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Determination of the Effects of University Building Usage on Energy Efficiency and Recommendations for Improvement

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DETERMINATION OF THE EFFECTS OF UNIVERSITY BUILDING USAGE ON ENERGY EFFICIENCY AND RECOMMENDATIONS FOR IMPROVEMENT

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ABSTRACT

Energy costs are increasing at an alarming rate, and electricity use can contribute to carbon emissions and, therefore, to global warming. With this in mind and under direction of the University of Alabama at Birmingham (UAB) Facilities Management Department, researchers conducted building occupancy surveys of UAB buildings after working hours and on weekends to evaluate occupancy by day and time and by lighting condition of unoccupied rooms. The goals of this research consisted of identifying situations in which measures such as motion sensor installation or heating and/or air conditioning shutdown or setback could result in energy and cost savings and evaluating instances in which excessive unnecessary lighting is being used.

Surveys were typically conducted every 2-3 hours, from 5:00 p.m. to 12:15 a.m. on weeknights, and all day on weekends (from 7:00 p.m. to 11:00 p.m.), for at least one week's worth of surveys. Individual surveys were ideally conducted as follows: Starting at the nominal time, a member of the research team began surveying the entire building. Each room was investigated for two criteria: occupancy and lighting. If there were any occupants in the room, the number was counted and recorded. If there were no lights on in the room, a zero (*0*) was recorded; if 1-50% of the lights were on in the room, a "*P*" was recorded, for partial lighting; and if more than 50% of the lights were on in the room, a zero with a slash through it (*Ø*), which is defined as full lighting, was recorded.

These results were summed for the entire building, averaged, and compared statistically. It was found that, over time, occupancy of buildings on weeknights follows an exponential decay function. Next, three metrics and building ranking methodologies for energy efficiency were defined. Then the different occupancy classes of buildings were compared and found to have no significant differences in overall ranking for these metrics. Last, some recommendations for reducing each of the metrics were discussed.

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Last but certainly not least, I thank my family and friends for never giving up on me. I am grateful to God, through whom all things are possible, even if they take a little longer than originally expected.

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LIST OF ABBREVIATIONS AND SYMBOLS

0	room is unoccupied with no lights on
Ø	room is unoccupied and fully lit
μ	population mean
σ	population standard deviation
%Lit	percentage fully lit
A	an exponential decay parameter determined by curve fitting
AAHFL	average after-hours fully lit
Admin	administrative
B	an exponential decay parameter determined by curve fitting
b	utility bill amount for month
BEC	Business-Engineering Complex
BTU	British thermal unit
calc	calculated; used as subscript in hypothesis testing
CBSE	Center for Biological Sciences and Engineering
CI	confidence interval
CO_2	carbon dioxide
crit	critical; used as subscript in hypothesis testing
ECM	energy conservation measures
F	F-test (variance analysis) parameter
FY	fiscal year
GSF	gross square foot (feet)

h	number of hours in month
HCPO	hourly cost per occupant
HUC	Hill University Center
HVAC	heating, ventilation, and air conditioning
i	rank out of all possible ranks in the weighted methodology
kWh	kilowatt-hours
M	metric involved in weighted methodology
n	number of buildings, day of week, surveys, etc. (depending on context)
NA	no access
o	average number of occupants over all surveys
O_2	oxygen
O&M	operation and maintenance
P	room is unoccupied and partially lit
r^2	square of correlation coefficient (also written as R^2)
s	sample standard deviation
SON	School of Nursing
t	Student's t-test parameter
UAB	University of Alabama at Birmingham
UBOB	University Boulevard Office Building
X	In weighted methodology, index
x	Axis parameter commonly used in trendlines, here, denoting time
$\bar{x}$	sample mean
y	Axis parameter denoting usage, cost, or occupancy of building in trendlines
yr	year

