5.2. WAY FINDING

5.2.1. FINDING STAIRS AND ELEVATORS
“Sometimes I take the stairs down, but there is no way to take them coming up...”

5.2.2. FINDING RECYCLES BINS
“I recycle if I see a recycle bin...”

5.2.3. FINDING THERMOSTATS AND LIGHT SWITCHES
“I didn’t know where it was and finally I found it after one year...”
5.2.1. FINDING STAIRS AND ELEVATORS

As discussed before, the ease of accessing and using stairs and elevators is a noticeable factor in altering the energy performance of an office building. In addition to the fact that stairs should be user friendly and not too steep, they should be very visible and found without difficulty.

Newcomers to the buildings may have a hard time finding the location of the elevator and use the stairs instead. The opposite scenario is also possible when they prefer to use the stairs but can’t find them. Therefore, both the stairs and elevator should be easy to find and navigate.

In Harvill, finding the elevator which is located in the middle of the building is very hard and therefore newcomers usually use the stairs. However, permanent users are happy with its location.
In Marshall, finding the stairs is somehow impossible for the newcomers because they are hidden from the main lobby and as shown in the plan, each visitor needs to pass through two doors to reach the stairs. The doors may imply entering a private space and therefore, all the newcomers eventually use the elevators even for going to the second floor, which means some energy which could be saved is used. Besides, for health reasons, probably walking up a couple of flights of stairs a day is good exercise and many users like doing that.

Figure 36. Finding the stairs and elevators in Marshall
6.2.1. FINDING STAIRS AND ELEVATORS

SIMULATION

By entering the new building from the north entrance, the users will easily see the middle staircases (shown in yellow). However if they enter the building from south, they may just enter the interior space before going to the courtyard and seeing the stairs and be directed to the west elevators first (shown in red) and then the west stairs (shown in orange.)

Figure 37. Finding the stairs and elevators in the new building
5.2.2. FINDING RECYCLE BINS

The average office worker in the US generates approximately two pounds of paper and paperboard products every day. Although there is an effort in using recycled materials in construction in the new trend of green design, there is not in office buildings.

Placing sufficient number of recycle bins and paper shredders in strategic and visible locations is a key factor in encouraging the users to recycle paper in their offices.

Finding recycle bins is not very easy for users of the fourth floor of Harvill and there is only one set of recycle bins for the whole floor. Some of the users were not sure about their location or found them not close enough to their office.

Figure 38. Recycle Bins of Harvill
6.2.2. FINDING RECYCLE BINS

SIMULATION

At this point, it is hard to exactly predict how designers of the new building will manage recycling because recycling locations are not included in schematic designs. Nevertheless because the new building intends to achieve a LEED Platinum rating, as one of the prerequisites of “Materials and Resources” section of LEED, the design should “Provide an easily-accessible dedicated area or areas for the collection and storage of materials for recycling for the entire building. Materials must include, at a minimum: paper, corrugated cardboard, glass, plastics and metals (USGBC.)”

This prerequisite emphasizes “easily-accessible” recycling which is more related to task performance. However it does not highlight the importance of the visibility of areas dedicated to storage and collection of recyclables which is the main concern of this issue. As mentioned in the design guidelines of Facility and Campus Planning at the University of Massachusetts Amherst, trash & recycling bins should be located along the path at regular intervals and at intersections of major paths (URL 4.) Standard pathways should accommodate trash & recycling bins near building entrances and each office and similar spaces should be provided with a separate trash and recyclable containers.

Figure 39. Noticeable recycle bins for the new building
5.2.3. FINDING THERMOSTATS AND LIGHT SWITCHES

By placing thermostats in noticeable and reachable locations which could be easily found, the efficiency of the spaces can be improved. As a result users will work in offices with desirable temperatures and no energy will be consumed for over-cooling or over-heating the offices.

In the studied buildings, even though some of the offices’ temperature can be controlled by thermostats, their invisible and hardly found location is the main obstacle for their usability.

There is a similar problem in finding the light switches of common spaces like corridors and meeting rooms. Users usually do not turn these lights off because they are neither easily found nor noticed. Therefore some of the lights are on all the time.

“There should be a thermostat for this office somewhere, I am not sure where it is and I think it does not work anyways…”

“I didn’t know where it was and finally I found it after one year... now it is much better and I feel so lucky because I could increase the temperature of my bed…”

SIMULATION

According to the new buildings schematic design documents, users will be in control of their temperature and light levels in offices. There is still no specifications of the design of the control devices and how they will be located in the building and therefore it is hard to predict if they will be easily found by the users. Occupancy sensors and light level sensors in common areas will eliminate wasted electrical power when not in use and reduce energy consumption. There is a big question about the functionality of these sensors as a task performance issues. In Marshall users were not happy with the light sensors:

“...I have one of those light sensors, but I have taken it out because I like daylight during the day and I don’t want the light on, and when I am here at night it is a pain because I have to manually put it back and it goes off after a certain period of time and I have to turn it back on…”
5.3. SOCIAL TERRITORIALITY

All the issues that are listed here influence the occupancy of the building. Because of these problems users don’t like to stay in their offices for long hours and prefer to work in other spaces, like their homes, cafes or libraries.

5.3.1. LACK OF COMMUNAL SPACE
“…there is no soft space in the building and the courtyard on the first floor is just a big concrete slab with no benches and no shades.”

