# Healthy by Design:

# A Post Occupancy Evaluation of Student Housing

A Senior Project Presented to

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# Approval Page

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To Cal Poly students,
past, present, and future

• • •

Never doubt that a small group of thoughtful, committed citizens can change the world.
Indeed, it's the only thing that ever has.
-Margaret Mead

• • •

The world will not evolve past its current state of crisis by using the same thinking
that created the situation.
-Albert Einstein

• • •

Always design a thing by considering it in its next larger context –a chair in a room,
a room in a house, a house in an environment, an environment in a city plan.
-Eliel Saarinen


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• • •

Special thanks:
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*Thank you*

# Abstract

Green buildings have been found to have an array of benefits including improved worker health and productivity. This study evaluates whether or not the impacts of a green building found in a workplace can also be observed in a student population housed in a green building. This document presents the findings of a post occupancy evaluation of two university buildings both used for student housing. One building is certified Leadership in Energy and Environmental Design (LEED) Gold, and one was constructed with traditional building practices. The aim of this research is to identify differences between buildings for occupant health, academic performance, and behavioral change. Data has been collected from existing sources including the campus Health Center, Registrar's Office, and Facilities Services. In addition to existing data sets, an online social survey was conducted to triangulate data.

**Search Words:**

Post occupancy evaluation, evidence based design, environmental design research, sustainable building, green building, Leadership in Energy and Environmental Design (LEED), planning, climate change, health

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# Introduction

While the environmental and economic advantages of green buildings have received a great deal of attention over the last several years, occupant benefits are increasingly recognized as an additional outcome of green buildings. Green building workplaces have been found to have a variety of benefits including improved worker health and productivity (Kats, 2006). This study evaluates whether or not the influence that green workplaces have on workers can also be observed in a student population housed in green buildings. A post occupant evaluation was conducted of two university student housing buildings. One building is certified Leadership in Energy and Environmental Design (LEED) Gold, and one was constructed with traditional building practices (Bloom, personal communication, 2010). The aim of this research is to identify differences between the buildings for occupant health, academic performance, and behavioral change.

Universities are an ideal place to conduct research of this type due to the nature of the subject population and readily available data. Generally speaking, the student population that moves through campus housing will remain constant. Meaning that over time the average population age, gender, and number of people will remain more or less constant. This allows for research that evaluates trends and long-term building performance.

The following research explores several aspects of user benefits of green buildings including health, performance, and behavior. Findings and conclusions are presented at the end of the document.

## Background

Modern buildings are a triumph of human civilization, but they have a hidden cost. Buildings provide essential services and allow us to live comfortably in otherwise inhospitable environments. Buildings use almost three-quarters of all electricity generated in the United States and are responsible for the associated greenhouse gas (GHG) emissions and other pollution (Randolph & Masters, 2008). In 2008, James Hansen along with a team of other scientists published an alarming finding:

> "If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that $CO_2$ will need to be reduced from its current 385 ppm to at most 350 ppm, but likely less than that" (Hansen, 2008, p.1).

This finding more than any other has simplified the message of the climate science community and has drawn attention the urgency of our situation. We have only a few years to reduce our carbon emissions to safe levels.

A key component to this transformation is low-carbon and resilient buildings (Roaf, Crichton, & Nicol, 2009). The U.S. Environmental Protection Agency (EPA) defines "green building" as "the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle, from site selection to design, construction, operation, maintenance, renovation and deconstruction" (U.S. EPA, 2010). To understand the challenges and opportunities inherent in green building practice the industry itself must be understood along with associated governmental policy and health context.

## Policy

At all levels of government (federal, state, and local) we are seeing the beginnings of a policy response to this crisis. The federal government has recently passed legislation, the American Clean Energy Leadership Act of 2009 that mandates utilities to provide a portion of their electricity generation from renewable sources, and provides funding to aid this transition. However, progress continues to be slow at the federal level. Congress missed a huge opportunity to include a carbon emissions cap on this year's energy bill. Instead of the much needed comprehensive climate change legislation, the energy bill is severely watered down and politically safe. The bill mostly consists of increased liability for oil spills, promotion of natural gas, and energy efficiency (Wolff, 2010).

An easier way for the federal government to transition to a sustainable future is for President Obama to implement serious energy policy without the help of Congress by having the federal government employ green technologies (Parenti, July 15, 2010). Because the federal government makes up 38 percent of the U.S. economy this investment would create a stable market for clean technologies and drive down their cost.

State governments are embracing green building practices. California and other states are regulating GHGs through improved building codes and other legislation. One of several climate bills passed by California is Assembly Bill 32, Global Warming Solutions Act of 2006 that aims to cut carbon emissions from the business as usual scenario for the State nearly 25 percent by 2020 (California, 2006).

California is leading by example and now requires all major State building projects to be LEED Certified Silver (California, 2010). Effective January 1, 2010, all new construction in California must meet the improved Title 24 Energy Efficiency Standards. The updated code has

revised provisions for efficient heating and cooling technologies, provides a reflective roof index, and provides energy efficiency credit for installing photovoltaic systems.

Cities are doing their part too through the creation of green building ordinances and are adapting their permitting processes to allow green buildings to be more easily approved. A few examples of this are cities like San Francisco, Portland, Seattle, and Chicago which have adopted climate action plans, green building ordinances or both (Cal Poly, San Luis Obispo Consulting Team, 2009). Chicago's Green Permit program now waives review fees and expedites building projects that are LEED certified. This encourages green development and reduces the permitting process to 30 days or less (Chicago, 2008). This is a great benefit for developers because time is money especially when costly debt services loom over a project.

## Green Buildings

Currently LEED registered buildings account for approximately five percent of new commercial building construction value in the United States, and ten percent of public sector and nonprofit green building value annually (Yudelson, 2008). In recent years, green building markets have been impressive and this is projected to continue into the foreseeable future (Yudelson, 2008). Green builders claim their projects have various benefits over conventional buildings such as water efficiency, marketing potential, long-term cost, energy efficiency, worker productivity, environment, and benefits to occupant health and wellbeing, among other things (Yudelson, 2008).