INTRODUCTION

In the current time, at the beginning of the second decade of the 21st Century, energy usage has become a serious matter across the country; one place in which its effects are most felt is Birmingham, Alabama, home to the University of Alabama at Birmingham (UAB). With record drought conditions and high temperatures in 2007, this city can be assumed to be experiencing direct effects of global warming (National Weather Service, 2008). Global warming is caused by the greenhouse effect, a condition in which greenhouse gases disrupt the planet's normal cooling processes and trap heat in the atmosphere. Greenhouse gases include carbon dioxide, methane, and nitrous oxide, among others. Energy-related carbon dioxide (CO_2) accounted for 5.825 *billion* metric tons of emissions in 2006, or 82.3% of the total emissions of greenhouse gases. In addition, methane made up 605.1 million metric tons of CO_2 equivalent emissions in 2006, or 8.9% of the total emissions (Energy Information Administration, 2008). Burning and mining for coal, which is composed primarily of carbon crystals, produces copious amounts of (CO_2 by way of the general combustion equation:

$$12\ \text{g Coal (C)} + 32\ \text{g } O_2 \rightarrow 44\ \text{g } CO_2$$

Thus, roughly 44 tons of CO_2 are produced for every 12 tons of coal that is combusted (Carnegie Mellon University, 2003). Of all energy produced in the U.S., coal accounts for 23% of energy production but leads to 36% of CO_2 emissions; only petroleum, at 40% and 44%, respectively, exceeds those statistics. If only electrical fuels are considered, the figures are much more lopsided: Coal accounted for 52% of consumption and 83% of CO_2

emissions in 2006 (Energy Information Administration, 2008). Alabama is no exception to this rule; 57% of the electricity generated in the state is produced by coal combustion (Birmingham Newschart, 2007). Because these statistics indicate climate change, greenhouse gas production from coal, and coal consumption in electricity generation, great need exists to control electricity usage.

Strong economic impact is felt from the usage of electricity at UAB, as well. Coupled with the global-warming crisis involved with the use of coal to produce electricity, this impact represents a clear need for UAB to minimize usage of electricity in its buildings or at least to eliminate unnecessary wastes. It is with this in mind that the occupancy and lighting building-surveying project was commissioned.

The scope of the project included the 14 buildings approved by Facilities Management for occupancy and lighting surveys, which were completed from February 2007 to May 2008. However, because of limitations imposed on some buildings' analyses or because of a detrimental amount of missing data, the number of surveyed structures in which the full scope of results was available was reduced to 11. The objectives of the study were to determine which buildings were not being used efficiently after hours and which buildings had substantial instances of lights left on when rooms were not in use. The method involved collecting data which represents a "snapshot" about the occupancy and lighting in each accessible room of the building every two hours. Details including locations of people (or the absence thereof), lit rooms, and other factors that would indicate substantial energy wastes within the buildings were given as deliverables. However, this thesis focuses on only an examination of the deliverables leading to consistent metrics of energy efficiency within all of 11 buildings.

PREVIOUS STUDIES (LITERATURE REVIEW)

The University of Alabama at Birmingham (UAB) spends a large amount of funds each year on utilities such as electricity, water, and heating. The total amount spent by UAB on all utilities over six fiscal years (FY) from 2002 to 2008 is given in Figure 1.

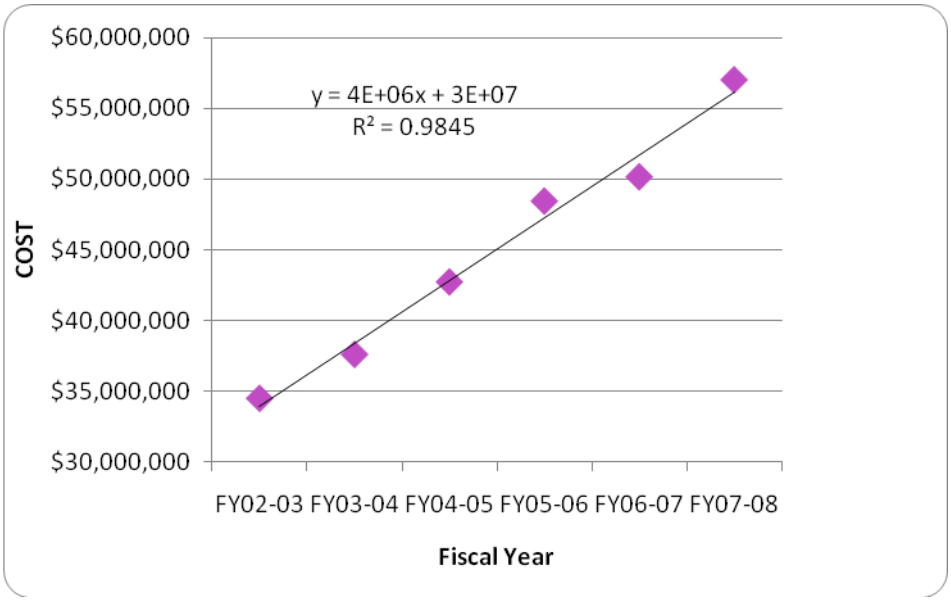

Figure 1. UAB Total Utility Costs (Winslett, 2009)