5.3.2. SHARED AND RANKED OFFICE SPACES
“…I need to have a private workspace, I just can’t do certain types of work when there are people around me…”

5.3.3. FULL HEIGHT OPENINGS
“…I covered them with pieces of paper because I did not like people staring inside my office…”

Figure 41. Working at home or in cafes and libraries
Lack of interactive communal spaces in Harvill, discourages its users from spending maximum time in the building. They prefer to meet people in other buildings, the library, or even some empty classrooms.

“...there is not a very encouraging layout for organization in this building, there is no soft space and the courtyard on the first floor is just a big concrete slab with no benches and no shades...”

One of the Professors who has studied the physical layout of twelve different schools of Geography in terms of their educational functionality, suggests that the layout for communication is very important and there should be more communal spaces with access to natural light where people can socialize.

“...lack of social interaction has created spaces that are not pleasant to work in and this is why I do not see many students working in their offices..."

The only designated break room in Harvill is a very small space in one of the corners of the building mainly used for warming up food or storing it in the fridge. Other shared spaces in the floor like the meeting rooms are not used for socializing because they are not immediately visible to most active areas and do not have access to natural light. For socializing or less formal meetings, users either stand on the terraces where are not designed for this purpose, or simply leave the building.
5.3.1. COMMUNAL SPACES

SIMULATION

The main indoor communal spaces (the two yellow bubble spaces in the plan) designated for students, are not located on the main routes that users will take after entering the building from east or west entrances and therefore will not encourage the users to enter them and socialize with others. Only if they take the middle stairs they will pass one of them before entering the building. The material chosen for these spaces’ walls is glass block with a sandblasted finish which will let some light in the spaces but lacks translucency and therefore these spaces may be perceived as private spaces by users and not as communal spaces.

The small green outdoor spaces which will be planted may be successful as spontaneous outdoor gathering spaces. Still, some generously sized indoor communal spaces, usable for everyone, seem to be missing in the floor plan. The small gathering spaces, shown in yellow between the cubicles, are not big and visible enough to encourage interaction.

Figure 43. Communal spaces of the new building

Spontaneous outdoor communal spaces

Small indoor gathering space

Students communal space
5.3.1. COMMUNAL SPACES

PRECEDENT

The office design of the 1970s with office cells and endless corridors, and the regimented cubes of open-plan spaces of the 1980s are far from the needs of the modern users. Now the emphasis is on the “combi-office” which recognizes the need for communal work as well as privacy (URL 5.)

The combi office is defined by teamwork, sharing of common facilities, and good access to back-up spaces. In the office buildings of the information society, the efficiency and success of the employees depends on communication and the concentrated work of the individual is performed in constant consultation with the team. The combi office permits a connection between the open communication of the team and the individual work of the team members and combines team spirit and communication, transparency and flexibility.

Perhaps the design of the new building is somehow similar to a combi office because of the individual workrooms surrounding the interior space. However it lacks the communal spaces that should be in the center of the plan as seen in this example (URL 5.)

Figure 44. The Combi office
Source: http://www.scribd.com/doc/52167532/2/Combi-offices
5.3.1. COMMUNAL SPACES

PRECEDENT
SOCIAL DEMOCRATIC OFFICES

Office workers may spend long hours outside their offices in a working day because they can not always find what they need in the boundaries of office buildings. Many communications take place at home, on the road, in a restaurant or club, in the hotel room, on the train or plane.

The more an office building includes these types of activities and communications that take place in alternative locations, the more successful it is in utilizing the space and increasing worker’s performance.

Frank Duffy calls the offices that can fulfill these requirements the “social democratic” model, mostly seen in Germany, Netherlands and Scandinavia. A good example is Niels Torp’s SAS headquarters in Stockholm which dislikes the display of hierarchy. The street as the main collective feature of the interior and another symbol of organization values has a glass roof and lined by communal spaces, beautifully planted, and leading to an entrancing exterior restaurant view of a lake as fjord (Duffy, 35.)
5.3.2. SHARED AND RANKED OFFICES

5.3.2.1. SHARED OFFICES

In a study in Sweden, 469 employees in 26 different companies rated their satisfaction with the office environment in different office types including individual offices, shared offices with two to three people per room, traditional open plan offices and flexible offices with no personal workstations. The overall analysis showed that the people most satisfied with privacy situation of all office employees were those working in private offices. Among people working in shared office environments, the most satisfied were those in flexible offices. The least satisfied were those in large open plan offices with cubicles concerned for being observed (visual privacy) (URL 3.)

In Harvill, all the offices shown in purple are shared between two or three people, mostly graduate students. The main issue with these shared spaces is lack of privacy, specifically when they need to talk with their students about exam results and other sensitive issues.

“I am OK with sharing my office, but for this size, which is less than one hundred feet, three people are a lot especially if we are meeting students.”

In cubical work spaces of Marshall students do not feel very productive and prefer to work in other places:

“...people are less productive... people can’t focus is cubicles... it is not good because people watch you and always hear you and you also hear everything...”
The offices of Harvill are ranked among their users according to their access to natural light and privacy. Almost all the interviewed users defined the most preferred offices as those ones with best access to natural light and view.

For faculty members, who have the option of choosing their offices, this is the main criteria and also means that natural light functions as a status sign. The second criteria in ranking the offices was privacy. Most of the users preferred private offices over shared spaces.

The offices which did not have privacy and access to natural light are mostly unoccupied and the energy used for their operation is wasted.