There is a lack of attention to human health in the LEED rating system. A report released this year by the nonprofit research organization Environment and Human Health, Inc. (EHHI) points out imbalances in the design of the LEED credit system. The organization is comprised of

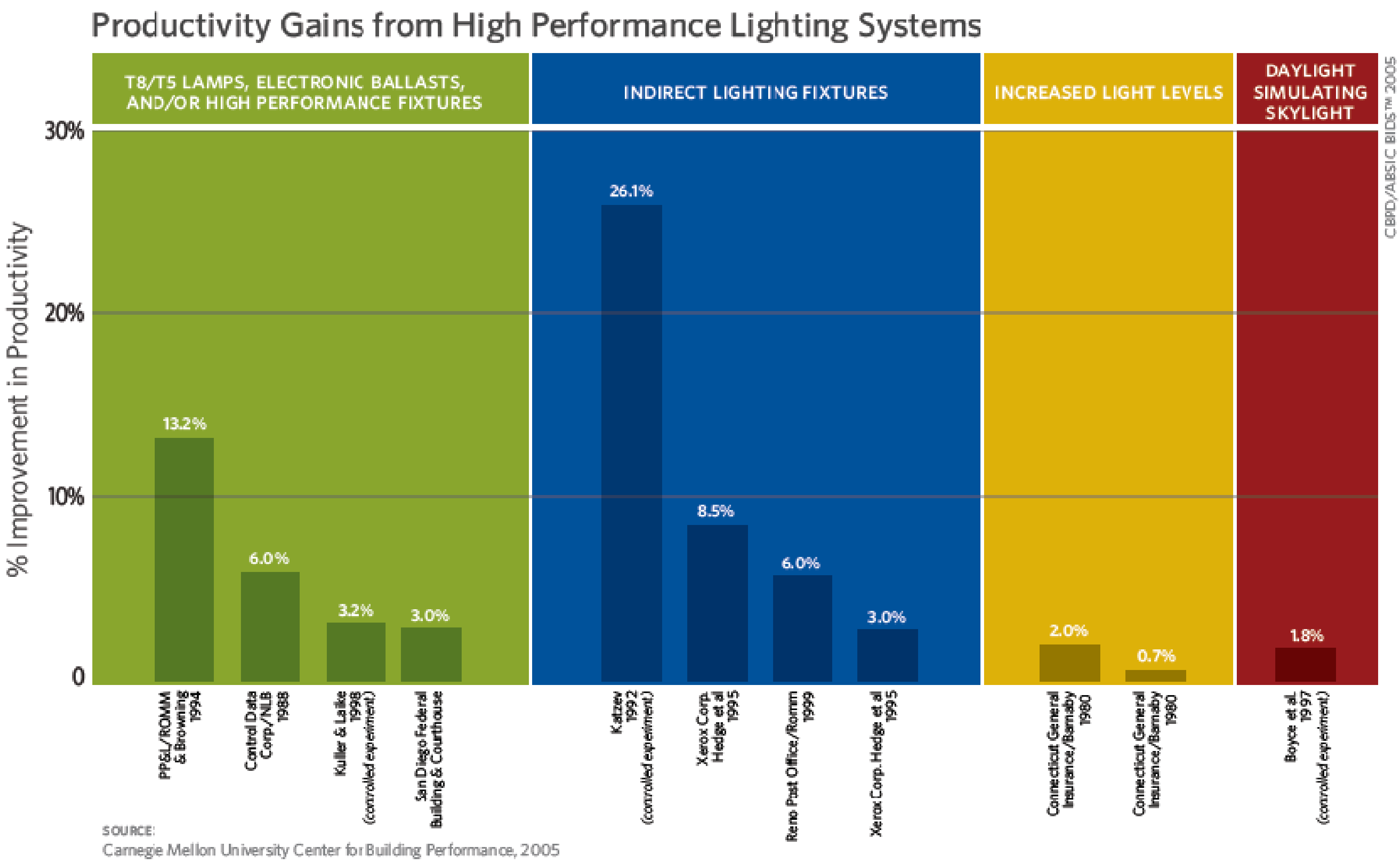
medical professionals and has done extensive research and analysis on the subject. The report states that there are, "nearly four times as many credits awarded for energy conservation technologies and designs (35 possible credits) as for protection of indoor environmental quality from hazardous chemicals (8 possible credits)" (EEHI, 2010).

Recently the building industry and allied professions have focused primarily on energy efficiency improvements, with little regard for occupant health. Most commonly, improvements are to heating and cooling systems, and tighter building envelopes to decrease air exchange. This has greatly decreased electrical demands and subsequently reduced building operation costs and environmental impact. However, in doing so indoor air is less likely to be replenished with cleaner outdoor air, thus concentrating airborne particulate and chemicals leading to increased human exposure (EHHI, 2010).

While the environmental and economic advantages of green buildings have received a great deal of attention over the last several years, occupant benefits are increasingly recognized as an additional result of green buildings. For example, workers in green buildings with high quality lighting have been found to display an increase in productivity (see figure 1) and fewer absences due to illness (Kats, 2006).

## Occupant Health and Productivity

The harm caused by buildings has largely been overlooked. There are air quality standards for industry and automobiles but air quality standards are virtually nonexistent for buildings. This is ironic as building air quality is comparatively easier to improve and maintain than for industry or for cars (Roodman, Lenssen, 1995). Pollutants indoors can be as much as 10 times greater, or in some cases even 100 times greater, than outdoors (U.S. EPA, 2010). Since



