. To maintain the flow of the interview and to facilitate transcription, interviews were recorded with a digital voice recorder.

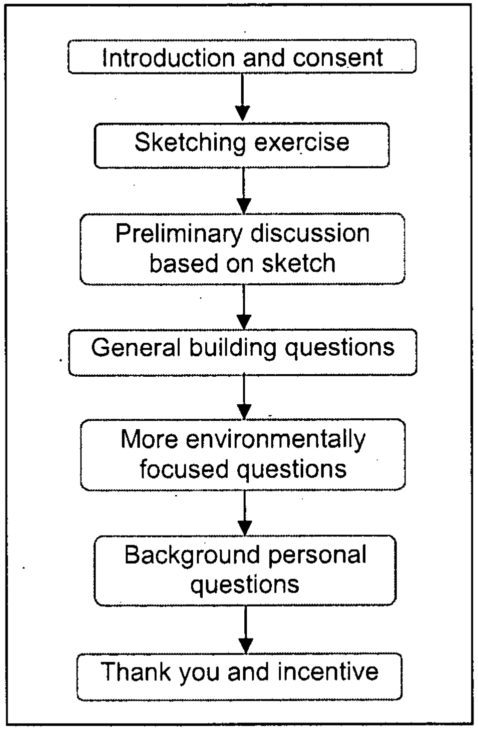


Figure 3.7. Flow chart of interview process

A semi-structured interview was chosen based on the assumption that participants are more likely to express their viewpoints in an openly designed interview situation than a standardized interview or questionnaire (Flick, 1998). Semi-structured interviews are also more flexible than a standardized interview or questionnaire as there is more freedom to deviate from the interview guide and explore ideas that may arise.

Two indirect projective techniques were also used in this study – a sketching exercise and a personification exercise. Indirect projective techniques are used when the researcher needs to "probe below the level of conscious awareness" (Oppenheim, 1992, p. 210). Commonly used projective techniques include word association, fantasy, ambiguous stimuli, and conceptualization (Oppenheim, 1992). Clare Cooper Marcus relied on indirect methods when conducting research for *House as a Mirror of Self,* since she "firmly believe[s] that a deeper level of person / environment interaction can only be approached by means of a thought process that attempts to eliminate observer and object" (1995, p. 13). The sketching technique used by Cooper Marcus allowed her to gain a deeper insight into how residents viewed their homes, which is a metaphor for how they viewed themselves. People are not always cognizant of messages that a building may be communicating. Incorporating projective techniques, either by having occupants sketch what comes to mind when they think of the building or by imagining what the building would be like as a person, can probe below the level of consciousness to uncover these latent messages.

The four main sections of the interview are explained in more detail below.

3.4.3.1 *Introduction and Consent*

Sessions commenced with a brief introduction to the project and the methods used to maintain confidentiality and privacy. Participants then signed two consent forms, keeping one for their files (the consent form can be found in Appendix C).

3.4.3.2 *Sketching Exercise*

Following a method similar to that used by Cooper Marcus (1995), respondents were asked to sketch what first comes to mind when they thought of the building. Participants were given some fruit scented magic markers, an 18" x 24" sheet of paper and ten minutes of privacy to create their sketch. The idea was to create a comfortable atmosphere that encouraged occupants to share their feelings about the building.

This sketching exercise served several useful functions:

- It set the context for the interview and provided a transition from the participant's previous activity
- It helped to dissolve the barrier between respondent and interviewer and helped the participant focus on their feelings towards the building without speaking
- Most importantly, sketches served as a starting point for the resulting discussion and as an artifact of the participant's thoughts towards the building (Cooper Marcus, 1995)

Of the 26 people interviewed, three chose to write because they were uncomfortable drawing and in one instance, the participant was short on time so this initial step was skipped. Although this was not the most ideal situation, forcing participants to draw when they were clearly uncomfortable doing so could have overshadowed the interviews. Figure 3.8 is a sketch by an occupant at the C.K. Choi.

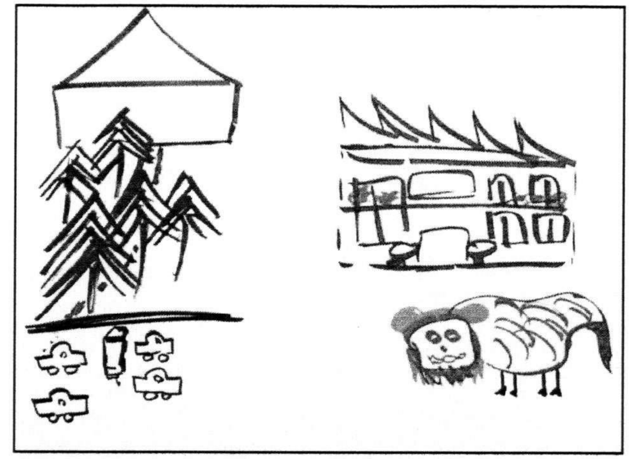


Figure 3.8. A participant's sketch of the C.K. Choi showing that the site was a parking lot before it was built (left), an external shot of the building (top right) and a Chinese dragon to depict the Asian focus of the centre (bottom right)

The instructions to participants for the sketching exercise went through several iterations. Initially participants were asked to draw a personal map of the building, however, this seemed to lead to some confusion as occupants were asking for a lot of clarification on the directions. To compensate, the question was modified and the participant was asked to draw what first comes to mind when they thought of the building.

3.4.3.3 Semi-Directed Interview

Using the sketch as a launching pad for further discussion, respondents were then asked a series of questions to determine the messages that they thought the building was communicating.

Although an interview guide was used, it was deviated from as necessary to follow up on any topics that arose.

Several types of questions were used in the interview: unstructured, semi-structured and structured questions. Unstructured questions are open ended to allow participants to discuss general thoughts on the building (i.e. "What are the most striking features of the building?"). With semi-structured questions either the concrete issue is defined and the response is left open, or the reaction is defined and the concrete issue is left open (i.e. "What messages do you think the building communicates?"). Whereas in structured questions, both the issue and the response are defined (i.e. "Do you think this building communicates a pro-environmental message?") (Flick, 1998). To avoid bias, interviews started with unstructured questions, and as the interview progressed, more structure was added with an environmental focus. Conducting an interview in this matter "prevent[s] the interviewer's frame of reference [from] being imposed on the interviewee's viewpoints" (Flick, 1998). The interview guide can be found in Appendix D.

Redundancy was used to gain an understanding of what features stood out to occupants, their feelings towards the building and any messages derived. Asking questions repeatedly in a slightly different manner also let participants build on their previous answer and helped them to bring to light subconscious thoughts on the building. Some of the questions used (such as "What would you tell a friend about this building") were inspired by Robin Moore's 1989 work talking to elementary school children about their experiences in the Washington Environmental Yard – a naturalized schoolyard at Washington Elementary School in Berkeley, California.

Over the course of the research, the semi-directed interview evolved. New questions were added, questions that occupants found confusing or were not eliciting useful answers were eliminated or modified. Certain questions were also tailored to each new study building. To keep track of this process, a journal was kept and after each interview preliminary thoughts were recorded along with any emerging themes.

3.4.3.4 Background Information

The last step in the interview process involved collecting socio-demographic background information on the participant's exposure to the building (i.e. how many hours a week they spent in the building, areas used, how long they have been an occupant, etc.) and on the participant themselves. These questions are found in Appendix D.

3.5 Analysis Procedure

One of the challenges with qualitative research is that a dialogue is used to gauge an understanding of the topic under discussion. Although this method enables occupants to express their answers without the restriction of pre-determined themes (as with a questionnaire) the diversity of answers generated presents a challenge for analysis. A multi-step analysis procedure was used to analyze the data. This procedure is outlined below.

1. To build a method of reflection into the data collection process a research journal was kept. With the limited time available in each study building (i.e. just one week in each building), it was not possible to completely transcribe and analyze each interview before moving on to the next participant or, in some cases, the next building. After each interview, the journal was used to record thoughts on how the interview went, the participant's key insights and how the questions were received, as well as any preliminary thoughts on an emerging theory. This enabled the researcher to reflect on which aspects to explore in subsequent interviews. Since the journal was regularly reviewed, it provided a method to keep previous interview material fresh.

2. Interviews were transcribed either in full (for the Liu, Choi and RRC), or due to time constraints, partially (York).

3. At the first reading of the transcripts, text was broadly coded with descriptive codes. This included concepts, design strategies mentioned, feelings, and answers to questions. Codes were recorded on a "rough data" sheet and similarities between responses were identified.

4. During second reading, an excel spreadsheet was started to keep track of the frequency with which each design strategy, theme or concept was mentioned. The spreadsheet contains several pages, each corresponding to a question asked. Spreadsheets were also used for socio-demographic information, materials, setting, and complaints. Cells were recorded with a "1" if the participant mentioned that attribute during the interview without being prompted (i.e. if they were asked about the use of PV, any mention of PV in their response was not included). If the participant mentioned that attribute several times over the course of the interview, then the cell was bolded "**1**" to indicate that it was important to the participant.

These areas of importance were also recorded for each participant in a separate spreadsheet.

5. During second reading, any relevant occupant comments on design strategies, answers to questions, perceived messages, etc. were selected and placed in a separate word document.

6. Excel spreadsheets were sorted by frequency for each building and for each question, and similar attributes were grouped.

7. Selected occupant quotes were reanalyzed according to an emerging theory.

3.6 Encountered Difficulties

Several difficulties were encountered throughout this project, including: low participation rate, time intensive, self selection trap, occupants who believed things would change as a result of participation, and the difficulty occupants had in separating the social sphere from the physical building.

3.6.1 Low Participation Rate

The low participation rate was a challenge at the C.K. Choi, the Liu, and to a lesser extent the Computer Science Building. There are several possible reasons for the low participation rate observed in these buildings:

- *Sampling times* – both the C.K. Choi and Liu were sampled during the summer months. Although these buildings primarily house staff and researchers, sampling times may have conflicted with vacation schedules.

- *Small building population* – even though only a few people were interviewed from the C.K. Choi and Liu, these buildings also have relatively small populations (the Choi was designed to accommodate 300 people, however, actual occupancy is half of that). Placed in this context the overall percentage of occupants interviewed is not as low as first thought.

- *Lack of compelling incentive* – given the small budget for this project, it was only possible to thank occupants for participating with a coupon for a free coffee or tea. If a more desirable incentive was offered there may have been a greater turn out.

- *Poor recruitment strategy* – in retrospect, recruiting participants via email was not the most effective strategy. Although email offers a way to directly get in touch with occupants, most people receive more email then they have time to answer and it is possible that recruitment emails were buried in inboxes.

- *Survey fatigue* – over the years that the C.K. Choi and the Liu have been operational their occupants have been subjected to numerous studies. As such, it is possible that occupants of these buildings are suffering from "survey fatigue."

- *Apathy* – the most probable reason for the low participation rate is that people were not compelled to volunteer due to a lack of interest or lack of time. This reason contradicts earlier assumptions that occupants of academic buildings may be more willing to participate in a research study as they were assumed to be more sympathetic to research.

A recent post occupancy evaluation conducted by Keen Engineering on the Choi and the Liu also encountered low participation rates. They attributed a number of factors to the low response rate, including:

> - The survey was for the interest of Keen Engineering, not an initiative by the building owner or administrator
> - The occupants are academics with many pressures on their time
> - Some occupants (visiting professors) may have had language issues
> - "Survey fatigue" – the buildings have received so much attention that occupants are tired of being asked what they think of the building
> - The total population in the two buildings is small…with many short term occupants who have not been in the building long enough to be familiar with its behaviour (McCarry & Hyde, 2002, p. 5).

3.6.2 Time Intensive

Verbatim transcripts of the interviews were made, although in some cases where the conversation steered off topic, tangent stories were omitted. The transcription process was quite time intensive, and faced with the challenge of transcribing over twenty interviews in the context of a strict time constraint two methods were used to speed up the process. The first strategy involved the use of voice recognition software (Dragon Naturally Speaking) to transcribe most interviews. This involved the researcher listening to the interview while simultaneously narrating what was said. The accuracy of this software is not 100%, so the original recordings were referred to during analysis to clarify any errors. The second strategy was used for the interviews from occupants at York University. Due to time constraints, these interviews were only partially transcribed. Instead of creating a full, verbatim transcript, the researcher listened to each interview, noting key themes and concepts, and transcribed only relevant sections. The benefit of this strategy was that it sped up the process by merging initial analysis with transcription, however, during more in depth analysis it was necessary to refer back to audio files.

3.6.3 Self Selection Trap

Volunteers were solicited from the general population for participation in this study. Whenever participants are recruited there is the risk that individuals with strong opinions – either positive or negative – are more likely to volunteer, which can skew results. This was a phenomenon that was indeed witnessed and was most apparent at the Computer Science Building at York University.

3.6.3 Occupants Who Believed that Things Would Change as a Result of Participation

Several occupants came in with the false assumption that problems that they had encountered with the building could be rectified with their participation, or their participation could somehow change the way buildings are designed in the future. An extreme example of this comes from participant Y7 who stated: "The reason why I wanted to volunteer for this interview is because I wanted to make sure that things like the improperly designed lecture halls weren't going to take place in the future of academic buildings."

3.6.4 Separation Between the Physical and the Social Spheres

From this research it was found that occupants had a difficult time separating the physical space from the social space. This is a common challenge with post-occupancy evaluations where an occupant's perception of their environment is heavily influenced by their psychological working conditions, including their relationships with management, job satisfaction, and treatment from maintenance staff (Preiser, Rabinowitz, & White, 1988). To address this challenge, it was decided during analysis that instead of attempting to detangle the physical from the social influences on the message, the social sphere would be acknowledged as a mitigating factor on the overall message communicated by the building. This is discussed in more detail in Chapter 5.

Overview of Study Buildings

Chapter 4

"As places of learning, they can serve to educate their occupants about the environmental benefits of design features. Schools have tremendous potential for conveying a message about sustainability that will help to further its implementation throughout society."

(Wilson, 2002, p. 9)

This chapter will provide an in-depth overview of the four study buildings using text, interview excerpts and images. Each study building will be discussed in four sections: context of development, overview of green design strategies, the lived experience and potential for pedagogy.

The first section, "Context of Development," explores the social and cultural context at the time the building was designed.

Section two, "Overview of Green Design Strategies," will introduce the various design strategies that were employed in these buildings to make them green.

The third section, "The Lived Experience," uses interview excerpts to illustrate the experience of the building from an occupant's viewpoint.

Drawing on interviews with the project architects, the last section, "Potential for Pedagogy," will discuss whether it was an intention of the design team for the building to actively or passively communicate a pro-environmental message to their occupants. If this was the case, strategies used to achieve this goal will be explored.

In addition to these four sections, basic information for each building, including building owner, date completed, architects, design team, area, budget and awards recieved, will be presented.

4.1 C.K. Choi Institute for Asian Research, UBC

Figure 4.1. The C.K. Choi Institute for Asian Research at UBC

Owner: University of British Columbia, BC
Project Manager: Brian Murfitt, John Anderson
Architects: Matsuzaki Wright Architects Inc.
Structural: Read Jones Christoffersen Ltd.
Mechanical: KEEN Engineering Co. Ltd.
Electrical: Robert Freundlich & Associates
Landscape: Cornelia Hahn Oberlander

Location: Vancouver, British Columbia
Area: 3,000 m^2
Budget: $4.5 million
Description: 3-storey building with offices, workstations and seminar rooms
Completed: 1996

Awards:
2000 Earth Day Top Ten Award, American Institute of Architects Committee on the Environment
2000 Millennium Celebration of Canadian Architecture, Royal Architecture Institute of Canada
1998 Award for Innovation Excellence, Architectural Institute of British Columbia
1998 Lieutenant Governor of B.C. Award of Excellence, Architectural Institute of British Columbia (Matsuzaki Wright Architects)
1997 Building Award of Excellence, Consulting Engineers of British Columbia
1997 "Best Building," International Resource Award (awarded in Seattle)
1996 British Columbia Earth Award, Building Owners and Managers Association
1996 Power Smart Award of Excellence, New Institutional Building, BC Hydro

4.1.1 Context of Development

When the C.K. Choi Building (Figure 4.1) was opened in June 1996, it set a benchmark in green design in North America. The building was the idea of Freda Pagani who was working at the Campus and Community Planning department at UBC at the time and was in charge of new buildings on campus. Having just completed a Master's in Environmental Studies, Pagani was "uncomfortable" with UBC building practices. As she recounts: "I was really uncomfortable with what we were doing, but I desperately needed a job, but I was feeling less and less comfortable. Then I realized, well maybe I can do something. So I made up my mind that the next building we did would be a demonstration green building" (F. Pagani, personal communication, June 16, 2005). Pagani persuaded the university administration with a promise that the building would be kept on budget and on schedule – which it was. The building was built for $150 per square foot, the same construction budget as all other buildings constructed at UBC at that time (E. Matsuzaki, personal communication, August 16, 2005).

The design process for the Choi was quite different than the one usually used. Front loaded with an emphasis on design, it used an integrated design process that required engineers and architects to work together. To kick start the process, all building stakeholders, students, consultants, project manager, maintenance people and the design team were gathered for a visioning workshop. Led by Bob Berkebile, the goal of this workshop was to set aggressive targets for the building, including:

- Reduce water consumption by 50% as compared to a regular building
- Reduce energy consumption by 25% of the Model National Energy Code for Buildings
- Of materials used, source 50% from reused, recycled and recyclable materials
- "Make it so nice that people wouldn't want to go home at 4:30" (CSO, n.d., p. 3).

Another way the design process differed from conventional practices was that salvaged materials were heavily incorporated into the building. This meant that an "upside down approach" was used in the design of the building, where the form was dictated by the salvaged materials that could be found (D. Klein, personal communication, August 30, 2005).

The C.K. Choi was envisioned during a time when there were few green projects around. As such, members of the design team were faced with several challenges and opposition – not the least of which was inexperience. The composting toilets raised regulatory challenges, as well as social challenges. In fact there were even rumours after the building was opened that occupants were refusing to use the toilets, preferring to go to the neighbouring building instead. Sourcing and purchasing the reused building materials in the context of the funding approval process of the time presented one of the largest challenges to overcome. Typically, funding for a project is not approved until tenders are submitted. However, for this building it was necessary to modify these rules as the C.K. Choi design was driven by what salvaged materials could be sourced and purchased ahead of time. The incorporation of salvaged materials also posed storage challenges as they needed to be made available to contractors for inspection during the tendering process (F. Pagani, personal communication, June 16, 2005).

An interesting note is that all of the major players involved in the design of the C.K. Choi were women.. The structural engineer for this project, Diana Klein, believes this fact partially explains why the design team was able to incorporate so many green features within the building, since "women are traditionally more open to ideas that protect and preserve mother earth" (D. Klein, personal communication, August 30, 3005).

4.1.2 Overview of Green Strategies

The C.K. Choi is situated on the footprint a former parking lot in order to reduce site disturbance and maintain as much as the forest as possible (see Figure 4.2). The resulting narrow floor plate allows for maximum daylight penetration. Electric light is provided by high efficiency T8 lights with electronic ballasts that are regulated by photosensors and occupancy sensors. Natural ventilation is achieved using trickle vents, operable windows, cross and stack ventilation (show in Figure 4.3). Double glazed, argon filled glass with a low-E finish reduces heat loss through windows. Through these measures, the building uses 23% less energy than ASHRAE 90.1 and is run using BC Hydro Power Smart Green Power certificates. The five distinctive "sails" are oriented for solar exposure and pre-wired to facilitate the future installation of photovoltaics.

Figure 4.2. The costal forest setting behind the C.K. Choi

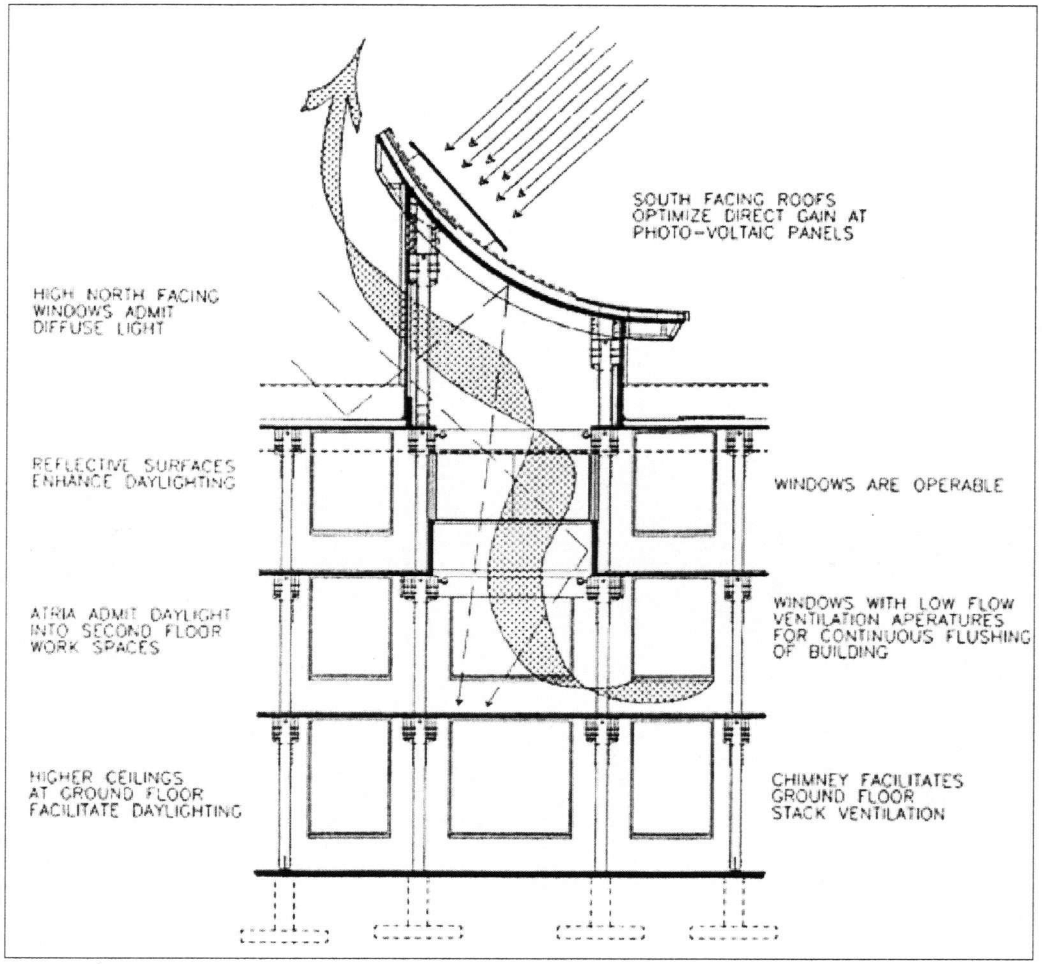


Figure 4.3. Schematic of the C.K. Choi showing natural ventilation flow and daylighting strategies. This diagram also shows the placement for a photovoltaic system which was never installed (Laquian, 1996, p. 83)

Unless strictly needed for acoustical reasons, the building has few finishing materials and paint was only used for light reflection. Salvaged materials were employed throughout the structure including 75-year-old timbers salvaged from an adjacent building that comprise 90% of the structure. The exterior cladding is comprised of bricks that came to Canada from Europe as ballasts in ships, and were then were used as road paving in Yaletown (Figure 4.4). All doors, toilet accessories, towel dispensers, partitions, stair handrails, and conduits for electrical wires were reused from a downtown office building that was demolished. In addition, all of the drywall, steel, concrete, and metal roof panels used at the C.K. Choi include recycled material (CSO, n.d.).

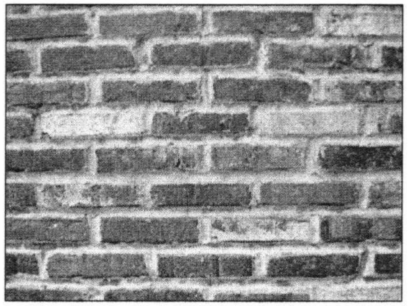


Figure 4.4. Exterior cladding is from 100% salvaged bricks

Occupants at the C.K. Choi have operable windows, access to views, and control over lighting. High indoor air quality is maintained through high ventilation rates and careful specification of building materials without VOCs.

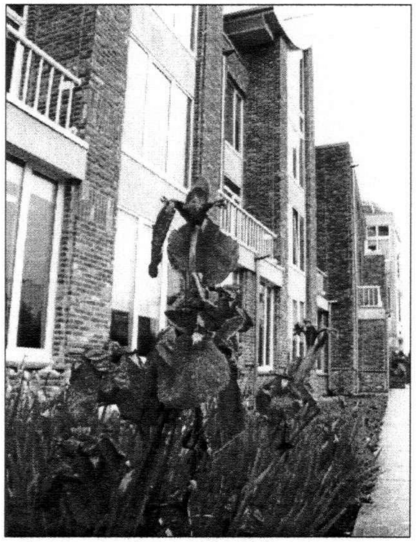


Figure 4.5. Irises at the C.K. Choi that are part of the subsurface wetland filter

The C.K. Choi is probably best known for its wastewater reduction strategies. Built without a sewer connection, the C.K. Choi is the first commercial / institutional building in North America to have composting toilets. Wastewater is managed on site using 10 Clivus composting toilets and trapless ventilated urinals which save over 1,000 litres of water a day. Greywater from the lavatories and the "compost tea" (the liquid portion left over from the decomposition process) is piped into the subsurface wetland filter located on the east side of the building (Figure 4.5, Figure 4.6). Planted with irises and rushes, this system was devised by landscape architect Cornelia Oberlander based on research conducted by NASA. The subsurface wetland filter is so effective at removing fecal coliform that when the City of Vancouver tested the quality of the water exiting the greywater trench in 1996, the sample taker was accused of contaminating it with bleach (McCarry & Hyde, 2002). Table 4.1 compares fecal coliform levels found pre- and post-treatment with the greywater trench to levels typically found in raw sewage and beaches.

Table 4.1. A comparison of typical fecal coliform levels found in raw sewage, beaches, and the C.K. Choi compost tea (McCarry & Hyde, 2002, p. 9)

Sample Source	**Fecal Coliforms [per 100 mL]**
Raw Sewage	200,000
Beaches	200 (maximum)
Compost "tea" (Choi Building)	40
Exit from greywater trench (Choi)	<10

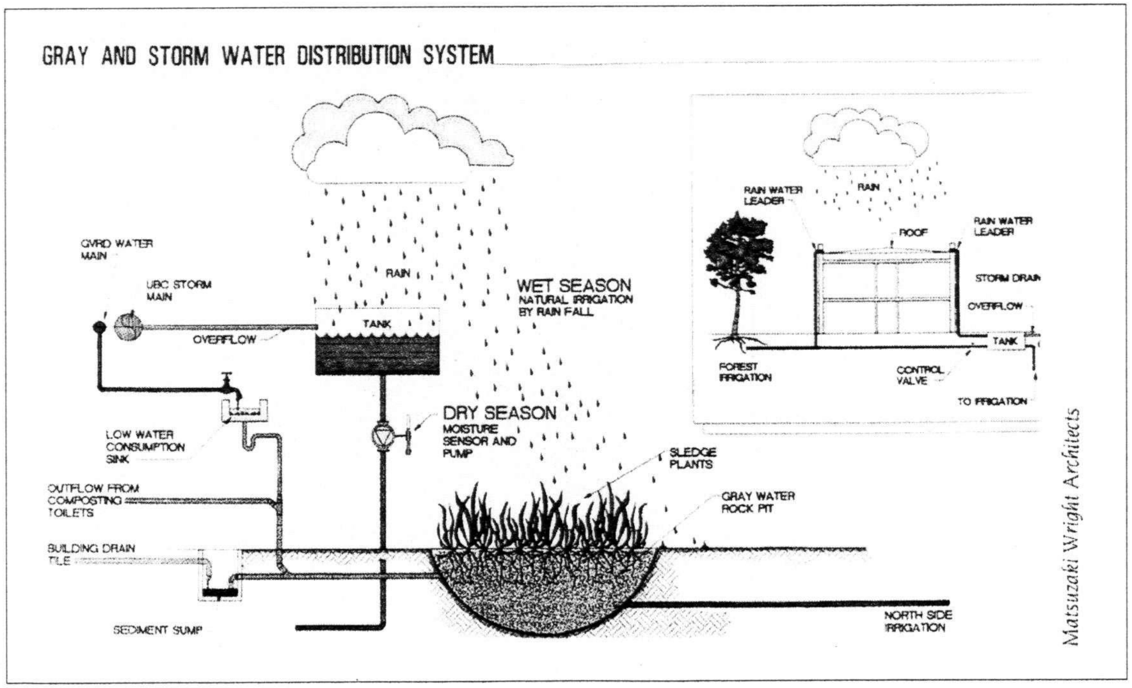


Figure 4.6. Schematic of the subsurface wetland filter at the C.K. Choi (Laquian, 1996, p. 21)

4.1.3 The Lived Experience

One of the strongest impressions from the interview data is the strong social atmosphere that has been nurtured within the building. Every occupant interviewed mentioned how they felt the building encourages "fellowship" and "community" (C3). They mentioned how staff relationships go beyond friendly with the staff being "good friends, good colleges" (C2). Everyone mentioned how much they would miss the staff if they had to leave. One occupant thought that the building itself fostered the social atmosphere as the main staff gathering space – the atrium – is visible from much of the building. As a result, the building staff ends up eating lunch together in the atrium since the "staff sees us and they come out and have lunch all at the same time" (C1). Another occupant thought the social atmosphere to be a byproduct of the glass partitions between the offices and the hallway and the fact that "it's a very long building so you basically have to pass everybody's office and say hello when you walk by" (C2). This was reiterated by C3 who thought the atmosphere had something to do with the long corridors, "the light pouring on both sides," as well as the meeting room on the main floor that can be arranged as needed.

Occupants at the Choi had a very strong emotional attachment to the building, which is perhaps best illustrated by comments from C2 who readily admitted that, "I spend so much time here so I get seriously weirdly attached and personal about the building" (C2). She elaborated that she is "much more attached to this building [than other buildings she has worked in], because I feel I have some responsibility for it, we only have four full-time staff for the Institute as a whole...and because we use the space for our conferences, and we eat here, we do everything here – we even plot our plants here" (C2). She also mentioned that the Choi family, who gave a significant financial donation for the building, is still very much involved with the building by participating in events, conferences and special occasions. This appears to add to the personal dimension that exists at the Choi. C2 was certainly passionate about the building and when asked what she would miss if her next job was downtown, she interrupted with "I would die!"

An expression of ownership and responsibility towards the building was evident in the other occupants as well and could be the reason for the strong attachment to the building. For example, C1 has taken on the responsibility of opening the windows in the atrium every morning and closing them at night before she leaves. The length of tendency in the building could also be a factor with two of the occupants interviewed had been there since it opened in 1996 and the third had been there for five years. There is a level of "pride" and ownership evident among occupants, with C2 remarking that the "staff treat it like their home" (C2).

4.1.4 Potential for Pedagogy

When conceived, there were not many examples of green buildings around. As such this building was considered "quite a funky, 70's, hippy-type of thing" to do (E. Matsuzaki, personal communication, August 16, 2005). Within this context, the designers were faced with the challenge of pushing the green envelope, while making the resultant building palatable to an institutional audience. The design team did discuss the desire for the building to communicate an environmental message and the extent in which the building should attempt to achieve that. For example, salvaged materials were used for the stair railings, all of the doors, and washroom fixtures, however because they all originated from the same office building that was being demolished, they match. This means that it is not obvious that they are salvaged. In contrast, it is quite obvious that the wooden structural beams are salvaged. The "strongest teacher" that was incorporated into the Choi was the composting toilets, since they are "not your usual solution" (E. Matsuzaki, personal communication, August 16, 2005). Eva Matsuzaki did mention that if they were designing the same building today, they would have made greater attempts to make the environmental features more obvious (personal communication, August 16, 2005).

Originally, the design team had hoped to incorporate a computerized display in the lobby that would exhibit data on how much energy the building was consuming, and how this energy consumption compares to other buildings on campus. Unfortunately, due to budgetary constraints, this feature did not materialize (E. Matsuzaki, personal communication, August 16, 2005). Instead of a dynamic energy consumption display, the C.K. Choi has a static display that consists of articles on the building features from the book, *Design for the Next Millennium: The C.K. Choi Building for the Institute of Asian Research* (Laquian, 1996). There was also a desire to include interpretive signage on some of the green design features that may not be obvious to the average person – such as natural ventilation – however budget constraints prevented this from happening (E. Matsuzaki, personal communication, August 16, 2005).

4.2 The Liu Institute for Global Issues, UBC

Figure 4.7. The Liu Institute for Global Issues at UBC

Client: University of British Columbia
Architect: *ARCHITECTURA* Planning Architecture Interiors Inc in collaboration with Arthur Erickson
Structural: Bush, Bohlman & Partners
Mechanical: KEEN Engineering Co. Ltd.
Electrical: Robert Freundlich & Associates
Landscape: Cornelia Hahn Oberlander Landscape Architects
Quantity Surveyor: James Bush & Associates
Specifications: Alan Scott
Material Testing: Levelton Engineering
General Contractor: Haebler Construction Ltd
Demolition Contractor: Litchfield & Co Ltd

Location: Vancouver, British Columbia
Area: 1,750 m^2
Budget: $3.1 million
Description: A one-storey seminar wing with conference rooms and reception areas, and a three-storey research wing with private offices, a library and board rooms.
Completed: September 2000

Awards:
2001 Lieutenant Governor's Medal for Excellence in Architecture, Architectural Institute of British Columbia
2001 Architectural Institute of British Columbia Innovation Award
2001 Award of Merit, Consulting Engineers of British Columbia
1999 Environmental Award Winner, Association of Professional Engineers and Geoscientists of British Columbia

4.2.1 Context of Development

The Liu Institute for Global Issues (Figure 4.7) is the second green building at UBC and the first to be designed and constructed under the Sustainable Development Policy adopted by the University in 1997. The purpose of this policy is "to develop an environmentally responsible campus community that is economically viable and reflects the values of campus community members" and "to ensure integration of ecological, economic, and social considerations at all levels of strategic planning and operations with the University" (Architectura, n.d.b, p. 7).

A similar visioning workshop to that used for the C.K. Choi – which was also led by Bob Berkebile – took place in January 1998. This daylong 'project alignment' workshop was attended by 36 stakeholders who defined a common vision for the project and set out aspirations and objective for the project (Architectura, n.d.b.). A specific list of 60 sustainable targets was also determined at this workshop which guided decision making for the design team throughout the project.

4.2.2 Overview of Green Strategies

The Liu Institute for Global Issues is nestled in a mature coastal forest and located immediately adjacent to the C.K. Choi. To reduce site disturbance, the Liu was built on the footprint of a decommissioned student residence (Pan-Hellenic House) and its parking lot. During construction, care was taken to avoid damage to the roots of established trees – especially a rare, large-specimen katsura tree, that sits in the centre of the sheltered forecourt (Architectura, n.d.a.).

Water consumption is reduced through the use of low flow plumbing fixtures and native plant landscaping eliminates irrigation requirements.

The Liu Institute was designed to be 55% more efficient than the Model National Energy Code. This was achieved using passive ventilation and cooling, a high-performance building envelope and energy modeling (see figure 4.8). Effective daylight strategies, occupancy sensors and photosensors reduce lighting loads.

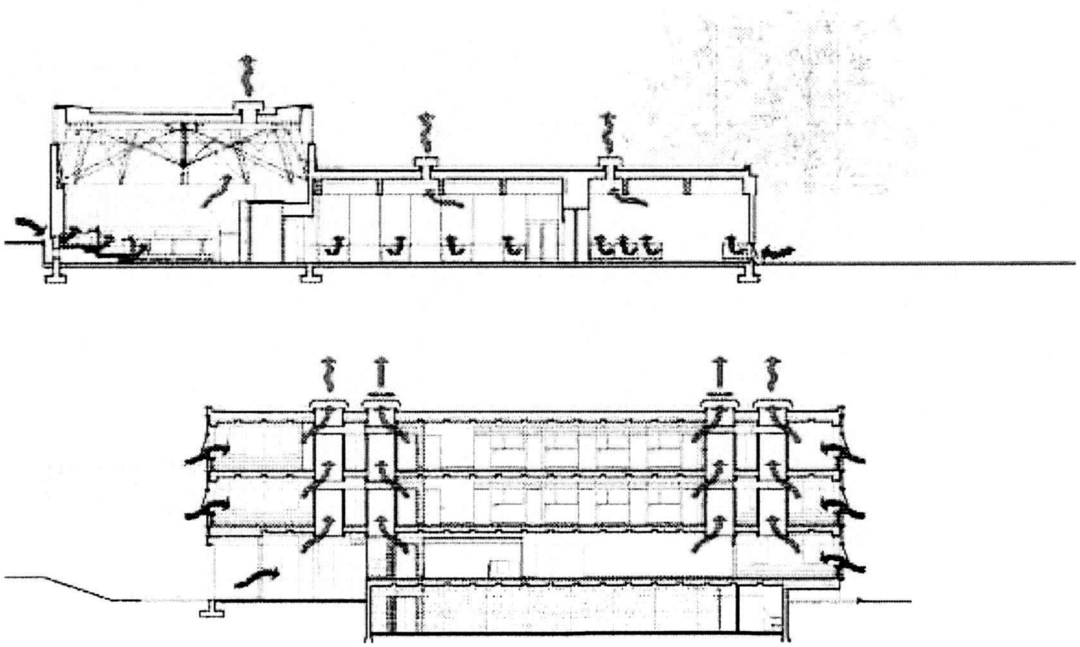


Figure 4.8. Diagram showing how natural ventilation works at the Liu Institute (Architectura, n.d.a, p. 10)

Part of this project included the manual deconstruction of the Pan-Hellenic building. Conducted over a six-week period, the deconstruction resulted in 1,263 cubic yards of demolition materials, of which only 6% was sent to landfill (CSO, n.d.). Heavy timbers that were salvaged from the Pan-Hellenic House were incorporated into the roof the seminar wing. Bricks used in the patio are reclaimed from around campus. The building also includes recycled materials throughout including the first application of EcoSmart™ concrete in British Columbia. To reduce the need for finishes, the structure was left exposed.