Figure 48. Ranked offices of Harvill
5.3.2. SHARED AND RANKED OFFICES

**SIMULATION**

In the new building, private offices (shown in green) are designated for the faculty members and postdoctoral researchers and the cubical shared spaces (shown in yellow) are for graduate students. The corner offices are for directors of the programs and their assistants. This is very similar to traditional office layout and is questionable in this fluid modern office setting. In combination offices the designers will eliminate the corner offices to avoid the sense of undue control by directors.

Since each group of users (Faculty and researchers, students and staff) has similar offices amongst themselves, there will not be a clear ranking among each group of users’ offices. All the private offices have access to natural light with similar sized windows and they have a view out. The only workplaces without a view and direct natural light are for director’s assistants (shown in red) and students.

As discussed before sharing cubicles is not very pleasant for the students mainly because of privacy issues and they prefer to have their own offices or at least work in offices shared between two or three students.

Figure 49. Privacy and Ranking in the New Building
6.3.3. FULL HEIGHT OPENINGS

Full height openings of Marshall individual offices are mostly covered by pieces of card-board. Lack of privacy caused by these openings makes them an unpleasant element in the office and although covering them does not let natural light travel into the corridors and may not be aesthetically pleasant, it makes the offices more usable. As a result more energy is used to light up corridors designed to borrow natural light from the offices.

SIMULATION

In the new building all the individual offices have full height openings both towards the student cubicles and exterior communal spaces. If the users decide to cover these openings as they did in Marshall, there no indirect natural light will reach student's cubicles.

Figure 50. Marshall Full height openings

Figure 51. Full height openings in the New Building
5.3.3. FULL HEIGHT OPENINGS

PRECEDENT

Buy using appropriate day-light strategies it is possible to let the users cover their full height opening for privacy reasons and still let some natural light penetrate to the corridors. In the Science & Technology Facility of National Renewable Energy Laboratory in Colorado, the Smith group have used light shelves to extend sun light into the building without increasing glare. This strategy lets more light into the building during winter and less light during summer which is an important energy saving factor (URL 6.)

A similar strategy can be utilized in the new building. As a result it would be possible to let the light travel to the cubicles area and also the faculty and Post-Doc researchers will be able to close the office blinds, curtains or shades whenever they need to. Of course this means students will only have indirect natural lighting and still will not have access to any windows. The building is too thick, and to give graduate students their own exterior light sources would probably require more building floors with less square footage in each floor.

![Figure 52. Light Shelves of Science & Technology Facility in Colorado](image1)

![Figure 53. How to use a light shelf with reflective convex surface in the new building](image2)
5.4. **CULTURAL EXPRESSION**

5.4.1. **RIDING A BIKE OR WALKING TO WORK, USING THE STAIRS**
“...I like to use the stairs, it is a good exercise and I don’t have to rely on the elevators...”

5.4.2. **PERSONALIZATION OF WORKSPACE**
“... I want to see something in the new building that shows the building is for environmental sciences...”

5.4.3. **HAVING PLANTS**
“I like to have a plant in my office or at least look at a plant outside...”

5.4.4. **VIEW OF MOUNTAINS**
“The only reason that I chose this office was because of this view towards the mountains ... this view is the most important thing for me and this is why I want our department to be higher up in the new building...”

5.4.5. **THEMATIC EXPRESSION**
“It is important for us as Environmental Scientists to work in a building that somehow reflects the values of the works that we are doing..."
5.4.1. RIDING A BIKE OR WALKING TO WORK, USING THE STAIRS, TAKING SHOWER AT WORK

Considering the fact that most of the interviewed users excluding the staff are environmentalists, it is not a surprise that more than 80 percent of the users ride their bike or walk to work and live less than two miles away from their offices, or in other words have many “Green Habits.”

More than 85 percent of the users wish to use the stairs more often than the elevators because they find them healthier and less harmful for the environment.

“I like to use the stairs, it is a good exercise and I don’t have to be relied on the elevators…”

SIMULATION

As discussed before in the new building users will have more options for using the stairs instead of the elevators. This will increase their satisfaction and as a result they will care more for the building and the way they use it. It is not clear if the designers have intended to express environmental values of keeping fit, in a Cultural Expression sense, by creating more options in using the stairs. However the result may imply these values for the users and increase their satisfaction.

Figure 54. Walking and Biking to work, Taking the stairs for exercise
5.4.2. PERSONALIZATION OF WORKSPACE

The users tend to personalize their offices by bringing in different personal objects or by modifying and attaching meaning to specific elements already in the buildings. Signs and symbols are developed within a work setting according to social convention. These objects affect what a person can do socially, either by expanding or restricting the scope of that person’s action and thoughts (Csikszentmihalyi, 1981.)

These symbols may represent positive or negative characteristics of the workspace for the users. Those who find more negative objects are less likely to care for the building. Additionally when they find the building not capable of representing significant cultural meaning, they are less willing to bring their own objects. When they find more potential symbols connected to their beliefs, they find the building more appealing and usable.

Most of the users of Harvill and Campus Christian center found the buildings generally lacking in the expression of cultural meaning. In Harvill, faculty members who had bigger offices with windows had made an effort to bring their own items. PhD students with shared dark offices had little interest in their workspace and had not brought any personal items to their offices.

Figure 55. Personalization of workspace in Harvill
5.4.2. PERSONALIZATION OF WORKSPACE

SIMULATION

In the individual offices of the new building users will be able to personalize their workspace by bringing their own items. This will be much harder for PhD students working in the cubicles. They may not leave their personal items in the shared working areas because they will not have any control of their workspace when they are away.