In Figure 1, the trendline and the associated R^2-value (the square of the correlation coefficient), indicate a strong linear increase relationship between the year and the expenditure on utilities. The equation on the trendline indicates that, for year x, the total expenditure will be approximately y, with FY 2002-2003 being defined as the base year, or year 1, as determined by the default setting of Microsoft Excel. When modeled by using this linear relationship, the total expenditure only ten years later, in 2012-2013, or year 11, would be $77 million, which is more than double the amount from 2002-2003. This rate of

increase indicates that the UAB expenditure on utilities will more than double in only ten years (Winslett, 2009). However, whether the rise in cost results from rising usage, or rising rates, remains unclear.

A portion of each of these annual amounts was spent on electricity. Figure 2 provides a graphic representation of these expenditures.

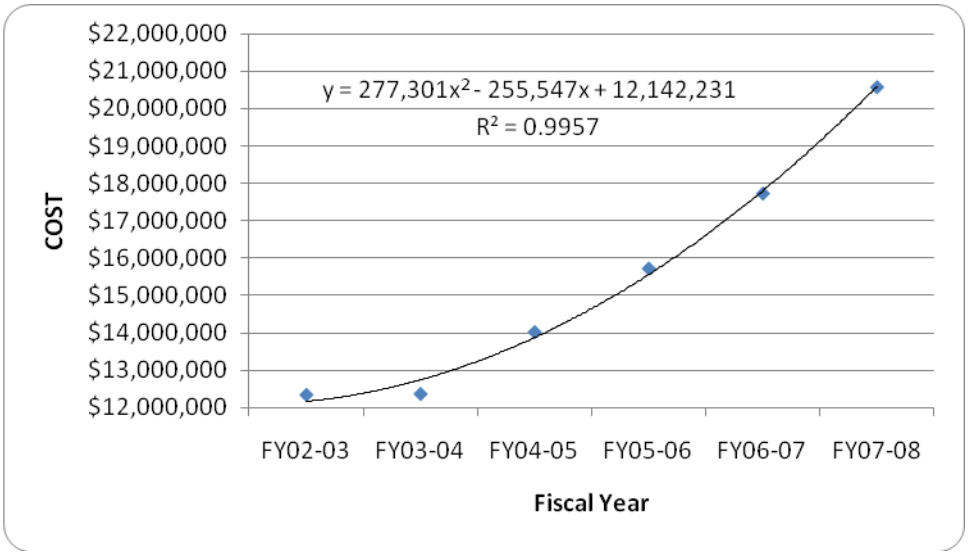

Figure 2. UAB Electricity Expenditures (Winslett, 2009)

The data are best described by a second-order polynomial curve-fitting; projection of the data for year 11(2012-2013) yields an electrical cost of almost $43 million, a 353% increase over only ten years. This increase may be further explicated by an examination of the variation through time of the total amount of electricity used in kilowatt-hours (kWh) (Figure 3).