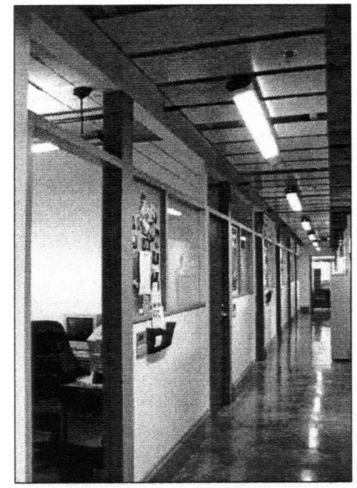


Figure 4.9. Offices at the Liu Institute are open at the top to allow for natural ventilation

A high quality indoor environment is achieved through a narrow floor plate that accommodates daylight penetration, cross ventilation and access to views of the surrounding forest. Low VOC materials were specified and ventilation rates were maximized to provide good indoor air quality. To facilitate natural ventilation, offices were designed with an18 inch opening at the top (Figure 4.9)

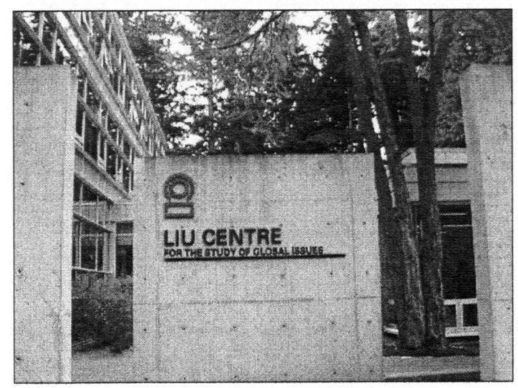


Figure 4.10. Concrete slabs "block the flow of luck" out of the building

A Feng Shui expert assessed the building during the design process. As a result, concrete slabs were placed at the front entrance to “stop the flow of luck out of the building,” through the creation of a circuitous path around the walls known as a “spirit wall” (CSO, n.d.; Architectura, n.d.a.). These concrete slabs also buffer noise from North West Marine Drive (Figure 4.10).

There were several green design features that were planned for the Liu that were cut due to budget constraints. This included a grey water filtration system like the one found in the Choi and a green roof (CSO, n.d.; N. Best, personal communication, August 16, 2005).

4.2.3 The Lived Experience

Occupants of the Liu repeatedly commented on how much they enjoyed the natural setting. The building was described as a "cabin" that was "tucked away" in the woods, which contributed to the "peaceful," "secluded" feel. Occupants frequently mentioned how much they liked the windows, the views of the forest, the walking trails from the building, and the aesthetic of the building. When describing the feel of the building, responses were generally favourable and the building was described as "alive," "friendly," "safe," "comfortable" and "welcoming." Occupants also mentioned that the building had a "good atmosphere" and a "good feeling" about it.

Individual feelings towards the building have as much to do with other people and the social atmosphere within the building as with the physical structure. This was particularly evident in comments from the two occupants with the longest tenancy in the building who felt that there was an imposed "hierarchical" feel to the space. This atmosphere was generated mainly by the placement of the Institute's Director on the top floor and the attitude of the staff toward the previous director. As L3 discussed:

> Traditionally there was certainly a very marked difference between the people who worked on the third floor, and people who worked on the second floor and the first floor...There was a real sense of hierarchy. And the director of the centre had his office right on the top of third floor and there still is his office there (L3).

These feelings of hierarchy correspond to the implicit understanding within Western culture that the top floor denotes higher status. This hierarchical atmosphere was not expressed by the newer occupants, who perhaps had not encountered the politics that shaped the other's viewpoints.

Noise was a major complaint among occupants at the Liu – a common problem among green buildings that use natural ventilation strategies. The academic researchers at the Liu found the lack of acoustical privacy to be "unacceptable" (L3). Apart from complaints about noise, occupants generally found the Liu a good building to work in. The in-house boardrooms and conference facilities were seen as convenient and the smaller building helped to make communication easier.

Overall, the general feeling was that although the building was liked, it was not a total success as a green building because of the noise.

4.2.4 Potential for Pedagogy

There was no conscious intention by the design team for the building to passively communicate a pro-environmental message to their occupants (N. Best, personal communication, August 16, 2005). However, in attempt to "bridge a communication gap that traditionally exists between the designers and end users of a building" (Architectura, n.d.a, p. 3), a detailed user manual was produced for building occupants. This document was commissioned by UBC to orient occupants to the Liu facility and "to increase awareness of the building systems and how they function, so that they may be used in the most effective and energy efficient manner" (Architectura, n.d.a, p. 3).

As discussed in Chapter 2, the performance of the Liu Institute as measured against the 60 Sustainability Targets set out at the onset of the project was determined from a post occupancy evaluation. The results of this study formed the basis of a detailed case study that was widely disseminated in attempt to share the lessons learned at the Liu with other design professionals.

4.3 Princess Street Campus, Red River College

Figure 4.11. Red River College's Princess Street Campus

Owner: Princess Street Consortium Inc. (Comprised of: Ada Holding Co. Ltd., A. Akman & Son (1991) Ltd., Corbett Cibinel Architects and J.J. Barnicke Winnipeg)
Client: Red River College and the Province of Manitoba
Architect team: Doug Corbett, George Cibinel, Ryan Bragg, Don Blakey, Mark Thomas Ager, Glen Gross, Martin Kuilman, Hein Hulsbosch, Mike Karakas, Dan Salong, Gae Burns, Ali Lillo
Interiors: Corbett Cibinel Architects
Structural: Crosier Kilgour & Partners Ltd.
Mechanical: Corbett Cibinel Architects
Electrical: PC Engineering
Acoustic consultants: Daniel Lyzun + Associates Ltd.
Energy consultant: Gord Shymko, GF Shymko & Associates Inc.
Environmental consultants: David Rousseau, Archemy Consulting Ltd.; Ken Klassen, Natural Resources Canada

Location: Winnipeg, Manitoba
Area: 20,500 m^2
Budget: $35 million
Completed:
Sept. 2002 (phase 1); September 2003 (phase 2); January 2004 (phase 3)
Description: Classrooms, lecture theatre, library, Learning Commons, offices, TV and radio studios, art studios, cafeteria, gym, housed in 3 buildings ranging from 1 to 5 storeys and connected by a central atrium

Awards:
2004 Society for College and University Planning and the AIA Committee on Architecture for Education (SCUP/AIA-CAE) Excellence in Planning Honour Award
2003 Canadian Urban Institute Brownie Award in the Best Overall Project category for a brownfield redevelopment
2002 Canadian Green Building Challenge Submission

4.3.1 Context of Development

Conceived as a catalyst to rejuvenate Winnipeg's derelict Exchange District, Red River College's Princess Street Campus (Figure 4.11) was one of three Canadian Entries to the 2002 Green Building Challenge in Oslo, Norway. Occupying a full city block and constructed on a brownfield site, this educational institution is actually three buildings connected by a central atrium that used to be a back alley (Figure 4.12, Figure 4.13).

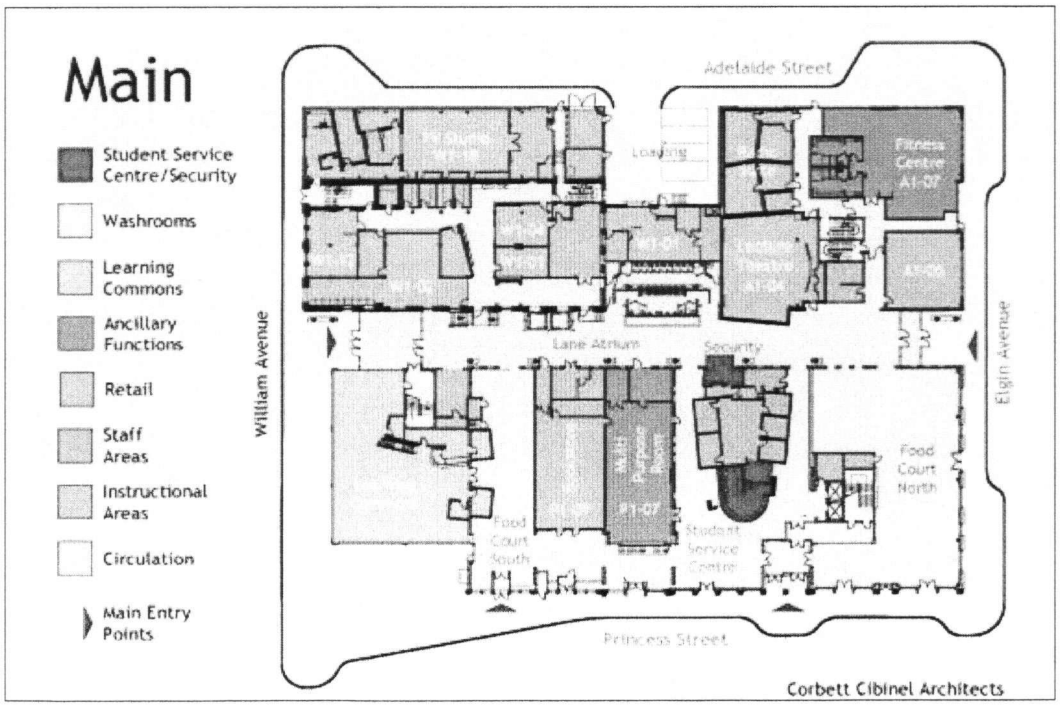


Figure 4.12. Main floor plan for Princess Street Campus (RRC, 2005)

Figure 4.13. The central atrium at Princess Street Campus that used to be a back alley

4.3.2 Overview of Green Strategies

To enable Princess Street Campus to blend into its historical setting, material reuse and conservation was stressed. This involved the renovation of an existing early 1900's warehouse and attached annex building, and the incorporation of the façades of five historic buildings along Princess Street (Figure 4.14, Figure 4.15). Although the buildings themselves were deconstructed, materials were salvaged from these buildings and used throughout the new structure as architectural accents. In several instances entire rooms were reconstructed in their original location but in the new building's structural frame. Preservation of these spaces – such as the historical Boardroom from the Grain Exchange (Figure 4.17), and the ground floor commercial space from 150 Princess Street – required the designers to work alongside a team of heritage recorders and carpenters to document the rooms to allow for the rooms to be reconstructed with accuracy. The one entirely new building, Adelaide was designed to keep in warehouse character of the surrounding area (Figure 4.16).

Figure 4.14. View along Princess Street in 1900 (Photo from Manitoba Archives and used in Corbett Cibinel Architects, 2005)

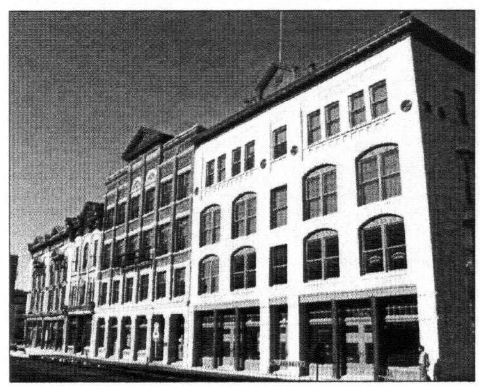


Figure 4.15. Facades of the historical buildings along Princess Street that were incorporated into the Campus

Figure 4.16. The Adelaide building was designed to keep with the warehouse character of the area

Princess Street Campus was the largest and most complex project designed according to the C-2000 Federal Sustainable Development performance standards. It is 47% more efficient than the Model National Energy Code. Energy efficiency is achieved through computerized room occupancy sensors that measure CO_2 and modify ventilation rates accordingly. High efficiency condensate gas burners, high performance glazing and a four-pipe mechanical system allows for zone control. The central atrium is designed for natural ventilation, as shown in figure 4.18. The computerized HVAC system allows the Operations Manager to further reduce the energy consumption of the building by modifying the building program.

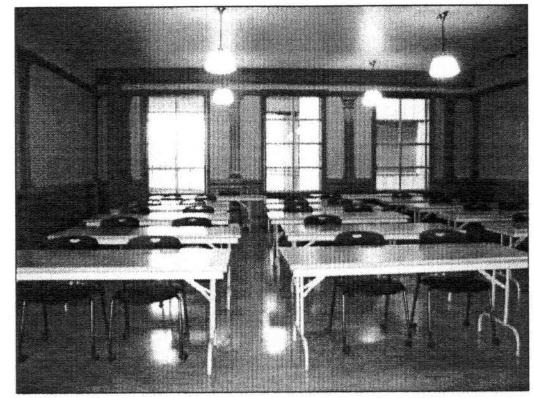


Figure 4.17. The historical Boardroom from the Grain Exchange that was reconstructed in its original location and is now used as a meeting room and classroom

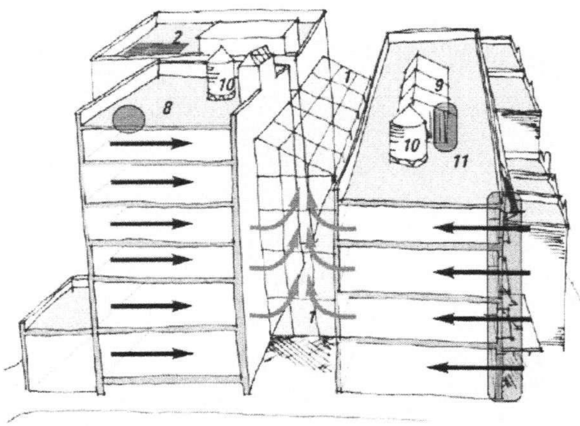


Figure 4.18. Diagram showing how the atrium is naturally ventilated (RRC, 2005)

A 12.8 kilowatt photovoltaic array is incorporated into the curtain wall glazing on the south façade (Figure 4.19). The array produces enough electricity to run lighting and outlets for about three energy-efficient homes (D. Rousseau, personal communication, August 28, 2005).

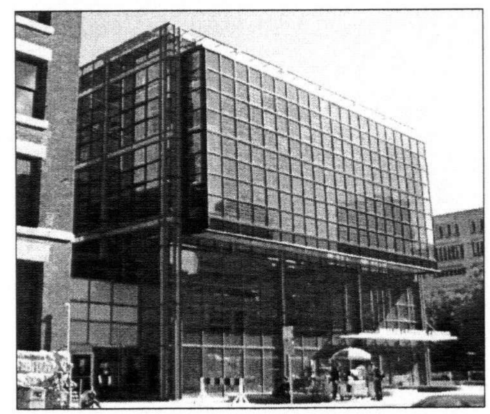


Figure 4.19. The 12.8 kW photovoltaic array incorporated into the southern curtain wall at Princess Street Campus

Occupants have access to operable windows, plentiful daylight and views. The building is wired to provide for easy access to network connections. Water efficient plumbing fixtures were used to conserve water and a section of the roof was planted with prairie grass to increase rainwater infiltration. Although the building was designed with a linear greywater treatment system, and waterless urinals, these items were cut due to budget concerns. The building was also designed to have a publicly accessible green roof that would cover the entire roof, however a code interpretation suggested that if this happened, it would have to be designed to allow for universal access. This would require extending the elevator and building a penthouse elevator lobby as well as adding guardrails. This was deemed too cumbersome and expensive so this idea was cut (D. Rousseau, personal communication, August 28, 2005).

One of the most remarkable aspects of the campus is that it was designed without any additional parking. Parking needs are met through on-street parking in the Exchange District and existing parking lots in the area. When the project was first conceived, there was very poor transit service to the site. In order to encourage occupants to take public transit, Red River College negotiated with Winnipeg Transit to change the bus routes (D. Rousseau, personal communication, August 28, 2005). Now the site is well serviced by transit with 15 buses stopping within two blocks of campus. Bike racks are located on the North entrance to the campus, and shower and change room facilities can be found in the fitness centre on the first floor. This central location and lack of additional parking encourages occupants to commute by bus, bike, carpool or walking. This central location is much different than Red River College's Notre Dame Campus, which is located in a suburban industrial office park.

4.3.3 The Lived Experience

The occupant comments about Princess Street Campus must be set against their prior experience at the old campus – Norte Dame. This facility was built at the height of the cold war at a time when the federal government declared all new institutions had to be designed to serve as bomb shelters (David Rousseau, personal communication, June 7, 2004). As a result, Notre Dame bears more resemblance to a concrete bunker than an academic institution. Located in an industrial area, there is a complete lack of amenities around, and the only place to go for a walk is the cemetery next door. As several occupants commented, "If you were on campus you were stuck. You can't go anywhere" (R3). Many of the staff interviewed taught in basement classrooms with no windows and "no natural light available at all," which contributed to a "claustrophobic" feeling (R7).

Norte Dame was also starting to show its age, with ventilation problems and out dated furniture. One faculty member described problems she had encountered with the air quality:

> The old Notre Dame facility… had a mould infestation which nobody cared about, which of course made the staff feel that nobody cares about them. Everyone had runny eyes and running nose and it was just the building. Our students were always sick. There's just no air movement. You'd sit in the computer labs and it would be hot and nasty, everybody was miserable. It's really hard to inspire people when they're uncomfortable, physically uncomfortable. And I had a problem that I had headaches every day, I really noticed that, and many of the other staff did… And that doesn't make you feel like coming to work (R5).

Her claims of poor air quality were backed by staff and students who had experiences with both buildings.

During the interview, occupants were asked what they would miss if they had to go back to Notre Dame Campus. Staff were so passionate about not going back that several occupants voiced their opposition before the question was even finished! In fact, out of five faculty members interviewed, four stated they would not go back, preferring to retire or return to the private sector instead. Out of two staff members, one stated that "I better not be" in response to that question (R2).

With the ventilation problems, rundown facilities, artificial lighting and industrial setting that offered no opportunities for escape – Norte Dame Campus is the opposite of Princess Street Campus. As one occupant commented: "there is no comparison" (R3).

Whereas occupants expressed a feeling of "dread" walking into Notre Dame Campus, the complete opposite was true for Princess Street Campus. In fact, time and time again occupants commented that the building makes them "want to come to work/school," that they look forward to coming in each day and are "happy" to do so. As R10 – a student – remarked:

> I'm just happy to come to school. You walk in and you feel good…I go to class, because I want to be in class. I don't go because I have to go. I found at the old campus…I would just really not want to be there. There are not that many windows and the windows they did have they didn't really face anything, they would just face the other wall (R10).

Another student mentioned that, even if "I don't like my apartment or I don't like my day or something's going wrong, you walk into school and it's…a feeling like Ya! I'm going to look forward to today!" (R11). R4, who was also a student, expanded on this point stating that: "The architecture is striking…and fairly well designed…which definitely makes me want to come to school a little bit more in the morning."

One thing that was repeatedly mentioned by both staff and students was how the school has a "professional" atmosphere and "doesn't feel like an institution." Occupants were comparing Princess Street Campus with their schema for classroom which appeared to consist of an artificially lit room with four white or orange windowless walls and old furniture. As R10 stated, "the old campus is more like being in school because there's not that many windows." Faculty members stressed the professional feeling of the space as well. One instructor found that "when I'm walking around I feel that we're all here at work together. We're all sitting over coffee in the morning going over what is required for today. So it feels to me like a working studio, it doesn't feel like a classroom" (R5). Another student who kept stressing this non-institutional feeling, thought that the building "doesn't portray itself as an institution because it doesn't seem stuffy. It's nice and open" (R8). She felt this way since the incorporation of salvaged materials gave the building a lot of "character" and there is a "welcoming" and "inviting feel" to the space. Other reasons occupants gave for the non-institutional feel was the use of "modern colours," the "glass windows" that provided views to the outdoors, having everything "built professionally," and having dedicated spaces with comfortable furniture and state-of-the-art-technology.

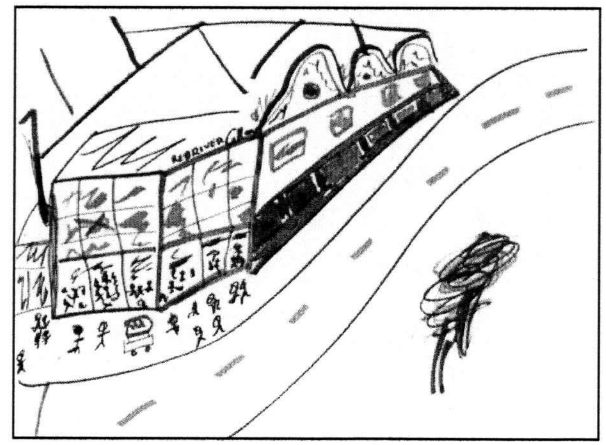


Figure 4.20. A participant's sketch of Red River College's Princess Street Campus depicting the historic façade, abundant windows, greenery around the building, the green roof, a street vender and lots of people

One of the first impressions when walking into Princess Street Campus is the energetic "vibe" of the building. R11, who tried to capture this feeling in his sketch (Figure 4.20), remarked: "It always has this aura when you come up to it and I always get this vibe even before I get inside."

R7 also tried to draw this feeling (Figure 4.21) and commented that "this place is alive." Other occupants discussed the "hustle and bustle," how there are "people everywhere" and how Princess Street Campus "feels more energetic and alive" than Notre Dame.

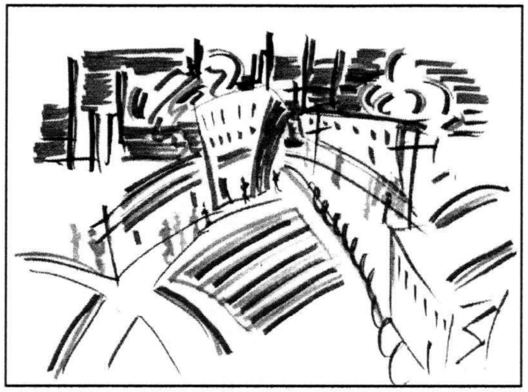


Figure 4.21. R7's sketch of Princess Street Campus illustrating the "hustle and bustle," the Market Square green space in the Exchange District, and the surrounding heritage buidlings (in brown)

Most occupants found the building to be "welcoming," "inviting," and thought that it "encouraged exploration." As R9 mentioned "when we have people come in the first thing they want is a tour – immediately. They go 'Wow, this is alright.'" Several occupants attributed this to the fact that "there's glass everywhere, you can see inside so there's nothing to hide" (R3). Still others pointed to a recent amenity – the Tim Horton's Kiosk – as reason why the building had a welcoming feel. As R6 stated, "[the building] is very accepting of the community…people are allowed to come in here with the Tim Horton's." It was even mentioned that since the Tim Horton's draws people in from the surrounding community, including the police from the Public Safety Building next door, that "makes us feel a lot more safe" (R2). Other occupants attributed the welcoming feel to the fact that "it blends in well," "is nice and open" and that there is "more of a sense of diversity here" (R8, R8, R7). Even the mix of technology, art and communication classrooms reinforced this welcoming atmosphere.

In contrast with occupants of the Liu who felt that the building had an imposed hierarchical sense since the director of the institute located his office on the top floor, there were no such feelings evident from occupants at Princess Street Campus. In fact, by locating the office of the Dean in the very middle of the building made the administration seem approachable, accessible, and added to the "welcoming" feel of the space. As R8 comments: "Going up to the third floor I didn't know that was the dean's office for the longest time…The dean's office in university, well you can't get to that. You are never allowed in there. It doesn't seems stuffy to me seems very relaxed, and comfortable" (R8). R7 felt the positioning of the Dean's office sent a message that "we are all in this together" and contributed to the general comradeship that existed at Princess Street Campus. As R7 stated: "I just feel that the people...running the show are in close touch with the people who are in the trenches. And the building helps that. Dave [our Dean] is right here in the oldest part [and] the doors seem to be open."

Permeating occupant comments was a sense of excitement to be apart of the project and genuine "pride" in the building. These feelings were especially evident when occupants were asked what they would tell a friend about the building. Several occupants said that they "do describe it often," and encourage their friends to come for a tour. As R10 stated, "I always tell my friends that you have got to come see this building!" After describing how impressed her friends in Toronto were with the building, R5 remarked that "I think it's fabulous that Winnipeg can do big city things." Its "hip" downtown location also contributed to the feeling of "pride" – as well as the sense of "exclusivity" and even "smugness" (R7). Several occupants also commented that their peers back at Notre Dame are "jealous" that they are not at the new building.

As a working environment, both staff and students commented that the building encourages you to work – "you walk in here in you're like, okay, let's get to work" (R4). R2 found "the students...to be more focused on working on their assignments" than at Notre Dame because Princess Street Campus has superior technology and no pool halls, games rooms or pubs to distract occupants from their work. R9 confirmed this, stating that: "there's nothing else to distract you. When you are here, [work] is all you are doing." She also felt that "this is the only place I can get work done" and added that "it makes me feel smart coming to this school" (R9). R11 finds it easier to work at Princess Street Campus since "you're in a professional environment...and you have access to all those tools." R4 credited the fresh air and natural light, which make "you feel more alive" to the positive working environment. R1 even thought that if the building could talk it would say "get your coffee and get back to work!" Whether due to the state-of-the-art-technology, the professional atmosphere, the lack of distractions, good indoor air quality and natural light or because occupants feel ownership over the space, a strong work ethic was evident from occupants at Red River College. Although not readily measurable - one instructor even felt that the work produced by her students in the new building was far superior to the work done in the older building.

As with the C.K. Choi, there was a strong sense of "belonging" and "ownership" evident amongst the staff and students. One faculty member felt this had to do with having spaces dedicated for both the staff and students to work. As she remarked, "My students, they have their own space, their own studio space, which is so fabulous because they feel like they belong here" (R5). Educational Assistants now have their own space in the building with offices in the shared staff office, whereas at the older facility their office was "wide open" and offered no privacy. This meant that "it didn't matter if you were scheduled for that hour, if you were in your office the students could see you and you couldn't say no [if they needed help] – even if you were in the middle of your lunch" (R2). With the new arrangement, it is not surprising that the first thing R2 thought of when he thought about the building was his office. A sense of belonging was evident in comments like "actually here, I'm not feeling hurried to go home every day" (R2).

For others, a sense of belonging came from being consulted during the design process. This made one occupant comment that "I feel like I've been a part of it" (R9). Even witnessing the building evolve during construction made one student feel a part of things. As he stated, "I like this building just because I've been at the Princess campus since it opened, and you can sort of see how things have developed...So they're getting to the point where it's fully functional. Which I'm glad I got to see" (R12). Still another student found that the social atmosphere inherent with the college setting where "all of your classes are with the same set of people," contributed to an "ownership feeling – not like it's mine and you can't have it – but that you belong" (R11). He contrasted this with his experience in university where "you kind of feel like [you are] just there to quickly take notes during the lecture – it's not a place to hang out or a place to meet friends or anything" (R11).

For some occupants, this feeling went much deeper, with comments like: "I feel like it's my second home now" (R7). This occupant loved the surrounding area, and felt a really strong sense of community at Princess Street Campus. In his words:

> I feel like I'm driving around and I know the roads, I know a lot of the people here, and a lot of shop owners...It's like working in a village, it's like 'oh there's the teacher from graphic design, I was in his class last year.' You talk to the coffee person, and you talk to the person who sells CDs, and the police (R7).

This "homey feeling" was reiterated by R11 who felt that "when it's filled with people and it's all bustling and we're working, for me it's almost like a big family gathering at Christmas." Another student – R10 – had even applied for jobs at the school because he knows he is going to miss it when he graduates.

Occupant attachment to the space was evident when they were asked whether vandalism is something that they noticed at Princess Street Campus. Although R4 said that there wasn't too much vandalism yet, one occurrence "upset me a lot. You just don't do that. It just seems so out of place, you just don't do that to nice places. If it's kept up, well-maintained, then I think that most people would be more respectful of this space." Another student, R12, reiterated this feeling, stating:

> I was bothered by the fact that people don't have respect for property. If you open a window in Winnipeg in the middle of winter, you should close it before you leave. And students [are] leaving coffee cups and chocolate wrappers around even though there's a garbage can 5 feet away. I guess you're spending the good majority of the next year or two or three or four here, treat it like you would your home. I hope they don't treat their homes like that (R12).

In terms of social environment, several of the faculty members mentioned that since being at Princess Street Campus, the "staff hangout a lot more together" (R5). With so many restaurants and bars within a five minute walking distance of the building, it is just easier to "go for a beer after work" (R5). This suggests that the location facilitates social interaction among the staff and the students.

One of the goals with the Princess Street Campus was to serve as a catalyst to revitalize the dying Exchange District. This goal was well received by occupants, with comments like: "I'm excited that they are looking at trying to revive the downtown area...the fact that the College is trying to make an effort with the city and the province to actually do something" (R9). The surrounding area is an interesting milieu of 1900 century warehouse buildings occupied by artists, secondhand shops and restaurants. Occupants were appreciative of being connected to the community and the freedom of being able to leave campus and walk to a variety of shops and restaurants within five minutes. Just knowing that "you can actually go and get off of campus" (R3) provided stress relief for occupants and counteracted any feelings of being trapped inside an institution. As summarized by one occupant, "just knowing that you could, if things were driving you mad a little bit too much, you could walk out the door and you're not faced with a big vast emptiness" (R7). The central downtown location also makes occupants "feel like we're part of the community, whereas in the old building we really did not" (R7). R6 found the building to send a message about "connections to the community" which is in part due to the location. The location was also the most often cited attribute that occupants would miss if they had to go back to the Notre Dame Campus.

When asked to personify the building, occupants thought the building as a person would be "experienced" and "wise" yet "open to new ideas" and "ahead of the trends." Some occupants thought the building would be a "hip," "creative," and an "entrepreneur." Others thought they would be "resilient" yet "invigorated" – like a "phoenix," or in the words of one occupant a "cranky, old copper who's had a hip replacement and is on Viagra" (R5).

4.3.4 Potential for Pedagogy

A major focus of the design for Princess Street Campus was to "interpret the history of the entire site including those buildings lost, those that remained, and everything in between" (Corbett Cibinel Architects, 2005). To achieve this purpose, several strategies were used. First, heritage components were restored or reconstructed where appropriate and buildings or architectural features that were lost have been recalled. For example, the 2000 floor plan from the Drake Hotel which occupied 146 Princess Street, has been painted on the library floor. A photograph showing the former civic precinct – which included the now demolished Market Building and City

Hall Building – has been printed on the glass by the entrance to the library to provide some sense of civic development. Similarly, the image of a sixth building along Princess Street that was deteriorated beyond repair and had to be demolished has been superimposed on exterior façade where it originally stood (Figure 4.22).

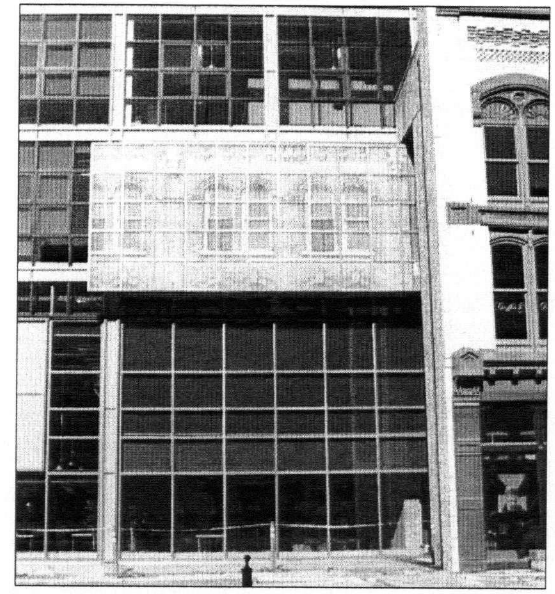


Figure 4.22. To acknowledge a sixth heritage building along Princess Street that could not be salvaged, its impression is superimposed on the exterior façade

As an initiative by the architects, interpretive signage was installed in June 2005 to express the history of the site. Originally, the plan was to have 17 interpretive signs that discussed not only the history of the buildings (both those along Princess Street and the warehouse on William Avenue) and the site, but also discuss the design and the green components of the building. This list had to be narrowed, which resulted in ten signs on the history and interpretation of the site, and two signs on the design (Figure 4.23). The signs that were planned for the environmental features were either removed or it was decided that it would be better to interpret them in another way (R. Bragg, personal communication, July 13, 2005).

The photovoltaics have been interpreted through a kiosk installed next to the PV panels in June 2005. Consisting of a computer, monitor and signage, the kiosk explains how photovoltaics work and displays performance data for the system (R. Gamble, personal communication, July 13, 2005).

As an active teaching strategy, the green roof was designed, planted and maintained by students of Red River College's Greenspace Management Program. This 30-month long diploma program focuses on the skills required to construct and manage landscape areas. For students of this program, the roof has become integrated into ecology courses as a show and tell demonstration project. Instructor Ruth Bob discusses how having a green roof makes "[lessons] much more meaningful for students" since they can see first hand that this is a technology that is viable –

even in a harsh climate like Winnipeg (R. Bob, personal communication, October 28, 2005). Another green roof that has been incorporated into this program is that of the nearby Winnipeg Mountain Equipment Co-op, which uses a different green roof construction technique than Princess Street Campus. A few students have been so inspired with this technology that they have expressed intentions of focusing on green roofs in their future careers (R. Bob, personal communication, October 28, 2005).

Although the designers discussed active strategies that could be used to educate building occupants on the environmental features utilized, the building was not designed with the specific intention of passively communicating a pro-environmental message (R. Bragg, personal communication, July 13, 2005).

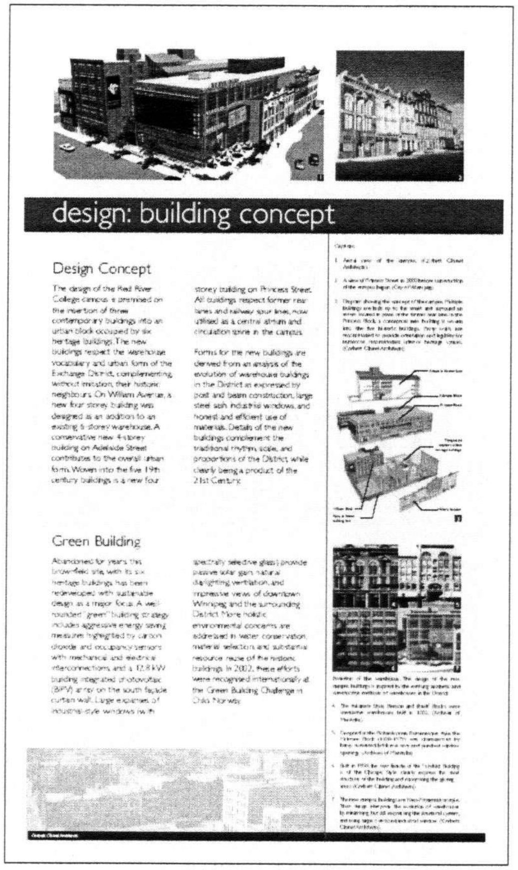


Figure 4.23. One of the interpretive signs at Princess Street Campus that discusses the design of the building (Corbett Cibinel Architects, 2005)

4.4 Computer Science Building, York University

Figure 4.24. The Computer Science Building at York University

Owner: York University
Architects: Busby + Associates Architects / Van Nostrand di Castri Architects (now architectsAlliance)
Structural Engineer: Yolles Partnership Inc.
Mechanical Engineer: KEEN Engineering Co. Ltd.
Electrical Engineer: Carinci Burt Rogers Engineering
Landscape: John Lloyd & Associates

Location: Toronto, Ontario
Floor Space: 10,700 m^2
Budget: $16.6 million
Description: Three floor building with computer labs, classrooms, seminar rooms, lecture halls and office spaces
Completed: September 2002

Awards:
2002 Governor General of Canada, Award for Architecture
2002 Lieutenant Governor of BC, Medal for Excellence
2002 World Architecture, International Green Building Award

4.4.1 Context of Development

Originally intended to be the new building for Environmental Science, lobbying pressure from within the university expressed the opinion that as an environmental science building, it should be sustainable. Although the building program changed, the goal to create the first sustainable academic building in Canada remained (A. DiCastri and M. Contras, personal communication, September 7, 2001). In order to do that, York hired the best people for the team, compiled a comprehensive design brief that included "Environmentally Responsible Criteria," put expectations into the contracts and eliminated escape clauses (M. Contreras, personal communication, May 13, 2002).

The mandate for this project was for the building to be done within budget (tender cost was $168/sq ft, whereas most York University buildings are tendered at $200/sq ft), it must perform as well as a conventional building, and it must satisfy the requirements of the computer science department (A. DiCastri and M. Contras, personal communication, September 7, 2001).

4.4.2 Overview of Green Design Strategies

One of three Canadian submissions to the 2000 Green Building Challenge, the Computer Science Building (Figure 4.24) was designed to use a variety of low-tech solutions to achieve an energy efficiency that is 40%-50% better than ASHRAE 90.1 (Figure 4.25). Energy loads are minimized through building layout, broader temperature ranges, zoned heating, passive heat reclaim, underfloor air delivery and external shading. A highly insulated and exposed concrete structure provides thermal mass to even temperature variations and capture solar gains, which has pushed the peak heating load of the building back 8 hours.