Figure 56. Personalization of workspace in the new building
5.4.3. PLANTS

Csikszentmihalyi and Halton interviewed members of 82 families living in the Chicago metropolitan area to find out what the empirical relationship between people and things in contemporary urban America are. Based on their findings represented in the book “The Meaning of Things”, plants are able to embody personal values more than any other object. These values involve nurturing, the caring for living things that respond to one’s attention (Csikszentmihalyi and Halton, 1981).

In the studied buildings, almost all the interviewees mentioned that they like to have plants in, or nearby their office spaces. Because their offices did not have any connections to outdoor green spaces and no green spaces were designed to be a part of the interior space, they had brought their own plants to the offices.

SIMULATION

The individual offices shown in yellow will have a view out towards a green space and some plants. Other individual offices and shared office spaces do not have this advantage and therefore may be less admired by the users.
5.4.4. VIEW OF THE MOUNTAINS

The users preferred to have a nice views of the mountains since their work is symbolically related to the earth and mountains. A geography professor in Harvill could choose his office between a few offices and he picked the office which had a view of the mountains.

“...The only reason that I chose this office was because of this view towards the mountains. Everybody assumed that I would prefer the other side of the building to be closer to my colleagues, but this view is the most important thing for me and this is why I want our department to be higher up in the new building. Other offices may have a view of some plants and sky but no mountains. I love to see the mountains all the time...”

He also mentioned that he is very happy of being in the fourth floor so that he could have this view.

SIMULATION

In the new buildings’ sustainability chapter of the schematic design documents, it is mentioned that “Building users have panoramic views of the university campus with the scenic views of the Santa Catalina Mountains.” The picture bellow shows the south view from the first floor and the picture on the right shows the north view from the first floor. Obviously only users on the south side of the higher floors will be able to have the view of the mountains.

Figure 59. View of the mountains

Figure 60. North and south views of the new building
5.4.5. THEMATIC EXPRESSION

SIMULATION

Most of the interviewees believe the studies buildings are lacking a thematic expression showing they are used by environmentalists. This is perhaps because Harvill and Marshall buildings have mixed used occupancy and are not solely for the Environmental programs. Campus Christian center is mainly a church and therefore looks like a church, not an environmental building.

“It is important to have a visual identity for a lot of reasons...Communicating to the rest world that University of Arizona is very strong in environmental arena...We should get that knowledge out there in any ways that we can.”

“It is important for us as Environmental Scientists to work in a building that somehow reflects the values of the works that we are doing...”

“Not necessarily the building should be different but because it is a building for the Environmental fields, it should be making us a statement on the campus about environmental factors...”

Figure 61. No thematic expression in Harvill and Marshall
5.4.5. THEMATIC EXPRESSION

SIMULATION

The new building, is designed to achieve a LEED Platinum rating. According to the schematic design documents' sustainability chapter:

“The team seeks to design a facility that is a reflection of the University’s commitment to sustainable design in the Sonoran Desert. The idea is to create a facility that brings the campus community together to improve interdisciplinary interactions, allowing for flexible office, research, and learning environments and provide the opportunity for building users and the public to tangibly see sustainability in action. It is the belief of the design team that this project is soundly sustainable and transcends the connotations of LEED buildings.”

This goal is achieved by innovative design solutions responding to the challenges of the Sonoran Desert. The design is based on the concept of a canyon in the middle of the building with tempering terraces and solar chimneys. The canyon acts both as a climate responsive element and also a representative of the region and corresponding environmental programs.

The users think this concept is very appropriate for a building designed for Environmental Sciences, relating to the land, particularly arid land of Arizona. They believe a canyon is a great symbol for the geographical location of the programs and related to the culture of their research.

Figure 62. Thematic expression in the new building
6.4.1. Riding a bike or walking to work
6.4.2. Using the stairs
6.4.3. Plants and view of the mountains

5.4.5. THEMATIC EXPRESSION

PRECEDENT

The new California Academy of Sciences, designed by Renzo Piano in San Francisco, is mainly known as a largest museum of natural history in the world. The academy conducts research in numerous fields including all branches of biology. The academy was first founded as a research center in 1853 and its first museum official museum opened in 1874 (URL 11.)

The new building aims to promote sustainability in every aspects of the design and to educate people about ecological concerns which is the main focus of the academy and its researchers.

By turning some parts of the new Environmental Sciences building at the University of Arizona to a museum open to the public, the researchers will be able to educate the public about environmental challenges in the Sonoran Desert and promote sustainability particular to the arid land.

Figure 63. California Academy of Science
5.5. VISUAL NON VISUAL AESTHETICS

5.5.1. SENSE OF OPENNESS,
“there is no connection to any open spaces, we go out of the building to get some fresh air and see nice views...”

5.5.2. LACK OF NATURAL LIGHT AND VIEW AND EXCESSIVE ARTIFICIAL LIGHTING,
“It is so dark in here, feels like working in a closet with flourescents, I have no sense of outside when I stay in my office for some hours...”

5.5.3. SUN AND THE SMOKERS ON THE STAIRS
Smoke odor on the stairs discourages the users from using them and they take the elevators instead.

5.5.4. NATURAL VENTILATION
“I really want the windows to open, I hate an office where I never connect with the outdoor and the new building is going to be as bad...”
Lack of pleasant open spaces is probably a major reason for the users to leave their workspace frequently.