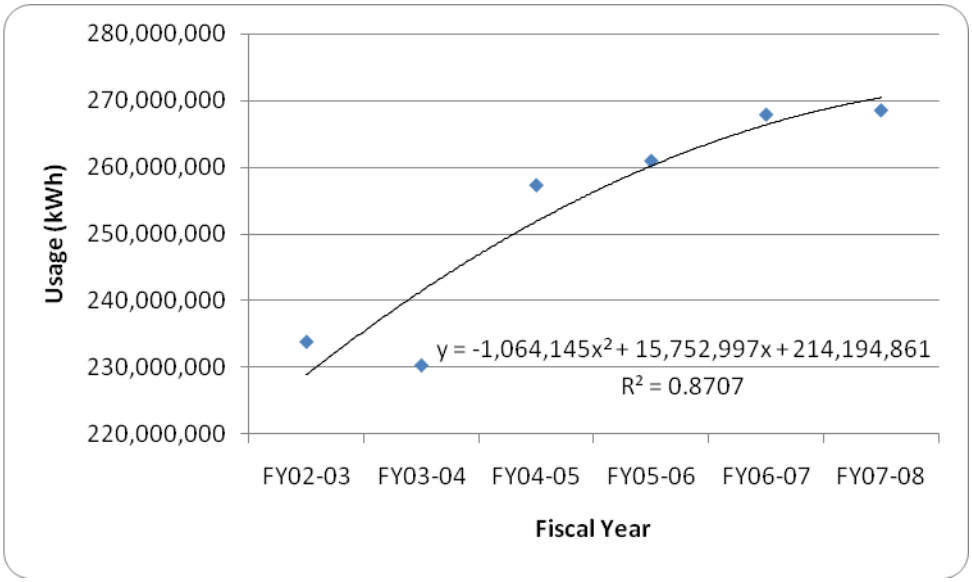

Figure 3. UAB Electricity Usage (Winslett, 2009)

The correlation is not as robust as that found for costs; however, it can be seen that usage has generally been curtailed in more recent years (Winslett, 2009), and a projection to 2012-2013 actually reveals a slight decrease in usage. Nonetheless, with costs rising more than exponentially, a need still exists for measures to limit electricity usage.

The 2007-2008 studies of the UAB Facilities Management Department, together with the Civil, Construction, and Environmental Engineering Department, encompassed three buildings that were also surveyed during a 1981-1982 effort by George A. Jackins and Michael E. Scruggs. These three buildings were the Education Building (Building #1) (Jackins and Scruggs, 1983-b), the Humanities Building (Building #3) (Jackins and Scruggs, 1983-e), and Sterne Library (Jackins and Scruggs, 1983-a). The 1981-1982 studies contained several other UAB buildings, as well. This older study and the more recent one expanded upon in this thesis differ in a number of key ways. The former was more of a proper energy audit, whereas the more recent study is more of an occupancy survey. The aims of both studies involved developing methods of conserving energy, but the approaches used differed: The older surveys were performed by a group of engineering professionals looking

for long-term solutions, whereas the newer surveys were done by management professionals and graduate students seeking more immediate solutions. In other words, the newer surveys were meant not to replace the older surveys, but to update them.

In general the older studies focused on a cost-benefit analysis method, by giving current costs for energy expenditures, and by providing a projected value representing what they can be reduced costs that can result from following the operation and maintenance (O&M) recommendations and energy conservation measures (ECM). These O&M recommendations and ECMs rely on retrofits to some parameters of building design, including heat loss and gain, temperature, and materials for construction. Occupancy is mentioned, but only in passing in the summary as an average, and only in terms of an impact on energy consumption (Jackins and Scruggs, 1983-a,b,e). The older reports lack data supporting the average occupancy figure in the provided appendix, and this lack underscores the need for the newer occupancy-centered surveys.

One section, "Analysis of Facility Energy Performance," of the report on the Education Building (Jackins and Scruggs, 1983-b), contains some of the information most relevant to this study. The report mentions that "the tendency seems to be to leave lights on in classrooms after use when there are other classes scheduled later in the day". This tendency was also observed in present-day surveys. In addition, Jackins and Scruggs (1983-b) stated that the lights would be better controlled from a "central control point on a schedule corresponding to classroom use," a suggestion that has still not been implemented. Most importantly, the section mentions the impact of occupants and operation, and includes the statement that the high number of occupants reduced the need for heat in the colder months but mandated the use of large amounts of electricity in cooling systems during the summer months (Jackins and Scruggs, 1983-b). The move from a year-round quarter system

to a spring- and fall-centric semester system appears to have somewhat reduced this phenomenon. For Sterne Library, the HVAC analysis was similar; results of the lighting analysis revealed that lighting was too low (less than 70 footcandles) in study areas, but was too high (20 footcandles is the accepted minimum) in stairways (Jackins and Scruggs, 1983-a). The section on occupancy and operation impacts indicated that occupants have little impact on the building's cooling, but that, because of its nature, all lights and equipment were on at all hours of operation, a condition that exists today (Jackins and Scruggs, 1983-a). For Building #3 (Humanities), the HVAC recommendations were quite different and called for more use of free cooling and less use of the preheat coil. Too many lights were found to be in use while the building was unoccupied. In addition, the occupants felt the building was too warm, that the lighting was too dim, and that lighting was often left on in unoccupied areas (Jackins and Scruggs, 1983-e). These conditions were similar to those of today.