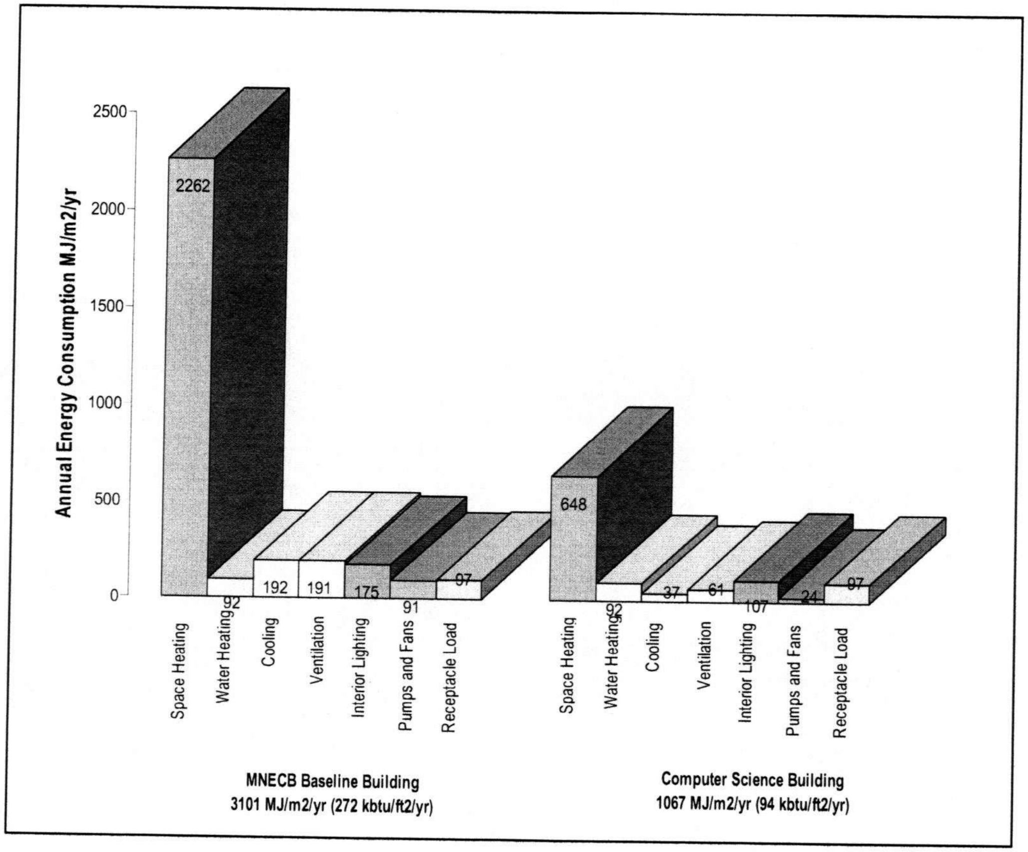


Figure 4.25. Comparison of energy use between York University's Computer Science Building (right) and a similar building designed to the Model National Energy Code for Buildings (left) (Graph courtesy of Busby, Perkins + Will Architects)

The most notable feature about the building is that it is a cold climate application of natural ventilation. Relying on a mixed modal approach, distributed fan coils serve the peak summer and winter loads while natural or mechanically assisted ventilation provides fresh air and space conditioning in the shoulder seasons. Fresh air is drawn into the building and can be tempered or left as is for circulation throughout the building. Two atriums receive the air plume, which has reduced the mechanical system by almost half that of a conventional system. Every office has access to fresh air through an operable window, which faces either an internal atrium or the outside. Natural ventilation is achieved with operable windows, high level stack ventilation and atrium ventilation. This system is very simple and does not require extensive operational equipment or sensors.

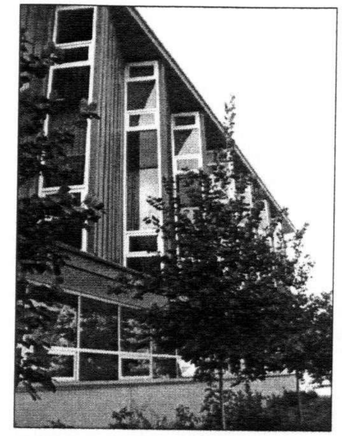


Figure 4.26. Solar control strategies on the eastern façade of the CSB, angled walls and deciduous trees

To introduce daylight into the building yet control solar glare, external window shades were installed on the south façade, a bank of deciduous trees was planted along the east side (Figure 4.26), and western facing windows are angled northward in a sawtooth manner. Natural light is supplied to the building's interior through the atria, which are fitted with glass with a 70% fritted pattern to provide some shading. Windows are double glazed and with a low-e coating.

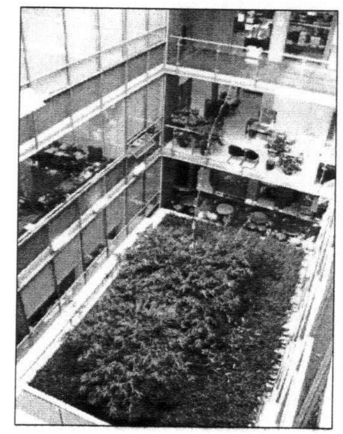


Figure 4.27. Planted bamboo atrium at the Computer Science Building

Indoor air quality is maintained through a planted atrium that filters the air (Figure 4.27), natural ventilation strategies and the specification of Low-VOC adhesives, paints, carpets and fabrics.

The amount of finishing materials required was minimized by exposing ductwork and reducing the floor-to-floor height. Material choices include linoleum flooring, 100% recycled reinforced rebar and recycled aluminum for glazing systems. The parking lot featured concrete that replaced the traditional gravel aggregate with crushed recycled concrete. In addition, the Computer Science Building is the first cold climate adaptation of EcoSmart™ concrete.

To ease future modifications to the interior space, and to increase the adaptability of the structure, the mechanical work has been centralized on the exterior walls. The adaptable interior floor and ceiling partitions can be easily repositioned to accommodate future needs.

An extensive green roof installed by Soprema Toronto (Figure 4.28) helps to maintain the zero net loss water policy of the watershed, while mitigating the urban heat island effect, reducing air conditioning loads and providing extra insulation. To recreate habitat, native plants were used for the landscaping plan.

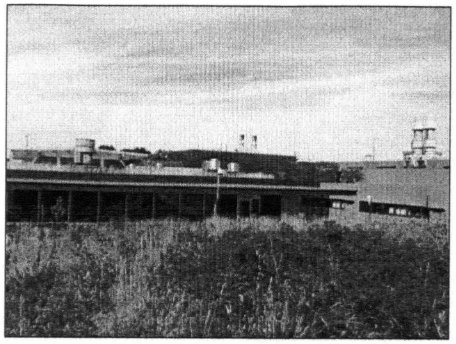


Figure 4.28. Extensive green roof at the Computer Science Building

4.4.3 The Lived Experience

Occupants interviewed from the Computer Science Building commented on how much they liked the windows, the openness of the building, and the bamboo atrium. The building was praised for its high indoor air quality and the presence of natural light. Occupant feelings towards the building ranged from "comfortable" and "welcoming," to "unsettling." Some occupants even mentioned pride in the building and its environmental design. For example, Y4 was so interested in the building that she "wrote back to my friends saying…there's something cool going on here!"

Although occupants were very positive about some of the building attributes, there were also a lot of complaints. This could be partially attributed to the recruitment method chosen, a misunderstanding of design intent for certain features, and in the words of one occupant "the nature of computer scientists" (Y3).

One problem encountered when relying on self selection for recruitment is that it may attract participants who either have very favourable opinions or very negative opinions (Babbie, 2002). This was the case at York. There are also some individuals who just like to complain. Out of the seven people interviewed, two fell into this category and a third had a lot of hostility and anger towards the building that seemed to stem from an altercation with the University surrounding building maintenance. Essentially this person had a leaky window which had not been fixed and the frustrations he had with dealing with this issue were transferred to the building. Although the responses of these occupants may not be representative of the building as a whole, they are still a reflection of that individual's perspective on the building and are therefore valid. These comments were also useful in determining the attributes that affected the overall message a building communicated to occupants.

A lack of understanding of the design intent for some of the building's features seemed to be partially responsible for the complaints encountered at the Computer Science Building. For example, several occupants had negatively commented on how they moved in before the building was finished and they were still waiting for them to finish it, which affected the way they viewed the building. However, in reality the building was designed without finishing materials in order to reduce the resource consumption. After the intent behind these misunderstood design features was explained in the interviews, there was greater appreciation for the strategy. This suggests that greater communication of these design strategy could help occupants become more accepting of misunderstood attributes.

One of the occupants interviewed attributed complaints of the green building to the nature of computer scientists. In his words: "Computer scientists are very bad at thinking outside the box. We think very methodically and it really limits our thinking… I have to say I never met a more [impenetrable] group of people" (Y3). If this generalization is true, it could explain why some occupants were dismissive of green design solutions employed at the Computer Science Building that are outside conventional practice. These strategies included the use of baffles for air circulation, the saw-toothed east and west walls, the green roof, the electronically controlled windows and the elimination of finishing details.

Two design strategies used within the Computer Science Building, the expanded temperature ranges and the use of transparent glass partitions between graduate offices and the hallway, generated many complaints. These two strategies, discussed below, affected the occupant's enjoyment of the building either because of thermal comfort, or lack of privacy.

In order to achieve the energy reduction targets at the Computer Science Building, the design used greater temperature ranges throughout the building. Although this strategy was carefully negotiated between the architects and the administration at York University, the top complaint from the occupants of the building was that the building was too cold. One occupant that was interviewed worked in the office beside the bamboo atrium. She commented that during the winter she often wore her coat because it was so cold and drafty. Other occupants commented on the fact that they had to have a change of clothes in the building just incase they did get too cold.

To enhance daylight penetration into interior student offices transparent glass wall partitions were used. Occupant responses to this design strategy were mixed. All of the students interviewed mentioned how the glass partitions made them feel like they were on display, or living in a "fish tank." This feeling is clearly evident in the sketches from Y3 (Figure 4.29) and Y4 (Figure 4.30) who both drew aquariums. The glass partitions made occupants feel very "uncomfortable" and

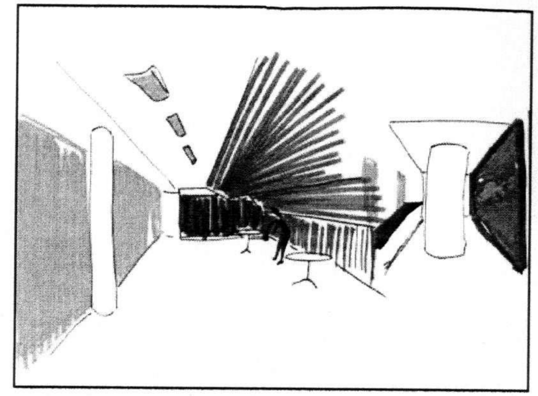


Figure 4.29. Y3's sketch showing the fish tank feeling of the office and the crush space on the main floor

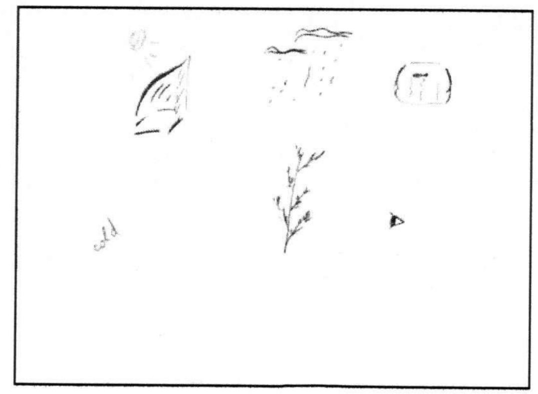


Figure 4.30. Y4's sketch showing the leaky ceiling, the fish tank feeling, cold, her favourite spot (the sunny window sill) and the bamboo atrium

contributed to the feeling that there was a "lack of privacy" within the building, or you were constantly "under surveillance." As Y3 stated:

> It feels like you are living in a fish tank. It's wonderful on the one hand to walk down the hall and have the sense that everything is open, but on the other hand it is just absolutely annoying that when you are sitting there and trying to work privately that there are people poking their heads, looking through the windows. You can't blame them for their curiosity. The building is set up so you can feel connected to people walking in the hallways (Y3).

The ability of the glass partitions to create social connections to other students was also commented on by one of the international graduate students interviewed. Although the glass partitions did make her feel like she was in a fish tank, they also helped her to develop friendships. In her words:

> When I first came here I was really bashful and shy...but somehow I connected to the openness of the building. Because the other people they would see me. Somehow you think that you're not alone, you're just walking around the corridor and you see some student in his office you can just wave at him and say hi through the glass wall. Otherwise I would just see a wall and go to my office, I wouldn't see anybody. And sometimes it's easier just to start from saying hi through the wall and then communicate than to knock on the door...and say 'What are you doing here? How are things going?' (Y4).

Although the glass partitions catalyzed social relationships and facilitated daylight penetration, they also left occupants feeling "uneasy" and "self-conscious." Y7 mentioned how the glass partitions made him feel "very self-conscious when people were walking around and I was eating [in my office]. It just didn't feel right" (Y7). To combat this lack of privacy, most of the occupants within the glass offices have put up posters or wallpaper to discourage people passing by from looking in (Figure 4.31). The fact that occupants felt uncomfortable enough with this design strategy to physically alter their space, suggests that a fritted pattern on the glass that maintained some degree of privacy while still allowing light penetration may have been a more appropriate solution.

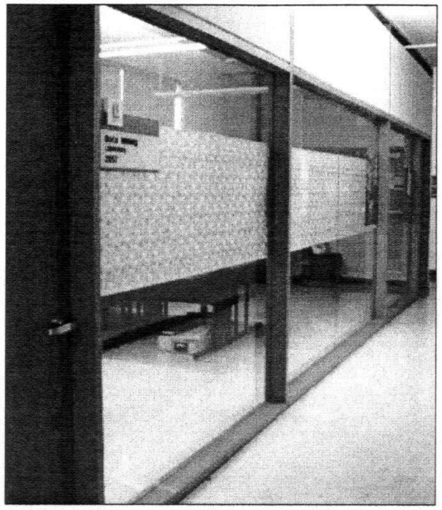


Figure 4.31. Wallpaper used in a student office to prevent people from looking in

This design strategy seemed to have a large impact on the overall message communicated by the building. For example, occupants mentioned that the building communicated messages about the "flow of ideas," that the building "encourages exploration" and "social interaction," and it also sends a message to occupants to "get to work."

4.4.4 Potential for Pedagogy

Creating a building that "communicated the underlying awareness and sensitivity towards the environment" was a conscious decision for the Computer Science Building design team from the outset (W. Bettio, personal communication, October 25, 2005). The project architect for the Computer Science Building, Walter Bettio, thought this message was communicated through the minimum material palette, durable materials, as well as "obvious signifiers" like the planted roof, thermal chimneys, occupancy sensors, uplighting and plentiful daylight (W. Bettio, personal communication, October 25, 2005).

In terms of strategies that actively communicate this message, an energy consumption monitor was installed at the client's request in order to compare the actual energy consumption of the Computer Science Building to a building designed according to ASHRAE 90.1 1999 standards. To quantify the benefits of the green roof installed on the Computer Science Building, the Sustainable Technologies Consortium is collecting climate and hydrometric data. This public partnership between Seneca College, the Toronto and Region Conservation Authority, several universities and local governments, has a mandate "to pursue scientifically defensible technologies for sustainable development and successfully quantify their potential benefits relating to global warming, air pollution, stormwater runoff control, and water and energy conservation" (Sustainable Technologies, n.d.). Climate and runoff data is available to the public through the internet (www.greenroofssystems.org "Members Access"), and a web camera on the Sustainable Technologies Consortium's website provides a 360° view of the Computer Science Building's green roof (Sustainable Technologies, n.d.).

Interpretive signage was not discussed during the design and is "something [that the designers] would never advocate or want" (W. Bettio, personal communication, October 25, 2005). Bettio stated that the building's environmental features were incorporated because "it's the right thing to do" not to gain recognition or to boast about those features (W. Bettio, personal communication, October 25, 2005). That being said, York University is currently exploring the possibility of installing interpretive signage (T. Mohammed, personal communication, October 27, 2005).

Results

Chapter 5

> "What matters with gesturing is not what signals we think we are sending out, but what signals are being received."
> (Morris, 2002, p. 21)

The results for this study are divided into two sections in response to the two thesis questions. This chapter will explore the first thesis question, "Do high caliber green buildings implicitly communicate a pro-environmental message to their occupants?" The second thesis question, "Are some design strategies more effective than others in communicating that message?" will be examined in the following chapter.

The following section will look at results of various questions organized by building. In addition, Appendix F contains a table listing the main issue areas for each occupant.

5.1 Basic Statistics

For this study 26 people were interviewed in 4 buildings. Interviews lasted from 20 minutes to 80 minutes, with the average interview being 43 minutes. Over 18 hours of tape was collected in total. Table 5.1 outlines how many people were interviewed at each location, length of interviews, and dates sampled.

The Liu Institute for Global Issues (Vancouver, BC) June 28, July 12-15, 2004				
L1	0:42:37	Sum L:	3:08:47	L = 4 people interviewed
L2	1:19:16	Average L:	0:47:12	4 staff
L3	0:38:47			0 students
L4	0:28:07			
C.K. Choi Institute for Asian Research (Vancouver, BC) July 21 - 28, 2004				
C1	0:41:04	Sum C:	2:08:07	C = 3 people interviewed
C2	0:53:04	Average C:	0:42:42	3 staff
C3	0:33:59			0 students
Red River College's Princess Street Campus (Winnipeg, MB) Sept 13 - 17, 2004				
R1	0:35:19	Sum R:	7:46:55	R = 12 people interviewed
R2	0:42:58	Average R:	0:38:55	7 staff
R3	0:39:57			5 students
R4	0:35:54			
R5	0:47:25			
R6	0:15:55			
R7	0:44:09			
R8	0:35:39			
R9	0:41:44			
R10	0:31:46			
R11	0:54:21			
R12	0:41:48			
Computer Science Building at York University (Toronto, ON) Sept 27 - Oct 1, 2004				
Y1	0:45:17	Sum Y:	5:38:47	Y = 7 people interviewed
Y2	0:28:07	Average Y:	0:48:24	4 Staff
Y3	1:21:11			3 Students (grad students)
Y4	0:22:53			
Y5	1:02:58			
Y6	0:54:08			
Y7	0:44:13			
Sum:	**18:42:36**	In total over 18 hours were recorded with the average interview lasting 43 min. 26 people were interviewed in 4 buildings		
Average:	**0:43:11**	Approximately 200 pages of transcribed interviews		

Table 5.1. Number of Occupants Interviewed, Duration of Interview and Average Length of Interview by Building

5.2 Lack of a Definition for Pro-Environment

To minimize researcher biases, a qualitative research method relying on semi-focused interviews was deployed. Using open ended and semi-structured questions enabled the participant to identify what aspects of the building were important to them, verses a pre-determined questionnaire approach that would only explore attributes that the researcher assumed would be significant.

For similar reasons the somewhat nebulous term "pro-environment" was purposely chosen to explore what constructs come to mind by building occupants when thinking about the "environment." This term, pro-environment, was derived from environmental education literature that discusses the desire for environmental education interventions to produce citizens that are engaged in "pro-environmental behaviour" (Kollmuss & Agyeman, 2002). This catch-all term is considered to encompass thoughts of sustainability, reducing the human ecological footprint and learning about place. When applied to a building, it would also include strategies employed to conserve energy, water, and resources.

Responses by occupants about whether they thought the building projected a pro-environmental message, suggests that they defined "pro-environment" in many different ways. For R3 the term pro-environment brought to mind images of "green space and trees" and R11 correlated pro-environment and "environmentally friendly" as "being a sacrifice to convenience." Other definitions for pro-environment included:

- energy efficient
- heat efficient
- water efficient

- recycling
- presence of plants and green space
- healthy (natural light, good indoor air quality, views)
- good working environment
- properly constructed
- properly maintained
- welcoming
- sensitivity to place
- simple materials
- behavioural/operational aspects (i.e. recycling)
- blending of inside and outside

Likewise, some occupants were confused with the term "green building" and a consistent definition was not apparent. In addition, some interesting misconceptions of green buildings were uncovered when occupants were asked if they would want to live in a green building. Comments about green buildings included "earth bermed houses" that "do not seem feasible for a city" or something that would require you to "move somewhere far out of the city." Other occupants thought green buildings are "very expensive" and "inhabited by hippies."

A Canadian Mortgage and Housing Corporation [CMHC] study, *Assessing Consumer Demand for Sustainable Development,* encountered a similar lack of definition for green buildings. When asked to rank the importance of various housing issues concerning Canadian homeowners, "environmental sustainability" appeared further down on the list. This result was attributed to the fact that "this question appeared at the start of the survey, before a series of informative questions were asked about Healthy Housing. At that point in the survey, interviewees may have been unsure what environmental sustainability actually meant" (Connolly, 2004, p. 3).

These results suggest that a public education campaign aimed at defining nascent terms such as green building and sustainability would be beneficial. This could perhaps be a task that the Canadian Green Building Council could take on with likeminded organizations such as CMHC.

5.3 Green Building Awareness

The following questions examined whether occupants knew that the study building was considered a green building, and if they did, how they knew that.

5.3.1 Did You Know This Was a Green Building?

Of all the occupants interviewed, only 2 did not know that the building had been designed incorporating green principles and strategies. These occupants (one a student and one a staff member) were both from Princess Street Campus and had been there for a year. With over 2000 occupants, Princess Street Campus was the largest building studied, and is subjected to a large turnover rate being a college institution. As different courses commence, new students and staff members are added to the building's population, and occupants leave as courses finish. Due to the volume of new occupants to the building each year, these occupants may not have been told about the environmental features of the building.

At the Liu, not only did everyone know that it was a green building, but the occupants interviewed demonstrated sophisticated knowledge of green design strategies that are less visible to an untrained eye – such as the use of high volume fly ash concrete and a complement of recycled materials. Considering that the Liu and the Choi have been promoted as examples of green buildings at UBC, this knowledge is perhaps not that astonishing.

5.3.2 How Did You Know This Was a Green Building?

Occupants who were aware that the building was designed according to green principles gave a variety of reasons, including: someone told them, they had participated in initial consultation meetings during the design process, they had been on a tour or had seen tours in the building, they had heard that it was green at the opening, or read information sources such as literature, news items and the website. Occupants from the Choi and Liu made mention of the fact that they knew because "it's everywhere." These comments allude to the idea that the green features of the building have been so intertwined with the building's identity that it was difficult for the occupants to pin-point how they first knew it was green.

Table 5.2. Occupant answers to the question "how did you know this was a green building"

	Liu	Choi	RRC	York	Total
Someone told me	2	2	2	2	8
Consulted during design		1	3		4
Tour	1			2	3
It's everywhere	2	1			3
Literature			2	1	3
News			2		2
At opening			2		2
"Picked up on that"		1			1
Salvaged materials			1		1
Recycling			1		1
Website			1		1

Of particular interest is C1's response to this question. At first she didn't know that the Choi was a green building:

> I didn't know in the beginning that it was a green building until...we started moving in. We looked up and said, "Oh this is different." But after awhile you start to pick up a few things that are different. Not just the toilets and the materials but sound carries a lot in this building so when you speak anyone who is next door can hear you (C1).

Similarly, an occupant at Princess Street Campus had heard that it was a green building at the opening, but she also mentioned that:

> I can see it. I can see it by the way that they reused a lot of things. Put it in a building where they could've torn one down and just gone to waste. But I didn't know how far they

> considered it, or to what extent that they considered it a green building, but I knew they did by reusing most of the materials here (R8).

R8 was skeptical to "what extent they considered it a green building" because some of the salvaged materials – such as the old crates on the walls and the old doors – she found to be mainly for decoration.

When R11 was asked if he knew that Princess Street Campus was considered a green building, he replied, "Ya I've heard that - but I really don't know what that means, which is too bad." Even though he didn't know a formal definition of a green building, he postulated that it would be a building where "the heating efficiency would be higher [and] it would be insulated…I would imagine its very heat efficient, energy efficient, and I guess water efficient too" (R11). This comment reiterates that the term "green building" is not clearly defined in the general public.

5.3.3 Is It Evident That This Building is a Green Building?

Occupants were asked if they thought it is evident that the building was a green building. Although it was expected that the answers to this question (Table 5.3) would mirror the answers for the pro-environmental question, this was not the case. It was more evident among occupants at Princess Street Campus and the C.K. Choi that the building was green and less evident in the Liu and Computer Science Building.

Table 5.3. Answers to the question "Is it evident that this is a green building?" presented by building

	Liu	Choi	RRC	York	Total
No	1		5	6	12
Yes		1	4		5
Not until you study it	1	1	1		3
I'm not sure	1	1	1		3
Not if someone didn't tell me	1		1		2
Not like CK Choi	2				2

* Due to interviewer error, this question was not asked to an occupant at York and RRC

Of particular interest was a comment from an occupant at Princess Street Campus who thought that someone walking in off the street could "pick up" that it was a green building just by "the design of the school – because there are some parts in the wall where you can actually see where the original building was, where they built onto it" (R8). Another occupant at Princess Street Campus (R7) thought that you may not be able to "consciously articulate that" it was a green building, but they would identify the building as being "healthy." This occupant felt that the windows, natural light, the surrounding environment and the "oldness" contributed to this reaction.

Reactions at the Liu Institute were different, with one occupant commenting that you could not tell that the building was green because of a lack of visual cues and a lack of signage. As he stated:

> You can't tell what the concrete is [High Volume Fly Ash] by simply looking at it. You can't tell where the wood came from by looking at it. And there's no, well there used to be somewhere on the website that talked about it, but I'm not sure if it's still there. There used to be a big display case...but I don't think it mentioned anything about the materials...So yeah, I don't think it's obvious when people come in (L2).

A similar reaction was given by occupants at York. Although a few occupants expressed that it "feels like any other postmodern building that was created to let in more natural light," occupants did not think that it was evident that it was a green building (Y5). As one occupant commented, "if [someone walking in] didn't know anything about this building and the monitor's not working, and they don't see [the bamboo atrium] then there's no way they can tell" (Y7). These comments allude to the importance that visual cues have for occupants in determining if the building was designed differently than a more conventional building. This tread is discussed in greater detail in Chapter 6.

The reputation of the C.K. Choi Building among occupants at the Liu Institute cannot be overlooked. Although the overall impression at the Liu Institute is that it is not directly evident that the Liu is a green building, when asked this question, two occupants said that the Liu wasn't as evidently green as the C.K. Choi. This demonstrates the wide field of influence that the C.K. Choi has.

5.3.4 How Could it be Made More Evident That This is a Green Building?

Occupants were asked how it could be made for evident that the building was a green building. Table 5.4 gives the range of responses.

Table 5.4. Answers to the question "How can it be made more evident that this is a green building?"

	Liu	Choi	RRC	York	Total
Posters & Interpretive Signage	5		6	2	13
Plaques		1	4		5
Word of mouth		1	1		2
Waterfalls - more outside/inside				2	2
Food production			1	1	2
Energy monitor				2	2
Composting toilets	1				1
Literature		1			1
People don't care			1		1
Website			1		1
Public relations campaign			1		1
Pamphlet			1		1
Incorporate into curriculum			1		1
Video display				1	1
Plant wall				1	1
Different colour paint for walls				1	1
More plants				1	1
Unusual				1	1

The majority of responses to this question involved some use of interpretive devices – such as posters, signs, plaques, pamphlets or video displays. It is no surprise that signage was the most often mentioned strategy since plaques are commonly used to point out historical buildings and signage can be found in museums. The following two quotes illustrate typical occupant comments:

> Our City Hall is a couple of buildings over, and when you walk through there's plaques explaining dedications or whatever. They have a patio with ample space outside [Princess Street Campus], they could put a plaque up there or something just explaining how the building was developed and what features it has. Not even so much for students, but just for people coming by (R12).

> Signage would be a good idea. A really good idea. Not maybe just signage but a little pavilion or something. That would be awesome – especially if it was done well. And if the architectural firm did it then that would be even better, because I'm sure that they would make sure that it was very esthetically pleasing (Y3).

Other, more design related suggestions, included strategies that would change the experience of the space. Blending the distinction between inside and outside through the addition of a waterfall, incorporating a plant wall, having more "unusual" plants in the atrium, or installing composting toilets.

A few occupants suggested strategies related to the building program and thought that the building should be actively incorporated into the curriculum. One occupant at Princess Street Campus who suggested this thought that the first year creative communications students should have a project where they create a pamphlet explaining the green features of the building in one of their courses.

5.4 Pro–Environmental Message

Buildings can project a variety of messages to their occupants. Some of the messages that participants thought the study buildings were projecting included: inviting, welcoming, accepting of the community, friendly, not-friendly, open mindedness, professional atmosphere, alive, and open. This section discusses whether occupants thought that the building projected a pro-environmental message.

5.4.1 Do You Think the Building Sends a Pro-Environmental message?

Near the end of the interview, occupants were directly asked if they thought the building sent a pro-environmental message. From their responses, it appears that green buildings can communicate a pro-environment message – however that message is stronger in certain buildings (Table 5.5). A pro-environmental message was more evident at the C.K. Choi Institute for Asian Research and Red River College's Princess Street Campus, whereas this message was less evident from occupants at the Liu Institute for Global Studies and York University's Computer Science Building. Some occupants interviewed thought that a pro-environmental message would only be discerned with a guide – either a person or some sort of signage that would educate the occupants on the green building practices used.

A building by building look at the results to this question is examined below.

Table 5.5. Answers to the question "Do you think this building sends a pro-environmental message?" presented by building

	Liu	Choi	RRC	York	Totals
Yes	2	3	10	2	17
No			1	3	4
If you were aware	2		1	1	4
Not without a guide	1			1	2
Not obvious	1	1			2

C.K. Choi Institute

Although only three occupants were interviewed at the C.K. Choi, they all thought the building communicated a pro-environmental message. One of these occupants stated that a pro-environmental "message is clear, but it's not loud and clear," and therefore may require additional explanation – either through signage or guides – to discern that message (C2).

Princess Street Campus, Red River College

Most of the occupants interviewed at Red River College felt that a pro-environmental message was evident. One person thought that if you had prior knowledge of green building practices and knew what to look for, then a pro-environmental message could be discerned. Only one person felt that that the building did not communicate that message – an interesting note is that this person was one of only two people interviewed who did not know that the building had been designed to embody green principles. Although it is not possible to determine from this study if an influencing factor as to whether occupants felt the building communicated a pro-environmental message is prior awareness that the building is green, it is certainly a question that warrants further exploration.

Liu Institute for Global Issues

On a whole, the occupants interviewed at the Liu felt that there was a subtle pro-environmental message, however discerning that message required interpretation – either through a guide or prior knowledge of green building practices. One occupant felt that the building was "trying to make some sort of message about environmental responsibility" through the "human environment" created by the "open air," "operable windows," and the "recycled materials" (L3). L3 also mentioned that he did not think that message was coming across clear, as there are areas of the building that "do not work," including high noise levels that interfere with academic work (L3).

Every occupant interviewed at the Liu knew that the building was a green building and in every case the occupant mentioned this without being prompted. Given the small occupancy at the Liu (approximately 40 occupants) and high profile that both the Liu and the Choi have at UBC for being green buildings – a position that is reinforced with tour groups visiting on a regular basis – this knowledge is not that surprising. This knowledge influenced occupant's perceptions of the building as evident in the following excerpts:

> This place is really environmentally friendly so I thought of trees so I drew a couple of trees (L4 , commenting on her sketch, Figure 5.1).

> [If the building was a person it would be an] earthy dignitary – somebody who is important yet down to earth (L1).

> [If the building was a person it would be someone with] old fashioned values because of the recycled materials in the building so there is a little bit of a history there and

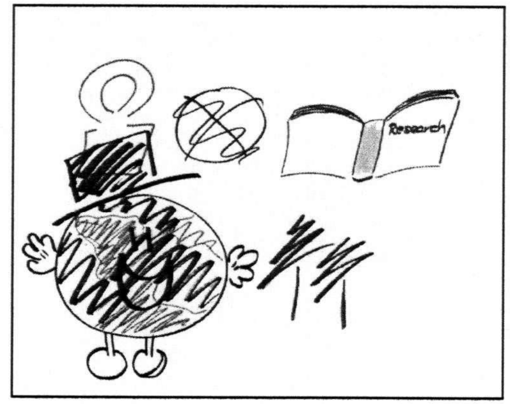


Figure 5.1. L4's sketch showing the Liu's symbol, a book to represent research, a globe to represent the Institution's focus, and trees to represent that the building is a green building

> awareness of that history, and environmental because of the way that the building is situated. It is definitely an environmentalist – but maybe not one that you'd want to hang out with (L2).

> It's trying to make some kind of message about environmental responsibility. And I'm not sure that message is coming across super well (L3).

Most of the green design strategies used at the Liu, such as the recycled materials, high volume fly ash concrete, solar design and natural ventilation strategies, closely resemble conventional practices. Without prior knowledge of the green building features it is uncertain if occupants would have similar responses.

An interesting note is that everyone interviewed at the Liu Institute mentioned that they considered the neighbouring C.K. Choi building to have a pro-environmental message primarily because of its composting toilets.

> To somebody who was an expert or to somebody who was trained in that I think it would....But I don't think it's obvious from a non-expert that it's more environmental or anything. In fact the strongest demonstration of an environmental technology or whatever is the composting toilet that they put into the Asian studies building (L2).

Computer Science Building

Of the occupants interviewed at York's Computer Science Building, more thought that a pro-environmental message was not evident, or required prior knowledge of green building practices or a guide, than occupants who felt a pro-environmental message was evident.

Even though Y1 did not think an overtly pro-environmental message was evident, when initially asked about what message the building would send, she replied: "More like an energy saving message" (Y1) because she always saw tour groups come to see the building. This suggests that the presence of tour groups reminds occupants of the energy efficiency features of the building.

5.4.2 Reasons Why the Building Did or Did Not Communicate a Pro-Environmental Message

Reasons why occupants felt the building did communicate a pro-environmental message are listed in Table 5.6, whereas Table 5.7 lists reasons why occupants felt that message was not apparent.

Table 5.6. Reasons why occupants felt that the building sent a pro-environmental message, listed by building

	Liu	Choi	RRC	York	Total
Photovoltaics		1	7		8
Salvaged materials	1	1	5		7
Recycling bins			4		4
Reused building			4		4
Plants in atrium			1	2	3
Composting toilets	2	1			3
Natural ventilation			3		3
Tours	1	1	1		3
Polished concrete floors	1		2		3
Positive indoor environment	1	1	1		3
Green roof			1	1	2
Windows			2		2
Occupancy sensors			2		2
Blends in well		1	1		2
Simple materials	2				2
Exposed concrete	1		1		2
Knew from the beginning		1		1	2
Energy efficient	1			1	2
Green space			1		1
Clean		1			1
No parkade			1		1
Passive solar - thermal mass				1	1
Bike racks	1				1
Open air	1				1
Operable windows	1				1
Recycled materials	1				1
Minimum materials	1				1
Outside interest		1			1
Operational – recycling			1		1
Network connections			1		1
Not intimidating			1		1

Table 5.7. Reasons why occupants felt the building did not send a pro-environmental message, listed by building

	Liu	Choi	RRC	York	Totals
Salvaged/recycled materials look like regular materials	2	1	1		4
Do solar panels work?			3		3
Not enough green space and trees			1	2	3
Wasted paper			2		2
You need to be aware	1		1		2
Nothing stands out				2	2
No signage		1			1
No connection between greenery and program			1		1
Hard to tell low-flush toilets	1				1
New building = bad			1		1
Convenient			1		1
Hot stairwells				1	1
Cold				1	1
Electric windows don't work				1	1
Poor construction				1	1
Cannot interact with plants in atrium				1	1
Broken monitor				1	1

In *The Meaning of the Built Environment: a Nonverbal Communication Approach,* Rapoport (1990) discusses three building realms that can communicate messages within buildings: the fixed, semi-fixed and non-fixed feature realms. These three realms provide a useful organizing framework to examine how a building can communicate a pro-environmental message, how that message may change over time, and who is responsible for the messages that a building communicates. Table 5.8 organizes the reasons occupants gave as to why a building communicated a pro-environmental message into fixed, semi-fixed and non-fixed feature realms.

5.4.2.1 *Fixed Feature Realm*

The fixed feature realm relates to the structural elements of the building that are fixed in time and can only be modified – if at all – under substantial effort. This realm provides the foundation for the message and is set in place during design. Messages derived from this realm are under the jurisdiction of the design team. Design strategies that fall into the fixed feature realm that were mentioned by occupants as a reason why the building was communicating a pro-environmental message include: reused buildings, salvaged materials, efficient detailing, simple materials, photovoltatics, green roofs, sensitivity to location, window related triggers (i.e. connection to outdoors, electronically controlled windows, natural ventilation, natural light), and biophilic elements (i.e. such as large planted atriums and plant walls). Actively instructional design strategies such exposed or expressed building systems would also fall into the fixed feature realm.

5.4.2.2 *Semi-Fixed Feature Realm*

The semi-fixed feature realm relates to elements found within the building that can be modified without much difficulty during the lifecycle of the building. Semi-fixed feature realms that occupants mentioned in connection with a pro-environmental message include furniture, internal decorations, wall colours, occupancy sensors, low-flow showerheads, presence of recycling bins and plants. Actively instructional design strategies that fall into the semi-fixed feature realm include interpretive signage and data display monitors. Attributes of the semi-fixed feature realm change fairly quickly and easy and therefore messages derived from the semi-fixed feature realm are influenced by both the designer and the occupant.

5.4.2.3 *Non-Fixed Feature Realm*

According to Rapoport, the third realm in which buildings can communicate messages is the non-fixed feature realm. This realm is comprised of activities connected to the inhabitants of the space (Rapoport, 1990), and therefore this realm is under the influence of the building management and the occupants themselves. Attributes associated with this category that were mentioned by occupants include recycling, energy efficiency campaigns, and maintenance. Actively instructional design strategies such as integrating the curriculum with the building, offering tours, and outreach publications would also fall into this category.

Table 5.8. Reasons why occupants felt the building communicated a pro-environmental message, organized into fixed feature, semi-fixed feature or non-fixed feature realms

	Liu	Choi	RRC	York	Total
Fixed Feature Realm					
Photovoltaics		1	7		8
Salvaged materials	1	1	5		7
Reused building			4		4
Composting toilets	2	1			3
Natural ventilation			3		3
Polished concrete floors	1		2		3
Green roof			1	1	2
Blends in well		1	1		2
Simple materials	2				2
Exposed concrete	1		1		2
Energy efficient	1			1	2
Windows			2		2
Passive solar - thermal mass				1	1
Operable windows	1				1
Recycled materials	1				1
Minimum materials	1				1
Green space			1		1
No parkade			1		1
Semi-Fixed Feature Realm					
Recycling bins			4		4
Plants in atrium			1	2	3
Occupancy sensors			2		2
Bike racks	1				1
Non-Fixed Feature Realm					
Tours	1	1	1		3
Positive indoor environment	1	1	1		3
Knew from the beginning		1		1	2
Clean		1			1
Open air	1				1
Outside interest		1			1
Operational – recycling			1		1
Network connections			1		1
Not intimidating			1		1

5.5 Factors that Influence if a Building Communicates a Pro–Environmental Message

When determining whether or not a building communicated a pro-environmental message, occupants appeared to weigh four factors:

- Number and type of design features used (triggers)
- Operational context
- Occupant experience
- Comparisons to other buildings

The number and type of design features used, fall into the fixed and semi-fixed feature realms and forms the baseline message that is communicated by the building. A building may be energy efficient, conserve water and be constructed with recycled materials however unless there is some noticeable difference in the experience of that building to the occupant – a trigger – then a pro-environmental message will not be as apparent. Triggers are design solutions that cause an occupant to pause and reflect on their purpose. Design solutions are efficient triggers when they are well placed, stand out, and their environmental reasoning is self-evident. Triggers can either be part of the fixed feature realm (such as the incorporation of salvaged materials) or the semi-fixed feature realm (such as the presence of plants). Triggers are discussed in greater detail in Chapter 6.0.