As most of the interviews in Harvill mentioned, the shaded exterior terrace of the building is the only open space on each floor and other parts of the building have no interactive connection with outdoor space. Even though these terraces are mainly designed as the access route for each floor, sometimes they are used as open spaces for the users to get some fresh air and sun.
6.5.1. Sense of openness

SIMULATION

The connection of indoor and outdoor spaces is very successful in the new building. The design includes a central courtyard, the “canyon,” encompassing for much of the circulation and interaction spaces. As stated in the schematic design documents’ sustainability chapter:

“This approach yields a smaller environmental footprint resulting in comparatively lower energy costs, promoting the use of the natural environment. Additionally, plant filled terraces provide a seamless transition between interior and exterior spaces.”

Figure 65. Sense of Openness in the new building
6.5.2. LACK OF NATURAL LIGHT AND EXCESSIVE ARTIFICIAL LIGHTING

As mentioned before artificial lighting counts for 21% of the total energy used by commercial buildings. With good design daylight can provide 70 to 80 percent of total light needed during the day (Chalfoun, 2009.)

New inventions in artificial lighting technology started in 1920s and because of the ease and advantages of electric lighting, the standards for task lighting levels increased. As a result instead of using artificial lighting to augment daylight, now daylight is used to augment artificial light which consumes more energy and also is not a good solution for the well-being of the users and decreases their productivity. It also discourages them from spending time in their offices and they tend to go elsewhere to work.

Occupants in day-lit and full-spectrum office buildings have reported an increase in general well-being and satisfaction. Specific benefits in these types of office environments include better health, reduced absenteeism, increased productivity, financial savings, and preference of workers. Benefits to the office worker are so great that many countries in Europe require that workers be within 27 feet of a window (Franta and Anstead 1994).

Lack of natural light and decent sized windows was probably the interviewees main complain about their office spaces and is the main reason for calling them a “closet with fluorescent fixtures.”

Dark offices of Harvill with no natural light are the least pleasant work places in the building. Even the offices with access to natural light have very small windows and do not fulfill occupants’ need for natural lighting.

As one of the users mentioned: “what is lacking is a pretty decent size window where I could have natural light, but none of the offices has enough natural light.”

Figure 66. Lack of Natural light and excessive artificial lighting in Harvill
Lack of natural lighting has resulted in overcompensating with artificial-lighting in an attempt to create the feeling of day-lighting, which means consuming more energy.

The glare caused by the excessive fluorescent lighting makes working in the offices difficult and unpleasant. A more natural and indirect general lighting and optional task lighting is what most of the users prefer and can also help in saving energy.

In Harvill, Marshall and Campus Christian Center, most of the users who spend long hours in their offices, do not usually use the fluorescent lights unless they have to. They usually turn on some kind of desk light that they have brought to their offices. These desk lamps usually have an incandescent light bulb which consumes more energy than any other bulb type.
6.5.2. LACK OF NATURAL LIGHT AND EXCESSIVE ARTIFICIAL LIGHTING

SIMULATION

In the new building, all individual offices, shown in yellow, have access to natural light; however the shared work spaces or the PhD students cubicles, shown in gray, do not have natural light. Although their cubicles are not more than 27 feet away from the peripheral windows, the light needs to pass through individual offices before reaching them. Furthermore users of the individual offices may block the natural light by covering interior glass walls to have more privacy. As a result a student will not enjoy working in their offices from this perspective.

Figure 68. Natural and artificial lighting in the new building
6.5.2. LACK OF NATURAL LIGHT AND EXCESSIVE ARTIFICIAL LIGHTING

PRECEDES

Core day lighting concepts have always been used to let all the spaces of a building be within daylight distance of the perimeter. This strategy is also used in the new building. However, students cubicles in the Environmental and Natural Resources Building will not get enough natural lighting.

In an office building designed by the Catalonia based, H Arquitectes, the interior courtyard has a flexible shape with glass walls around the inner core to let the light penetrate to all different parts of the building. This lighting strategy makes sense with four internal patios that function as a great linked atrium that supplies natural lighting to every common space (hall, bar, accesses, etc) and particularly to every work space (URL 9.)

Figure 69. Core day lighting, by H Arquitectes
Source: http://www.archdaily.com/50433/office-building-810-h-arquitectes/
6.5.3. STAIRS: SUN AND SMOKERS

As mentioned before, most of the users prefer to use the stairs, however besides problems like steepness or location difficulty, some issues related to Visual and non-Visual Aesthetic, discourage the users from using the stairs.

In Harvill, many users mentioned that the perimeter stairs are always facing direct sun. The only shaded staircase is in the middle of the building, which is “harder to access and ugly.” Moreover, many of them didn’t like the polluted air of this staircase because of the smokers who wouldn’t probably smoke on the stairs if there were an appealing designated smoking area for them.

Figure 70. Stairs: Sun and smokers, Harvill
5.3. STAIRS: SUN AND SMOKERS

SIMULATION

In the new building East and West staircases (shown in light blue) are protected by flat panel anodized wall panels (shown in dark blue). This solid screen on the east and west elevations shield the stairs and walls from the intense morning and evening sun when low on the horizon.

The middle staircase is also protected from south sun by anodized aluminum sun shade/guardrail fins. The fins act as a solar diffuser, preventing direct sunlight into the building while allowing sight lines to the Santa Rita Mountains in the distance. As a result users will not have any problems with the sun in using the stairs.