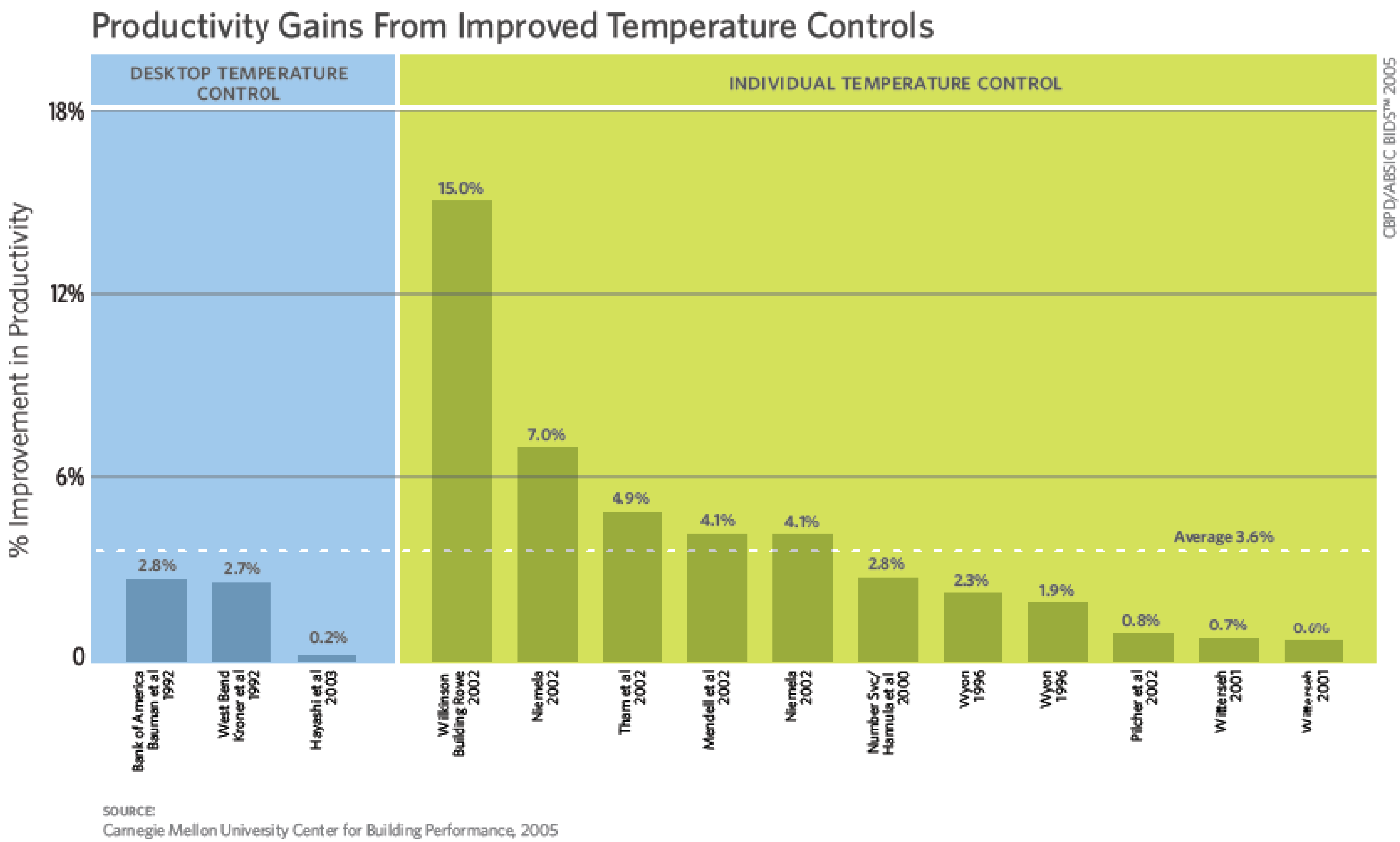

(Figure 1) *Productivity Gains From High Performance Lighting Systems.* Source: Carnegie Mellon University Center for Building Performance, 2005

the early 1980s childhood asthma has increased at an alarming rate and data suggest that building efficiencies related to indoor environments may be to blame (EHHI, 2010). California's Building Code Title 24 has only a minimal requirement for air quality (California, 2007). Furthermore, people spend upwards of 90 percent of their time in buildings (U.S. EPA, 2010). These facts are reason enough to elicit support for healthier buildings.

### i. Indoor Temperature

Temperature is a health concern associated with buildings designs. As climates changes people will be exposed to an increased number of extreme weather conditions. This will be in the form of greater occurrence of extreme weather such as severe cold weather and heatwaves. A strong relationship has been demonstrated between outdoor temperature and the number of deaths from chest and heart illness (Bull & Morton, 1978).

Recent health studies show a relationship of cold temperatures and increased occurrence of respiratory illnesses in the presence of mold (Rudge & Nicol, 2000). There are other physiological effects of temperature as well including asthma attacks (Rudge & Nicol, 2000). The use of central heating and insulation appears to have reduced the incidence of deaths in winter months. These building improvements have been recognized as the main cause for decreased mortality in developed nations (Sakamoto-Momiyama 1977). In a recent study, building improvements like insulation have been shown to decrease hospital visits for people with respiratory ailments (Howden-Chapman, Matheson & Crane, 2007). According to researcher Gregory Kats, in 14 studies by Carnegie Mellon University temperature control was shown to have an effect on student productivity (figure 2). In these studies student populations




(Figure 2) *Productivity Gains from Improved Temperature Controls.* Source: Carnegie Mellon University Center for Building Performance, 2005

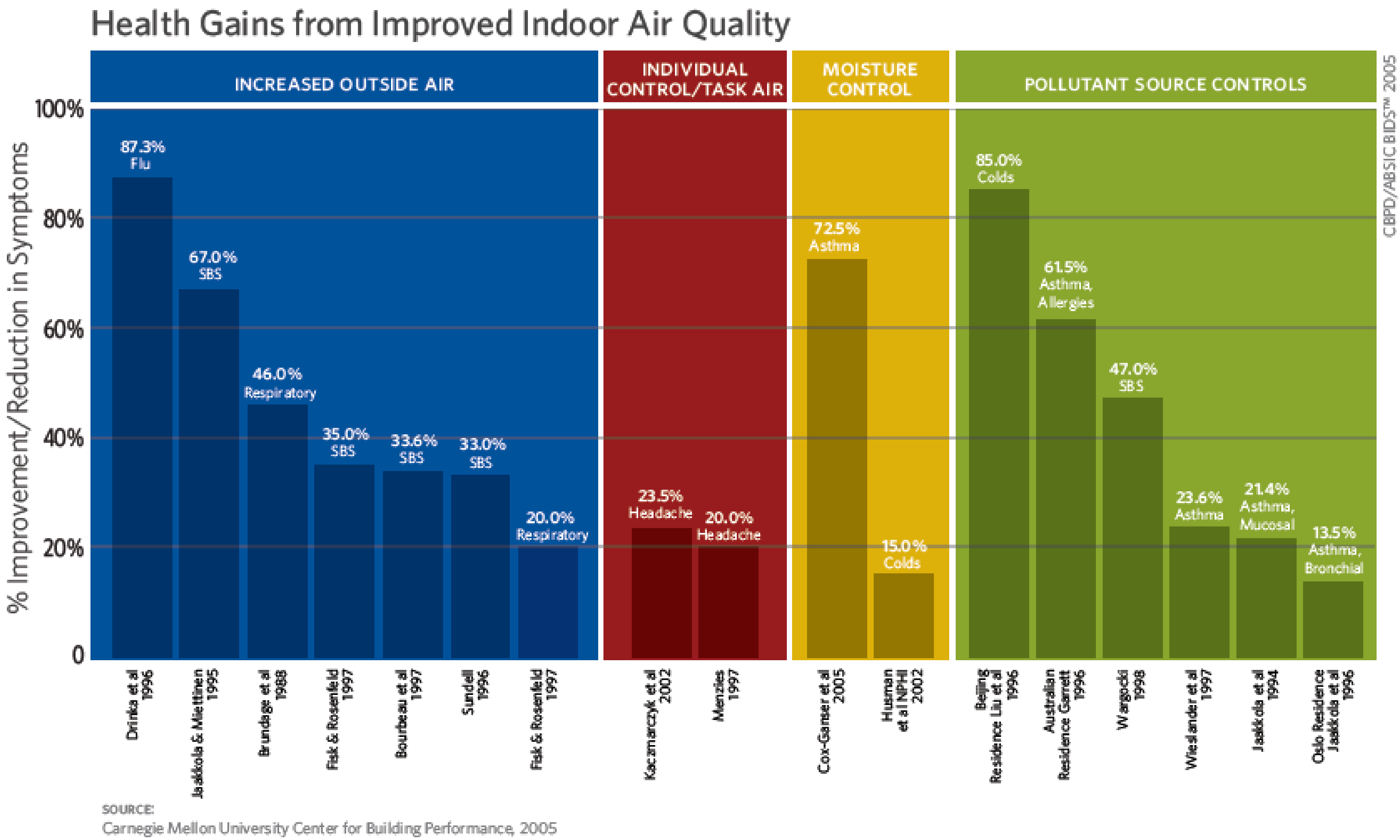
in classrooms with temperature control were compared to those without. Productivity improved 0.2% up to 15%, with a mean average of 3.6% (Kates, 2006, p. 10).