The number and type of triggers utilized creates the baseline message that a building communicates. The other three factors – operational context, occupant experience and to a lesser extent comparisons to other buildings – either enhances or diminishes that baseline message and are a part of the non-fixed feature realm. The relationship between these factors is illustrated in Figure 5.2. This section will discuss the non-fixed feature realm qualifiers in more detail.

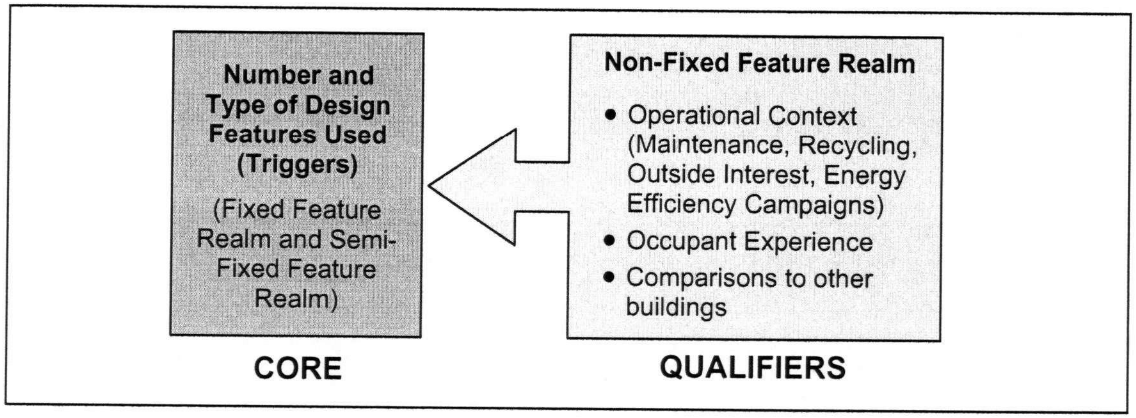


Figure 5.2. Core and qualifying factors that influence whether a green building communicates a pro-environmental message

5.5.1 The Operational and Management Context

From occupant interviews it is apparent that the operational context of the building impacts the message communicated. The operational context includes maintenance, recycling, energy efficiency campaigns, as well as the organizational culture at the building (discussed below). The operational context has an amplifying or diminishing affect on the baseline environmental message communicated by the building, and falls into the non-fixed feature realm.

5.5.1.1 *Recycling*

Through aggressive social marketing campaigns aimed at shifting social norms, recycling is strongly associated with pro-environmental behaviour. The success of these campaigns is illustrated when occupants were asked whether they consider themselves to be "green," and answers usually included some mention about recycling. Recycling is the bellwether for pro-environmental behaviour. If occupants considered themselves to be "green" it was because they recycled, and if they did not recycle, they did not consider themselves "green." Comments from three occupants at Princess Street Campus demonstrate how much the presence of recycling influences the overall message projected by the building.

- R8 thought that Princess Street Campus communicated a pro-environmental message with the photovoltaics and the incorporation of the old warehouse and historical façade, however that message was somewhat tarnished by the amount of paper wasted. In her words:

> Yes, in a sense that they don't waste the resources that they have...Some of the practices inside the school doesn't seem like that. You know they have the recycling boxes that you can find, but there's so much wasted paper going around here... Just the little things with the building, you're trying to be environmentally friendly but there's a lot of waste going on (R8).

- R1 recognized that the green roof and the photovoltaics would suggest an environmental message, however he was not convinced that the photovoltaics were operational. Overall he concluded that a pro-environmental message was not evident based on the prevalence of wasted paper that overshadowed any message that the triggers may have been communicating. As he commented:

> No, I don't think so... I see a lot of wasted paper, and that's really the only thing I can judge by. Because we definitely do recycling, recycling is big here, so we would get credit from that, but there's an unbelievable wasted paper because you have unlimited access to these printers (R1).

- R5 felt that the building did send a pro-environmental message since she saw "people recycling more in our office" as compared to her previous office at Notre Dame Campus.

These differing perspectives indicate that individuals give varying weights to the importance of certain factors when analyzing the same information. For some people, the building would only be considered to have a pro-environmental message if the behaviour of the occupants in the building corresponded to the occupant's understanding of environmentally responsible behaviour.

5.5.1.2 Maintenance

How well a building is maintained will impact the overall message received by occupants. Maintenance encompasses both cleanliness of the building and timely response to problems. If a building is well maintained, that can project a message to occupants that the building is cared for and occupants matter. L4 illustrates this point: "I've liked all my jobs but this one you go there and you know when you see that everything is new and maintained really well, there's this extra sense of 'wow this is such a great place to work.'" Timely response to problems is a key part of maintenance. At Princess Street Campus, the Director of Facilities, was praised for keeping everyone informed of construction progress, and actively solicited input about problems that the staff may be encountering. With all of this communication, R7 "felt that we are all in here together." The Building Manager has also been praised with his attention to detail, and prompt response to complaints from occupants on temperature or ventilation rates (R. Bragg, personal communication, July 13, 2005).

If, on the other hand, the building is not maintained well, or problems go unchecked, occupants are left feeling like they are unvalued. For example, when discussing Red River College's Notre Dame Campus, R5 talked about the mold infestation that was not mitigated, "which of course makes staff feel that nobody cares about them" (R5). Another occupant at York had a leaky window that had not been fixed despite repeated requests, which made him exclaim, "no one gives a shit about my little problem" (Y6). These negative experiences with building management and maintenance can influence the overall message and feelings towards the building. For example, R5 had a "feeling dread" going to work at the moldy Notre Dame Campus, whereas the leaky window was one reason why Y6 felt the CSB was not-welcoming. In his words: "I would say it's an unfriendly building and therefore it's an environmentally unfriendly and it doesn't promote environmental concerns" (Y6). This occupant felt that his leaky window was due to poor construction, which made him comment that "[a building] that would be pro-environmental would be one that...was properly constructed and properly maintained" (Y6). Again, these comments illustrate that maintenance influences the overall message received.

These reactions from occupants on maintenance concerns correspond to findings from Leaman and Boardass who have conducted numerous post occupancy evaluations on buildings predominately in the United Kingdom. In a paper entitled "What Occupants Want" Leaman

(2001) summarizes what occupants are looking for from a building. In Leaman's experience, often what differentiates a "good" building from a "bad" one "is management attitude, organisational culture and resources. Where management acts rapidly on staff complaints, and staff appreciate the efforts made – whether or not they are actually successful – then occupants will be happier" (Leaman, 2001). This can account for the reaction of R7 who expressed feelings of inclusiveness as a result of the rapid response of the building manager and Y6's dissatisfaction with the building since his leaky window was not fixed despite repeated requests.

5.5.1.3 Outside Interest

Attracting interest from the wider public can enhance the overall message received. This can either take the form of information inquiries, research requests or building tours (Figure 5.3). Outside interest in the building seems to increase the profile of the building to the occupants.

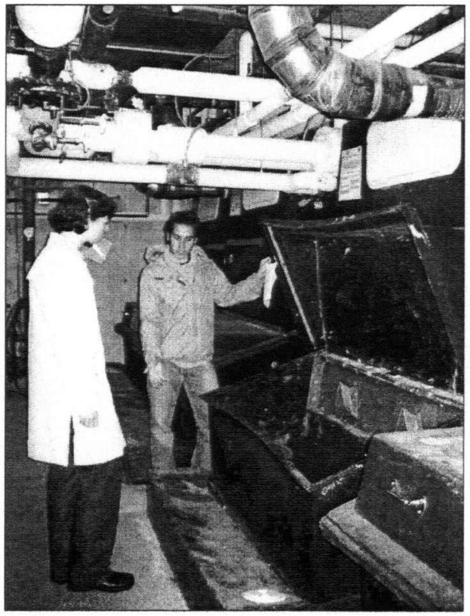


Figure 5.3. The Campus Sustainability Office at UBC conducts regular tours of the C.K. Choi and the Liu Institute

One of the reasons C1 thought the building communicated a pro-environmental message was due to the amount of phone calls she received from outside parties interested in the environmental features of the C.K. Choi. In her words: "Yes, because we receive a lot of phone calls, a lot of inquires from people because they want to copy and do a building similar" (C1).

R2 felt that the building did communicate a pro-environmental message since "you notice every once and again there will be tours through here...tours with people from all over...it's attracted a lot of people, every now and again you see just groups touring the place." Although Y1 did not think that the building outwardly projected a pro-environmental message, she did feel like the building communicated an energy saving message because of the presence of tour groups. In her words: "More like an energy saving…again, I guess I can't get away from it, because all these people come on tour and they always come to where I am…to look at the one bamboo plant and get out their cameras…so I can't get away from that feeling" (Y1).

The presence of groups touring the building and receiving outside interest seems to act like a mnemonic device – reminding occupants that the building is known in the wider public as an example of a green building.

5.5.1.4 Energy Efficiency Campaigns

By implementing an energy efficiency campaign, management can have the potential to sway the messages that occupants derive from the building. For example, L1 felt that the Liu did project a pro-environmental message since she thought "there was a push for pro-environment [behaviour] in our meetings." What she was referring to is the fact that the building management stresses energy conservation during meetings by reminding occupants that "it cost $0.80 to travel to use the elevator up the three floors. And so, we just don't use the elevator unless we have something that we need to transport. We just wouldn't use the elevator for no reason, we'd use the stairs" (L1). For this occupant, these reminders by management influenced the message that she felt the building communicated.

5.5.2 Occupant Experiences

Repeatedly what emerged from the interviews was how an occupant's experience in the building shaped their overall perceptions of the building and contributed to the messages that the occupant thought the building was projecting. Considering that several occupants linked a welcoming, people friendly environment with one that expressed a pro-environmental message, creating a positive indoor experience is not a trivial exercise. Also, the two study buildings where occupants seemed the most content – Princess Street Campus and the C.K. Choi – are the ones that were associated with stronger pro-environmental messages.

Although it is difficult to pinpoint the exact criteria for creating a positive indoor environment, there are certain attributes that were mentioned more frequently and can serve as a guide. Occupants from all buildings repeatedly commented on how much they enjoyed the presence of natural light, the "open" feel of the space, the operable windows that let in fresh air and the view (see Section 6.3.2). The choice of colour and presence of plants also contributes to the overall feel of the space. When discussing colour choices, one occupant at Princess Street Campus remarked: "I love that they actually hired someone who understands colour to choose the colours. You can tell that the designer was involved in the choice of fabric and furniture and walls, as a designer I appreciate that" (R5). Furniture arrangement and 'details' in the indoor environment are two attributes discussed below, along with the impact of perceived problems on the overall message communicated by the building.

5.5.2.1 *Furniture Arrangement*

Furniture selection and placement can influence the overall feel of the space, and therefore the messages that it may communicate. The choice and arrangement of furniture can help create an inviting feel, encourage private reflection or facilitate socializing with friends. In the environmental psychology literature, settings that encourage social interaction are known as sociopetal, whereas those that discourage it are described as sociofugal (Cassidy, 1997). The seating behind the historic façade at Princess Street Campus (Figure 5.4) and the chesterfields in the atrium at the Choi (Figure 5.5) are two examples of sociopetal furniture arrangements that received high praise from occupants.

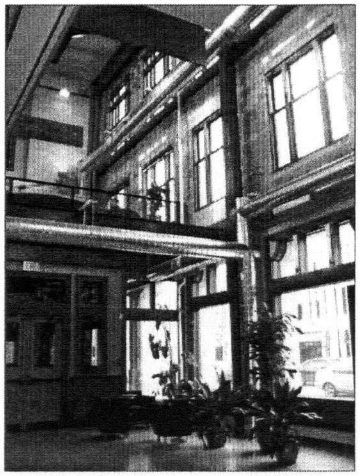


Figure 5.4. Sociopetal seating behind the historical façade at Princess Street Campus

This was not the case at the Computer Science Building were a lack of seating deters occupants from lingering. The seating on the first floor is so inadequate that it is a common site to see students sitting on the floors waiting to get into the lecture hall. Lack of seating also detracts from one of the best features of the Computer Science Building – the planted atrium. Although there is seating adjacent to the atrium in the basement, that area is restricted to one section of the department, so what should be a common amenity has become co-opted by a few groups. One occupant felt that, "There's no place in it, except for downstairs in the atrium...where you can sit down and be alone. There is not a really good place for people to sit down and actually study... It doesn't care who lives in it" (Y5). For this occupant, the lack of sociopetal furniture communicated a message that the building was unfriendly.

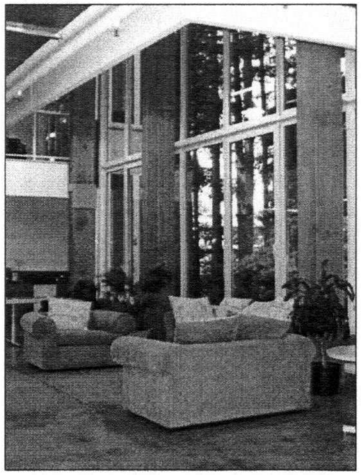


Figure 5.5. Sociopetal seating in the atrium of the C.K. Choi

Although beyond the scope of the designer, furniture arrangement may present one way in which a building's message can be modified over time. This will be discussed in more detail in the final chapter.

5.5.2.2 *Details*

According to architect Sarah Susanka, co-author of *Inside Not So Big House: Discovering the Details that Bring a Home to Life* (2005), "details" are everything that would be permanently attached to a building if you turned it upside down and gave it a shake. Examples of details include built-in bookcases, crown moldings, and banisters. Details help to personalize a space and enhance the indoor occupant experience. Examples of details from the study buildings include the clever inclusion of salvaged materials, such as the old vaults (Figure 5.6) at Princess Street Campus, the salvaged wooden ceiling of the multi-use room at the Liu, the glass catwalk at the Computer Science Building, and the salvaged beams and the Asian motifs at the C.K. Choi. The extensive collection of artwork displayed around the C.K. Choi, although not strictly a detail as described by Susanka, also adds to the occupant experience of the space.

Figure 5.6. Vaults salvaged from the demolished buildings add details to Princess Street Campus

Not only can details help to create a positive indoor experience, but these "nooks and crannies" imbue the building with a personality and create a space that occupants can get to know. Every occupant interviewed at Princess Street Campus commented on the salvaged materials that were incorporated into the building, and every one had their favourite "little artifact," from the Heritage Room which used to be the trading room for the grain exchange, the "beautiful old doors," the "safes with ornate illustrations," the old elevator shaft that was converted to a lounge space, or the painted ads left on the building façade (Figure 5.7). As R5 states:

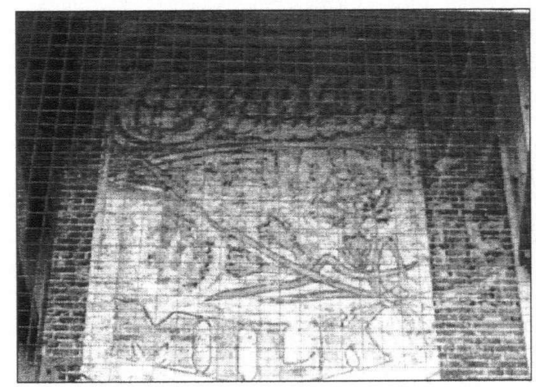


Figure 5.7. One of the painted ads on the side of the William's Building at Princess Street Campus that looks onto the central courtyard

> I love the fact that you walk down the hallway, and turn the corner and there's a beautiful old iron safe as an architectural detail. I love that you can see the old trading chalkboards up in the corner. And you walk through the atrium and you can still see the

old hydro lamps that don't work anymore but they just left them as architectural details. And I love how you can turn around a corner be surprised. (R5).

5.5.2.3 Perceived Problems

If a green building is not performing according to occupant expectations – either because of excessive noise, problems with thermal comfort, glare, etc. – then occupants were left with the impression that the building was not a complete success. For example, L1 commented that she did not think that the Liu was "a very good design. It's strange because people come in to tour the building. You know to talk about how wonderful the building is, and how green it is, but really there are really a lot of problems with it." Although L1 stated that she did really like the building, she found it very noisy to work in.

Several occupants at the Liu were dissatisfied with the lack of acoustical privacy in the offices, a result that was also seen in the post occupancy evaluation conducted by Keen Engineering (McCarry & Hyde, 2002). At the root of the Liu's acoustical problems is the use of natural ventilation, a technique that requires unfettered movement of air throughout the building, which inevitably involves the sacrifice of acoustical privacy. This disadvantage was made clear to the committee overseeing the building's design and it was agreed that this would be an acceptable tradeoff. Unfortunately, at the time of design and programming for the building, the Liu Centre itself "was still a concept" and the need for acoustical privacy may have been undervalued (Architectura, n.d.a). In attempt to explain the design intent of the building, a 14-page User Manual was written in non-technical language to make sure that occupants knew the principles behind the design strategies and how to use the building (N. Best, personal communication, August 16, 2005).

In situations when occupants were particularly bothered by perceived problems with the indoor environment, there were expressions of animosity towards the building. For example, one occupant at York commented that "the building won awards and actually, collectively in the building we resent that because the architect won awards at the expense of usability for us" (Y3). His main complaints were that support columns located in the grad offices reduced the amount of useable space, and the glass wall partitions which made occupants feel on display. There was also a feeling evident in a few interviews that the environmental concerns were given priority over usability, or the design "went a little bit too far" (L2). These opinions may only be representative of a small portion of occupants of the building, but they are illustrative of the passion that occupants expressed.

Unfortunately, perceived problems that impact an occupant's experience can overshadow the positive aspects about the building. This can reinforce existing cultural myths that green buildings do not work – or worse leave occupants with a distaste for green design. For example, one occupant at York who was always cold had mentioned that "it was sort of hard to appreciate what the building...was supposed to be doing, [when you were so cold]" (Y1). An occupant at the Liu, who was highly critical of the noise, felt that the natural ventilation "has been the heart of most of the problems. Everybody is upset about that, nobody likes it. From an occupancy point of view I don't think that you could get away from that sort of thing again" (L2). Another occupant at Princess Street Campus who felt the level of noise in the classrooms was unacceptable had commented:

> I think it's phenomenal to do something like this and to have it all great, as long as the fundamental functionality of the building is still in there. Sometimes we'll go into a room and say 'What were they thinking? This is just not a functional classroom.' It looks great, great awards, it's environmental friendly, but you can't use it (R3).

All buildings have their problems, and it takes time before the quirks are worked out. However, being a relatively new introduction to the public realm, green buildings are likely to be more closely scrutinized to determine if they work. If these buildings experience a lot of problems that go unchecked, occupants may end up questioning the feasibility of green design. How drastic the problems have to be before they overshadow an occupant's opinion of the entire building is uncertain, but is most likely dependent on the occupant's frame of reference and context.

In order to address occupant complaints of the study building, a number of retrofits have been conducted:

- In effort to mitigate classrooms noise levels at Princess Street Campus, chiller equipment has been wrapped and noise attenuation cloths have been installed into classroom ceilings (R. Gamble, personal communication, July 13, 2005).
- According to George McLaughlin, the Facility Manager for the Liu Institute, there have not been too many retrofits done at the Liu except for the occasional office (G. McLaughlin, personal communication, October 25, 2005). One of the occupants interviewed for this study was responsible for overseeing the renovations conducted at the Liu. Retrofits he mentioned included increasing soundproofing between the washrooms and the boardroom, converting some open office plans to closed offices, and adding windows to the first floor seminar rooms.

- The third floor of the C.K. Choi used to be an open office plan. In an attempt to reduce noise transmission, these open offices were enclosed (G. McLaughlin, personal communication, October 25, 2005).

- At the Computer Science Building, the electronically controlled windows in the offices were dismantled at the request of faculty. This was partly because occupants had no control over when the windows would open, which was slightly unsettling at night when people were working late and the windows would open (T. Mohammed, personal communication, October 27, 2005). One of the design features at the Computer Science Building was larger temperature ranges and a zonal HVAC system that enabled different temperatures in different parts of the building. However, due to complaints from workers, Operations has increased the temperature in the winter, and reduced it in the summer, which has affected the overall energy consumption of the building (T. Mohammed, personal communication, October 27, 2005).

Since green buildings are still relatively new, constructs of "green building" will be based on these first experiences. If an occupant is thermally uncomfortable, finds the environment too noisy, or is bothered by glass partitions, then they will associate those attributes to their construct of "green building." For example, when asked whether they would want to live in a green building, one occupant from York who had particular problems with thermal comfort mentioned that she would like to, "if I can regulate the temperature!" (Y1). Another York occupant who felt on constant display with the glass partition walls mentioned, "I don't want to live in a fish tank because it's so environmentally friendly" (Y7). On the other hand, occupants will also associate the attributes of the indoor environment that they were very positive about with their construct of "green buildings." For example, when occupants at Princess Street Campus were asked this same question, occupants mentioned buildings with "atriums" and "renovated old buildings" that were located in the exchange district (R10, R7).

5.5.3 Comparisons to Other Buildings

When answering questions, occupants were constantly making comparisons to buildings they had previous experience with. Often, the green building attributes that the occupant stressed and were very positive about were features they had previously been without. For example L4 used to work for a non-profit organization in a noisy open concept office in Vancouver's downtown eastside. Having had that experience to compare to, she kept reiterating how she clean and safe she found the Liu and she was not at all bothered by the noise levels. This suggests that L4 has a higher threshold for noise than other occupants that was calibrated from her past experiences in a noisy environment. This can explain why the noise levels at the Liu do not bother her – it is because noise levels are less than her threshold for noise.

L3 really enjoyed having an operable window, and was lamenting his upcoming move into a windowless office at the University of Calgary. L2 was also very "happy" with the operable windows since he "came from U of T and all the buildings at U of T you couldn't open the window." This occupant had also been working at the Forestry Building for a year before the interview and really missed how easy it was to communicate with colleagues and the friendly atmosphere at the Liu.

The most telling example of how previous experience can influence an occupant's perception of a building was from faculty members and students from the Arts Department at Princess Street

Campus who had formerly been located in the basement at Notre Dame Campus. All of these individuals had stressed how much they liked the windows, fresh air, view, and natural light. For example, R4 found the windows the most striking feature of the building. In his words:

> To me coming from the old campus, it's definitely the windows. In the old classroom we were in the basement and they had no windows whatsoever, and there is poor ventilation. The classroom I was in last year, as well as this year, there are windows. And the ventilation is quite good for the building. (R4)

Also, occupants who had been to both campuses stressed how much they liked the downtown location of Princess Street Campus. Compared to the Notre Dame Campus which is located in an industrial area and the only place to go for a walk is the cemetery next door, the downtown location provides occupants with more opportunities to take a break from the stress associated with work or school and get off campus.

These comments suggest that not only does an individual's construct of "building" evolve with each successive experience, but they also hint at the existence of a baseline expectation for buildings that is continually being revised with each new experience. Buildings that fall below this baseline expectation are met with disproval and buildings above the baseline raise the bar. A comment by R7 illustrates this point:

> Just strictly talking about being in the space, I feel good…I find that the building doesn't add to my stress. In Notre Dame – although I don't know if I would have articulated it at the time – but I believe that the building added to any stress that I or anybody else would have had (R7).

So R7 did not know what he was missing before exposure to Princess Street Campus which raised his expectations. As occupants gain exposure to different buildings, they find out what they had previously been living without and what they would prefer to not live without again. To what degree this occurs is dependent on the individual and the building in question. This may explain why so many occupants at Princess Street Campus were adamant about not returning to Norte Dame Campus – having experienced the fresh air, views, downtown location offered by Princess Street Campus, they were not willing to go back.

Design Strategies as Triggers

Chapter 6

"Without our knowing it, we see reality through glasses coloured by the subconscious memory of previous experiences."

Thomas Merton

As this research has shown, to varying degrees, green buildings can communicate a pro-environmental message to their occupants. Out of the buildings studied, a pro-environmental message was more evident at Princess Street Campus and the C.K. Choi, whereas this message was not as clear at the Computer Science Building and the Liu Institute. What accounts for these differences? Why do buildings of an equally green caliber score differently on this question?

The most mentioned reason as to why the Liu and the Computer Science Building did not send a pro-environmental message was because "nothing stands out" or the green "materials look like regular materials." For example, although L4 had extensive knowledge about the green features of the Liu Institute acquired by reading literature on the building and taking a tour, without that prior knowledge she thought that she "wouldn't know about the [high volume fly ash] concrete or the [salvaged] wood, because it looks like some sort of concrete and wood." She has a point. The green design strategies used in both the Liu and the Computer Science Building – such as the high volume fly ash concrete, natural ventilation and recycled materials – are virtually indiscernible from their mainstream counterparts. This leaves occupants with few visual cues to suggest that the building is different.

At the C.K. Choi and Princess Street Campus, the response was quite different and occupants mentioned several green design strategies when answering this question. For example, R6 felt that the building did communicate a pro-environmental message because of "the solar panels on the south side of the building, they used a lot of recycled materials in here, by not putting carpeting on the floors, [and] just re-building rather than destroying a building."

Energy efficiency is a green building characteristic that may not be evident to occupants unfamiliar with green design as the visual cues are not that obvious. Y6 commented: "I knew the building was designed for energy efficiency...but I had forgotten about it completely because it has no affect on your day to day life." Other design strategies – such as photovoltaics and salvaged materials – were more frequently mentioned in connection to an environmental message. These responses suggest that certain design strategies are more emphatically green, and therefore are more effective than others in communicating a pro-environmental message.

As discussed in the previous chapter, the core message communicated by the building is based on the number and type of design features within the fixed feature and semi-fixed feature realm that occupants could identify as being green. Non-fixed factors, such as occupant experience, the operational context and comparisons to previous buildings, either enhanced or diminished that baseline message.

This chapter explores why some design strategies are more effective at communicating a pro-environmental message. These design solutions – known in this thesis as triggers – are design solutions found in the fixed and semi-fixed feature realm that stand out and cause an occupant to link the strategy with a pro-environmental construct. This chapter will outline the structure of a trigger, discuss what makes a good trigger and examine triggers found in the four study buildings based on this criteria and occupant comments. An approximate ranking of the effectiveness of triggers in communicating a pro-environmental message will be presented, along with suggestions to enhance the effectiveness of these design solutions.

6.1 What is a Trigger?

Triggers, as defined in this thesis, are design solutions that stand out in some way to cause an occupant to pause and reflect on their purpose. Although triggers can communicate multiple messages, for the purposes of this thesis, the interest is on the ways and extent that triggers can project a pro-environmental message. The following occupant quotes are illustrative of triggers:

> If you just walked in to use the washroom then all of a sudden you would realize that [it was a green building]. If you walked-in just to use the couch, you wouldn't really notice it, but after awhile you will start to figure it out because of the different colour of the wood. Like I'm sure you can tell that this [beam] is newer then that one. Perhaps they would notice the cement floor that is not carpeted, and the knob on the glass windows, and I guess outside all of the marshy plants that we have. Yeah it takes time for people to figure it out and notice that it's different...[Which can lead] you to start to wonder (C1).

> There's little things like none of the offices are closed up and you wonder why. There's no heating system, no centralized heating. There are little things that you wonder about and then it all makes sense when someone tells you [that it's a green building] (L4).

Triggers spark an observer's curiosity and lead them to theorize why that strategy was used. When an occupant initially encounters a trigger, they will seek out an explanation for the strategy either actively, through research or by asking a fellow occupant, or passively if the individual devises their own reasoning based on past experiences. Figure 6.1 illustrates an idealized version of how this process may work using a composting toilet as an example of a trigger.

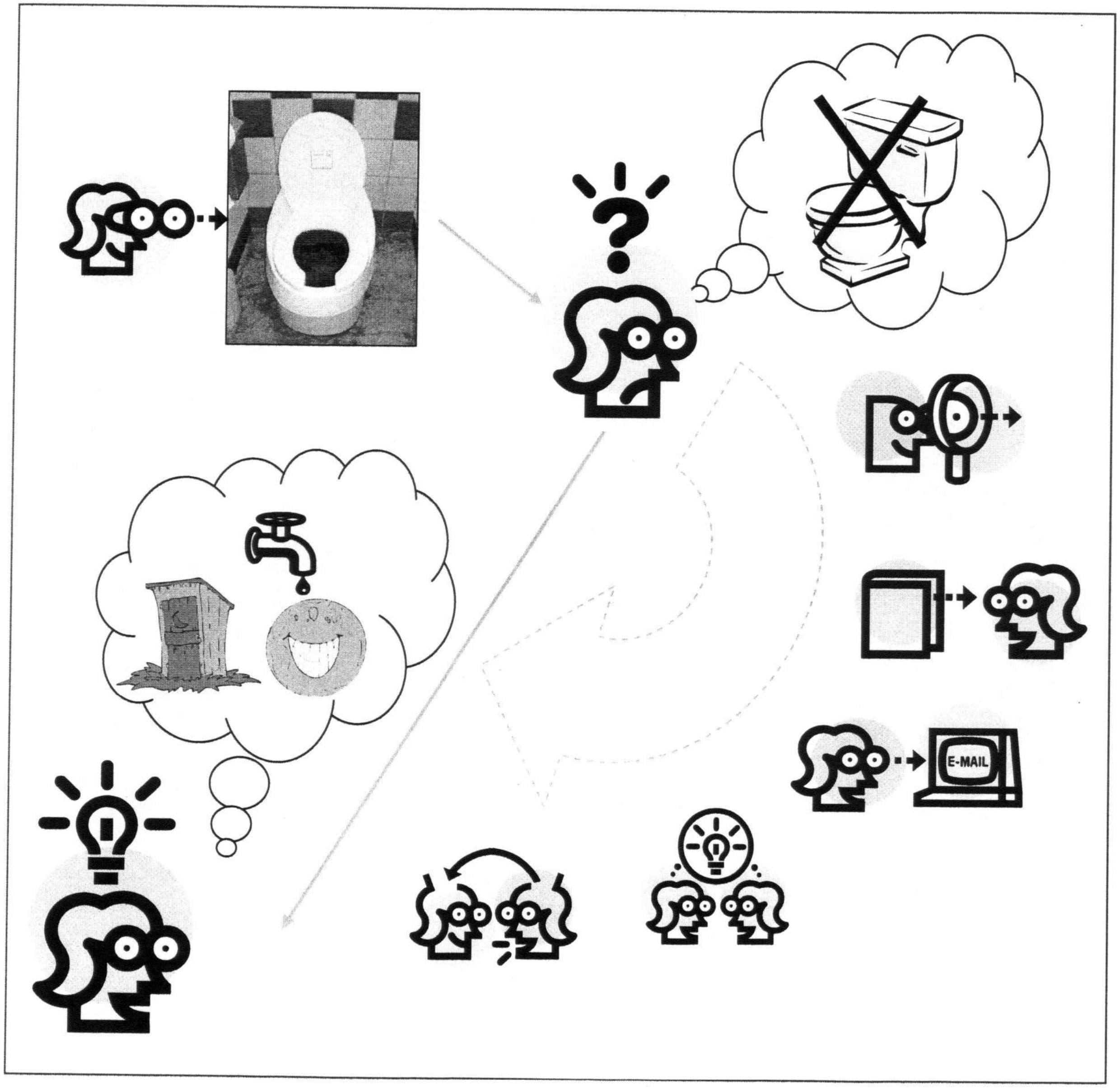


Figure 6.1. Illustration of how a trigger works

In this example, the observer is initially confused when they first encounter the composting toilet. Although the composting toilet bears some resemblance to their construct of "toilet" there are marked differences, such as a "chute" instead of a flushing mechanism. These differences can act as a trigger, causing the occupant to wonder why. With their curiosity peaked, the observer goes on a fact finding mission to determine why this strategy was used. Possible paths they could take include reading the sign in the washroom, learning about the building or strategy in print or on the internet, consulting another occupant or postulating a reason for themselves using previous experience and knowledge. In this example, the composting toilet may evoke connections to constructs of "outhouse," which can bring to mind constructs of "water conservation," leading the observer to possibly conclude that the composting toilets were used to save water, and therefore linked to constructs of "environmentally friendly."

Although the trigger-information collection process illustrated above shows several avenues that the occupant may explore to understand why the strategy is used, the most likely course of action would be for an observer to determine a reason for themselves or ask a fellow occupant. To what extent the occupant is willing to seek out information about the feature will depend on their curiosity level and how difficult it is to find information.

Kaplan and Kaplan (1989) have identified three aspects of information processing based on evolutionary reasoning that provide support to claims that an observer will seek out information if they do not understand why a certain feature was incorporated within a building – especially if the design strategy is in conflict with their construct for that strategy. According to Kaplan and Kaplan (1989) these three aspects include:

- People are motivated to know, to understand what is going on; they hate being confused or disoriented.
- People also are motivated to learn, to discover, to explore; they prefer acquiring information at their own pace and in answer to their own questions.
- People want to participate, to play a role in what is going on around them; they hate being incompetent or helpless (Kaplan & Kaplan, 1989; quoted in Kaplan, 2000, p. 498).

If explanatory information on these misunderstood design strategies is easily accessible and presented in a manner that encourages self discovery (i.e. signage, interpretive displays, etc.), then the building can help facilitate this information gathering process, and the occupant can fill the gaps in their schema created by the design strategy.

Triggers can evoke different messages to different people. So although one occupant may interpret an environmental message from a certain design strategy, another occupant may have an entirely different interpretation. That being said, some design strategies were more frequently associated with being green, suggesting that they have a message that is more congruent. That is, there was widespread agreement on the environmental reasoning for certain design strategies.

As stated earlier, triggers can carry multiple messages. C2 provides an example of triggers incorporated into the C.K. Choi to evoke connections to the Institute's research focus:

> They've taken care to integrate little tricks or little motifs into the building, to put subtle reminders of the purpose which is an Institute of Asian research...[such as] the Yangtze River which was painted on the concrete on the third floor. People think was just painted

> over because it was a cracked, but it's actually a schematic of the flow of the Yangtze River... It's very subtle but they are constant reminders for those of us who are using the building (C2).

The schematic of the Yangtze River (Figure 6.2) and the impression of the Gingko leaf on the beam in the main stairwell (Figure 6.3) are design elements that were incorporated to trigger connections to the Asian focus of the building and its research institute.

Once a trigger is connected with a certain construct – for example, either "environmental" or "Asian" – then from that point on, it serves as a mnemonic device, blending into the background yet subconsciously reminding the observer of that message whenever they see it. As Rapport (1990) discusses, "Meanings are not constructed *de novo* through interaction in each case. Once learned, they become expectations and norms and operate semi-automatically" (p. 62).

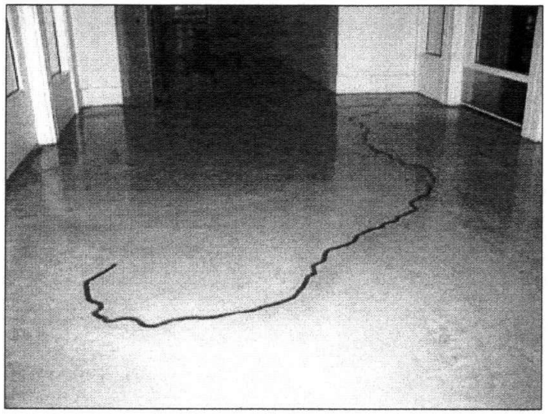


Figure 6.2. The schematic of the Yangtze River painted on the third floor of the C.K. Choi

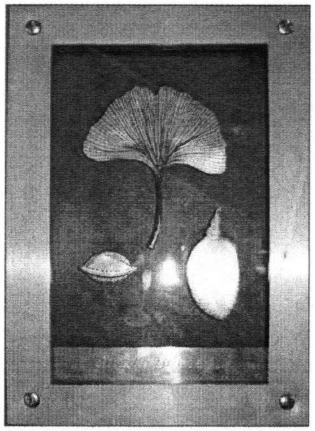


Figure 6.3. An impression of a gingko leaf at the C.K. Choi

6.2 The Structure of an Effective Trigger

Figure 6.4 illustrates the three properties of an effective trigger: Interaction, Pause and Reflect. These areas are discussed in more detail below.

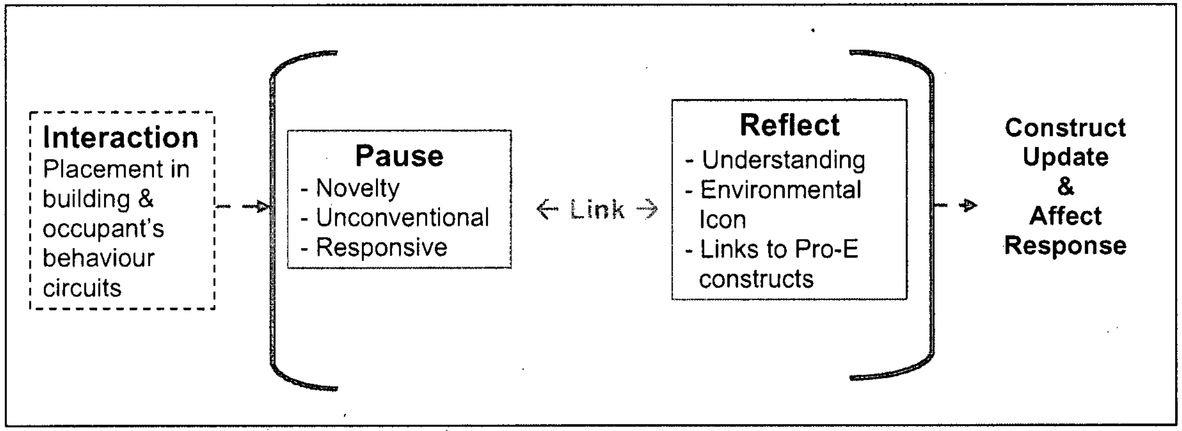


Figure 6.4. The structure of a trigger

6.2.1 Interaction

In order to be effective, a trigger has to be noticed. This can only occur if it is placed in a location where it can be noticed – visually, aurally, or physically. For the most part, the more prominent its location within the building, the greater the likelihood that it will be noticed by potentially more occupants, and the more effective it will be. Obviously, more prominent placement is not possible for certain green design strategies, such as low-flow showerheads, which will only be encountered by occupants who use the showers. This suggests that certain design features, although effective at communicating a pro-environmental message, may only reach a portion of the building population.