In view of the fact that the designated smoking area is not clear at this stage of design, it is hard to predict if it will have any effects on the stairs.

Figure 71. Stairs: Sun and smokers, the new building
6.5.4. **NATURAL VENTILATION**

Naturally ventilated offices have 25 percent to 50 percent lower annual energy costs than air-conditioned offices and natural ventilation has a payback period of two and a half years.

Lack of natural ventilation and fixed windows are major problems in Harvill and Marshall’s users. Lack of interchange between indoor and outdoor air reduces air quality and creates unpleasant environments that make staying in the buildings for long hours very hard for the users.

As one of the researchers mentioned:

“I really want the windows to open, I hate an office where I never connect with the outdoor and the new building is going to be as bad…”

Inability in opening the windows and poor ventilation and limited air flow in the office spaces of Harvill are noticeable sources of dissatisfaction for the users.
6.5.4. **NATURAL VENTILATION**

**SIMULATION**

In the new building the central courtyard, the “canyon” (shown in green,) and the outdoor terraces are tempered with solar chimneys (shown in yellow) through the process of natural convection. During warm periods, two solar chimneys heat up a vertical mass of air which expands, rises and is expelled at the roof level. The movement of air across the body and its reduced humidity level makes the exterior spaces feel cooler. In winter the solar chimneys are closed, trapping air warmed by the sun and the thermal mass of the building thus, warming the spaces passively. This strategy mostly works for outdoor spaces. All the interior windows are fixed and there does not seem to be any natural ventilation for the interior spaces.

**PRECEDENT**

The city hall of London designed by Norman Foster relies hugely on natural ventilation. The South, East and West sides, which receive direct sunlight, have panels “composed of a banded grid of triple-glazed panels, solar blinds, and operable vents” (Merkel 2003.) In summer these large air vents allow natural ventilation.

As shown in the natural ventilation diagram, the air enters offices through grilles in the floor while vents in the facade provide external offices with natural ventilation. During winter, heat and moisture is retained from the outgoing air and used to condition incoming ventilation air.

![Natural ventilation diagram](image)

**Figure 73.** Natural ventilation in the new building

**Figure 74.** Natural ventilation in London city hall design by Norman Foster
1.0. ABSTRACT

2.0. INTRODUCTION

3.0. RELATED STUDIES

4.0. METHODOLOGY

5.0. OBSERVATION RESULTS AND BEHAVIORAL SIMULATION

6.0. POTENTIAL APPLICATION

7.0. APPENDICES

8.0. BIBLIOGRAPHY
6.0. POTENTIAL APPLICATION

Today, proliferation of energy consumption in office buildings has made energy efficiency and savings strategies a priority objective for energy policies and designers in most countries. Many new methods, like LEED, are available to rate energy performance of different buildings including office buildings. These verification systems usually underestimate the role of human behavior in the performance of green offices and as a result the energy use of these buildings, after occupation, is much more than predicted by the rating systems.

This happens for two main reasons. Firstly the work environment may or may not have the affordance to allow the users to perform different work related activities in the building. Consequently users may solve these problems by their own means which may result in using more energy. For example, if the artificial lighting is be too bright, they may cover it to avoid glare, or if the stairs are too steep, they take the elevators even for very short trips.

Secondly if the users do not have the ability to solve these problems, or if the building fails to meet their social and cultural needs, they leave the office buildings and prefer to work in other spaces. This means having considerable unoccupied, conditioned work spaces resulting in wasting energy.

But how can we solve these problems? Is there a way to avoid repeating the same mistakes in designing and building new office buildings? As Frank Duffy stated in the book “work and the city,” there is by no means an agreement between the users on what makes a good office; but people may be able to define a bad office from their point of view and can probably point out a few choice examples. This is why this research first tried to find what made an office building bad in users point of view, what was their reaction to inadequate design, and which of these behaviors could influence energy performance of an office building.

By simulating the same behaviors in a new green office building designed for the same users, it was possible to investigate the building’s potential in meeting the users’ needs and predict whether or not the new design was repeating the same mistakes.

Although this research focused on an office building designed for a specific group of people, Environmentalists, a similar simulation process is applicable for different types of buildings and can help the designers to create more efficient user-centered buildings. To achieve this goal, designers should think about the needs of the users throughout each step of the design and spend some time with them through a limited but systematic post occupancy evaluation and understand how they use the space and what are their needs, limitations, and preferences. This process is different from regular full-blown post occupancy evaluations done after occupation in the sense that it particularly focuses on behaviors related to the energy performance of a building.

In the next step, methodological behavioral simulation, will make it possible to predict whether or not the design meets users needs, and the design can be changed accordingly.

Although the presented work is more of a prototype example of what an ideal process might look like, it can be a stating step towards the eventual professional process which might be more comprehensive in terms of detail, participation, feedback and the like as part of the pre-design and design process. The findings of this report are more professionally oriented than scientific research and therefore are less definitive as “truths”, but show where serious discussions should occur among users and designers in the process.

The eventual professional approach would provide the potential for creating buildings which are more efficient and effective and also more enjoyable and compatible with other activities. These buildings would be evaluated before occupation in the pre-design process, and therefore better satisfy their occupants, be more cost effective, and contribute to sustainability by low energy consumption and high occupancy rates.
INTERVIEW SAMPLE

GENERAL INFORMATION: GENDER/AGE/OCCUPATION
Female, professor, more that 40 years old, in Marshall building

She works here 8 hours a day and 5 days a week and is mostly in her office unless she has meetings.