In the older surveys, occupancy, a major cornerstone of the newer surveys, was mentioned only as an average over a period of operation. However, there was mention of the effects of body heat on the temperature of a room and on the amount of energy required to cool the air in the room to a desired temperature. Lighting, on the other hand, is described in much greater detail in Appendix A of the older reports than the three-symbol notation used for each room in the newer surveys and includes details such as number of lights, square footage, ballast factors, and total wattage. However, in the body of the older reports, more emphasis was given to the systems that deliver, transport, and consume energy of various types, as well as the monthly and annual expenditure of types of energy. The aims of the older studies comprised a comprehensive energy portfolio of the buildings and detailed recommendations for reductions in energy expenditure (Jackins and Scruggs, 1983-a,b,e). However, these studies were limited in that these conditions are stationary in each

room that do not change much in accordance with time of day; the newer surveys described in detail in this thesis and in the one of Atul Kajale (2010) focused on *dynamic* conditions such as the number of occupants present and if none or few, on the number and/or proportion of lights that were on in the room. In these newer studies, graphs indicate the occupancy at various times after hours and on weekends and also depict the variation by floor. The primary aim of these newer studies was not necessarily comprehensiveness, but the identification of hours at which the provisions of the older study, such as shutdown and setback of different energy devices at hours when the building was not heavily used, could be implemented. However, a secondary aim of the newer studies consisted of providing data with which it could be determined whether lights were unnecessarily left on in certain rooms—in other words, which rooms were "problem rooms." This thesis considers both parameters in order to determine metrics for the energy efficiency of each building. This aim is closely tied with the installation of motion sensors in the corridors of several buildings during the 2009-2010 academic year, as well as with the installation of newer T8 electronic-ballast fluorescent lighting to replace the older T12 magnetic-ballast fluorescent lighting.

Other buildings were included in the older studies that were not included in the newer studies. On the same grid as Building #1 (Education), Building #3 (Humanities) and Sterne Library were Building #2 (Jackins and Scruggs, 1983-d) and the present-day Chemistry Building and its Annex (Jackins and Scruggs, 1983-c). These two buildings were constructed in 1972 and 1978, respectively. In their reports for these buildings, Jackins and Scruggs (1983-c,d) stated in their "Analysis of Facility Energy Performance" that Building #2 (Chemistry) involved a major waste of energy from the operation of lights during unoccupied hours; this finding corresponded to an occupancy impact statement that mentions classrooms and laboratories were in use on weekends and after hours because they

were available to individuals conducting research (Jackins and Scruggs, 1983-d). The authors found that for the Annex, the major wastes were the same as Building #2 (Chemistry); in addition, the Annex had a gold textured wall that does not reflect sunlight as well as white walls do, occupancy varied widely at all days of the week and at all times, and there was a tendency to leave lights on when the building was unoccupied (Jackins and Scruggs, 1983-c).

Recently, three major studies from UAB also dealt with this topic, although different measures were used, and off-campus and on-campus buildings were both investigated. Harshad Prakash Shetye in the summer of 2005 studied seven buildings at the Alabama State Capital in Montgomery and of 11 buildings at the Alabama Department of Youth Services in Chalkville (Shetye, 2006). The pre-site review involved the determination of a value called the energy usage index (EUI), a measure of the number of British thermal units (BTU) consumed in each square foot each year. The Shetye study also involved an assortment of different instrumentation devices used over the course of the walkthrough audits: a light meter; data logger; infrared thermometer; anemometer; flicker checker; digital stroboscope; and clamp meter. These instruments were used to measure various conditions of the building and to determine the amount of savings in energy costs that would result from a variety of energy conservation measures. In the thesis, Shetye (2006) stated that, if all recommendations provided in that report were followed, a 30-50% decrease in energy costs at the Chalkville buildings and a 20-40% decrease at the Capitol buildings (Shetye, 2006) could result.