Another way to look at trigger placement is in consideration of an occupant's behaviour circuit, which are the set sequences or paths that people use when traveling about a room, building, block, neighbourhood, city or region (Thiel, 1997). Once a person establishes a path, it becomes routine and they rarely stray from it. Figure 6.5 is an illustration of a behaviour circuit of a commuting route. This person's weekday commuting route takes them from their house, through the neighbouring park to the train station, where they take the train downtown and then take a cab to their office. The same is true in buildings. Once established, people will follow a set behaviour circuit through a building to their office or classroom. If a trigger is not along the occupant's behaviour circuit for the building, they will probably not encounter it. This was illustrated by several occupants who commented that they had not seen a certain feature because their daily routes through the building did not intersect with the location of that feature. For example R7 had not yet seen the green roof and stated that: "At this point, after being here for a couple years, I'd have to admit to not exploring every corner of the building." By determining the most likely behaviour circuits through the building and by placing triggers in high traffic areas, there is greater likelihood that occupants will interact with the trigger, which increases the likelihood that a pro-environmental message will be communicated. This, of course, is dependent on whether there is flexibility in the placement of the design strategy in question.

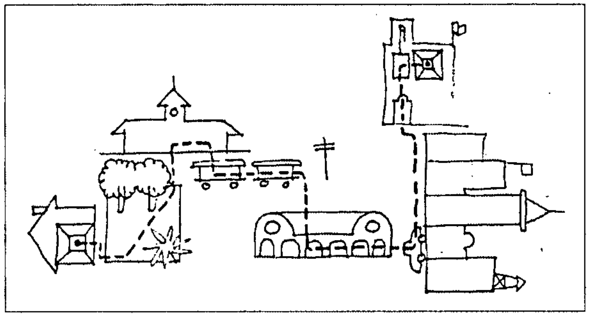


Figure 6.5. An illustration of a behaviour circuit, in this case a commuting routine (Thiel, 1997, p. 99)

6.2.2 Pause

A trigger is only effective if it is noticed. As Rapport discusses in *The Meaning of the Built Environment,* "noticeable differences are a necessary precondition for the derivation of meaning" (1990, p. 26). This means that a trigger must stand out in some way in order to initiate the communication of a message. Triggers will stand out if they are unconventional, respond to changing environmental conditions (i.e. how photosensors adjust lighting levels depending on how much daylight is perceived), mimic something else, or challenge our expectations and constructs of what that design strategy is. As L4 commented, she knew the building was different because "it was unlike other buildings." When presented with a design strategy, the occupant will compare it against their construct of that "strategy" that has been developed through previous experience. It is in this capacity that the occupant will compare the building they are currently in, to buildings that they have previously experienced. Unconventional or novel design strategies that do not fit this preconceived schema have a greater potential for creating opportunities for learning since "anything that is strange or different requires more attention and 'cognitive work' than something that is very familiar" (McAndrew, 1993, p. 57).

As schemata are used to make sense of the world, to anticipate changing conditions and to guide our behaviour, when an occasion is encountered where there are disparities between the building and the schema, this disparity needs to be accounted for by updating our schema. As Kelly, the founder of Personal Construct Theory has postulated, in a way we are all scientists, comparing our model of the world to actual conditions. When the model doesn't fit, it needs to be modified to rationalize this difference (Crittenden, n.d.).

It is the "pause" stage that engages the curiosity of the occupant, encouraging them to seek answers and clarification. As C2 expressed, "Once you come in, you do get a sense of like 'Oh this is a good place to be. What is it about this building?' So it makes you kind of curious I guess." It is that curiosity that can drive the occupant to discover why the building was designed in that way.

6.2.3 Reflect

After a trigger is noticed an occupant will reason what it is and why it was used. This is the stage where the observer determines the purpose of the trigger (representational meaning) and any messages that they interpret based on that trigger (responsive meaning). The message that an individual derives from a design strategy will in part be dependent on their past experiences. As people come from a variety of backgrounds with a variety of experiences, this reflection stage can be open to idiosyncratic interpretation. This concept is illustrated in Figure 6.6, where the performer is acting out a charade of a "flower," however every audience member has a different interpretation.

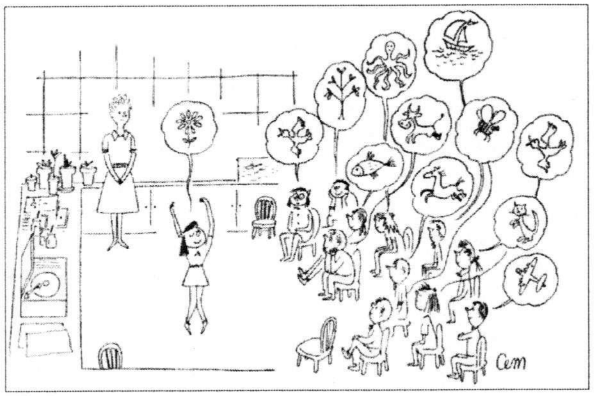


Figure 6.6. Idiosyncratic interpretations (Thiel, 1997, p. 105)

A design solution is emphatically green when there is less variation among messages that different people derived and the connection to its environmental reasoning is explicit – either because it is easy to make that connection or it is a known environmental strategy. For example, in this study it was found that some triggers, such as the inclusion of salvaged materials, had a strong association with a pro-environmental message and were frequently mentioned as an example of why the building as a whole was considered green. This suggests that the link between the design strategy and its reasoning was clear. One possible explanation for this may be due to years of social marketing campaigns that have encouraged the public to adopt pro-environmental behaviour by conserving water, saving energy and reducing waste by using the 3R's. These activities are strongly associated with the schema for "environmentally friendly" and any design solutions that rely on one of these strategies will more likely be perceived as green.

Certain design strategies are icons of environmentalism, and as such they are closely associated with a pro-environmental message. Photovoltaics and wind turbines fall into this category, as they have been discussed in mainstream media for years as an alternative to fossil fuel consumption.

Other triggers attract the interest of occupants, but their design intent may be more ambiguous. Examples of design solutions that fall into this category are the elimination of finishing materials and green roofs. These design strategies are relatively new and as such there exists a lag time between knowledge possessed in the academic or professional realms and that of the general public. Without more information on the reasons for their use, occupants will construct their own explanation – which may not always be accurate.

Rapoport (1990) has argued that environments encode information and messages, which can be decoded by occupants. When designers share the same schema as occupants then there is "maximum congruence" in the message, as illustrated in Figure 6.7. That is, there will be less variation in the messages derived by occupants when they have the same schema regarding the design strategy as the designer. This can offer an explanation as to why certain design strategies emphatically communicate a pro-environmental message – it is because the trigger embodies a shared schema of "pro-environment," leading to greater congruence of the message among occupants. When the connection between the design strategy and a schema

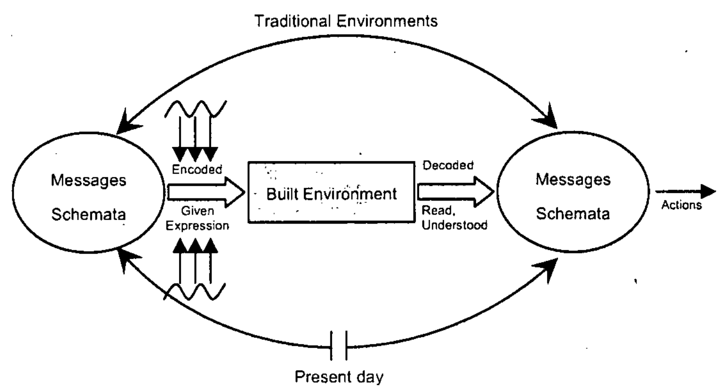


Figure 6.7. Encoding and Decoding of Environmental Information (Rapport, 1990, p. 82)

of "pro-environment" is not that apparent – either because the strategy is relatively new and therefore not understood, or it does not embody the occupant's definition of pro-environment then there will be greater variation in the messages received among different occupants. This process is further complicated by the fact that there exists a wide variety of definitions for "pro-environment" among occupants. This was witnessed in the interviews, with participants identifying pro-environment as meaning everything from energy efficiency, water efficiency and recycling to the presence of plants and a welcoming atmosphere (see section 5.2).

When the link between the design strategy and its environmental reasoning is not apparent, there exists a lack of understanding about the design feature, or the design feature elicits a negative affect response, then the design strategy falls into a "trigger trap." Trigger traps occur when a design strategy attracts the attention of the occupant, yet an environmental link is not apparent. Trigger traps can also happen when the shared cultural schema for the design strategy is unfavourable. For example, although occupants at Princess Street Campus could identify photovoltaics and strongly associated them with a pro-environmental message, there existed a level of uncertainty about whether they were operational. This reaction can be explained since photovoltaics have no moving parts and the prevailing social schema is that photovoltaics are not currently feasible because they are too expensive and produce low quantities of energy. In instances where trigger traps occur, it may be necessary to resort to a secondary form of communication such as interpretive signage (see Section 6.5).

Therefore, a design strategy is an effective environmental trigger when it is well placed, stands out, and the link between the strategy and its environmental reasoning is explicit. In instances when this link is not direct, or the design strategy is misunderstood, it may be wise to include a secondary form of communication.

6.3 Design Strategies as Triggers

This section will examine the extent to which certain triggers used in the study buildings communicated a pro-environmental message using the Interaction, Pause and Reflect properties described in Section 6.2. This section will draw on occupant quotes and sketches to provide an analysis of triggers and sort them into three different categories: highly effective design triggers, triggers that were associated more with a healthy interior and triggers that were noticed but not well understood by occupants.

A relative ranking of certain design strategies based on their effectiveness at communicating a pro-environmental message is given in Figure 6.8. This ranking was based on occupant's answers in response to the "why does this building communicate a pro-environmental message." Design strategies that were more frequently mentioned were given a higher status on the continuum. It is worth reiterating that the relative ordering and subsequent analysis of these features is based on occupant opinions of design strategies used within the study buildings. If a different set of buildings with a different set of design features, or a different application of similar design strategies were used, the results obtained may not be the same. Similarly, these results may also change if different occupants were interviewed or a larger study group was obtained. That being said, the following figure offers a relative ordering of the effectiveness of design features to communicate a pro-environmental message as determined in this study.

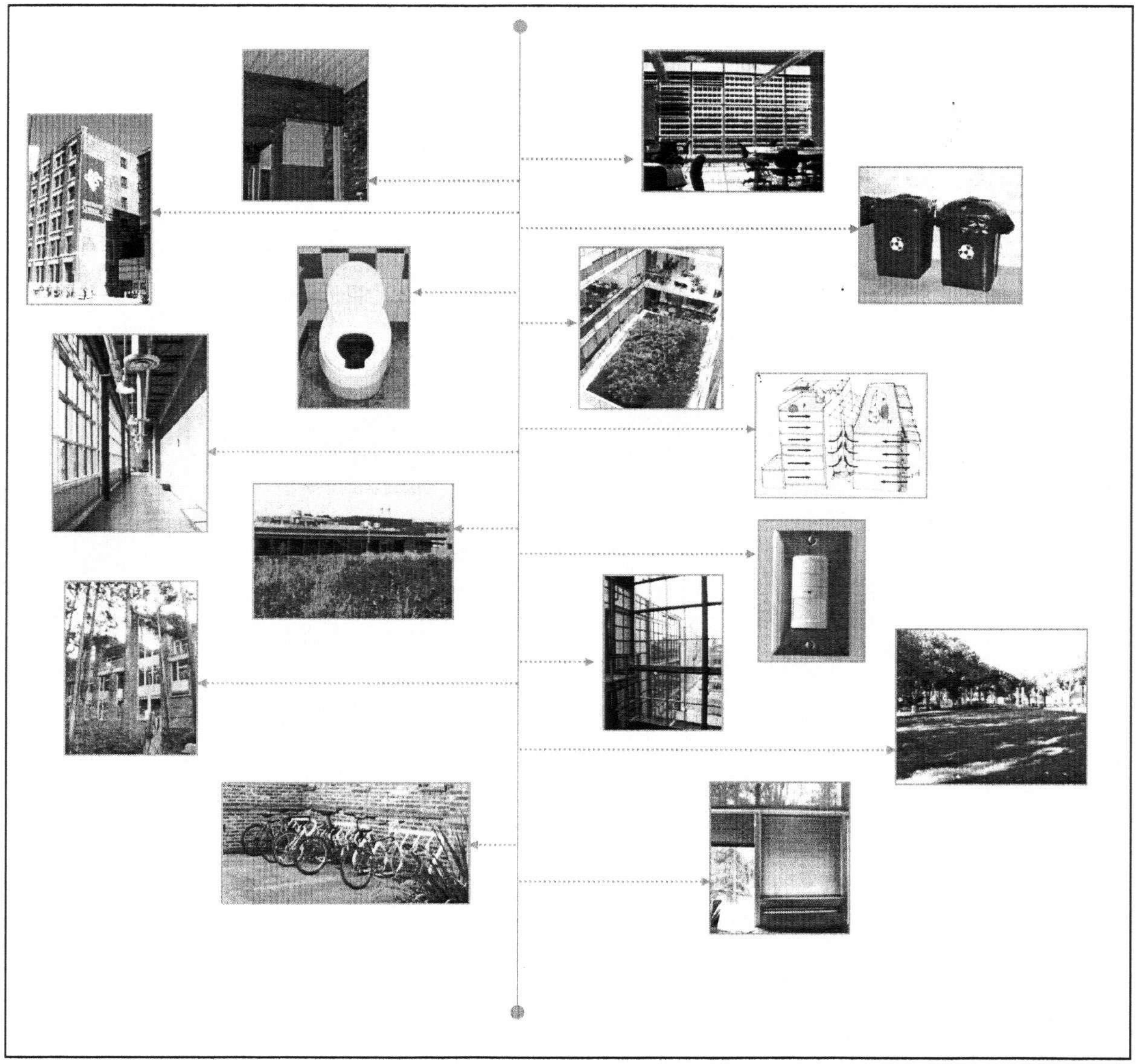


Figure 6.8. Relative ranking of the effectiveness of triggers as based on occupant responses, triggers that are more effective are located near the top of the continuum (From top to bottom: photovoltaics, salvaged materials, reused buildings, recycling bins, composting toilets, biophilic elements, natural ventilation, elimination of finishing materials, green roofs, occupancy sensors, windows, sensitivity to location, surrounding green space, bike racks, and operable windows)

6.3.1 Highly Effective Triggers

Highly effective triggers address all three categories laid out in section 6.2: they are extremely visible and therefore interact with most of the occupants in the building, they stand out from conventional building practices and they are easily linked to an environmental message. These triggers were also mentioned repetitively by occupants during the interviews as reasons why the building communicated a pro-environmental message.

Triggers discussed in this section include: reused buildings, salvaged materials, photovoltaics, composting toilets, occupancy sensors and recycling bins.

6.3.1.1 Reused Buildings

Princess Street Campus includes the renovation of 315 William Avenue, a 1905 6-storey brick and stone exterior warehouse (Figure 6.9). Occupants at Princess Street Campus had a somewhat fluid classification between salvaged materials and reused buildings, with the retention of the heritage façade and the reconstruction of several rooms from the demolished buildings (i.e. the reconstruction of the Winnipeg Grain and Produce Exchange Boardroom and the reconstruction of the commercial space from 150 Princess Street, which now houses the RRC bookstore) sometimes being defined as a "reused building."

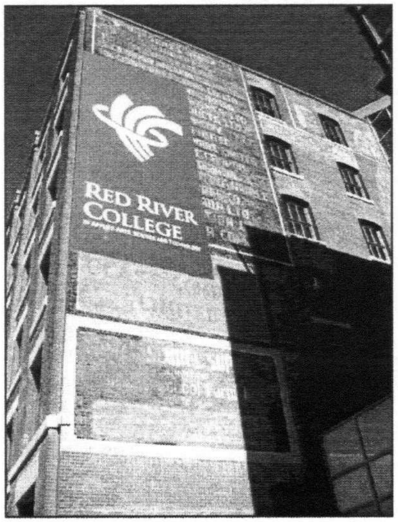


Figure 6.9. Phase One of Princess Street Campus involved the renovation of the Williams building, an early 1900's warehouse

It is common development practice to demolish an existing building to create a clear site from which a new building can be designed. Reusing an existing structure can be more complex and time consuming. For example, an early architectural analysis of the heritage buildings along

Princess Street revealed serious structural problems so preserving the buildings in their entirety was not an option. In order to preserve as much of the buildings as possible, the design team had to work closely with heritage recorders and carpenters who meticulously documented and numbered spaces so they could be deconstructed and than reconstructed with accuracy. This was an extremely labour and time intensive process. For this reason, this strategy is relatively uncommon in conventional practice, and therefore stands out.

Reuse is strongly linked with pro-environmental behaviour through the wide-scale promotion of the 3Rs. As the following occupant comments demonstrate, there exists a strong association with reused buildings and an environmental message.

> Yes [Princess Street Campus sends a pro-environmental message] in the sense that they don't waste the resources that they have. There's no point in knocking an old building down and putting it back up if you can salvage some of it (R8).
>
> [The building sends a pro-environmental message by] just by re-building rather than destroying a building (R6).
>
> I think it just shows some class on the school's part to be honest.... it seems that everyone's always trying to get rid of things that are obsolete and old, that they think are crappy...it's neat to know that these buildings were used for something else (R10).

Along with a pro-environmental message, retaining a historic building communicated a connection to the past, increased longevity, and healthy interiors.

A connection to the past and respect for history was the second message to emerge through the incorporation of a historic building. This is illustrated in the following quotes:

> Manitoba has a lot of buildings from the forties or so which was kind of the primetime here, they have a lot of buildings which looked nice and beautiful, and people admired them in that it was great. Then they got dilapidated and rundown. And when [Princess Street Campus] came back they've brought it back. So it kind of feels like it was back in its splendor. They brought back that feeling (R1).

> Your roots are always there, no matter what happens that's always your past. If you look for examples from places like Calgary when they had old buildings the just dozed them over and rebuild from new, with 100% new technology new everything. Well that doesn't have very much culture or heritage... it just seems a lot nicer to know what Winnipeg was like back in the early 1900s. I like it. It's culture. It's a part of what shaped us and it's a part of our heritage (R8).

> I guess you would say [the building sends messages of] respect for Winnipeg's history, and the traditions, and one time where Winnipeg sat as a city (R9).

> But by doing this, maintaining the front and stuff, it gives an appreciation for the style of the past... in some way it acknowledges the past, and the people in the past who also made this, who also had a big vision...it gives homage to the vision that they had (R11).

A third message was that by reusing an existing building, the resultant building will have more "staying power" and greater longevity.

> I think it has a lot more staying power, because you got something from an era gone past, and it's not going to come and go, because it's already come and gone, but now it's kind of permanent. And so, even 15 years from now, that's still cool. Where in 15 years from now whatever white room you put up will probably look crappy (R1).

Finally, one occupant equated the reused building with being healthier. As he stated: "I think a lot of people think that modern structures equal modern problems, whereas older structures indicate something healthier. I might be making that up, but I believe that's true" (R7).

There was some confusion by at least two occupants interviewed, who were unsure whether the materials used in the building were original or replicated. R11 wasn't sure if the façade "is actually a wall, you can't actually walk behind that and appear on the top, but I guess it is original" and R8 did mention that she knew "a lot of this stuff is all replicated" but liked it all the same. The salvaged materials used throughout the project and the façade are in fact original. A comprehensive interpretive signage program was installed at Princess Street Campus in June 2005 that is comprised of 11 signs that discuss the history of the site (R. Bragg, personal communication, July 13, 2005). Designed by Corbett Cibinel Architects, these signs explain the history of the buildings incorporated within Princess Street Campus, describing their former occupants and uses. This will most likely alleviate any confusion about the heritage buildings.

6.3.1.2 *Salvaged Materials*

Similarly, salvaged materials are strongly identified with the 3Rs and therefore a pro-environmental message. This is a very visual strategy, and it is typically easy to identify salvaged materials because they look older than virgin construction materials. As one occupant commented, "It looks old. It looks used. And when people do come here on a tour they… ask…'are these old?'" (C1). The intuitive connection between the presence of the salvaged material, how it is an obvious visual cue that hints at its age, and the association between the older material and an environmental message was most clearly expressed by C2 when discussing the salvaged beams used at the Choi (Figure 6.10):

> I think that you pick up [on a pro-environmental message] because the beams are all exposed and you can kind of pick up quite easily that the beams are reused. So I guess in a very subtle way it does register, 'oh that's good that they're using recycled materials (C2).

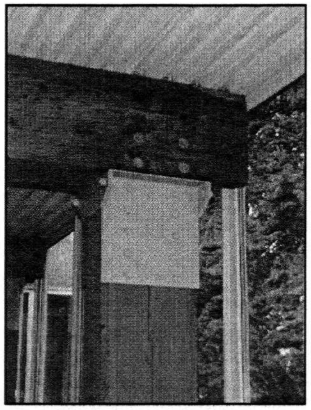


Figure 6.10. 75-year-old timbers salvaged from the demolished adjacent armory comprise 90% of the structure of the C.K. Choi

The ability of this strategy to prompt an occupant to pause and reflect on its design intent is evident from occupant quotes. As L1 stated: "Nobody's ever told me that but I'd wondered if maybe they had used the trees they had to cut down inside of the building." Although she was incorrect and the wood used for the ceiling of the multi-purpose room in the Liu comes from salvaged sources, this quote illustrates how the visual presence of the strategy encouraged the occupant to seek out an explanation.

Not only were salvaged materials associated with an environmental message, but occupants seemed to generally appreciate this strategy. This was especially true at Princess Street Campus where occupants consistently rated salvaged materials and the "mix between old and new" as one of the most striking features about the building (see R1's sketch of the salvaged brick and doors in Figure 6.11). Occupants also expressed how it is "really neat to see" the "salvaged materials that were part of the building that was here" (R2).

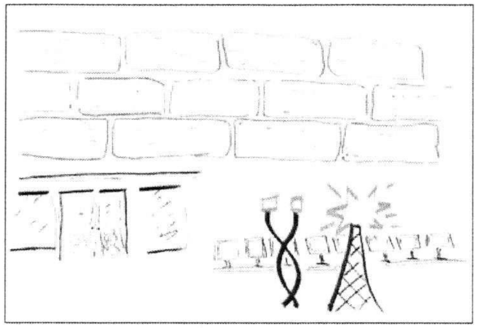


Figure 6.11. R1's sketch showing the salvaged doors and brick walls, and internet connections

As with reused buildings, salvaged materials also carry a strong message of connection to the past. That incorporating elements of the past is not only respectful, but adds a feeling of permanence to the building.

> In the old heritage room... you look at the old fireplace and you feel the history... you look at the old surfaces, and the reclaimed brick that they've used for construction and you can see the years of wear on them. So you get the feeling of the bones here. But you do get sexy new projectors, and modern furniture and tables and things like that, so it just feels like something that has been resurrected, but you can still see the bones and feel the old soul of the structure but there's also the new stuff too. Sort of like a phoenix although that might be extreme. But that sort of the idea, this old grand one that's been brought back to life and invigorated (R5).

> There's a sense of permanence that is lacking now in day-to-day activity, but is reinforced by the building itself I think. With those painted safes, and lovely wood out here, this door reminds me of going to the doctor in 1961 (Figure 6.12)...It seems that this door was good enough 75 years ago, it's just as good now, and it looks nicer than the new door down the hall (R7).

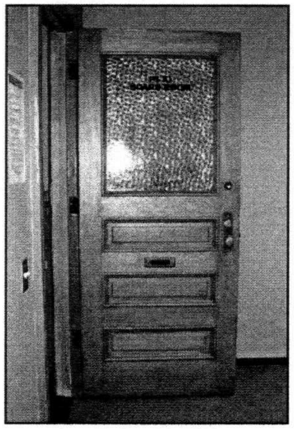


Figure 6.12. Salvaged wood door at Princess Street Campus

6.3.1.3 *Photovoltaics*

A 12.8 kW photovoltaic array is integrated into the curtain wall of the south façade at Princess Street Campus (Figure 6.13). Figure 6.14 shows the view from one of the classrooms that looks out onto the photovoltaics.

Photovoltaics have long been discussed in the media as an alternative way to generate electricity cleanly. As such they have become an iconic image for the environmental movement – an association that was clearly evident in occupant responses. For example, the photovoltaics made R8 think, "oh they're being environmentally friendly" and R4 "like[d] the fact that they have them there, because hopefully they're conserving energy…with their usage."

As one occupant commented, the photovoltaics are located "on the busiest corner of the school" "where the whole public can see them" (R10). Although the PV is located in a prominent location, if viewing them from the outside, they are subtle and can blend into the curtain wall glazing. From the inside, they were more obvious but not always immediately recognized. For example, R8 "wasn't sure what it was at first" what they were and "had to think about it for second." R11 saw them and "assumed that it was for some reason" such as shading the room. Whereas R12 found them "easy enough to see…[and] they are definitely not curtains." This delayed recognition could be due to the fact that they are not a common strategy, and therefore people do not necessarily have a construct to recognize them. Alternatively, if an occupant did have a "photovoltaic" construct, it is possible that with the tremendous growth of photovoltaic technology – especially in terms of building integrated versions – the photovoltaics used at Princess Street Campus did not match the occupant's visual construct for "photovoltaic."

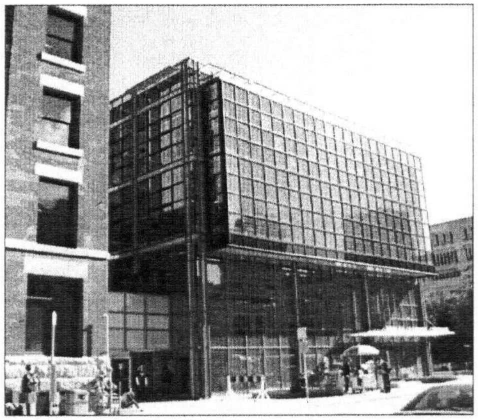


Figure 6.13. A 12.8 kW photovoltaic array is integrated into the curtain wall of the south façade at Princess Street Campus

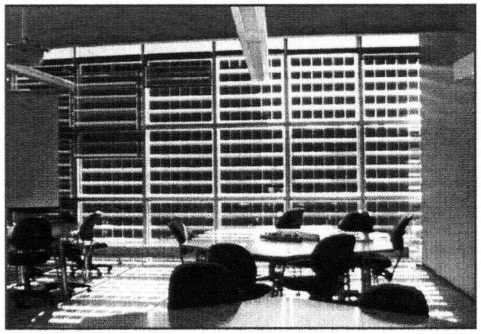


Figure 6.14. One of the classrooms at Princess Street that looks onto the building integrated photovoltaic

Unlike wind turbines which have moving parts, photovoltaics have no clear signs that they are functioning. At Princess Street Campus, the electrical inverters for the photovoltaics were displayed in a glass cupboard, however, without an understanding of this technology, it would be difficult to understand what you were looking at (Figure 6.15). Without a visual cue that the PV are operational, some occupants questioned if they were working. For example, although R1 thought the PV "looks neat" he questioned whether they worked. As he stated: "They don't really talk about [the photovoltaics] here, and I think it's kind of underutilized. That's because I don't think it's doing what it's supposed to yet, and so they don't discuss it. Because I feel that if it was doing a lot, they'd be pointing it out a lot more" (R1). This sentiment was reiterated by R7, who stated: "I think people may not know that [the photovoltaics] are operational, or exactly what they do, the just generally like the sound of oh solar panels that's good." These comments suggest that some sort of interpretation program is advisable for photovoltaics, in order to overcome the stigma that they do not work. Fortunately, as of June 2005, a kiosk has been installed at Princess Street Campus. This kiosk is complete with computer and monitor that will showcase real-time data on how much energy is being produced by the panels in an interactive way (R. Gamble, personal communication, July 13, 2005). Hopefully this kiosk can help dismiss the misinformation that exists surrounding this technology.

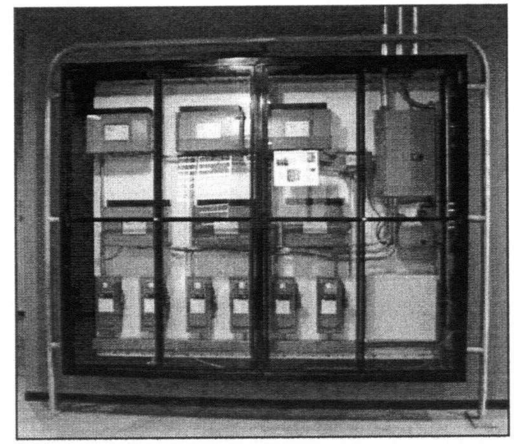


Figure 6.15. The electrical inverters for the photovoltaics at Princess Street Campus

The most surprising connection between photovoltaics and an environmental message came from occupants at the C.K. Choi. Although this building was designed so that photovoltaics could be easily installed, at the time of the interviews this retrofit had not yet happened. Regardless, two occupants at the Choi thought that the building communicated a pro-environmental message partially because of the "photovoltaics" that they thought were installed but were too expensive to operate. Although these comments are a testament to how effective PV are at communicating a pro-environmental message, this miscommunication is most disturbing since it perpetuates a negative image about photovoltaics as being too expensive and therefore not feasible.

Occupants were mostly very positive about solar technology. For example, R3 stated: "I like the idea of using solar energy. I think that is very cool. And why not use that in sunny Manitoba? Why not take advantage of the sun?" Similarly, R8 felt that "It's just a good use of technology. I guess it makes sense with the bills too. It makes a lot of sense for new campus, especially new campus with technological courses. It just makes a lot of sense." The presence of photovoltaics led other occupants to comment that "It's good to know that they are concerned about that stuff here" (R4). These positive feelings towards photovoltaic technology suggest that a potential spin off benefit with this strategy is an increased positive image.

Although occupants knew what "photovoltaics" were, there was some confusion around this term. Instead, occupants used the more generic term "solar panels." This discrepancy in nomenclature reiterates the lag time that exists between technical and academic realms to that of the general public.

6.3.1.4 Composting Toilets

The composting toilets at the C.K. Choi building are a very effective environmental trigger. They are definitely noticed as they involve an intimate interaction with the user and are not a conventional solution. Composting toilets can also be linked with a pro-environmental message. For C1, she felt that the building communicated a pro-environmental message partly due to "the washrooms that don't waste water…that [the water] doesn't go anywhere else except back to the land" (C1).

The strength of this design solution to serve as an indicator that the building was green was evident in occupant comments. L3 stated that the composting toilets were "certainly a dead giveaway" that the Choi is a green building, and C2 stated that: "the toilets will always bring you to question [if it is a green building] and ask if you're curious" (C2). Although the C.K. Choi was the only building studied that had composting toilets, they were so effective at transmitting a pro-environmental message and indicating that the building was green, that they were mentioned by every occupant interviewed at the Liu.

> The strongest demonstration of an environmental technology… is the composting toilet that they put into the Asian studies building. Because then people go to the bathroom and they realize, 'oh, these are composting toilets.' At the Liu you go in and they are low-flush toilets so you go in and it's not that obvious (L2).

> You know the C.K. Choi over there? That's a building that you go into and you know is green, because the stink of sewage around the building. But, I mean, you know it's green because it has a little toilet (L1).

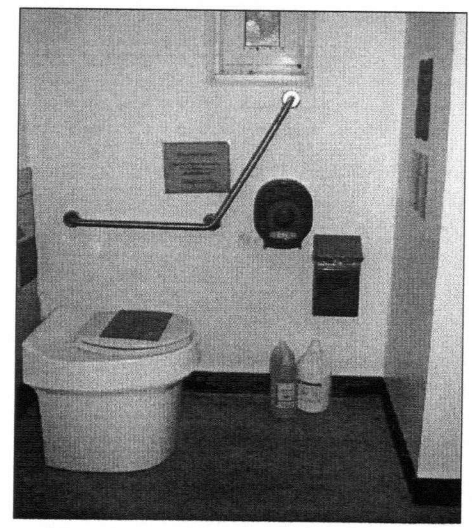


Figure 6.16. Signage in the washrooms on the main floor at the C.K. Choi

The ability of this strategy to spark an occupant's interest, and drive them to seek answers was apparent in a discussion with C2. She found that when unsuspecting visitors come to the building, they were usually "stunned" when they first use the toilets and "come out a little bit confused" and "ask why it was done this way" (C2). For C2, the composting toilets are a method of starting a dialogue with the visitors, and she often explains "how the non-flushing toilets are just a small part of what they wanted to do with the building...That's when we...launch into talking about the beams and how they were recovered from the armoury across the street" (C2). So because the composting toilets are so unconventional and are in contrast with an occupant's construct of "toilet" they captivate interest, and drive occupants to seek answers.

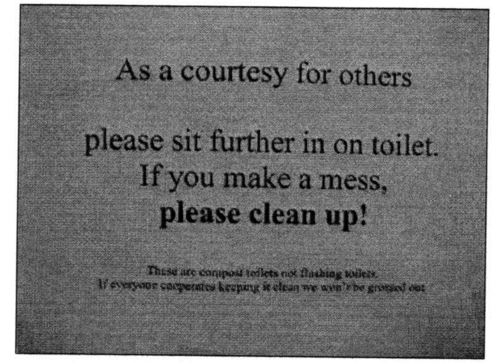


Figure 6.17. An example of the signs that have been placed in the first floor washrooms of the Choi

Occupants at the Choi are familiar with how to use the composting toilets, however, when visitors come to the building they "don't use it properly so they make a huge mess" (C1). To try to educate the public how to use the toilet, one of the staff members at the Choi made "all these signs and she was sticking them up everywhere – on the mirrors, the doors, on top of the toilet lid – everywhere. That's all you can see" (C1) (Figure 6.16, Figure 6.17). The confusion experienced by visitors implies that this design strategy could benefit from permanent signage that explains the general idea of composting toilets and why this design was used in the Choi.

6.3.1.5 Occupancy Sensors on Lights

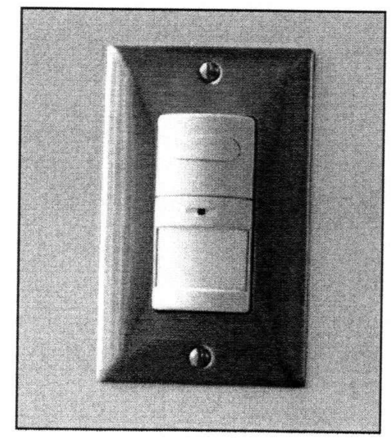


Figure 6.18. An occupancy sensor at the Liu Institute

Occupancy sensors are a relatively simple strategy, but they are an effective one. Occupancy sensors can be used for ventilation and cooling, security systems and for lighting control. However, the occupancy sensors that most occupants discussed are those that control light levels in a room (Figure 6.18).

Occupancy sensors work by turning on lights if they perceive movement, and turning them off if there is no movement in the room for a certain period of time. As these sensors are responsive to changing conditions they command attention. The link between the strategy and its environmental reasoning is clear as energy efficiency campaigns often urge people to "turn off the lights" to conserve energy. For example, R9 commented that "environmentally, you I think that they made an effort at least to be conscious of that" because "In the rooms the lights turn off automatically." Occupancy sensors were also linked with a "high tech" message (L4).

Some occupants were slightly frustrated with the sensors. For example, L1 stated that you were "constantly waving your arms" because the lights will turn off if there is no motion for a certain period of time. Newer models of this technology, such as the ones installed at the Fred Kaiser Building at UBC, are not only fitted with sensors to detect movement within a room but also noise (M. McColl, personal communication, June 23, 2005). This additional sensor is an improvement on the earlier version, and will hopefully reduce frustrations.

6.3.1.6 Recycling Bins

Although recycling bins are not a design strategy, they are visual element within the semi-fixed feature realm that transmits a pro-environmental message. For these reasons they are a trigger. Recycling bins are usually prominently placed and are obviously associated with recycling (Figure 6.19).

Figure 6.19. Recycling bins at Princess Street Campus

Years of social marketing aimed at waste reduction strategies through the promotion of the 3R's has linked 'environmentally friendly' with recycling. This connection was reflected by several occupants who thought that part of the reason why the building gave off a pro-environmental message was because "recycling bins are placed everywhere" (R4). This obvious connection between recycling bins and a pro-environmental message, and their placement within the semi-fixed feature realm, suggests that adding recycling bins to a building may be one way to increase the pro-environmental message of a building after it has been occupied.

6.3.2.1 Biophilic Elements

Taken from E.O. Wilson's concept of biophilia which is the "innate tendency to focus upon life and lifelike forms and in some instances affiliate with them emotionally," (2002, p. 134) biophilic elements are design strategies that can foster a biophilic response. Vegetation that is integrated with the building, either through planters, atriums or plant walls are examples of biophilic elements. Green roofs can also be classified as biophilic elements, however, given the uniqueness of this strategy, they will be discussed in their own section (6.3.3.2).

Based on the interviews, it was clear that occupants enjoyed having vegetation incorporated within the fabric of the building. The bamboo atrium at the Computer Science Building was well liked, partially because it gave occupants a chance to rest their eyes. For example, Y4 found the atrium "very relaxing" and he often goes there "to watch the green plants." Y7 elaborated on how the plants in the atrium are "very good for your eyes. Because you can exercise your eyes and change the focal point of your vision and kind of relax after half a day of work." He also found the "green plants... really nice to look at especially from the 3rd floor because you have a view of four floors down." (Y7). These comments illustrate that incorporated biophilic features can create opportunities for occupants to take a stress break.