### ii. Indoor Air Quality

Technologies necessary to improve indoor air quality already exist and their use is encouraged by the LEED standard. For example, refrigerators and air conditioners that use nonozone-depleting chemicals are available in European countries (Roodman & Lenssen, 1995). Shredded foam insulation from recycled refrigerators releases substantial amounts of chlorofluorocarbons (CFCs), one of the most potent GHGs (American Chemical Society, 2001). “What is encouraging, and perhaps surprising, is that buildings that are better for the environment are better for people” (Roodman & Lenssen, 1995, p.5) (figure 3). Switching to an alternative refrigerant and foam insulation would improve indoor air quality and at the same time reduce greenhouse gas emissions.

Schools and work places designed with adequate air quality have also seen productivity gains. By combining 17 air quality studies (figure 3) by Carnegie Mellon University, Kats found that productivity improvements ranged from 13.5 percent to 87 percent with a mean of 41 percent (2006). “The costs of poor indoor environmental air quality in schools, including higher absenteeism and increased respiratory ailments, have generally been “hidden” in sick days, lower teacher and staff productivity, lower student motivation, slower learning, lower tests scores, increased medical costs, and lowered lifelong achievement and earnings” (Kats, 2006, p.8).

A leading institution for the topic of indoor air quality is the Center for Building




(Figure 3) *Health Gains from Improved Indoor Air Quality.* Source: Carnegie Mellon University Center for Building Performance, 2005

Performance at Carnegie Mellon University. Multiple studies performed by the institution suggest that “[sentence continues] . . . speed and accuracy at specific tasks, such as typing, addition, proof reading, paragraph completion, reading comprehension, and creative thinking, were found to improve in high performance building ventilation, and thermal control, and lighting control environments” (Kats, 2006). These are exciting findings; for graphical representations see figures 1 through 3.

## Research Design

There are a variety of benefits to using green building practices including improved worker health and productivity. This study evaluates whether or not the impact of a green building workplace can also be observed in a student population housed in green buildings.

The goals of this study were: 1) to identify an appropriate research methodology for collecting occupant benefit data; 2) to develop a comparative study focused on occupants of a university housing complex built with green building techniques to one built with traditional techniques; 3) to communicate the results of the study; and 4) to provide analysis of the results and a set of recommended next steps for future study.

### Subjects

The studied population consists of university students that live in campus housing at California Polytechnic State University San Luis Obispo. The population has been further limited to two campus housing complexes, Poly Canyon Village and Cerro Vista Apartments. In these buildings, there are both male and female students from each of the six colleges within the university. Subjects are primarily sophomores and juniors, with fewer seniors and graduate

students represented.

University Housing policy generally excludes freshmen from living in either of the two complexes, which are reserved for older students. Other on-campus housing complexes are provided to accommodate freshmen students. As it turns out the exclusion of freshmen from Poly Canyon Village and Cerro Vista Apartments is desirable for the purposes of this study, being that first year students tend to have a greater occurrence of illness. This difference is attributed adjusting to a new environment removed from parental care (Bragg, personal communication, 2010).

To ensure the confidentiality and anonymity of all subjects involved in the study a research proposal was prepared and subsequently approved by the Human Subjects Committee at Cal Poly. As required by the committee all personal identifiers are excluded for the protection of the subjects involved. Data from the Registrar's Office had computations preformed before it was received. Data from the Health Center was grouped into large cohorts such as housing complex, college, gender, and number of Health Center visits. The online survey was voluntary and anonymous.

## Buildings

The built environment influences people's behavior, health, and wellbeing. That is to say different building floor plans, materials, and lighting will influence occupants in separate ways. Limiting the differences between housing complexes provides a reduced chance that results will be negatively influenced. The Cerro Vista Apartments housing complex was selected as a comparison to Poly Canyon Village because it is the only dorm with a similar apartment suite living configuration. The configuration of living conditions can influence academic performance

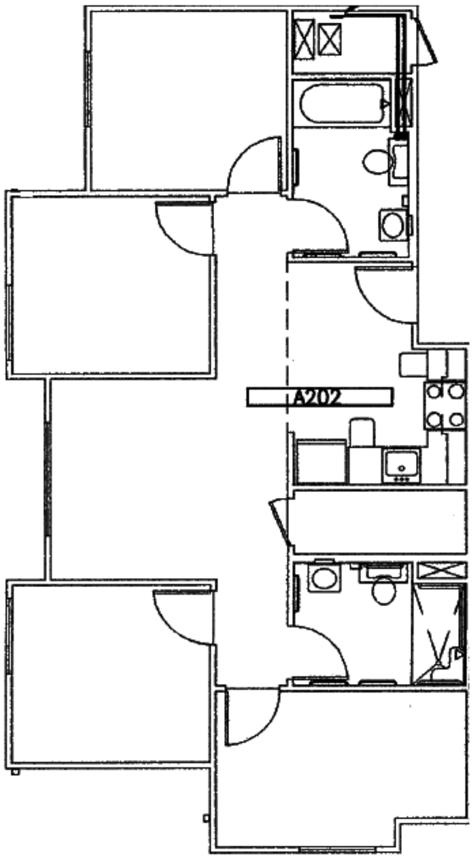
and health. Another similarity that limits variability is that these two buildings were constructed within five years of one another with modern building practices.