“I guess primarily I work on book series, I am officially the program coordinator and I work between the press and the book editors and developmental editors to make sure that things are moving forward and chapters are good and we are on schedule. And then I do other staff for the institute of the environment as far as furthering communications in general both on and off campus. I work part time on a web site that is designed to provide climate information to resource managers and consultants and for whom climate affects their work decision.”

“The elevator is locked for this floor after 5 pm, but our campus ID card let’s us up here. Sometimes people have meetings up here and you can ask them to keep it open longer.”

Do people work here longer?
“Oh yah, I am always here until six and there are people on this floor who work later. I work from 9 AM to 6 PM.”

TASK PERFORMANCE

“I have enough space in this office and part of the furniture is my own because I used to work at home before and I purchased my own furniture then. Therefore I have no complaints about the furniture and storage space.”

“One thing for the floor we have, there is a shower and I ride my bikes most days even in the summer, but one of the other people on this floor has taken over the shower for storage and nobody can use it. It is very annoying; I hope that he moves out soon. People have talked to him about it, he just doesn’t take it seriously.”

“The windows are not operable, I wish they could be but I know it screws up the air conditioning and would end up probably costing a fortune in the electric bills when people are able to open their windows. I actually blocked off the air coming in my office because it would get too cold in the summer. Several years ago I put a piece of cardboard on the vent and it has been much better.”

“We moved in to this building in 2005. Maybe it was 2004, in March 2004. It has been a while. There is no personal control of air conditioning. The control for this office is next door, but we couldn’t really demonstrate that. I had to have one of those light sensors, but I have taken it out because I like daylight during the day and I don’t want the light on, and when I am here at night it is a pain because I have to manually turn it on and it goes off after a certain period of time and I have to turn it back on.”

How is the artificial light?

“I don’t like artificial light, I love having daylight. I also have light here, under the book shelves and I don’t have glare problems. In the morning I have the curtains down when the light is shining in but otherwise they are open. The window is facing east.”

WINDOW/ DOOR/ AIR CONDITIONING/ LIGHTING/ NOISE/ SMELL:

“The insulation between the offices is very poor in fact my husband and I caulked along the window over there between this office and that office because you could hear everything. You could even slide a piece of paper from this office to that one and it is really a cheap thing that they made for a brand new building, so there is noise. There is more noise than it should be, I think.”

“Most people around here are quiet and currently my neighbors are quiet, but in the past I have had neighbors that laugh a lot and it was very disruptive. I haven’t noticed any bad or good smells.”
ELEVATOR, STAIRS

“I sometimes go down the stairs, I used to go up and down the stairs until they locked the stairway at the top, so you can’t get in. You only go down, which is, you have to be able to go down for fires. I used to use the stairs for exercise, but now sometimes I go down.”

SOCIAL TERRITORIALITY

“We have meetings in one of our offices and the other thing is that part of our group is in the Campus Christianity Center and I work with those people and sometimes I need to go down there and meet with them or they come up here and we go back and forth.”

WAY FINDING

“I don’t have many outside visitors. Sometimes people get lost and ask me for directions because they can find me easily because my of where I am.”

CULTURAL EXPRESSION

“I think the building should be environmentally friendly and LEED certified and that is what they are trying to do and we should set an example by doing that.”

“There are recycle boxes, the lights are on motion sensors so they go off if there is not motion around. The air conditioning goes off after certain time; I think it goes off at 5. So there is a way to manually turn it on after hours if you need it, so I think those things are better than having it heated all the time.”

“If there was a problem I would tell the floor manager and she knows what to do.”

Overall rating of comfort in current office/ Your thoughts about the new building/ Problems influencing your productivity/ Other places you work in/ Where do you think you can work more efficient?

My overall rating of my office is about 7 out of 10.

The new building looks nice and most of the drawings that we have seen are from the outside and I don’t care what the outside looks like as much as how it will be from the inside looking out, so it seems fine so far but you know my jury is still out as far as how it would be like to work in the new building, will I be able to have a nice view?

I want to be able to have my own office and I want to have day-light, these are two most important things for me and I think that will be the case but there is lots of discussion over whether we would have the north side of the building or the south side of the building which has a better view and all that stuff. To me the east side has the best view but it is not designed that way, so I think as long as I get day-light I will be ok.

Besides the office occasionally I work at home, not very often on a weekend. I like working at home but it is more efficient here and the people I need to talk to are here and I am sort of more in the work mode when I am here.
LIST OF FIGURES