Vegetation is strongly linked to the environmental movement and therefore a pro-environmental message. In the words of R3, "people think of green space, and trees" when they think of a pro-environmental message. For that reason, biophilic elements have the potential to communicate a pro-environmental message – however the degree to which that message is transmitted is dependent on how this strategy is deployed. Placement, scale, type of vegetation, and the ability of occupants to physically interact with the vegetation all seem to be important – as well as personal opinion.

The effect of personal opinion is witnessed from two occupant quotes at Princess Street Campus. One of the reasons R3 did not feel like Princess Street Campus communicated a pro-environmental message was because she did not feel like there was that much vegetation. The opposite opinion was held by R7 who thought that the building did send a pro-environmental message. In his words:

> [This building does send a pro-environmental message] just with the idea of green space. The fact that they are in the midst of surrounding it with what I believe will be more greenery – those planters that are under construction. I imagine some good size trees will be set up around the building, if that garden gets developed above the building. There's green in the atrium, they just filled the big planter in front of the mural (R7) (Figure 6.20 shows a photograph of the planters at Princess Street Campus after construction).

Figure 6.20. Fall 2005 photograph of Princess Street Campus showing the landscaping (Photo courtesy of Natalie Seaba)

Likewise, at the Computer Science Building – the study building with the most biophilic elements – one occupant commented how the building "is supposed to be an environmental building. You just kind of wish there was a little bit more green. A little bit more plants" (Y5).

The importance of placement is illustrated by Y7 who felt that the Computer Science Building did not communicate a pro-environmental message since "the vegetation is only [in the atrium]. You won't be able to find it anywhere else. You won't be able to find it on the window sills…it's only [in the atrium]…[but] there is some on the grad lounge on the third floor, you can see outside" (Y7). This occupant thought that the bamboo atrium was somewhat hidden, and you would only see it if you had reason to go down that hallway. In this occupant's opinion, confining biophilic elements to one area was not that effective at communicating a pro-environmental message.

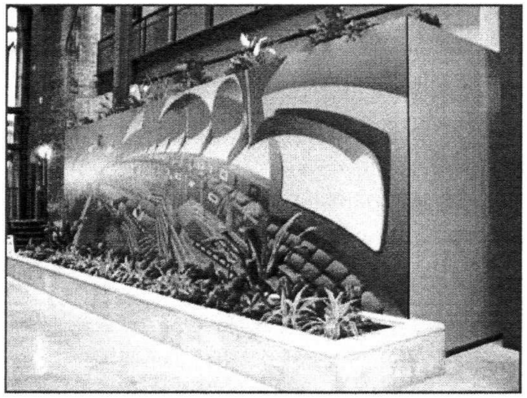


Figure 6.21. The planter in the atrium at Princess Street Campus

The type of vegetation used has repercussions on the overall message communicated. This point is best illustrated by an occupant of the Computer Science Building – Y1. When asked how it could be made more evident that the building was green, she mentioned "if they see something [unusual], then even after they leave the building they'll remember it…If you come in and you see, like a vegetable garden down there [in the atrium], most people will be used to see palm trees or bamboo trees-that's the common thing, you need something unusual" (Y1). Her comments hint at the "pause" attribute in the structure of a trigger. She felt that since bamboo can be found in conventional buildings, it does not stand out as an "environmental" trigger. People may like it, but it doesn't send a message. Changing the vegetation into something more unexpected will challenge existing constructs and make an occupant stop and think about why that particular strategy was used.

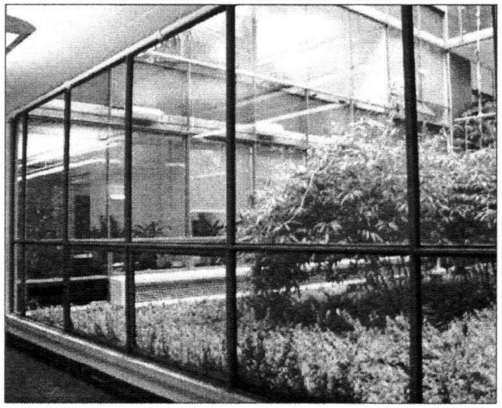


Figure 6.22. The bamboo atrium from the ground floor at the Computer Science Building

One comment that was mentioned repeatedly in association with biophilic elements – including green roofs – was how much people wanted to interact with the vegetation. For example, R10 "sometimes [goes] down [to the planter in the atrium] to read a book or something, because you can sit on the edge…It's just really nice" (R10) (Figure 6.21). This desire to interact with nature was also witnessed at the Computer Science Building. Occupants of this building were critical of the glass partition that separated the atrium on the ground floor, effectively preventing people from physically interacting with the vegetation (Figure 6.22).

Incorporating more biophilic elements throughout the building, using more unusual vegetation, creating opportunities for occupants to physically interact with plants can help to increase the environmental message communicated by biophilic elements. As R3 commented, "We're in a concrete jungle, a concrete brick jungle and if you can put in green somewhere than that's good....And not just paint."

These findings suggest that large scale, and unconventional biophilic elements such as a plant wall (Figure 6.23) or solar aquatic systems would be highly effective. In fact, Y5 even mentioned that if the Computer Science Building had a "plant wall like they have at Guelph-Humber College...it would really feel like environmental building" (Y5).

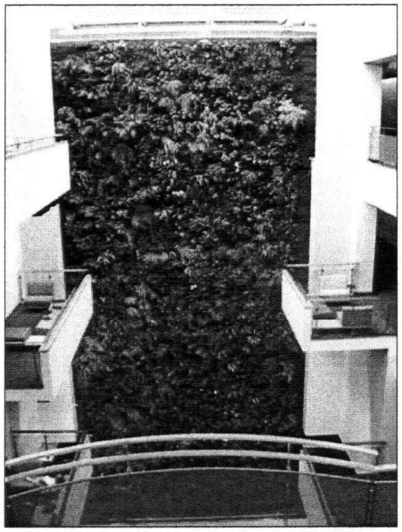


Figure 6.23. The Plant Wall at Guelph-Humber College in Toronto (photo courtesy of Alan Darlington of NatureAir Solutions)

6.3.2 Triggers More Closely Associated with Healthy Interiors

This section discusses triggers that occupants noticed, but were associated more with a healthy and comfortable indoor environment than a pro-environmental message. In fact, these strategies – including windows, natural light and natural ventilation – were some of the most frequently mentioned attributes and featured near the top of the list when asked "what are the most striking features of the building."

Windows were the number one most mentioned attribute and overall the most 'striking' feature about the buildings. Windows are closely tied to satisfaction with working environment. This is probably best illustrated in comments from occupants at Princess Street Campus who were previously in the basement at Notre Dame Campus. You can almost hear the appreciative tone in R5's comment that "the air is clean, and the windows open and you can actually get fresh air into it. We are not smelling mold and mildew like we did at the other facility. There's natural light which is so important." C1 enjoyed the windows at the Choi so much that her sketch showed how the operable window in the atrium opened up to the forest and allowed natural air and daylight to penetrate the building (Figure 6.24).

Figure 6.24. C1's sketch showing the windows which provide views to the forest, natural light and fresh air

Although windows contributed to how satisfied occupants were with the space, they were more strongly associated with a healthy indoor environment than a pro-environmental message. This could be due to the fact that windows can be found in most buildings and therefore do not stand out as an exclusive green strategy.

All of the triggers discussed in this section are interrelated and dependent on the presence of windows. For that reason they will be presented below in the broad categories of view, natural light, natural ventilation (operable windows), and electronically operable windows.

6.3.2.1 View

One of the benefits afforded by windows – and repeatedly mentioned by occupants – is view. From the many comments on view, accolades fell into three clear themes; views enabled an occupant to have a mini-break, connected them to the outdoor world, and offered a chance to rest the eyes.

Regardless of whether the view was natural or urban, windows create an opportunity for reprieve from daily activities and a chance to rest the eyes, all without moving. In the more natural setting of the Liu, occupants commented on how views to the setting "kind of keeps you away from the everyday business of life, even though you're on the computer doing tones of work, you can look out the window and it's really nice, relaxing" (L4). In the more urban setting of Princess Street Campus, windows provided views of "a lot of activity…people riding their bikes to work, cars and pedestrians walking around" (R6).

As Kaplan has stated, "views out the window readily draw one's attention. These pulls of attention in turn lead to very brief interludes that can provide a respite from the immediate tasks and demands, thus providing a micro-restorative experience" (2001, p. 508). The micro-restorative potential of views was evident from the following comment from a student at Princess Street Campus:

> You can see through the windows. It's just nice when you're doing your homework, especially on the inside, because even if you're having a hard time you can always just sit back for a minute and you can see everything going on outside. So you don't really feel like you're trapped inside the school (R10).

There was much discussion about how the presence of windows helped to overcome a feeling of being "enclosed," "trapped" or "stuck" in school, possibly because views offered occupants a chance to feel connected to the outdoors. Since occupants can witness the weather and the changing seasons, they "can see if the sun is out" (Y1), or "if there's a storm or something" (L1), occupants "did not feel cut off from everything" (R10).

As these comments illustrate, the importance that a view can have at creating a positive indoor working experience cannot be overlooked.

6.3.2.2 Natural Light

All four study buildings were designed to incorporate natural light, and natural light was one of the attributes most mentioned by occupants. Although daylight is closely tied with an occupant's enjoyment of the indoor environment and how healthy they perceive that environment to be, it was not always connected to a pro-environmental message.

The connection between daylight and enjoyment of the indoor environment is clearly evident in a comment by R5 – someone who's previous office and classrooms were located in the windowless basement of the Notre Dame campus: "This building and this facility is wonderful! ...There's natural light which is so important I think for the brain to function well. Even my own office space, the office space that I'm currently in, we have natural light" (R5).

The health affects of natural light was discussed by a few occupants. Y4 thought that being "able to see some light from outside...helps to keep your mood up." The importance of natural light on well being was reiterated by L1 who was comparing her current work space at the Liu with previous buildings she had worked in:

> Most offices I have been or worked in are really not well lit, and if it is lit it's not lit with natural light. So you're constantly under fluorescent lights. Actually I find that it gives me headaches, and it's not comfortable... I think that this building was intentionally designed to draw in lots of natural light. It's nice. It really makes a difference to have natural light (L1).

As these comments show, occupants were generally appreciative about the presence of natural light and some found the natural light so effective that "I hardly have to use my desk lamp" (C3) or that "we use the lights only in the evenings, because during the day some outside light comes from outside" (Y4). This was not always the case with some occupants commented that people still use electric lights even when there is sufficient daylight.

6.3.2.3 Natural Ventilation

Natural ventilation is a strategy that creates a rich sensory experience. Occupants can "physically feel" the air move and "smell" the fresh air. In the words of one occupant, "when you walk in it doesn't smell like a sock" (L1).

Most occupants at the buildings studied really appreciated the trickle vents, being able to open windows, and thought the air quality was quite good. L3 found "the fact that you can open windows and breathe in fresh air, that's great! Like wonderful" (L3). L3 found the natural ventilation to be one of the things which contributed to the "message of environmental responsibility" that the building was trying to send. However, he also felt that the "human environment" created with the "fresh air and light and…the colours and the mood of it" also communicated a message about humanity and "environments that are well adapted to people."

Natural ventilation strategies seemed to have the potential to trigger a pro-environmental message if it resulted in a physical difference in space. For example, the 18-inch opening connecting private offices with the hallway at the Liu building made L4 remark: "there's little things like none of the offices are closed up and you wonder why." This comment illustrates how a building that is slightly different than our construct for "building" creates a chance for reflection.

Comments around fresh air uncovered how constructs of typical academic buildings correspond to a building with poor air quality. For example, C2 mentioned how "the air quality is really good…this is not your typical University-like old building."

The largest challenge with natural ventilation is how to deliver fresh air without the noise, a challenge that has not always been met with success. For example, offices at the Liu Institute have a large opening facing the hallway to facilitate air circulation – which it does quite well. However, the problem is that this design also circulates noise. As L2 commented, "I understood why they did it from an environmental point of view and the idea of having a demonstration building, but I could never understand it from the point of view of how they expected anyone to get anything done. It just didn't make much sense" (L2). As the Liu houses academics who "require a certain amount of quiet and privacy, it's a very dysfunctional building" (L3) in that it is difficult to get work done. Similarly, the walls at the C.K. Choi do not meet the ceiling, which C3 finds a "little unnerving" as "you have to be careful what you say" (C3). Findings from the Keen Engineering post occupancy of the C.K. Choi and the Liu institute emphasized the noisy working conditions of these buildings as 100% of respondents complained about acoustical privacy (McCarry & Hyde, 2002). As an industry as a whole, this problem requires attention.

Another challenge with natural ventilation is that it can create drafts with can lead to problems with thermal comfort. This was most audible from an occupant at the Computer Science Building who was quite cold in the winter since the fresh air added a "wind chill factor" (Y1).

6.3.2.4 *Electrically Controlled Windows*

The operable windows in the graduate and faculty offices at the Computer Science Building were designed to be controlled electronically according to weather conditions as recorded on the roof top weather station. Although this strategy definitely captured the occupants' attention, the lack of control frustrated occupants. This frustration is clearly illustrated in a comment by Y3:

> The conditions under which they opened and closed were ridiculous...since the wind direction changes so rapidly, yet the code was written so the next decision isn't made until half an hour after the previous decision. We were wondering why it wasn't 5 minutes. It opens and closes when you think it shouldn't....feels like it wasn't tested (Y3).

The lack of control over the windows in part explains why Y5 felt that one of the messages that the building communicated was: "You live by my rules." As she stated: "I understood the concept behind having automatic windows, but it just feels like you're at the whim of the building. [You can't open the windows], the building's got to. You can't set the temperature in your office, the building's got to" (Y5).

Not only did occupants object to the lack of control over the windows, the electronically operated windows "scared" occupants who were working alone late at night and the windows would open by themselves (T. Mohammed, personal communication, October 27, 2005). After numerous complaints, this strategy was dismantled.

The negative reaction observed from occupants towards the electronically controlled windows corresponds to studies by Boardass and Leaman. Through their extensive post occupancy evaluations they have found that occupants are generally more tolerant to "poorer conditions if they are given some degree of control over lighting, ventilation, glare and so on. Take control away...and occupants are much less likely to react well when things go wrong" (Leaman, 2001, p. 2). Hence, occupants at York felt as if they did not have control over the conditions to which the windows opened and closed, and they reacted negatively.

6.3.3 Triggers Noticed but Not Understood

These triggers stood out, however occupants did not necessarily understand the environmental connection. Strategies that fall into this category are the elimination of finishing materials and green roofs.

6.3.3.1 *Elimination of Finishing Materials*

Those with prior knowledge of this strategy did recognize the lack of finishes as being a green design decision. However, some occupants thought that the lack of finishes was because the building "wasn't finished" or "they ran out of money." This came up several times at York and Princess Street Campus. Although at Princess Street Campus (Figure 6.25), people generally knew that the lack of finishing materials was a green strategy and it just looked as if it was unfinished; the occupants at York seemed to genuinely believe that the building was not finished. As Y5 mentions: "We moved into the building before was finished, and we kept waiting for them to finish it."

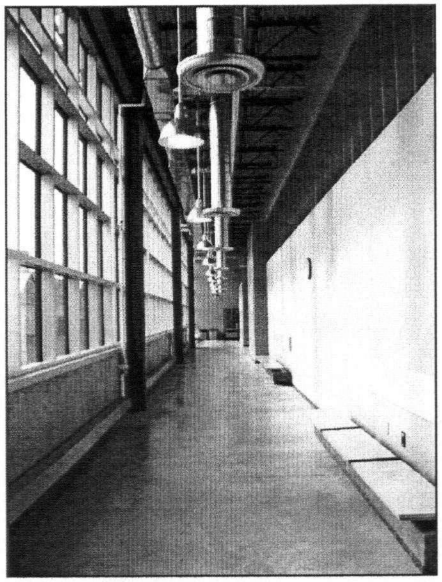


Figure 6.25. A hallway at Princess Street Campus showing the lack of finishing materials

C2 picks up on that point, stating that she doesn't think the reasoning behind the elimination of finishing materials is clear. As she states: "I don't think a lot of people would look at the concrete flooring and say 'Oh that is there for it number of reasons: it's easier to maintain, left for the cooling effect.' All that stuff right. So I don't think that it's so obvious." This is illustrated by R1 who "saw the ductwork and just assumed that was part of the architecture." These comments suggest that it may require prior knowledge to understand the connection between this strategy and an environmental message.

Other occupants were aware of the design intent, but did not find the "industrial aesthetic" pleasing. This was especially the case with the concrete floors. Occupants repeatedly mentioned how they thought the concrete "looks dirty" and "depressing." The desire to have carpets, especially in the office environment, was constantly reiterated. This could be based on the fact that concrete floors are more associated with industrial spaces than warm, comforting environments. It may be possible to counter some of these concerns by employing a different strategy for public and private spaces, where concrete flooring was restricted to high traffic public areas and carpeting solutions were used in more private areas. The addition of area rugs in office areas could also mitigate these concerns, and help to reduce noise transmission.

Occupants commented on the use of “simple” and “cheap” materials that are not extravagant – yet designed in a way that was pleasing. As L3 states:

> The fact that a lot of the materials are pretty cheap for lack of a better term, definite bare bones materials that are used very well. So you have very minimum not super fancy materials that are used very well and very nicely. The sort of particle board surfaces that are not a material that you would consider to be very fancy in a nice building like this, but it's used to great effect, with the exposed concrete and the polished concrete floors are also they are pretty bare bones, but they are used very effectively. But there's something about using minimum materials to great affect, in a very sophisticated way (L3).

6.3.3.2 Green Roofs

Both the Computer Science Building (Figure 6.26) and Princess Street Campus (Figure 6.27) have green roofs, and in both buildings perceptions towards the green roof were mixed. Occupants did not seem to emphatically understand the environmental rational for using a green roof, but appreciated the addition of vegetation. This is illustrated by R8: "I've seen it but I don't know what they're doing with it or why it's there...It made me think that they are trying to make me feel like I'm not stuck on the fourth floor...but I'm outside the park or something." R11 really liked this strategy because "you can block out the cityscape in the background and almost pretend that you're in a meadow." Other occupants were critical as to whether this strategy would actually work. For example, Y6 commented: "I predict it will leak very badly, it will not work and therefore it will be removed and it will be the first thing in the building to be replaced." This quote illustrates not only a distrust of new design solutions, but reiterates the importance of communicating successes.

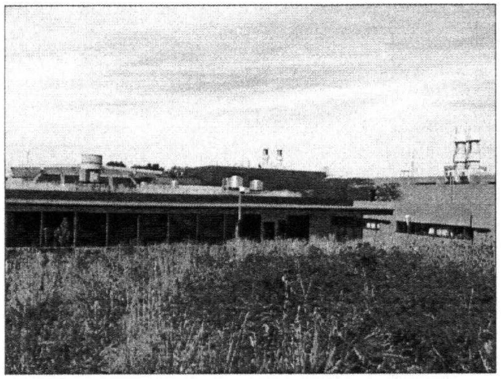


Figure 6.26. An extensive green roof blankets the rooftop of York University's Computer Science Building

The lack of understanding around green roofs can be attributed to the relative newness of the strategy in North America. Mixed perceptions could also be explained by aesthetic reactions to the choice of vegetation, with a cultural preference for manicured landscapes clearly evident among occupants. Occupants with a negative reaction to the vegetation viewed it as "messy" or a "weed patch" and would much prefer a more conventional "garden" or a "duck pond." Lack of knowledge on the feature was seen as well, with occupants referring to it as "the grass out there" or stating "I don't know what you call it out there" (R8).

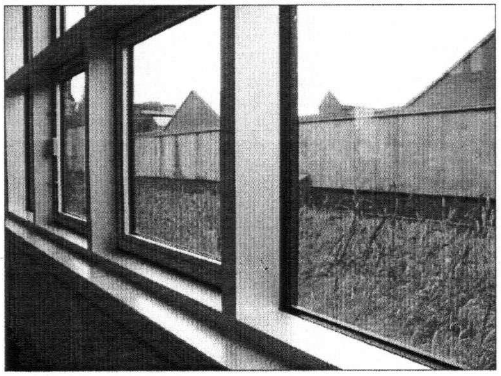


Figure 6.27. View of the green roof at Princess Street Campus

The common perception amongst occupants was that it would send a stronger pro-environmental message if connections were made between the vegetation and the building program. For example, R1 felt that the green roof would elicit a stronger pro-environmental message "if they would…serve toss salad from the garden." A similar opinion was expressed by Y1 who did not "think it's being used right. Even a garden could have been planted there, even a food garden – or vegetable garden. I think that would show a little bit more emphasis as to what this building is really about." This person was an avid gardener and had even requested permission to start a garden on her lunch hour, but she was denied. As she stated:

> I'm willing to use my lunch hour to plant some stuff, to make a little garden, not the whole thing, but there's a little part there in the front to do…I think it would be therapeutic for me too, because sometimes you have a long stressful day, for me anyways, and it would be good to just go up there and work on a little garden. And it would be nice to because sometimes people go up there because they want to see what's growing and there's nothing up there. When they have their tours, there's nothing up there (Y1).

This quote not only reinforces how undervalued wildflowers are, but it shows a desire to physically interact with vegetation. This was not an isolated comment. R10 thought it was "unfortunate…that the students really can't experience [the green roof]…So all you're doing is walking by, and you can't smell or anything. It seems a bit of a waste...people can't really make any use of it" (R10). These comments suggest that it may be possible to increase the pro-environmental message that a building communicates – and provide an amenity for occupants that they would genuinely appreciate – if green roofs were designed to allow occupants to physically interact with the vegetation.

6.4 Actively Instructional Design Strategies as Triggers

The actively instructional design strategies used in some green buildings and discussed in Chapter 2 typically embrace the interaction, pause, and reflect characteristics that make an effective trigger. For example:

- *Exposed building systems* are an effective trigger in that they cause an occupant to stop and wonder why a window is showcasing mechanical equipment that is usually hidden. As occupants are typically not educated in mechanical equipment, a secondary form of communication may be necessary to make the link between the strategy being shown, and its environmental reasoning.

- *Integrating Feedback* through real-time monitoring displays can communicate a pro-environmental message by detailing resources being consumed by the building. This strategy stands out since it is relatively uncommon in buildings. The effectiveness of this trigger will be determined by placement of the display screen in the building and whether the information displayed is in a form that can be understood by occupants.

- *Didactic Art* may cause an occupant to pause and make connections between the design element and the natural feature that it is referencing, thereby sending a pro-environmental message.

- *Interpretive Signage* serves the purpose of drawing an occupant's attention to a strategy or explaining something that may have stood out, yet was misunderstood. Interpretive signage is a supplementary communication device that can be integrated with other strategies whenever there is the potential for confusion. Signage serves to stress the environmental connection of the strategy.

6.5 Secondary Communication Methods

Although green buildings can silently communicate a pro-environmental message to their occupants, that message can be enhanced through the use of a secondary communication method. Secondary communication methods, such as interpretive signage, self guided tours, interactive displays, or comprehensive web pages, can explain the design intent for relatively new strategies and bridge the gap between the schema used by the designer and the schema used by the occupant. This can increase the congruency of the message received by helping occupants to decode design features accurately.

6.5.1 Communication Methods

Initial press coverage and websites are important vehicles to educate people about the building, however these methods are time sensitive. As Figure 6.28 depicts, there is typically a lot of interest and publicity when a building is first constructed, but this interest tapers off over time. As L2 commented: "When the building first opened, there was a lot of propaganda around campus, but it's been kind of forgotten over the last few years because there's so [many new buildings] going up."

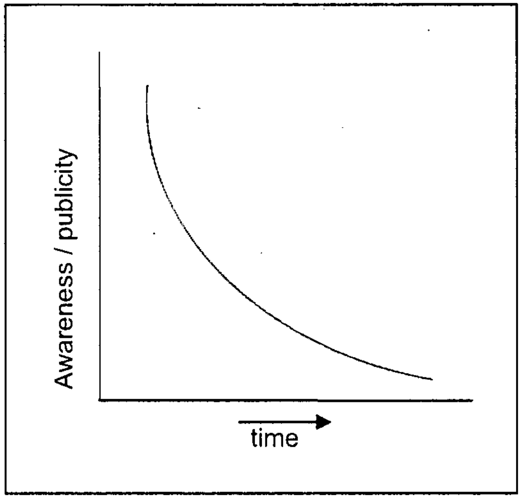


Figure 6.28. Initial publicity on a building is time sensitive

Building manuals – such as the extensive User Manual that was compiled to teach occupants of the Liu Institute about the features of the building – are one method used to educate occupants. The effectiveness of this method is dependent on whether the manuals are actually read. One of the occupants interviewed at the Liu commented, "There's a little package when you start working that you can read about the building, but I haven't actually read it" (L1).

Relying solely on occupants to educate new users of the building is not always reliable. Even if an occupant is initially very interested in the building it is inevitable that over time the novelty of the new building will wear off, and that person will not discuss it with the same frequency or fervor as they may have initially. Occupants may also work on the assumption that 'everybody knows about the building.' This was illustrated by C3 who stated that she has "always known [that the Choi is a green building] and I think everyone always tells people who come here that it is." This assumption may mean that the building is not discussed over time and new occupants are left to make up their own reasoning as to why the building has been designed in that way. This will most likely be apparent in large buildings with high turnover rates. In fact, the only two occupants who did not know that the building was green were both from Princess Street Campus – a building with over two thousand occupants.

Triggers are useful at grabbing an occupant's attention and causing them to wonder, however, without a permanent, easily accessible communication method in place that can explain unclear design strategies, than an opportunity for learning is lost. There are many forms that this communication can take: interpretive signage, interactive displays, monitoring stations that report on the status of building systems, comprehensive web pages, and didactic art installations. Whatever the communication method chosen, it was clear from the occupants interviewed that it should be honest, non-boastful and should not gloss over any functionality problems that occupants may be experiencing such as excessive noise or problems with thermal control.

A research project currently underway in Vancouver has exciting applications in green buildings as a secondary communication method. The Mobile MUSE (Media-rich Urban Shared Experience) project relies on wireless networks and hand held electronic devices such as PDA's and web-enabled cell phones, to create a personal and interactive user experience (Mobile MUSE, n.d.). Visitors and occupants could use their cell phones or PDA's to gather information about a building or a particular green design strategy. That is, if they encounter a strategy that they do not understand, they could consult their wireless device to download explanatory text, photos, video or podcast.

Providing some sort of secondary communication method can transform a green building into heuristic learning tool. Green design features may stimulate an occupant's curiosity, which may encourage them to find out why those features were used. If information is readily available when that occupant is in this state of peaked interest, then green buildings can promote self-discovery about the feature. Of course, whether or not this is a desirable path for a building to take is dependent on the interest of building management. As Y1 alluded:

> If the Environmental Studies [Department] was here, they would have been able to project this building more as an environmentally friendly building than we can. We only care about computers, we're not dealing with the environment so I think that's one of the reasons too why this building would not stick out to someone who would not know about the building (Y1).

This comment suggests that it may be possible to increase the potential for buildings to communicate a pro-environmental message through partnerships with organizations that are interested in projecting that message. That is, the primary focus for the Computer Science department at York University is not the environment, and therefore educating occupants about the environmental features of the building will also not be a priority. Therefore, if the Computer Science Department partnered with the Environmental Science Department and the Education Department, then there is much greater potential that the building could become a heuristic green building.

6.5.2 Benefits of Communication

There are several benefits in providing a secondary form of communication: create understanding, communicate successes, gain acceptance, satisfy the desire to know, and combat lore.

6.5.2.1 Create Understanding and Communicate Successes

From this research it is apparent that the environmental rationale of some design strategies, such as reusing an existing building, are inherently understood. Other design strategies trigger an interest, but their purpose is more abstruse. Without some sort of method to communicate design intent, then the occupant may not fully appreciate the design or may express negative feelings towards the building. Some features are less obvious and the only way to draw an occupant's attention to them would be through a secondary communication method. As Y5 commented:

> The things that are not visible would probably be well worth pointing out. Like what you said about the concrete…I don't know what that means, but apparently something good. But there's no way I could know about it unless there was some sign saying that….if something like that was on the building people would probably see it (Y5).

A secondary communication method can provide occupants with a comprehensive overview of the green approach used for the building. This can overcome any misconceptions that the visual elements that occupants noticed were put there strictly as a "token" measure to communicate a message. This was touched on by R9 who stated that the building does send a pro-environmental message with "some of the attempts that they've made. Although it's almost a token response, at least they've got those things on the windows" (referring to the building-integrated photovoltaics).

There exists a public misconception that green buildings do not work, are ugly, or are still experimental and therefore not feasible – all comments that surfaced during this study. These negative images could be due to a distrust of new technologies, or could be the result of earlier, less than successful attempts. To overcome these misconceptions it is vital to establish some sort dialogue about the successes achieved with green building in order to persuade people that green buildings are viable.

6.5.2.2 Gain Acceptance

Educating occupants about green design features and the rationale behind the building's design can also help gain acceptance when the building does not perform according to expectations. For example, Y3 really did not like the exposed concrete throughout the Computer Science Building, however, after it was explained that the reason why the concrete was left exposed was because the CSB was the first cold climate application of EcoSmart concrete and so the designers left the concrete exposed since it turned out so well, he replied, "well I appreciate it more, but I still, I don't know" (Y3). L2 reiterated this thought by stating:

> I think that the occupants would like to see the building made more functional, but one of the things you could do to make it better now would be to point out the good things about the building on a proactive basis....most of them know most of the features, but they may not be aware of everything, and at least if that was explained to them or reinforced then that might help a little bit (L2).

This suggests that occupants may be more accepting of a design feature if they know the design intent.

6.5.2.3 Desire to Know

People are interested in their surroundings and have a desire to know more – especially when they were not familiar with the design features used. As Y5 mentioned: "Nobody tells you the truth. You think why is this building like this? Why are all our offices these long narrow things?" There was also an expressed desire from occupants to learn more about what makes the building 'green.' For example, R11 commented that: "I've heard that [this is a green building], but I really don't know what that means, which is too bad." R8 expressed a desire to know more about:

> What the college was doing, what they have done and what they will be doing to continue being a green building... Like I said, all I notice is the aesthetic things, like the fake doors and whatnot. I know the solar panels are there, and I know what they use them for, but I don't know how far they go with their environmental friendliness (R8).

This desire to know more about the building was also seen in a Post Occupancy Study of the Victoria Island Technical Park (VITP) – the first certified LEED Gold office building in Canada. Occupant comments from this study "frequently featured requests for more information, signage and advertising" (Coleman, 2004, p. 69).

6.5.2.4 Combat Lore

Leaving the responsibility for education in the hands of individuals increases the likelihood of miscommunication or "broken telephone syndrome." This miscommunication is passed among occupants and eventually becomes lore. For example, the sloping roof of the C.K. Choi is oriented and pre-wired to accommodate photovoltaics, however the occupants of the C.K. Choi believe that the photovoltaics are already installed – they just do not have the money to operate them.

> I wish we had money to run the photovoltaics, it's never been activated...It's too bad, particularly since the solar panels have become such distinct sort of emblem for the institute. And yet they're not in use. I'm not quite sure exactly why, but I have a feeling that we been told that it's been operational costs and maintenance (C2).

> I know it has solar panels above on the roof but I know it's not used at this time (C1).

Not only does this perpetuate an image of the building that is not true, it also reinforces the existing stereotypes about photovoltaics – that they are too expensive and do not work.

Conclusion

Chapter 7

"If the built environment is a powerful silent teacher, we can change the message people get from it. It can be redesigned so that people are richly informed about their place and the ecological processes endemic to it."
(Van Der Ryn & Cowan, 1996, p. 162)

"A measure of successful green architecture in its broader role of educating a public may well therefore lie in its ability to capture the public imagination by communicating new values in explicit and engaging ways."
(Cole, 2003a, p. 64)

7.1 Answers to Thesis Questions

In answer to the first thesis question, "Do high caliber green buildings silently communicate a pro-environmental message to their occupants?" the answer is yes, although that message was more pronounced in certain buildings. Out of the four buildings studied, a pro-environmental message was more apparent at the C.K. Choi and Princess Street Campus, whereas this message was more subtle at the Liu Institute and the Computer Science Building. Figure 7.1 provides a summary of reasons why each of the four study buildings did and did not communicate a pro-environmental message to their occupants.

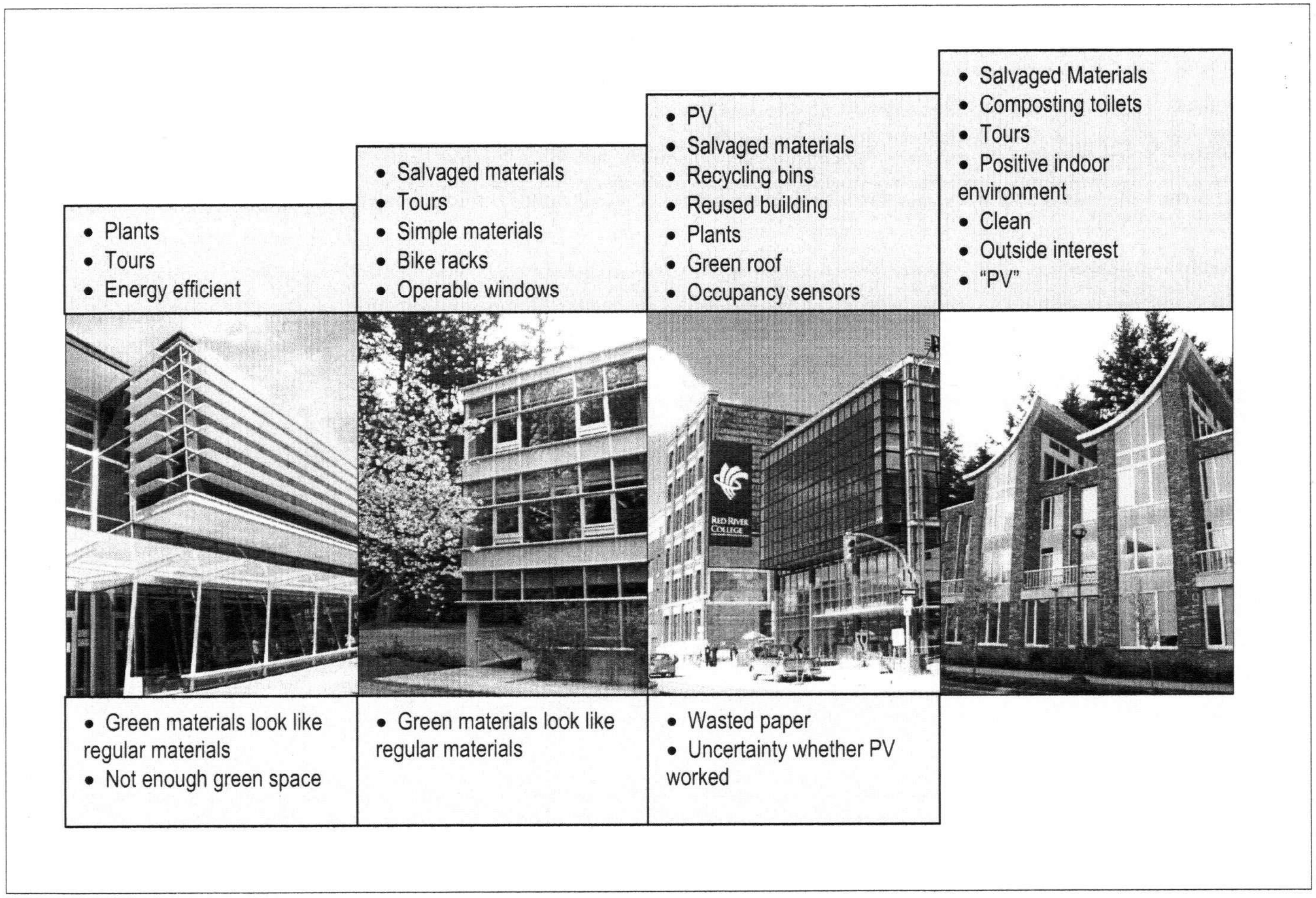


Figure 7.1. Summary of reasons why each of the four study buildings did (above in green) and did not (below in grey) communicate a pro-environmental message (Buildings from left to right: the Computer Science Building, the Liu Institute for Global Issues, Princess Street Campus and the C.K. Choi Institute for Asian Research)

Likewise, the answer to the second thesis question, "Are some design strategies more effective than others in communicating that message?" is also yes. Certain design features – such as salvaged materials and photovoltaics – were more frequently identified by occupants as reasons why the building communicated a pro-environmental message. This suggests that some design strategies are more strongly linked to environmental constructs, and therefore more effective at communicating a pro-environmental message. These emphatically green design solutions either utilize strategies that are heavily connected with pro-environmental behaviour such as the 3R's, energy conservation and water conservation, or in the case of photovoltaics are icons of the environmental movement. These design solutions acted as "triggers" that caused occupants to link the strategy with a pro-environmental construct. Design solutions are good triggers when they are well placed, gain the occupant's attention, and their environmental reasoning is explicit. Other design strategies, such as green roofs, were noticed by occupants but an environmental connection was less obvious. Design solutions that have recently been introduced into mainstream architecture may be subjected to this reaction since a time lag exists between the dissemination of knowledge from the academic and professional realms to that of the general public. When occupants do not understand what a certain feature is or why it was used, it is human nature to postulate an explanation – unfortunately this process does not always yield accurate results. The relative effectiveness of triggers to communicate a pro-environmental message as determined by occupant interviews is depicted in Figure 7.2.