The Poly Canyon Village housing complex is certified Gold under Leadership in Environmental Design for New Construction (LEED-NC) version 2.1 and received 42 credits out of a possible 69 (LEED, 2003). Cerro Vista Apartments complex is constructed with traditional building practices. Poly Canyon Village was completed in time to house students for the fall 2009 quarter. Finished in September 2004, Cerro Vista Apartments were constructed five years prior to Poly Canyon Village. Both buildings are located in generally the same remote edge of campus. At the time of this study Cerro Vista Apartments has approximately 773 students in residence compared to Poly Canyon Village that has 2,421 (University Housing, 2010).

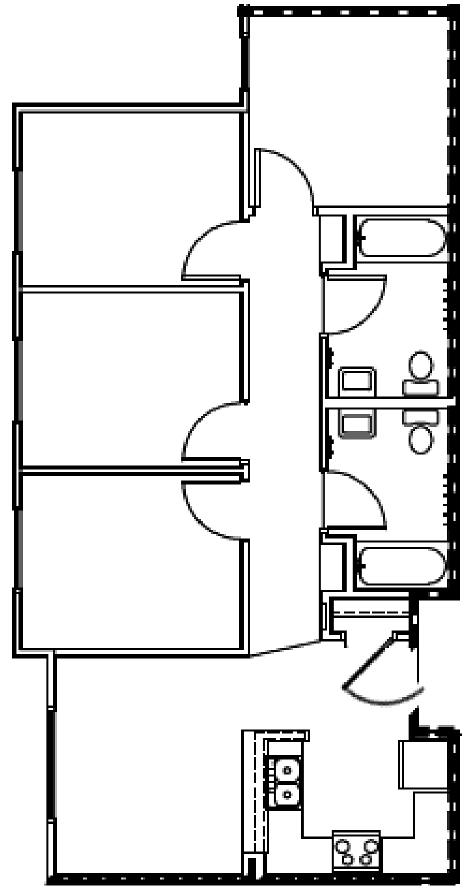
The living quarters of both complexes have many similarities. Both are designed as apartment suites for group living. In each suite there are four bedrooms two full bathrooms, kitchen, and living area (see figures 4 through 9). The size of each apartment suite is approximately 1,000 square feet with carpeted bedrooms and laminate flooring elsewhere. Appliances are what one would expect in a basic apartment, refrigerator, stove, and microwave. A small difference is that Cerro Vista Appartments has garbage disposals where as Poly Canyon does not.

## Limitations

There are limitations to using a university population for research purposes. For instance, the majority of students will live on campus for a year or two; at most, a particular student may spend four years in a given building. This limits the possibility of conducting a study that analyses a particular group's long-term exposure to the built environment.

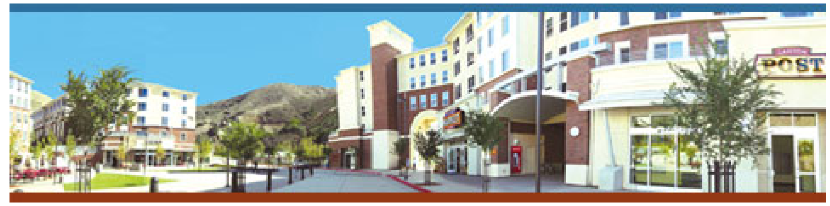



(Figure 4) *Typical Cerro Vista Apartments Unit Floor Plan*
*Source:* Cal Poly, San Luis Obispo Facility Services (2010).



(Figure 5) *Typical Poly Canyon Village Unit Floor Plan*
*Source:* Cal Poly, San Luis Obispo Facility Services (2010).

(Figure 6) *Cerro Vista Apartments Exterior*
*Source:* Cal Poly, San Luis Obispo University Housing (2010).




(Figure 7) *Poly Canyon Village Exterior*
*Source:* Cal Poly, San Luis Obispo University Housing (2010).

(Figure 8) *Typical Cerro Vista Apartments Amenities*
*Source:* Cal Poly, San Luis Obispo University Housing (2010).

(Figure 9) *Typical Poly Canyon Village Amenities*
*Source:* Cal Poly, San Luis Obispo University Housing (2010).

# Method

The aim of this research is to identify differences between buildings for occupant health, academic performance, and behavioral change. To evaluate the benefits of using green building techniques for campus housing, data has been assessed in an aggregated manner for student health statistics and grade point average (GPA) for two campus housing complexes, Cerro Vista Apartments, and the LEED certified Poly Canyon Village. Data has been collected from the campus Health Center, Registrar's Office, Facilities Services, and by online social survey. These data are used to compare Cerro Vista Apartments and Poly Canyon Village residents in an effort to test whether or not the literature findings that green buildings promote worker productivity and health are experienced in student housing built with green building practices.

Because the data are aggregated, the statistical analysis is straightforward. The analysis steps are as follows:

1. Establish similarity of populations. This comparison examines gender balance, year at Cal Poly, and college. If these percentages are significantly different, the comparison between GPA and Health Center visits will be split based on totals by gender, college, or year in school.

2. Compare mean GPA and per capita Health Center visits (total visits by dorm/dorm population) between Cerro Vista Apartments and Poly Canyon Village using a two-sample t-test (Appendix-1). Because different colleges may have differing average GPAs, data may be divided by college. In addition, because use of the Health Center may differ by gender, these data may also be divided by sex. The division of data based

on gender and college is a critical part of the analysis if the populations of the two dorms differ significantly. If the two populations are similar, the division will be used simply to confirm findings.

3. Significant results are interpreted in the context of structural differences between the two dorms, green building literature, and social survey.

## Results

This section presents the results of the post occupancy evaluation of the two Cal Poly housing complexes. Differences were observed in the health of students; however, these differences could not be conclusively identified as an outcome of green building. No significant difference was observed in the academic performance between the two populations. A difference in the reported health and happiness of residents was observed between the two housing complexes.