Figure 01. Marshall Building, Empty Cubicles
Figure 02. User-centered design
Figure 03. The Environmental and Natural Resources Building, University of Arizona
Figure 04. Harvill Building
Figure 05. Marshall Building
Figure 06. Campus Christian Center
Figure 07. Interviewees’ occupation
Figure 08. Sex distribution
Figure 09. Age distribution
Figure 10. Years worked in the office
Figure 11. Hours spent at work weekly
Figure 12. Typical floor plan of the new building
Figure 13. Sick Building Syndrome
Figure 14. Warming up workspaces
Figure 15. Low temperature in the new building
Figure 16. Traction elevator and Hydraulic elevator
Figure 17. Stairs’ steepness
Figure 18. Access to the stairs, Marshall Building
Figure 19. Using the stairs in the new building
Figure 20. Google Headquarters, Zurich, Positive Kinesthetic and Visual ways of Moving Between Floors
Figure 21. Commercial energy end-use splits, by fuel type
Figure 22. Artificial Lighting in Harvill and Campus Christian Center
Figure 23. Artificial lighting in the new building
Figure 24. Correct positioning of monitor according to window
Figure 25. New building positioning of monitors
Figure 26. Ambient side lighting + Task lighting
Figure 27. Ambient ceiling spot lighting + Task lighting
Figure 28. Task lighting and ambient lighting in Google Headquarters
Figure 29. Noise in Harvill and Campus Christian Center
Figure 30. Shared office spaces in the new building
Figure 31. Vetreria Airoldi office and showroom, Milan
Figure 32. Shared offices and private offices of Harvill
Figure 33. A decently sized faculty office, Marshall
Figure 34. Comparing office sizes of Harvill, Marshall, and the new building
Figure 35. Finding the stairs and elevators in Harvill
Figure 36. Finding the stairs and elevators in Marshall
Figure 37. Finding the stairs and elevators in the new building
Figure 38. Recycle Bins of Harvill
Figure 39. Noticeable recycle bins for the new building
Figure 40. Light switches and thermostats of Harvill
Figure 41. Working at home or in cafes and libraries
Figure 42. Communal spaces of Harvill
Figure 43. Communal spaces of the new building
Figure 44. The Combi Office
Figure 45. The street Niels Torl’s headquarters
Figure 46. Marshall Cubicles
Figure 47. Shared and Private offices of Harvill
Figure 48. Ranked offices of Harvill
Figure 49. Privacy and Ranking in the New Building
Figure 50. Marshall Full height openings
Figure 51. Full height openings in the New Building
Figure 52. Light Shelves of Science & Technology Facility in Colorado
Figure 53. How to use a light shelf with reflective convex surface in the new building
Figure 54. Walking and Biking to work, Taking the stairs for exercise
Figure 55. Personalization of workspace in Harvill
Figure 56. Personalization of workspace in the new building
Figure 57. Plants in Harvill
Figure 58. Plants in the new building
Figure 59. View of the mountains, Harvill
Figure 60. North and south views of the new building
Figure 61. No thematic expression in Harvill and Marshall
Figure 62. Thematic expression in the new building
Figure 63. California Academy of Science
Figure 64. Sense of Openness in Harvill
Figure 65. Sense of Openness in the new building
Figure 66. Lack of Natural light and excessive artificial lighting in Harvill
Figure 67. Excessive artificial lighting in Harvill and Marshall
Figure 68. Natural and artificial lighting in the new building
Figure 69. Core day lighting, by H Arquitectes
Figure 70. Stairs: Sun and smokers, Harvill
Figure 71. Stairs: Sun and smokers, the new building
Figure 72. Natural ventilation in Marshall
Figure 73. Natural ventilation in the new building
Figure 74. Natural ventilation in London city hall design by Norman Foster

Alexander Christopher (1979), The timeless way of building, Oxford University Press.


Duffy, Frank (2008), Work and the city, Black dog publishing.


BIBLIOGRAPHY


Merkel, Jayne (2003), “Along the Thames, Foster and Partners puts a new twist on government and gives green a different shape with the highly accessible London City Hall”, Architectural Record, V.191: 2, pp. 113.


Sundstrom, Eric D and Sundstrom, Mary Graehl (1986), Work places : the psychology of the physical environment in offices and factories, New York :Cambridge University Press.


ONLINE SOURCES:


THANK YOU

UNIVERSITY OF ARIZONA

Professor Dennis Doxtater, Architecture
For continual guidance, direction and inspiration,

Professor Nader Chalfoun, Architecture
For support and encouragement throughout,

Professor Martin Despang, Architecture
For noble ideas and precious comments,

May Carr, University of Arizona Planning, Design & Construction
For generously providing the information and key contacts,

The interviewees
Who contributed their time and insight which informed the thoughts presented in this report:

Barbara Morehouse, Institute for the Study of Planet Earth
Betsy Woodhouse, Ph.D., Institute of the Environment
Dan Ferguson, Institute of the Environment
Dr. Rafe Sagarin, Institute of the Environment
Dr. Tracey Osborne, Institute of the Environment
Dr. Diana Liverman, Institute of the Environment
Melissa Aquino, Institute of the Environment
Rebecca Macaulay, Institute of the Environment
Stephanie Doster, Institute of the Environment
Steve Novy, Institute for the Study of Planet Earth
Audra Elisabeth El Vitaly, School of Geography and Development
Brittany Davis, School of Geography and Development
Derek Eysenbach, School of Geography and Development
Dr. Carl J. Bauer, School of Geography and Development
Dr. Chuck Hutchinson, School of Natural Resources and the Environment
Dr. Gregg Garfin, School of Natural Resources and the Environment
Georgia Conover, School of Geography and Development
Jacob C Miller, School of Geography and Development
Jan Monk, School of Geography and Development
Jesse Minor, School of Natural Resources and Environment
Keri Jean Ormerod, School of Geography and Development
Majed Akhter, School of Geography and Development
Maria Swarts, School of Geography and Development
Paula Denise Decker, School of Geography and Development
Sallie Marston, School of Geography and Development

INDIVIDUALS

My Family
Thank you for your patience and continual support from far away.

Carol Heffern
Thank you for your enduring friendship your inspiring comments.