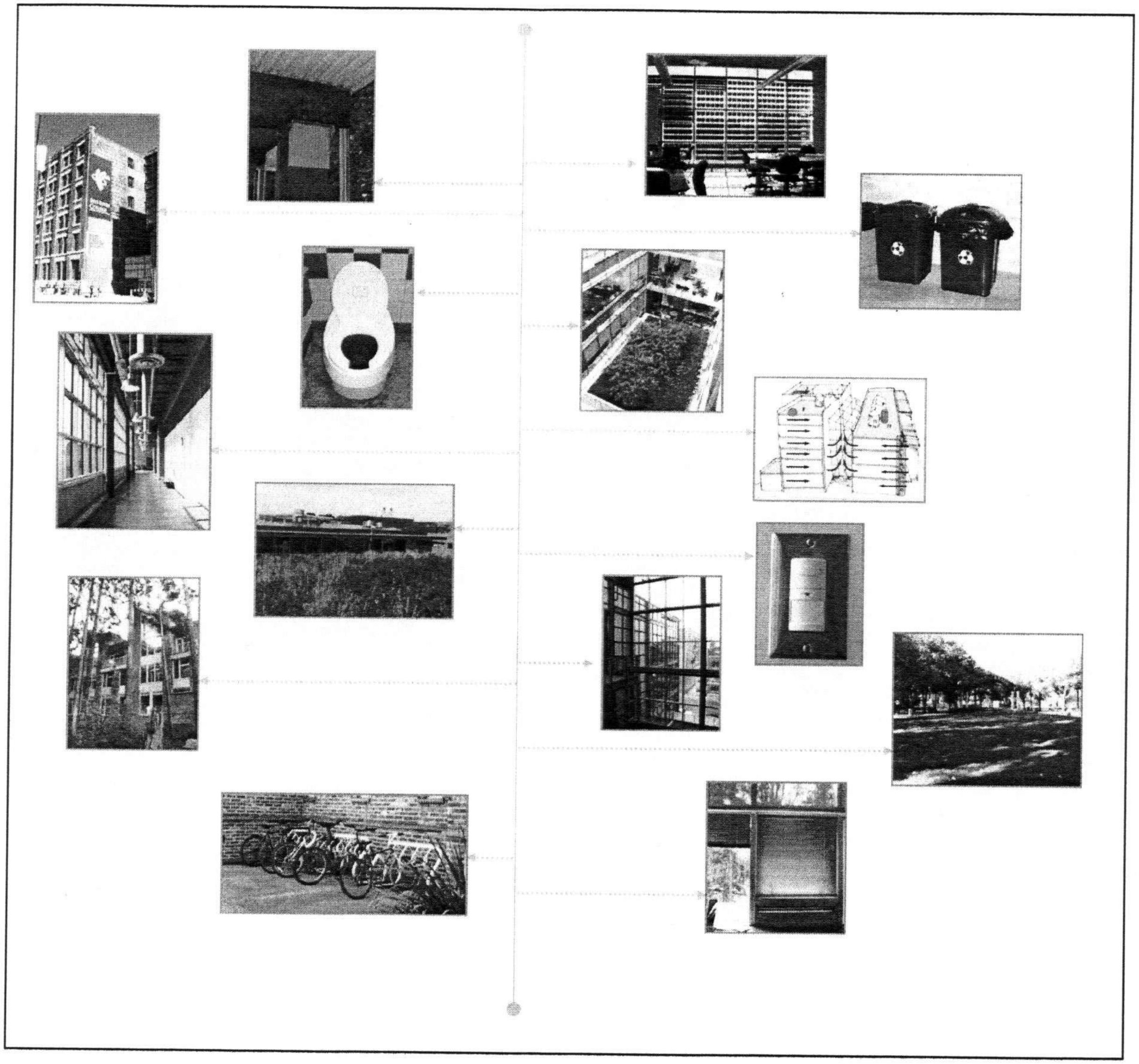


Figure 7.2. Relative ranking of the effectiveness of triggers as based on occupant responses, triggers that are more effective are located near the top (From top to bottom: photovoltaics, salvaged materials, reused buildings, recycling bins, composting toilets, biophilic elements, natural ventilation, elimination of finishing materials, green roofs, occupancy sensors, windows, sensitivity to location, surrounding green space, bike racks, and operable windows)

From this study, it appears that the core factor in determining if a building communicates a pro-environmental message is the number and type of design solutions (triggers) that occupants could identify as being green within the fixed feature and semi-fixed feature realms. The importance that triggers play in shaping messages is most evident among occupants who did not feel the study buildings communicated a pro-environmental message. The most often cited reason among these occupants was that the green strategies were indiscernible from regular strategies, so "nothing stood out." The baseline message created with triggers can either be enhanced or diminished by non-fixed feature realm factors such as the operational context, occupant experience and comparisons to other buildings. The relationship between the Core and Qualifying factors is depicted in Figure 7.3, and Figure 7.4 explores the Core and Qualifying factors present in each study building.

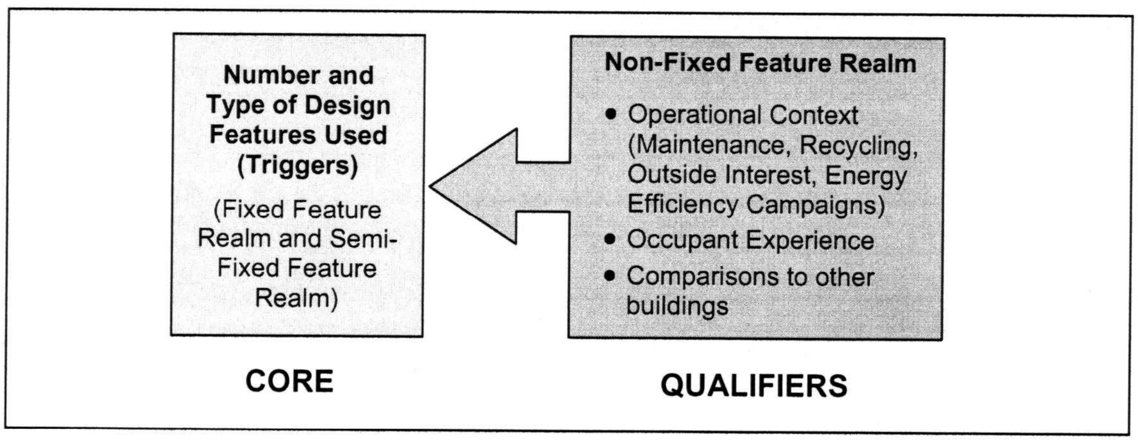


Figure 7.3. Core and Qualifying factors that determine if the building communicates a pro-environmental message

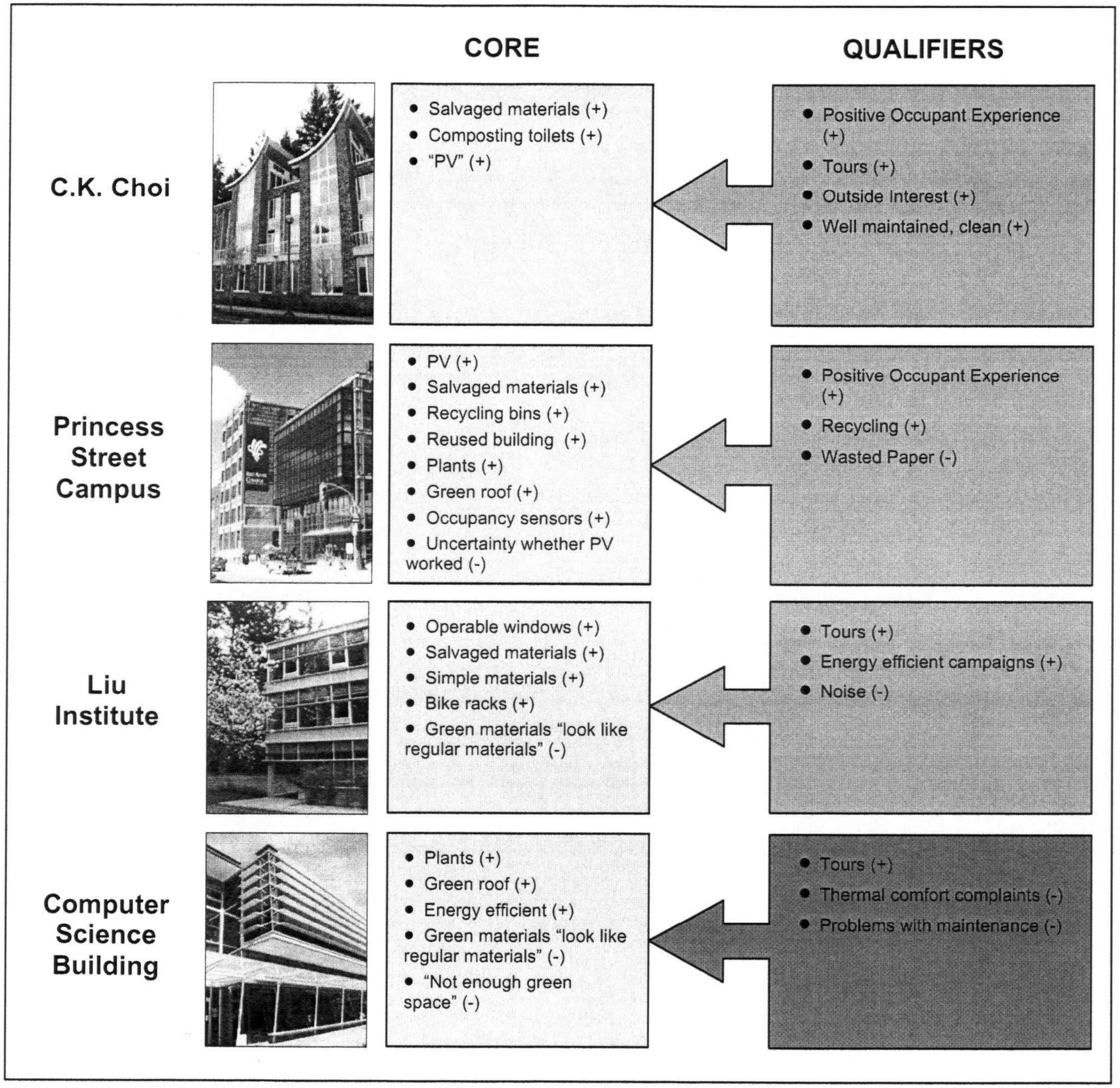


Figure 7.4. Core and qualifying factors that positively influenced (+) or negatively impacted (-) the communication of a pro-environmental message at the four study buildings

7.2 Potential Ways to Increase a Pro–Environmental Message Over Time

Time is an important dimension when discussing the message communicated by a building. Taken from Brand's *How Buildings Learn* (1994), Figure 7.5 illustrates the approximate lifespan of various building elements. Brand discusses how certain elements, such as space plans and "stuff" (i.e. furniture, decorations, and personal artifacts), change more frequently over time than other elements such as the site and structure. This corresponds to the dynamic semi-fixed feature realm and static fixed feature realm postulated by Rapoport (1990). Similarly, factors that fall into the non-fixed feature realm fluctuate with time, affecting the overall message that a building communicates.

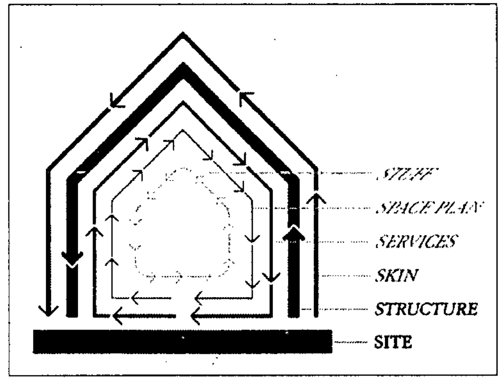


Figure 7.5. Different rates of change of building elements (Brand, 1994, p. 13)

Looking at the core and qualifying factors in the context of time it is apparent that the overall message communicated by a building to its occupants is not strictly under the jurisdiction of the building's designers. Instead, the responsibility of that message is divided among several different players. The design team may lay out the baseline message that a building will communicate in the fixed and semi-fixed feature realms, however that message is tempered by building management through the non-fixed feature realm and modifications to the semi-fixed feature realm (Figure 7.6).

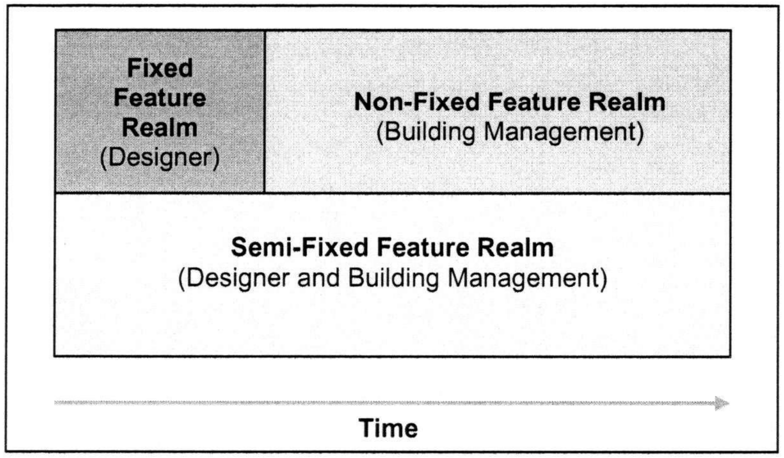


Figure 7.6. Realms in which buildings communicate messages and who is responsible for those messages

This section will look at ways designers and building managers may be able to increase the potential that a building will communicate a pro-environmental message by manipulating core and qualifying factors found within the fixed, semi-fixed and non-fixed feature realms.

7.2.1 Core Factors: Triggers

There are several possible ways to increase the pro-environmental message of a building through the use of triggers, including: utilize multiple triggers, use triggers that are more emphatic, or include active design strategies. In addition, when the design intent is not clear, employing a secondary form of communication can help create understanding.

Although one trigger may not lead to a pro-environmental message, multiple triggers may. Utilizing multiple triggers may increase the redundancy of a pro-environmental message, which may lead to greater congruency in the overall message received by occupants. As seen in the interviews, there is not a conclusive definition of pro-environment, and an occupant may not perceive a building as having a pro-environmental message if it does not address that occupant's definition. For example, if "the presence of vegetation" is how an occupant defines "pro-environment," then that occupant may not derive a pro-environmental message from a green building that does not have plants located throughout the building. On the other hand, a green building that incorporates a plant wall or a solar aquatic system would be more likely to communicate a pro-environmental message to that occupant. Incorporating multiple triggers increases the likelihood that an occupant's definition of pro-environment would be met, and a pro-environmental message will be communicated. The multiple triggers incorporated into the C.K. Choi and Princess Street Campus could be one reason why these buildings were assumed to have a greater pro-environmental message.

As previously discussed, there are certain design features that were strongly associated with "pro-environmental" constructs. This suggests that it may be possible for designers to increase the pro-environmental message of a building by choosing to use design strategies, such as salvaged materials or composting toilets, which are emphatically green.

Similarly, there are certain design strategies discussed in Chapter 2, whose exclusive purpose is to instruct. Including some of these actively instructional design strategies – such as exposed or expressed building systems, didactic art, and feedback display monitors – may help to increase the pro-environmental message communicated by the building.

When the environmental reasoning for a trigger is not well understood, it would be wise to include a secondary form of communication, such as interpretive signage, to help make the environmental linkages more apparent. A secondary form of communication can also help dispel inaccurate cultural perceptions about some green design strategies. For example, occupants strongly associated photovoltaics with an environmental construct, however, there was some uncertainty as to whether they were actually producing electricity. Including some type of interpretive element that intuitively shows how much energy is being produced could help to overcome these misconceptions that exist around this technology.

Triggers are found in both the fixed and semi-fixed feature realm. As such, both designers and building management have a hand in the message that they communicate. Although designers will lay out the baseline message communicated by the building in the fixed and semi-fixed feature realm, management can modify these elements over time. If the green design solutions used in a building are not obvious, it may be possible to boost the overall pro-environmental message of a building by adding emphatically green triggers that fall into the semi-fixed feature realm such as recycling bins and plants.

7.2.2 Qualifying Factors: Operational Context

The operational context is a qualifying factor and can either enhance or diminish the overall message that a building communicates. Under the jurisdiction of building management, the operational context falls into the non-fixed feature realm.

Although it may not be possible to influence every attribute in the non-fixed feature realm, it may be possible for building management to increase the pro-environmental message of a building by taking an active stance to encourage pro-environmental behaviour. This could include instigating programs that stress recycling, encourage energy efficiency, and recommend car pooling. Keeping the building clean and reacting to problems in a timely manner may increase positive feelings towards the building – which will also enhance an occupant's experience of the building and project a message that management cares.

Actively instructional design strategies such as integrating the curriculum with the building, offering tours to occupants and the general public, and creating outreach publications are other directions that management could take to enhance the environmental message of the building.

7.2.3 Qualifying Factors: The Experiential Reality

Perhaps most surprising was how experiential factors – the human variables – shaped the overall message received. Factors such as whether or not an occupant thought the building was "comfortable," "welcoming" or "inviting" seemed to enhance or diminish the messages communicated. The buildings where occupants seemed most content, Princess Street Campus and the C.K. Choi, were also the buildings that had a greater association with a pro-environmental message.

What constitutes a positive occupant experience is open for debate, however, there are certain building elements that occupants repeatedly mentioned in connection to a positive indoor experience. These include fixed feature elements that are associated with healthy interiors, such as the presence of windows, natural light, fresh air, and the ability to control environmental conditions. Semi-fixed feature realm elements such as wall colours, artwork, presence of plants, details, and furniture selection and arrangement all contributed to the "inviting" and "comfortable" attributes of the space. It may be possible to increase the "welcoming" feel of the space through manipulating features in the semi-fixed feature realm, which can increase the potential that the building will communicate a pro-environmental message.

For many designers and environmentalists, the ultimate hope is that "green becomes the norm" (Marks, 2005, ¶ 16). This means that green buildings are under a very close microscope. Architects who design green buildings are faced with a tremendous responsibility – ultimately, if occupants are dissatisfied with the experience offered by the building, then it will be more difficult for green buildings to gain the wide-scale acceptance that is needed in order to become the next status quo. For this reason, particular care should be made to create green buildings with comfortable and inviting interiors.

7.3 Conclusion

Architects have proved it is possible to create a green building that is virtually indistinguishable from a regular building – however green analogues offer few opportunities for learning. When green design strategies closely mirror conventional ones, it becomes necessary to label these strategies to gain the attention of occupants. This was the case at the fourth floor of the Population Health and Wellness Directorate building in Victoria, BC which underwent a healthy workplace redesign. In order to draw attention to the various healthy design strategies, such as clerestory windows, carbon dioxide sensors and low VOC paint and carpets, labels have been printed, framed in CD cases and mounted in the space (Clark, 2003). To overcome the problem of explicitly labeling green strategies, Andres Duany calls for an independent aesthetic for green architecture – "to make explicit the environmentalism" (Duany, 2005).

Results from this study provide direction for designers attempting to do just that. Through the use of design solutions that stand out and are easily linked to environmental constructs, it is possible for green buildings to silently communicate a pro-environmental message to their occupants. Design solutions that challenge an occupant's construct for that design solution – typically because the occupant has no previous experience with the design strategy – can create an opportunity for learning. Constructs are mental maps that people use to make sense of the world, form expectations for a given situation, predict possible outcomes, and guide behaviour (Crittenden, n.d.). When an individual encounters an experience that is in conflict with their preconceived constructs, it is necessary to revise the construct.

Design solutions that challenge constructs will initiate occupants to pause and reason why that particular strategy was used. If the linkage between the design solution and the environmental reasoning is apparent, than the design solution is an effective trigger with an emphatically green message. When a design strategy captures an occupant's attention, but the connection to an environmental reason is less obvious, it may be wise to include a secondary form of communication to facilitate this learning process. After a design strategy has been connected to an environmental construct, it will serve as a mnemonic device, quietly reinforcing the environmental focus of the building.

It is in this construct update process that green buildings fill the role of heuristic teaching devices. They can promote self-discovery through the use of design strategies that capture an occupant's interest, challenge their constructs, and provide them with cues in which to link the strategy with an environmental rationale. This is a process that would not occur in green buildings that closely mimic conventional buildings.

Green buildings also have a role as ambassadors for green design. This provides further reason to use green buildings in commercial and institutional settings where occupants may not be previously disposed towards environmental thinking and do not necessarily have a choice about being in the building. Green buildings can help to raise awareness among occupants on alternative design solutions and dispel outdated cultural perceptions that may exist about green design. Familiarizing a wider audience about green design solutions will hopefully help to catalyze the acceptance – and eventual adoption – of these solutions within the public realm. Creating highly comfortable indoor environments can help to achieve this goal, as occupants would more likely have favourable opinions of green buildings based on a positive experience.

As this study has shown, buildings are more than just a container for learning – but a tool that can be harnessed to passively teach about sustainability.

7.4 Suggestions for Further Studies

As with all research, answering one question just leads to more questions. Since this is an exploratory study, there are a number of possible directions that subsequent research could take. The following are merely a few suggestions:

Substantiate potency of green design strategies

The order of the design features ranked on their effectiveness to communicate a pro-environmental message as presented in this thesis was based on occupant responses and is therefore relative. Additional research is needed to create a more concrete ranking of green design strategies – including additional green strategies that were not located in the study buildings (i.e. wind turbines, plant wall, dual-flush toilets, etc.). Of course, the way in which a design strategy is expressed can vary greatly among buildings. For that reason, it would also be interesting to investigate how the degree to which a particular design strategy was expressed can affect the messages communicated. For example, biophilic elements could be expressed as potted plants located throughout the building, a plant wall, planted atrium or green roof. How do these different expressions affect the overall message communicated? Is one strategy more effective than the others?

Compare environmental messages received from occupants of green buildings and gray buildings

The ultimate study into this topic would be to compare messages communicated to occupants of gray buildings, with those communicated to occupants of green buildings.

Examine if occupant behaviour is influenced by the green building

Initially, this was the direction that this thesis was going to take. Do occupants of green buildings exhibit greater pro-environmental behaviour than occupants of grey buildings? However, given the diversity of variables that are thought to affect pro-environmental behaviour (see Kollmuss & Agyeman, 2002) it would have been very difficult to show a direct-causal relationship for any environmental behaviour that was witnessed. That being said, some of the occupants interviewed did mention that the building encouraged them to exhibit pro-environment behaviour. For example, the presence of shower facilities and bike racks encouraged L1 to bike to work, as she stated: "I don't know if I'd ride my bike if there wasn't a shower or if there wasn't a bike rack." Several occupants commented on how they recycled more in the green building, because the location of the recycling bins was "convenient" or "because of the building itself...everyone is more aware of [recycling] I guess" (C1). Another occupant at Princess Street Campus commented that "because [recycling is] easy, I see people actually doing it. And I think once you start doing it, you start thinking about it a little bit more" (R5). A few occupants at York commented on how building design encouraged them to take the stairs since the elevators are slow and there are windows in the stairwells so "you can actually stop at the landing and look out and look at the undergrads, and see what's going on underneath" (Y5). And several students interviewed at Princess Street Campus stated how the lack of parking encouraged them to bus to school – mind you a few of those students took the bus begrudgingly. As these comments suggest, it appears that green buildings can influence the behaviour of its occupants, and this is an area that could benefit from additional research.

Test claims that the pro-environmental message of a green building can be enhanced after occupation through the manipulation of variables in the semi-fixed feature realm

This thesis boldly suggests that it may be possible to increase the potential that a building will communicate a pro-environmental message by manipulating variables in the semi-fixed feature realm. That is, through the addition of semi-fixed feature realm triggers that have a strong association with a pro-environmental message such as plants and recycling bins. This thesis also suggests that it may be possible to increase the potential that the building will communicate a pro-environmental message by manipulating qualifying variables – such as enhancing the indoor experience through the addition of sociopetal furniture arrangements and artwork. Testing the accuracy of these claims would be an informative research study.

Test the connection between the communication of a pro-environmental message and prior green building knowledge

Only 2 occupants out of 26 interviewed for this study did not know that the building was green. Those 2 occupants were both at Princess Street Campus. One of those occupants thought the building communicated a pro-environmental message, while the other did not. To what degree this prior knowledge of green building strategies influences the message that the building communicates is unknown, but warrants addition investigation. If this study was undertaken, occupant selection would have to be conducted in a way that would not bias potential participants (i.e. by asking "do you know this is a green building" at the outset or as a qualifying question). Instead, it may be wise to interview a large sample from one building (preferably one with a large building population with a lot of churn) and sample until enough occupants who had no prior knowledge that the building was green were obtained.

Explore connections between how well an occupant liked being in a building, and whether they found the building to communicate an environmental message

As discussed in the conclusion and in Section 5.5.3, the study buildings in which the occupants seemed most content – the C.K. Choi and Princess Street Campus – were also the two buildings that were strongly linked to a pro-environmental message. It would be interesting to research this link and to see if there is any correlation between whether an occupant liked the space, and whether they thought the building exhibited a pro-environmental message.

Determine what messages are communicated to visitors to the building

As discussed in the methodology section, it would be very interesting to determine what messages visitors thought the building was communicating. If this study was undertaken, it would have to be designed in a way so that the participant's opinions are not influenced by the tour guide.

Determine to what degree individual perceptions of the working / learning environment are influenced by the social realm

Occupants in this study mentioned how the learning and working spaces in the green buildings were far superior to previous buildings they had been in. There was even discussion on how occupants found their productivity had increased since being in the green building. Determining what portion of this increased productivity and better working/learning environment is related to the social realm, and what portion can be attributed to the building itself would be an interesting study.

Determine how the message that a building communicates is influenced by time

Time is a variable that is briefly discussed in this thesis and warrants further exploration. There are many different questions that can be researched with respect to time. For example: How does the duration that an occupant spends within a building affect the message? Is a pro-environmental message more evident amongst occupants who have been in a green building for years or recent arrivals? What is the affect of time on occupant opinions towards controversial design strategies? Does acceptance increase with time?

Notes

Notes

[1] The term "pro-environmental message" was derived from environmental education literature that discusses the desire for environmental education interventions to produce citizens that are engaged in "pro-environmental behaviour" which is defined as "a behaviour adopted by an individual consciously attempting to minimize his or her negative impacts on natural and constructed environments" (Kollmuss & Agyeman, 2002, p. 241).

[2] These categories were partly inspired by a post from Jim Wasley to the Big Green ListServe on May 3, 2003. Wasley is an Associate Professor of Architecture at the University of Wisconsin-Milwaukee and posted a request for examples of green buildings that:

> have their features and/or aspects of their performance on display and explicitly interpreted. This might be through simple signage, real time monitoring, unique or interesting spins on the idea of exposed and expressed building systems, viewing windows and tour offerings, integrated environmentally triggered artwork, etc... (Wasley, 2003).

[3] Estimated LEED score for the Computer Science Building, Princess Street Campus and the C.K. Choi were determined from research papers from University of Waterloo Students as posted on Terri Meyer-Boake (n.d.) *Advanced Case Studies in Canadian Sustainable Design* website. Estimated LEED score for the Liu Institute was determined from the *Liu Institute Post Occupancy Environmental Assessment* (Architectura, n.d.b).

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"It is not at all likely that anyone ever had a totally original idea. He may put together old ideas into a new combination, but the elements which made up the new combination were mostly acquired from other people. Without many borrowed ideas there would be no inventions, new movements or anything else that is classed as new."

~ Dr. George Grier

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Definitions

Appendix A

Biophilic elements – taken from E.O. Wilson's concept of biophilia which is the "innate tendency to focus upon life and lifelike forms and in some instances affiliate with them emotionally," (2002, p.134) *biophilic elements* are design strategies that can foster a biophilic response. Vegetation that is integrated within the building, either through planters, atriums or plant walls are examples of biophilic elements.

Construct – a synthesized complex of mental images and impressions (Funk & Wagnalls,1989)

Didactic art – an active green design strategy that aims to evoke connections to the natural environment through art or structural design that tell a story of place. An example a green building that uses didactic art to teach about place is Brunswick High School in Maine, where supporting columns were painted to look like birch trees (Sutton, 1996).

Dominant Social Paradigm (DSP) – a worldview that assumes humans are separate from the natural world and dominant over nature. Limitless resources, the necessity of continuous growth, and the unfailing faith in science and technology to solve ecological problems are cornerstones of this worldview (Arcury *et al.*1986).

EcoSmart™ Concrete – a customer-friendly term used to describe concrete in which the Portland cement is partially replaced with an optimum quantity of supplementary cementing material(s) such as slag or fly ash, in order to reduce the carbon dioxide emissions associated with the concrete (For more information visit www.ecosmart.ca).

Heuristic Green Buildings – a green building that has is different from conventional buildings and therefore captures an occupant's attention and encourages them to learn more about the design strategies used. These buildings promote self-discovery as they are in conflict with existing schemas for "buildings." As such, individuals are compelled to learn more about the building in attempt to patch holes in their governing constructs.

LEED – *Leadership in Energy and Environmental Design* is a voluntary green building rating tool designed by the US Green Building Council (USGBC) to create a metric to define and measure green buildings. Buildings are awarded points if they meet the prerequisites, and the requirements outlined in each credit. Credits are divided in six categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation in design. Based on the total number of points earned, buildings are recognized as LEED Certified, Silver, Gold or Platinum. LEED has been adapted for use in Canada by the

Canadian Green Building Council. (For more information on LEED see www.usgbc.org/leed and on LEED Canada see http://www.cagbc.org/building_rating_systems/leed_rating_system.php)

Messages – symbolic meaning derived from the built environment. Messages are what Hershberger (1974) would refer to as responsive meaning, and Nasar (1989) as connotative meaning. Messages go beyond a simple understanding of the built environment and include the secondary considerations or feelings about an object. This may include the connection between the object and a particular construct, or judgments of value and beauty.

Mobile MUSE (Media-rich Urban Shared Experience) – a Vancouver based research project that is exploring how wireless applications, via cell phones and PDA's, can expand learning and build community through the creation of more personal and interactive experiences. There are many possible applications for Mobile MUSE to can enhance the heuristic potential of green buildings. For example, visitors and occupants can use their cell phones or PDA's to collect information about a green building in text, photos, videos and audio (i.e. a podcast recorded by the architect to explain a particular design feature). It would also be possible to set up a virtual tour of the building using these means, and a virtual diary could enable visitors to leave photos and impressions that they have about the building (For more information see www.mobilemuse.ca).

New Ecological Paradigm (NEP) – a worldview that assumes humans are a part of the ecosystem and therefore subject to natural laws. The desirability of restricting growth, protecting the integrity of ecosystems, and working with natural systems to find solutions to environmental problems comprise the fundamental ideas of the NEP (Arcury *et al.* 1986).

Personal Construct Theory – devised by George Kelly, Personal Construct Theory postulates that everyone is a scientist engaged in the process of anticipating the world (Crittenden, ND). Much like a scientist devises a working hypothesis for an event and then tests that hypothesis through experimentation, this theory states that individuals create constructs of the world based on perception and personal experience. These constructs, schemata or mental maps are then superimposed on everyday experiences and provide the filter by which the world is viewed. When a person's experiential reality matches their construct, these constructs are strengthened. However when the construct system clashes with the lived experience, then the original construct is revised. Constructs enable an individual to form expectations for a given situation, to predict possible outcomes, and guide behaviour (Crittenden, n.d.; CPCS, 2004).

Pro-Environmental – a somewhat nebulous term derived from the environmental education literature that encompasses ideas of sustainability, reducing the human ecological footprint and learning about place. When applied to a building, it would also include strategies employed to conserve energy, water, and resources.

Pro-Environmental Behaviour (PEB) – "behaviour adopted by an individual consciously attempting to minimize his or her negative impacts on natural and constructed environments" (Kollmuss & Agyeman, 2002, p. 241)

Schema (plural: Schemata) – a diagrammatic representation; an outline or model; A pattern imposed on complex reality or experience to assist in explaining it, mediate perception, or guide response; an internal representation of the world; an organization of concepts and actions that can be revised by new information about the world (http://moodle.ed.uiuc.edu/wiked/index.php/Schemas)

A schema is the mental construct from which behavior flows. http://www.brainconnection.com/topics/printindex.php3?main=fa/piaget

Sociofugal – an environment that discourages social interaction (Cassidy, 1997).

Sociopetal – an environment that encourages social interaction (Cassidy, 1997).

Trigger – a design solution that stands out in some way and causes an occupant to pause and reflect on the reason for their use. Although triggers can communicate multiple messages, for the purposes of this thesis, the interest is ways and extent that triggers can project a pro-environmental message.

Trigger Trap – occurs when a design solution captures the attention of the occupant; however the link towards an environmental reasoning is not explicit. Trigger traps also happen when the shared cultural schema for the design strategy is unfavourable.

Truth window – a window that showcases building assembly systems. Often found in strawbale construction to show that the structure is in fact made out of straw.

Recruitment Email

Appendix B

The following text is an example of the email that was sent out on departmental listservs to recruit volunteers for this study. This is Version: Y.2 (09/06/2004) that was used to solicit participants from York University's Computer Science Building. For confidentiality, phone numbers have been removed.

The University of British Columbia
School of Architecture
Lasserre Building
402 – 6333 Memorial Road
Vancouver, B.C. V6T 1Z2
Phone: (604) 822-2779, Fax: (604) 822-3808

Participants Needed for a UBC Building Perception Study

Staff and students of the **Computer Science Building** are invited to participate in an UBC School of Architecture study entitled "The Hidden Curriculum: Investigating the Messages Buildings Communicate to their Occupants."

Sessions will take less than one hour and will involve a sketching exercise and a semi-directed interview. Sessions will take place at the Computer Science Building, be one-on-one and will be audio recorded. Participants in this study will receive a gift card for a complimentary coffee or tea. The study will start **Monday, September 27th** and will continue until **Friday, October 1st**.

This data will form the basis of a Master in Advance Studies in Architecture thesis conducted by Amanda Mitchell (Co-Investigator), under the direction of Dr. Ray Cole (Principal Investigator).

If you are interested in participating, please email buildingstudy@hotmail.com to arrange an interview time. Make sure you provide us with your preferred interview date and time, your full name (first and last), duration of occupancy at the Computer Science Building and whether you are a staff or a student.

Thank you for the time and attention given to this notice. If you have any questions regarding this study, please contact Ms. Mitchell at 905-XXX-XXXX, or Dr. Cole at 604-XXX-XXXX.

Consent Form

Appendix C

Interview participants were given two copies of the following consent form to sign at the start of the interview. One copy was kept by the participant for their files and the other was retained by the researcher. This is Version 1.2 of the consent form, finalized on July 7, 2004, and it originally appeared in portrait format. For confidentiality, phone numbers have been removed.

The University of British Columbia
School of Architecture
Lasserre Building
402 – 6333 Memorial Road
Vancouver, B.C. V6T 1Z2
Phone: (604) 822-2779, Fax: (604) 822-3808

CONSENT FORM

The Hidden Curriculum: Investigating the messages communicated by buildings to their occupants

Principal Investigator:
Dr. Ray Cole, School of Architecture, University of British Columbia, contact telephone number: 604-XXX-XXXX, email

Co-Investigator:
Amanda Mitchell, Master of Advanced Studies in Architecture candidate, School of Architecture, University of British Columbia, contact telephone number: 604-XXX-XXXX, email.

Ms. Mitchell, a graduate student under the direction of Dr. Cole, is undertaking this project for her Master's thesis.

Purpose:
The purpose of this research is to gain an understanding of the messages that building occupants derive from the buildings in which they work or study. Your participation has been requested since you have an office or attend classes in the building under investigation.

Study Procedures:
The research sessions involve a one-on-one interview consisting of three parts. In part one, you will be asked to create a personal map of the building and any messages that you feel the space expresses. During that time, the interviewer will leave the room to allow you some privacy. Part two is a semi-directed interview in which you will be asked some open-ended and directed questions about your experience with the building. The last section, you will be asked some

background questions about yourself and your exposure with the building. Sessions will take less than one hour and will be audio taped for transcription purposes.

Confidentiality:
You can be assured that your identity will be kept strictly confidential. All interview transcripts and personal maps will be identified only by code number, and only the investigator and co-investigator will have access to these documents. Computer files of the interview transcript will be password protected, and hard copies will be stored in a locked filing cabinet.

The data obtained in this research study will form the basis of Ms. Mitchell's Master's thesis. As such, the final report is a public document and will be published. It is possible that your personal map or excerpts from your interview may be included in the report however you will not be identified by name in any report.

Compensation:
In return for your participation, you will receive a card entitling you to a complimentary coffee or tea.

Contact for information about the study:
If you have any questions or desire further information with respect to this study, you may contact Dr. Ray Cole at 604-XXX-XXXX or Amanda Mitchell at 604-XXX-XXXX.

Contact for concerns about the rights of research subjects:
If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

Consent:
Your participation in this study is entirely voluntary and you may refuse to participate or withdraw from the study at any time.

Your signature below indicates that you have received a copy of this consent form for your own records.

Your signature indicates that you consent to participate in this study.

____
Subject Signature Date

____
Printed Name of the Subject

Interview Guide

Appendix D

Questions were inspired by Robin Moore's 1989 work talking to children about their experiences in the Washington Environmental Yard a naturalized schoolyard, and Clare Cooper Marcus's research for "House as Mirror of Self" (1995).

Order of questions was not strictly adhered to, and not every question was asked to every participant. Staff, faculty and students were asked similar questions for the sketching exercise and semi-directed interview, but the third section, background information, was tailored to the different groups.

1.0 Sketching Exercise

Participants were presented with a blank paper and smelly markers and asked to:

- Draw what first comes to mind when you think of the building – anything you want, and there are no expectations

During this time the interviewer left the room, allowing the participant 10 minutes of privacy to sketch.

2.0 Semi-Directed Interview

The sketch produced by the respondent will be the launching pad to direct further questioning using open ended questions. Questions will start by being vague and end with more "environmentally" directed questions.

- Tell me about your sketch? What features did you include? Why?
- Now where are you located in the building?
- Discussion points can be initiated from the drawing. "I see that from your drawing you placed heavy emphasis on the .... "

Open-ended questions

- What are the most striking features in the building?
- Describe your office space – where are you located in the building?
- Describe your favourite spot in the building. Why?

- How is this building different from others you have been in or other buildings on campus? (*NOTE:* Occupants at Princess Street Campus were asked how the building differed from the older RRC campus?)
- If you were to describe this building to a friend, what would you say?
- How did you feel in the space?
- If your next job was on the 10th floor of a conventional office building downtown, what would you miss?
- What messages do you think this space projects? What characteristics about the building help to form those opinions?
- If I waved a magic wand and this building became a person, describe what that person would look like, act like, and behave?
- If the building could talk, what would it say?