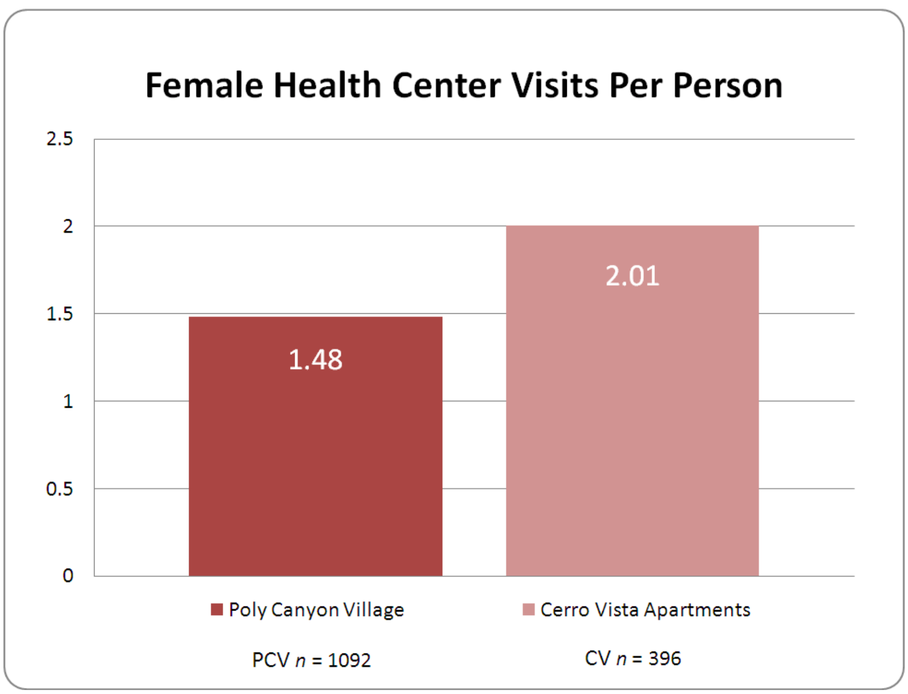
The Health Center data is the most unique for a post occupancy evaluation; therefore, the health data are presented first. Additional information including calculations, survey, and other sources regarding data are located in the Appendices.

### A. Health

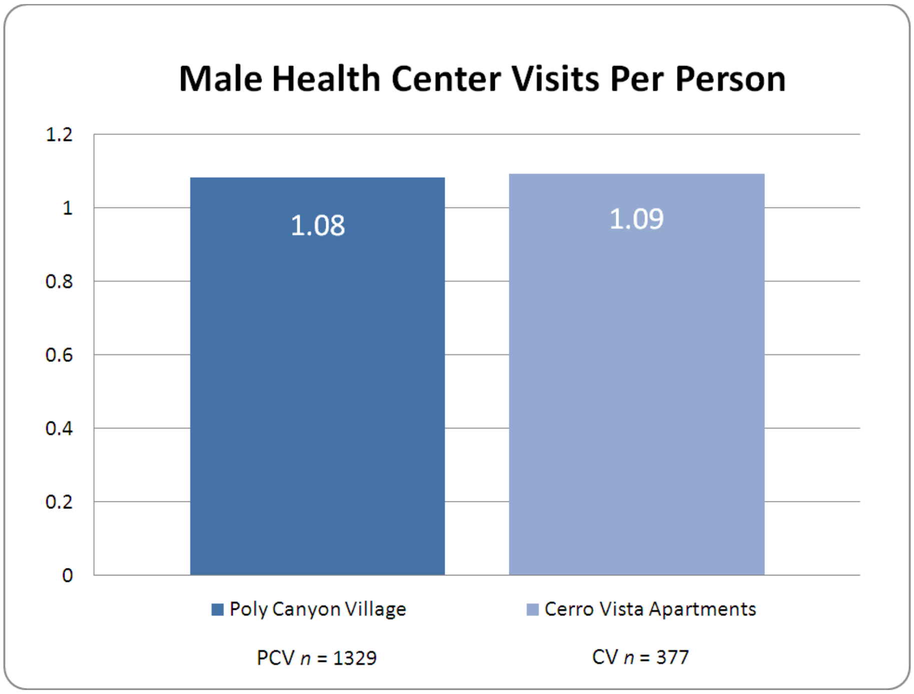
A difference in health was observed between the Cerro Vista Apartments population and Poly Canyon Village population. Data were then split by gender because it is a strong determent in health concerns. Analysis of health data indicates a significant difference between

the two housing complexes for number of female Health Center visits. The female population of Cerro Vista Apartments is 26 percent more likely to visit the Health Center then female residents of Poly Canyon Village (figure 10). Male populations are statistically identical in the number of visits per person (figure 11).

Given the data used in this study, one cannot make any direct correlations to the origin of the difference in number of Health Center visits; there are any number of possibilities. More research is needed to identify a specific cause. It is also important to mention that female visits compared to male visits are notably higher. This difference is attributed to reproductive health issues, which is normal for women of this age group (Bragg, personal communication, 2010).




(Figure 10) *Female Health Center Visits Per Person*



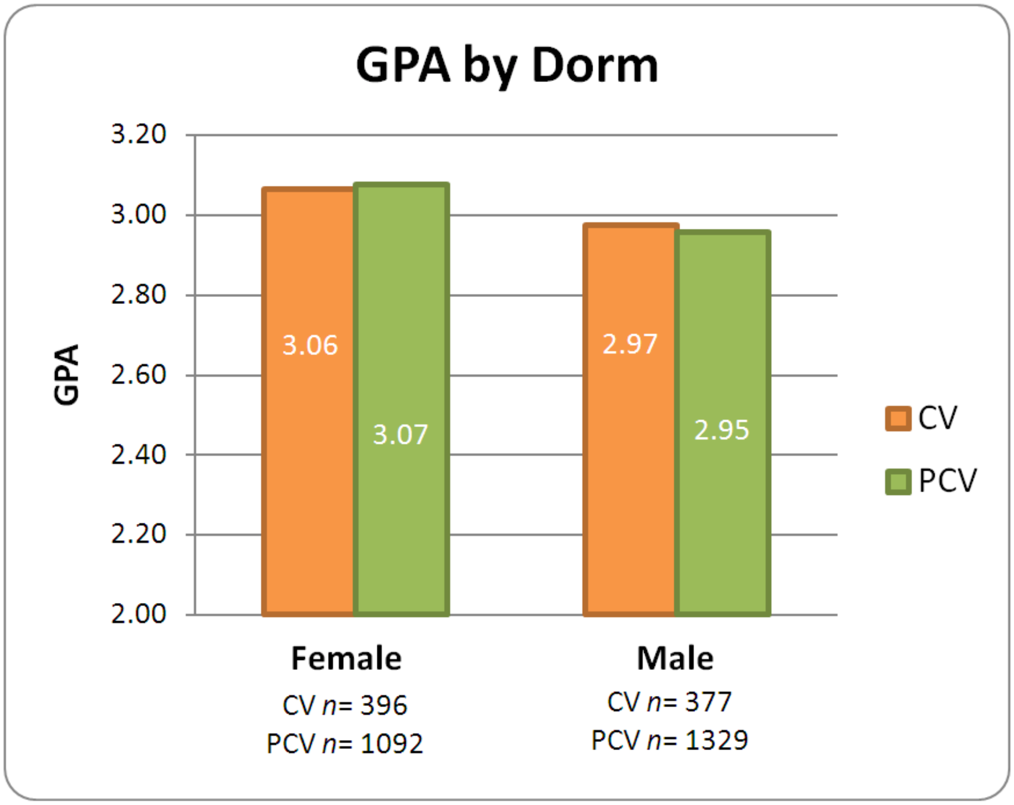

(Figure 11) *Male Health Center Visits Per Person*

## B. Performance

There is no significant difference between populations of each housing complex (figures 12 and 13). Statically speaking, both buildings have equal GPA for like genders. Two graphics are provided to better demonstrate the similarity of these findings.

| | GPA | POP | % By Gender |
|---|---|---|---|
| CV female | 3.0657 | 396 | 51.2% |
| PCV female | 3.0768 | 1092 | 45.1% |
| CV male | 2.9754 | 377 | 48.8% |
| PCV male | 2.9586 | 1329 | 54.9% |

(Figure 12) *GPA by Dorm by Gender, table*




(Figure 13) *GPA by Dorm by Gender, graph*

## C. Utility Use

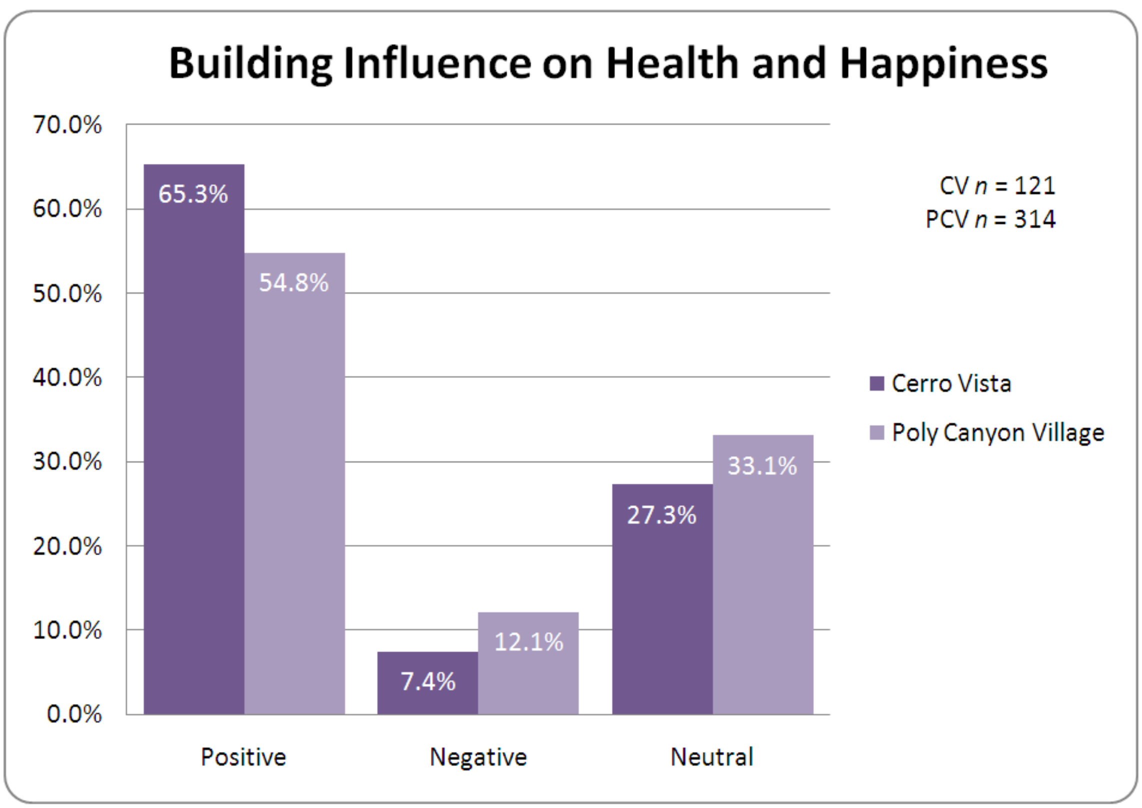
After evaluating utility data provided by Facility Services it was determined that sufficient data was not yet available. In some cases data simply did not line up, but overwhelmingly the issue was that of insufficient data. To put it simply, Poly Canyon Village is too new at the time of research; therefore, sufficient utility data does not exist.

Originally, the goal was to create a graphical representation of month-to-month average change in utility use for each housing complex. This is where the problem arises; the data made available was for one academic quarter. This was determined to be insufficient for the purpose of this study as no trend could be established given the small data size.

## D. Health and Happiness

The self reported health and happiness of individuals living in the two housing complexes is quite different. The overall trend is that a greater proportion of individuals living in the Cerro Vista Apartments believe that their building contributes to their health and happiness (figure 14). In Appendex-2 is a full copy of the survey.

When surveyed, the Poly Canyon Village population noted that the building design is rather institutional in form. As one of the participants wrote: “It's generally dark and the long hallway makes the apartment somewhat dis-joined socially”. It was also mentioned by several other individuals that the housing complex limits social interaction.




(Figure 14) *Building Influence on Health and Happiness*

## Discussion

The findings of this study are rather interesting and unexpected. The data gathered points out two important lessons for building design and construction.

Occupants are affected differently by their surroundings. From the health data it is apparent that whatever the cause of reduced female health in the Cerro Vista Apartment's population it appears not to affect the male population. This is a subtle but important lesson; building designers must take into consideration the needs of all populations. It should be noted that despite the decreased health of the Cerro Vista Apartments female population, their performance scores were statically indistinguishable from that of the Poly Canyon Village female population, but still above the male population. This can be seen as an indicator for the severity of the health concerns. That is, the women in Cerro Vista Apartments, despite the greater occurrence of health issues, be it whatever type of illness or medical need, it was not great enough to negatively affect their academic performance.