More "environmentally" directed questions

- Do you think that a pro-environmental message is evident from the building? What would lead you to conclude that?
- What do you think of the location, use of materials, energy saving features, landscaping, green roof, atrium, daylight, natural ventilation, air quality, photovoltaics, operable windows, photosensors, occupancy sensors, etc... (NOTE: this question was customized for the building under study)
- Do you know that this building is considered a "green building"?
    - If yes, how did you know?
    - If no, does this change your opinion?
- Do you think that it would be evident to someone walking in that this building is a green building?
- How do you think this message could be made more evident?
- Are there other buildings that jump out as green buildings? Why? What features make you say that?

- Are you aware of the national profile for being green that this building has?
- Has working here changed your behaviour at all? (biking, recycling...)
- What have you learned from your experience here?
- Does management reinforce a pro-E message?
- After your experiences here, would you want to work in a GB again? Would you consider living in a GB?

- Is there anything else that you would like to say?

3.0 Background Information – STUDENT

3.1 Background Socio-demographic

Age:

- 18-25
- 26-30
- 31-35
- 36-45
- 45-55
- 56-65
- 65+

Sex:

- Male
- Female

For students please state your:

- Major or Program:
- Diploma, Undergraduate, Masters, PhD, Post-PhD
- How long have you been at this school?

Where did you grow up?

3.2 Background Building Interaction

What best characterizes your relationship to this building?

- I have an office in this building
  - Individual or Shared?
  - Location?
- I primarily have classes here
- I primarily use the amenities of this building
  - If so, what amenities do you use?

How long have you been an occupant of this building?
On an average week, how much time do you spend in this building?

- 0-5 hours a week
- 6-10 hours a week
- 11-20 hours a week
- 21-30 hours a week
- 31-40 hours a week
- Over 40 hours a week

Where you involved in the consultation process for the design at all? If so, in what way?

3.3 Follow up Personal

Did you learn about environmental issues in school?
How "green" would you consider yourself?

3.0 Background Information - STAFF & FACULTY

3.1 Background Socio-demographic

Age:

- 18-25
- 26-30
- 31-35
- 36-45
- 45-55
- 56-65
- 65+

Sex:

- Male
- Female

Position:

How many years have you worked at this school?
What is your highest level of education obtained?
Where did you grow up?

3.2 Background Building Interaction

Do you have an office in this building?

- Individual or Shared?
- Location?

What amenities do you use?
How long have you been an occupant of this building?
On an average week, how much time do you spend in this building?

- 0-5 hours a week
- 6-10 hours a week
- 11-20 hours a week
- 21-30 hours a week
- 31-40 hours a week
- Over 40 hours a week

Where you involved in the consultation process for the design at all?

3.3 Follow up personal

Have you ever had any environmental education courses?
How “green” would you consider yourself?

Occupant Sketches

Appendix E

Figure E.1. **L1's sketch**

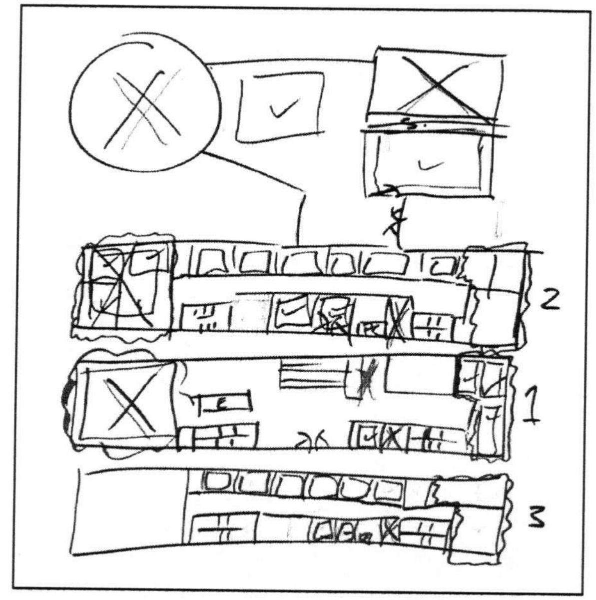

Figure E.2. L2's sketch

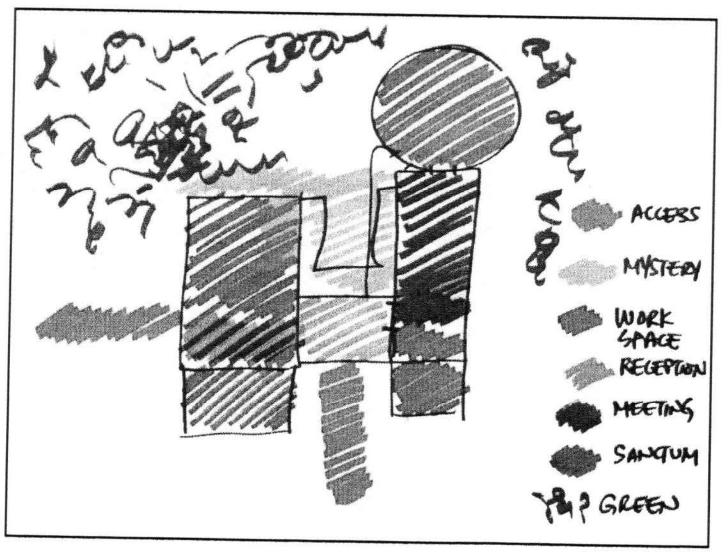

Figure E.3. **L3's sketch**

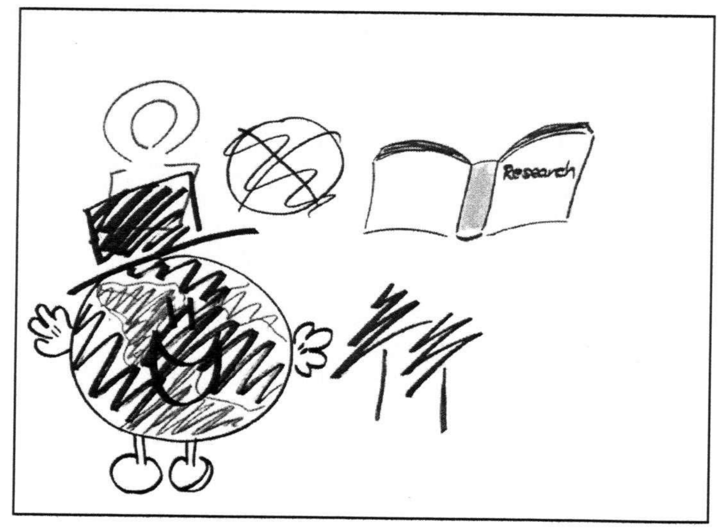

Figure E.4. L4's sketch

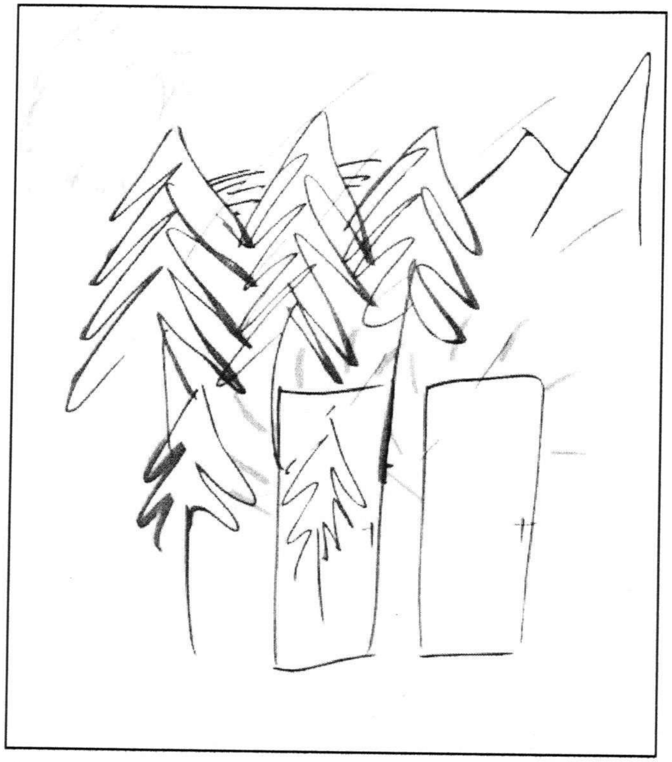

Figure E.5. C1's sketch

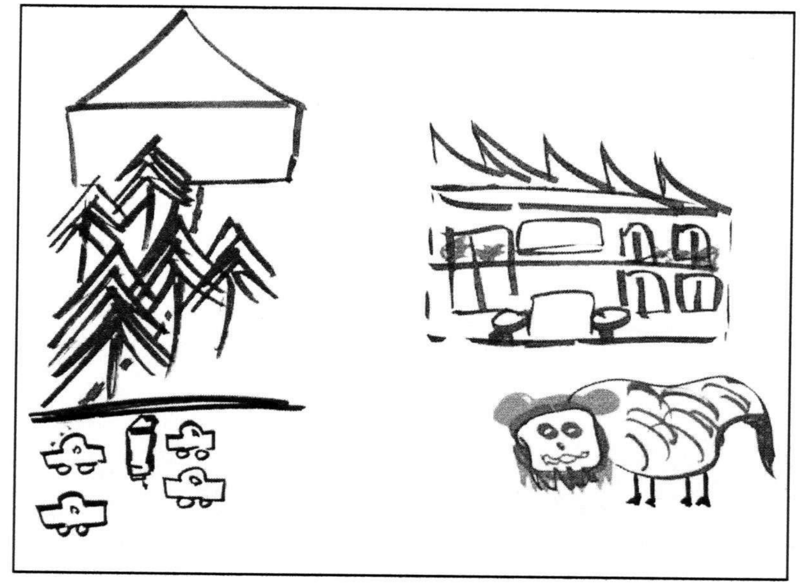

Figure E.6. C2's Sketch

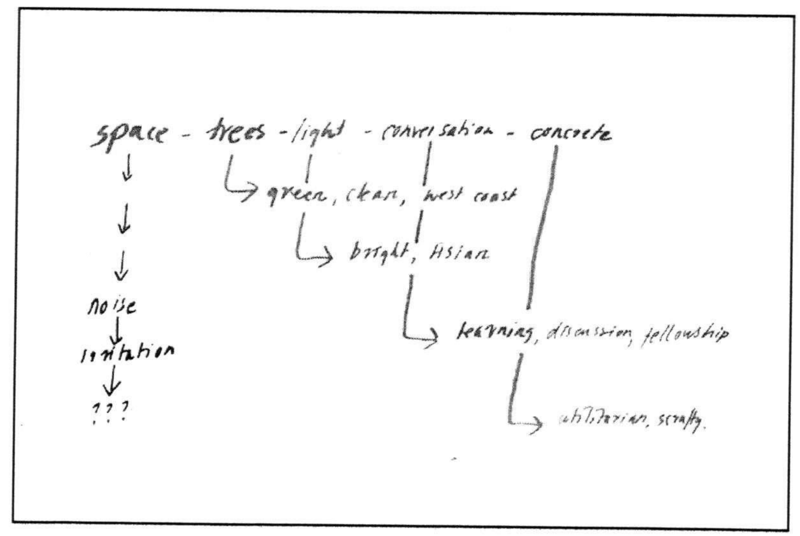

Figure E.7. C3's sketch

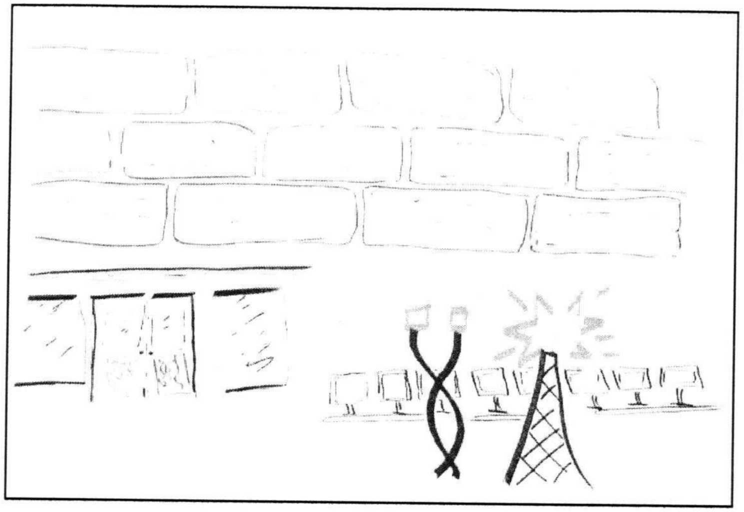

Figure E.8. R1's sketch

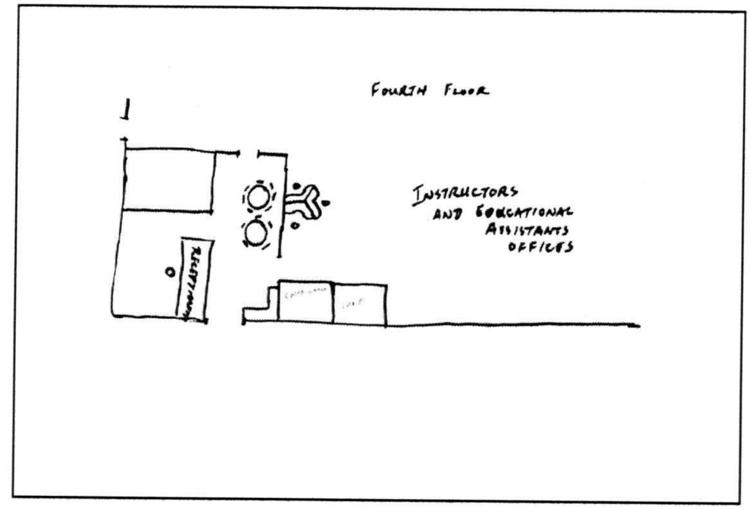

Figure E.9. R2's sketch

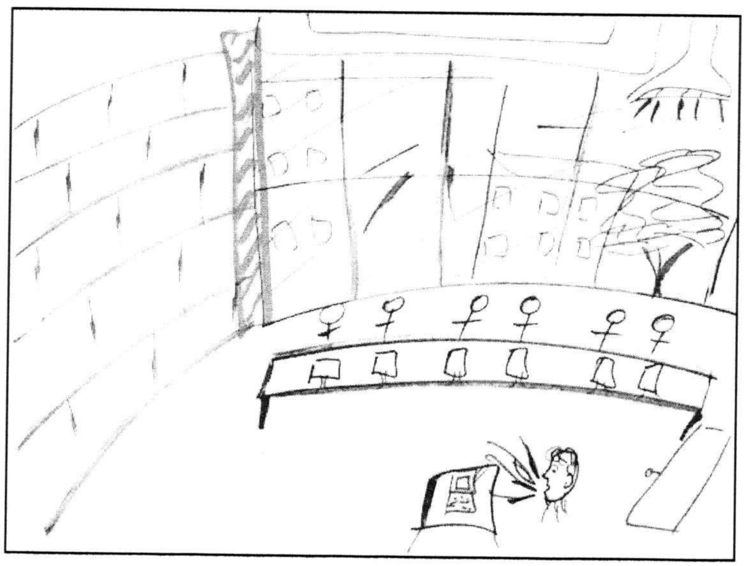

Figure E.10. R3's sketch

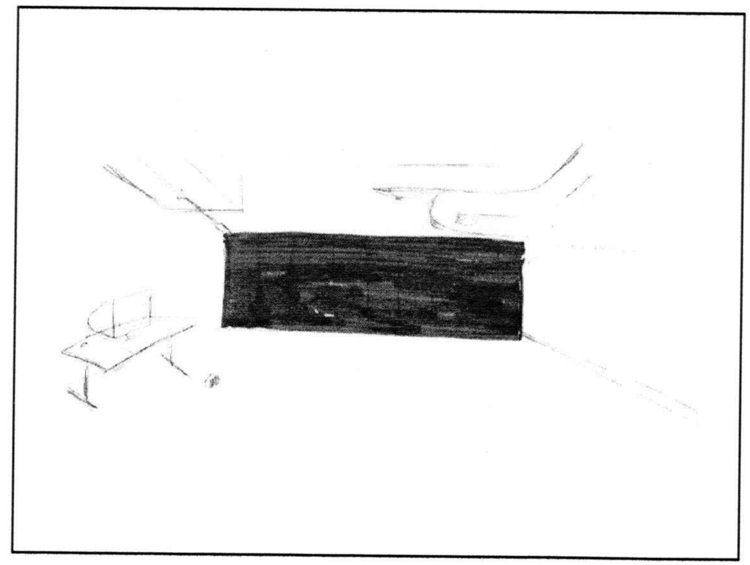

Figure E.11. R4's sketch

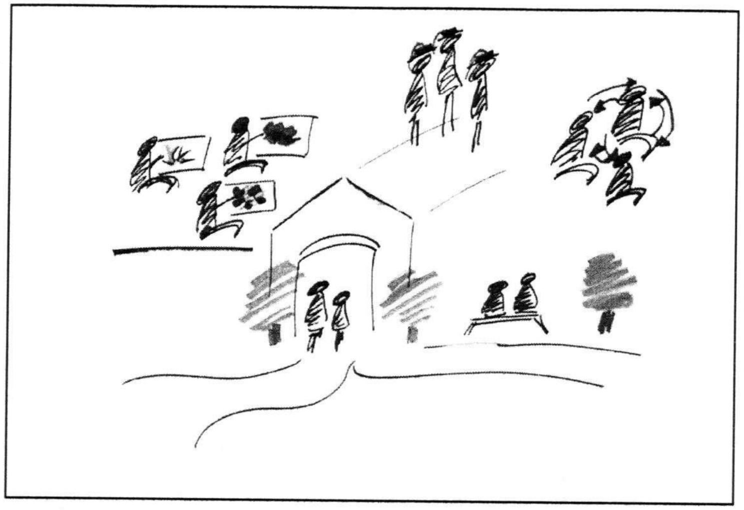

Figure E.12. R5's sketch

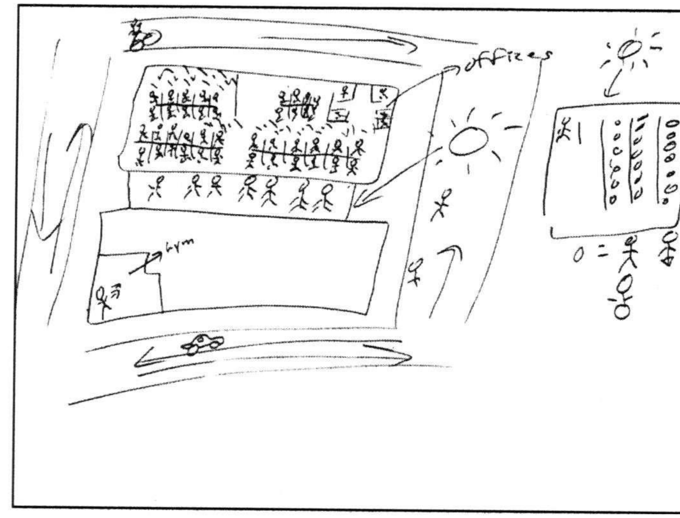

Figure E.13. R6's sketch

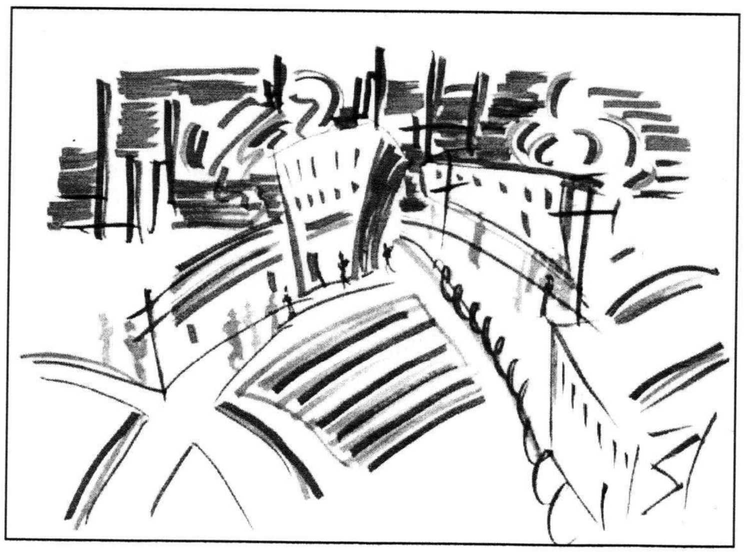

Figure E.14. R7's sketch

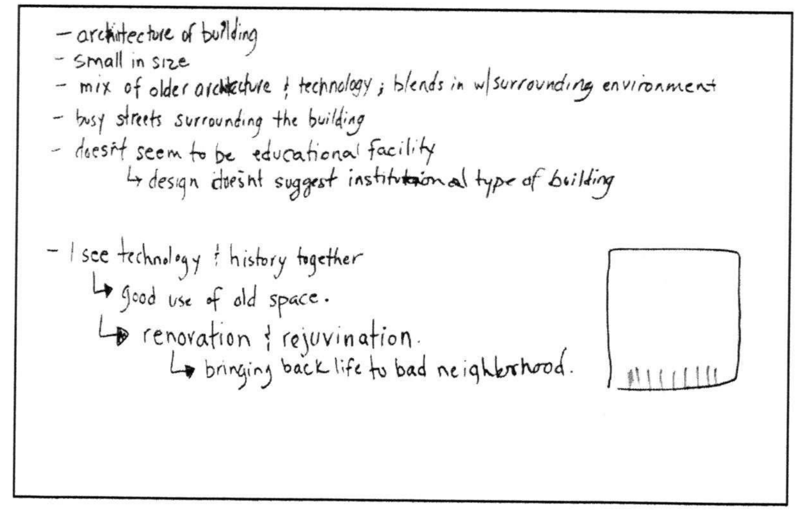

Figure E.15. R8's sketch

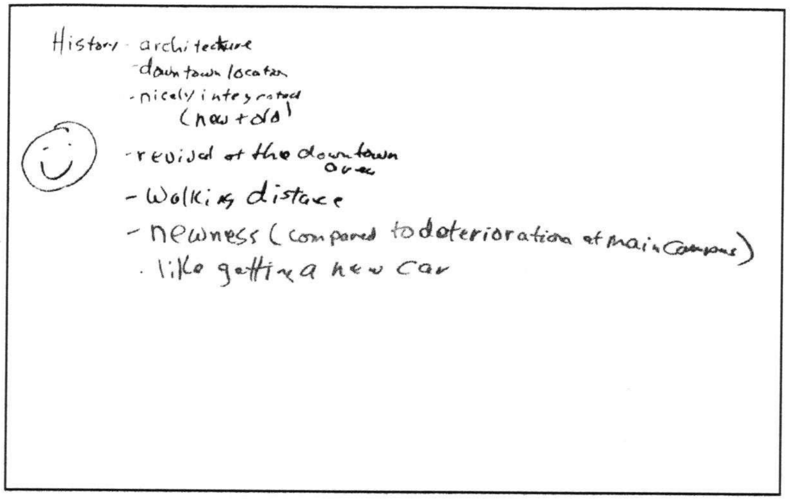

Figure E.16. R9's sketch

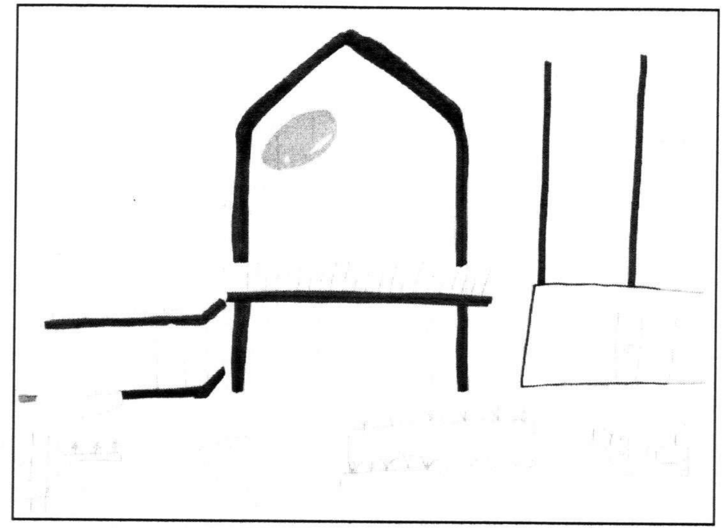

Figure E.17. R10's sketch

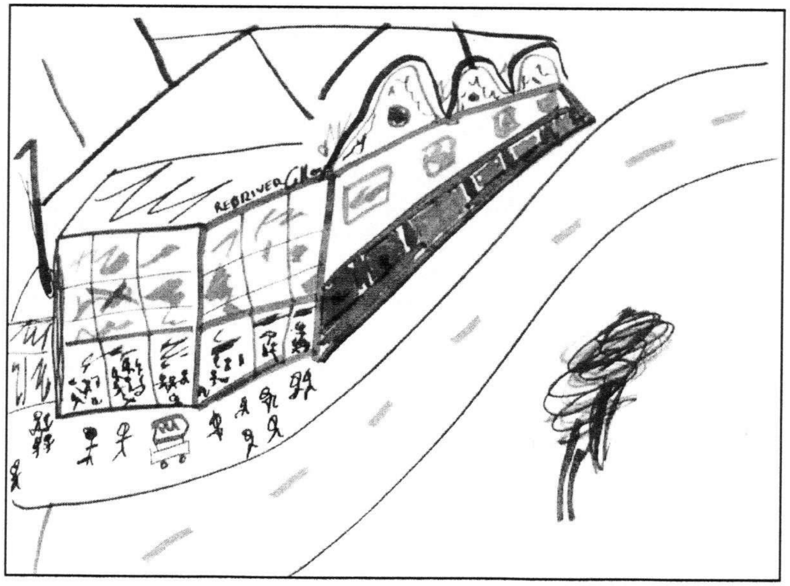

Figure E.18. R11's sketch

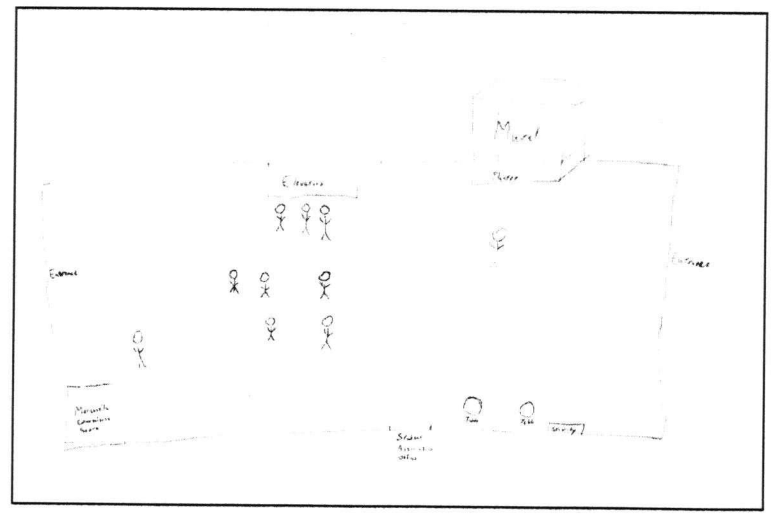

Figure E.19. R12's sketch

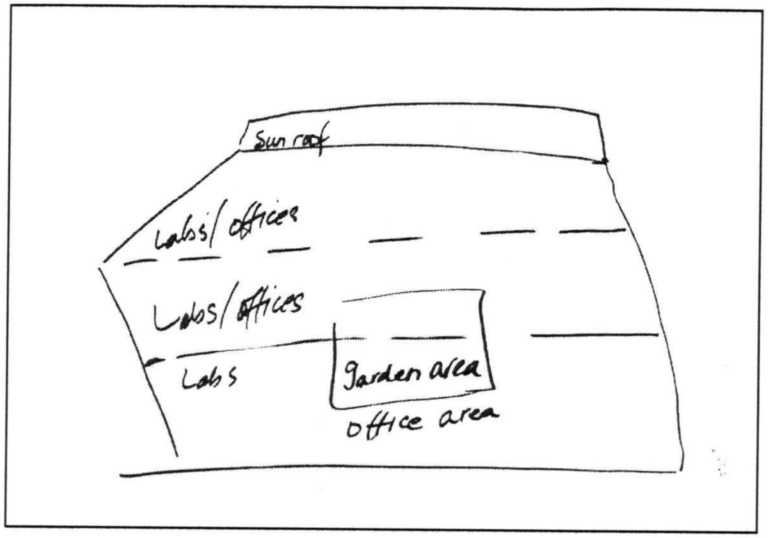

Figure E.20. Y1's sketch

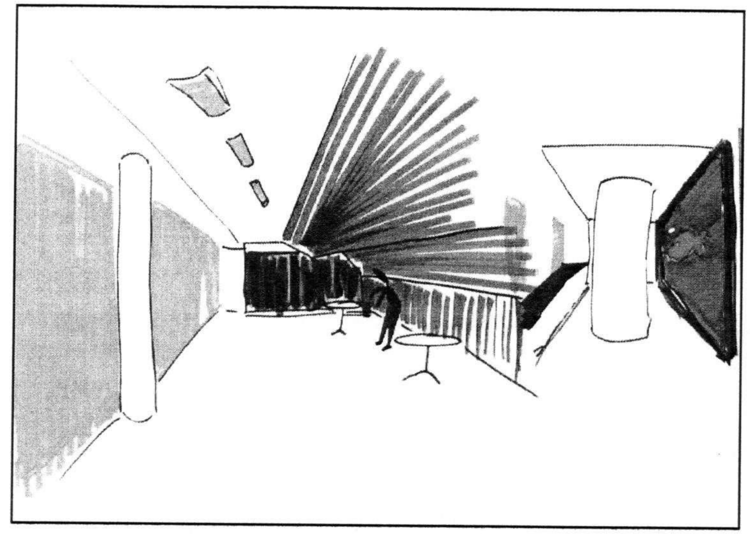

Figure E.21. Y3's sketch

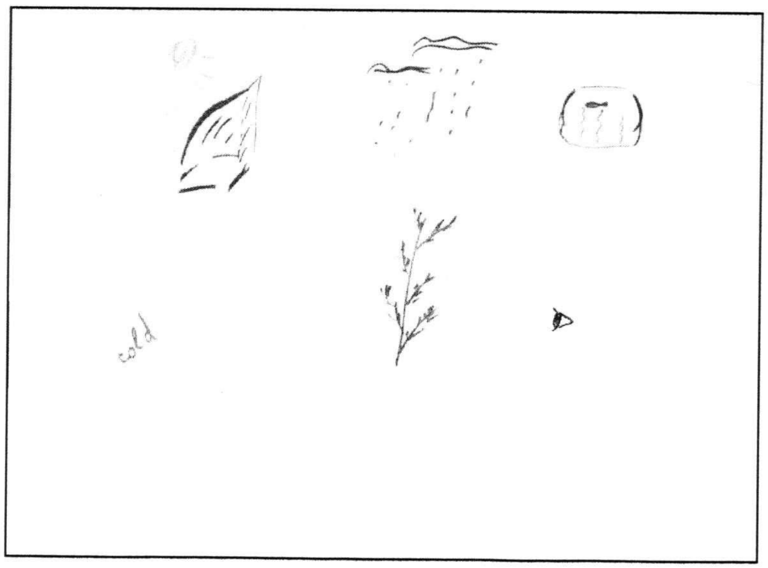

Figure E.22. Y4's sketch

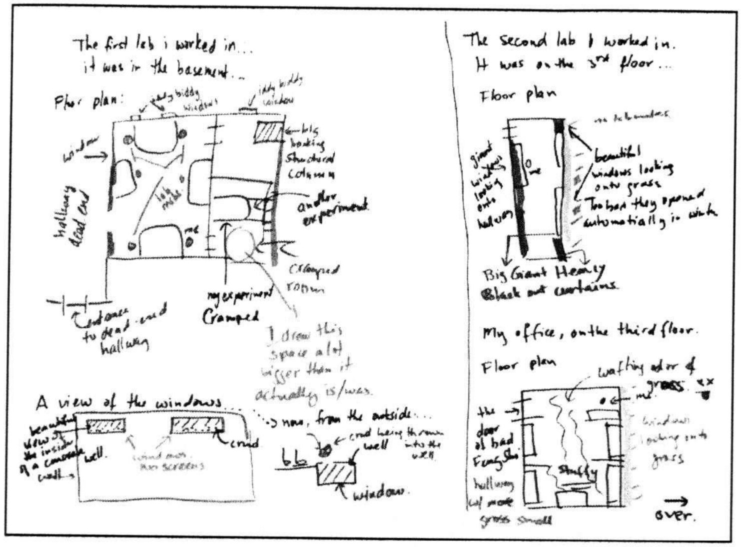

Figure E.23. Y5's first sketch

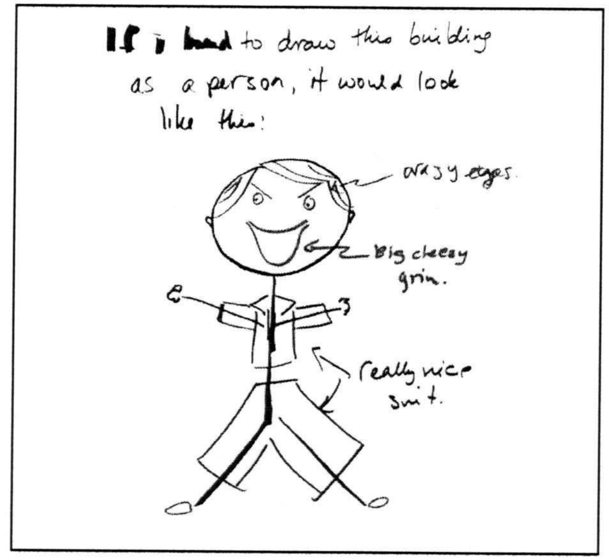

Figure E.24. Y5's second sketch

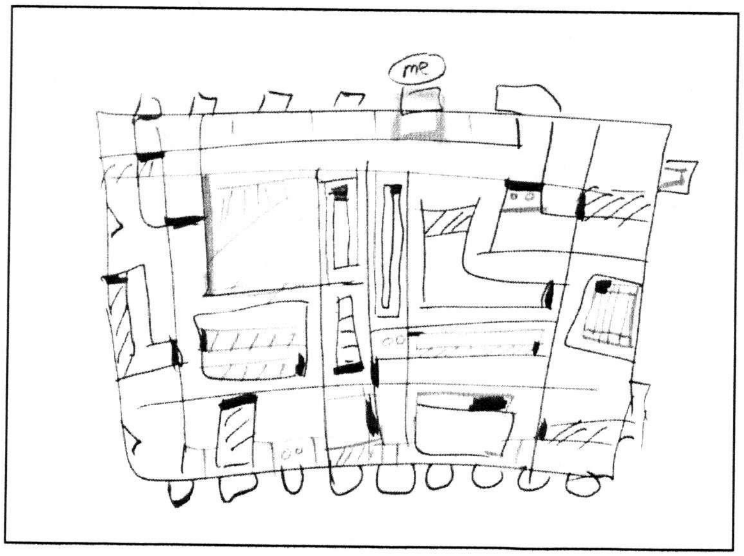

Figure E.25. Y6's sketch

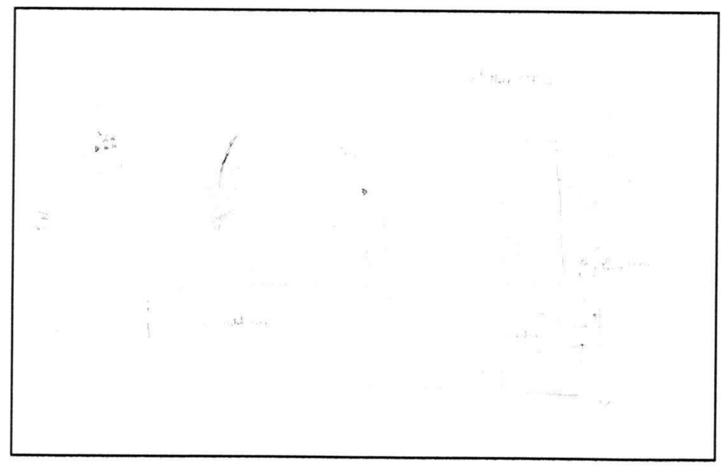

Figure E.26. Y7's sketch

Main Issue Areas for Each Occupant

Appendix F

During the course of an interview it was common for an occupant to stress a particular topic, design feature or issue area about the building. These main "issue areas" for each participant are summarized in Table 5.8.

Table F.1. Main issue areas for each participant

L1	• Windows • Setting • Natural light
L2	• Noise • Non-functional
L3	• Noise • Airiness • Operable windows
L4	• High tech • Clean • Environmentally friendly
C1	• Operable windows • Setting – trees • View • Recycled materials
C2	• Emotional attachment – home feeling • Community • Maintenance
C3	• Concrete floors • Community • Noise • Bright - natural light • View
R1	• Brick • Old • New technology • Patio • High ceilings
R2	• View • Windows • Breakout rooms • Area – restaurants
R3	• Beautiful, yet non-functional • Noise • Glare

	• Great area • Old & new
R4	• Fresh air • Feel like you want to work
R5	• Windows • Natural light • Operable windows • Air quality • Social • Little artifacts • Fosters creativity
R6	• Gym • More connected to community
R7	• Location • Green space • Interactive with area • More connected • Social • Reclaimed materials • Plants
R8	• Modern • "non-institutional" • Fits into landscape • Breakout rooms
R9	• Area • Old architecture • Glare • Technology – network connections
R10	• View • Little artifacts • Plants • Atrium • "good feeling"
R11	• View • Windows • Little artifacts • Plants

	• People/student vibe
R12	• Watching the building evolve • Belonging • Area
Y1	• Natural light • Cold • Garden
Y2	• Slow elevators • Good colours
Y3	• Complaints • Does not like exposed concrete • Non-functional spaces
Y4	• Glass partitions • Natural light • Green atrium • View
Y5	• Green roof • View • Staircases • Complaints!
Y6	• Illusion of security (locked doors) • Poor wayfinding • Lack of response from university about maintenance
Y7	• Lecture halls • Green • View • Wasted space