Designers should cater to the wellbeing of their client, the occupant. It is interesting to see that despite going far beyond the minimum legal building requirements the Poly Canyon Village designers largely neglected to account for the occupant's indoor comfort. The buildings within the complex have long narrow hallways that are poorly lit. Indoor social spaces are minimal. Basically the designers of Poly Canyon Village spent a great deal of time and money on energy efficiency and site design, but less on parts of the building occupants directly interact with, such as the building's interior. As stated earlier, according to the U.S. EPA people spend an average of 90 percent of their time indoors. This fact should be a compelling reason for designers to pay more attention to the inside of buildings as they relate to the occupant.

# Conclusion

## LEED Reform

In the past decade a transformation in the way we design buildings has occurred. Green building practices have become an important part of the building industry. In recent years, green building markets have been impressive. Green building practices are far superior to traditional ones, but they need to be further improved. The LEED rating system is heavily weighted toward energy efficiency and environmental responsibility, but little attention is given to occupant health.

It is estimated by the US EPA that people spend upwards of 90 percent of their time indoors (U.S. EPA, 2010). What this translates to is a high level of human exposure to indoor chemicals that are not monitored by LEED requirements. In the LEED rating system human health is allotted only 15 points out of a possible 110, which translates to only 13.6 percent of the total possible points available (EHHI, 2010). What this means is that a building may receive the highest LEED rating, "platinum" without scoring any points in categories intended to protect human health. Changes clearly need to be made to the current LEED rating system as it gives greater importance to energy efficiency and site selection then occupant health.

## Government

A fundamental change in the way we design our buildings and cities must take place, a transition to low-carbon and resilient buildings. We also need to change the way that we design and construct buildings and focus on the needs of the occupant. This will require leadership at

all levels, from government, to the building industry, to the people that live and work in buildings.

Currently the federal government has fallen behind. Where the building industry is undergoing a transformation and has taken great steps to improve building practices, government largely has not. The federal government is better situated to oversee the testing of building materials for chemical content. This along with improved safety standards and accountability would greatly improve the business as usual approach largely seen today. This could be done with incentives as well as regulation.

## Future Research

It is my hope that future studies will be done on Poly Canyon Village and extended to the other green buildings on campus. A continuation of this study would improve the accuracy of the presented findings and would add new information. The research conducted for this senior project is but a small piece of the larger potential that the subject presents. A more in depth and long-term analysis of occupant health would give more validity to the presented findings and could point to a cause for the differences.

Further research on occupant comfort would be an interesting addition to this study. A good starting point is to consider the relationship between the physical design or layout of the built environment and its relationship to the occupant. For instance, this could include the number of windows and their placement in a building and how this effects the wellbeing of occupants. The social survey is one part of this study that I would have liked to expand. Persons

interested in conducting further research on this subject should look at Appendix-3, for a more detailed social survey on occupant health.

Additional research could also be conducted on the construction techniques and building materials themselves. This might include the amount of air movement from heating and cooling systems and windows, as it relates to upper respiratory health. The type of chemicals used in the building materials may also point to other health concerns. Individuals looking for more information on this subject should meet with Facility Services to gain access the building specifications and other documents. There are also a number of helpful and very knowledgeable university staff members that can provide valuable information.

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# Appendix – 1

## T-test Calculation

This is an example of the calculation made to determine if the populations in both buildings are statistically similar. The calculation of the t-test is to determine whether the means of the populations are different.

*Two tailed independent t-test: unequal sample sizes, equal variance

***Equation:***

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_{X_1X_2} \cdot \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

***Given:***
Population CV, n1= 773
Population PCV, n2=2421
CV weighted GPA, $\bar{X}_1$ = 3.0216
PCV weighted GPA, $\bar{X}_2$ =3.0119
Averaged variance, $S_{X1X2}$ = 0.3071

***Solution:***
t = 0.7685
p-value = 0.44

# Appendix – 2

## Health and Happiness Survey

Participants were asked the following:

1. What is your sex? male; female

2. How many years have you been at Cal Poly?

3. What is your College? Agriculture, Food and Environmental Sciences; Architecture & Environmental Design; Business; Education; Engineering; Liberal Arts; Science and Mathematics; Not Applicable; Other (please specify)

4. Do you currently live on campus?

5. Dose the building where you live influence your overall health and happiness? Yes, positively; Yes, negatively; No influence; Other (please specify)

# Appendix – 3

## Future Survey

The following is a more detailed survey that could be used in the future. Many of the questions are borrowed from the U.S. Green Building Council - Chicago Chapter's 2009 *Regional Green Building Case Study Project*.

1. Did LEED certification or green building play a role in your decision to live at Poly Canyon Village? (Y,N)
2. Did health considerations affect your housing choice? (Y,N)
3. Do you have asthma, allergies, or upper repertory aliments? (Y,N)
4. Has your health improved or become worse since living on campus? Was this due in part to the dorm building design or construction?
5. Dose the building you live in affect your mental health or happiness? (positively or negatively)
6. Occupant satisfaction, rate 1-5 (low-high) resident satisfaction for the following areas:
    a. Lighting
        i. Overall lighting comfort
        ii. How bright it gets
        iii. Amount of light
        iv. Glare from lights
        v. Ability to adjust the electric light level
        vi. Amount of daylight
        vii. Glare from windows
        viii. *Other observations about light levels and control
    b. Acoustics
        i. Overall noise distractions
        ii. Background noise levels
        iii. Noise from adjoining areas or hallway
        iv. Noise from ventilation systems
        v. Noise from lights
        vi. Noise from outside the building
        vii. *Other observations about noise
    c. Temperature
        i. Overall temperature comfort
        ii. How cold it gets
        iii. How warm it gets
        iv. Temperature shifts

v. Ability to adjust room temperature
vi. *Other observations about temperature level and control

d. Air quality
  i. Overall ventilation comfort
  ii. Air freshness
  iii. Air movement
  iv. Ability to adjust ventilation
  v. *Other observations about air quality

e. Privacy
  i. Visual privacy
  ii. Conversational privacy

f. Overall building comfort
  i. Overall physical environment of building
  ii. Conditions in your suite
  iii. *What is one thing that you like most about this building?
  iv. *What is something that you would most like to see improved about this building?

*denotes open ended question

7. Anything else you would like to add?

100% recycled
30% post consumer fiber