The second study was undertaken by Vance Scott Gibbs (2009), and was consistent with the first, but included a different set of buildings: the Bryce Hospital Complex, at which 12 buildings were studied, along with the aforementioned Chalkville site. Although the

instrumentation used in the study was similar to that used in the Shetye study, the conclusions are more qualitative and pointed to a lack of resources and to the need for an energy conservation plan. However, in the Results section, Gibbs (2009) evaluated HVAC, lighting, and exit sign upgrades on the basis of annual utility savings, cost of retrofits, and payback period. Annual utility savings would be greatest with HVAC upgrades at Bryce, because they could save $321,000; however, they would cost $1.3 million to implement, which results in a payback period of four years. Lighting upgrades there would save $40,240 but require $235,730 to implement, for a payback period of almost six years. At the Chalkville site, both lighting and HVAC upgrades would cost about $10,000 to implement. Last, exit sign upgrades would save a total of $2,000 at both sites, but would cost a total of $9,500 and have a payback period of four to five years (Gibbs, 2009). Therefore, although not intended to save money in the short term, these upgrades would provide an immediate improvement in environmental quality that exacts a substantial price, but yields future monetary savings. On the other hand, the techniques for energy conservation mentioned in this thesis are designed for immediate savings and for resulting environmental quality improvement that is smaller in scope than that found from retrofitting but is easier to implement.

Last, Atul Kajale (2010) used the same data from four buildings also included in this study (because we served on the same research team) and determined that buildings are sparsely occupied and therefore not used efficiently in after hours, especially after 10:00 p.m. Kajale (2010) recommended motion sensors and building shutdown/setback to reduce energy waste during these hours. In addition, he recommended different timeout intervals on motion sensors for different types of rooms on the basis of their frequency of

occupation; these intervals ranged from 10-15 minutes for classrooms and restrooms, to 30-45 minutes for corridors and administrative offices.

The number of studies of the sort described in this thesis that were not conducted at UAB is surprisingly small, but the relevant literature contains a few interesting variations on traditional energy audits in various locations that may be relevant to this study. The first of them, by Maniccia et al. (2000), used a room-based approach instead of a building-based approach, and classified each room of the buildings surveyed as one of five different types (break room, restroom, classroom, private office, or conference room) based on its use by occupants. Their goal was to determine the percentage of energy that could be saved if motion sensors were installed within each type of room. In a number of each type of room that only had manual on/off control, building staff installed light loggers that recorded every time that the light was turned on or off over a 14-day period. The occupancy condition of the rooms was also a factor in the analysis, and an event in which a room was lit but unoccupied was classified as a "detection error." Although Maniccia et al. (2000) did not report the method they used to determine whether the room was occupied, the report appears to indicate that the building staff, as a condition of participating in that study, noted whether each room was occupied and those data were compared with the data from the lighting loggers. This comparison of data makes their study similar to the one embodied in this thesis. However, a key difference is that they did not count the total number of occupants in the building. They used the data collected from this phase to determine the savings that would result if motion sensors were installed and set to four different timeout settings (5, 10, 15, and 20 minutes); considered in their calculations were relamping costs that would be incurred from the more frequent switching on and off that is a side effect of using motion sensors. In all cases, the 5-minute timeout setting resulted in the greatest savings

potential. Their results indicated that restrooms would most benefit from motion sensors, with 60% cost savings from the 5-minute timeout setting, and that break rooms would benefit the least, saving only 29% for the 5-minute timeout setting (Maniccia et al., 2000).

The second study, by Nicol and Humphreys (2004), involved using a stochastic method to address a need to develop an algorithm for predicting occupant behavior in terms of using energy for indoor climate control purposes. In this report, they described research undertaken in United Kingdom, mainland European, and Pakistan office buildings to set trendlines and determine equations relating outdoor temperature to number of fans running, opening of windows, use of blinds or curtains, use of lighting, and use of heating. Obviously, most relevant to this study is use of lighting, which was shown to decrease for higher outdoor temperatures as well as for indoor globe temperatures, for all areas of the world but Pakistan (Nicol and Humphreys, 2004). However, that study differs from this thesis in that this thesis will examines the proportion of rooms left illuminated carelessly when not in use to the total number of accessible rooms; therefore it does not involve examining a reasonably predictable human behavior based on the basic human need for comfort but instead consists of investigating an aberration of human behavior that, viewed in light of the Nicol and Humphreys (2004) paper, would be counterintuitive.

The third study, by Masoso and Grober (2009), correlates more directly with the phenomenon that occupants tend to leave lights on when rooms are not in use. The authors found that in Botswana and South Africa, 56% of the aggregate energy is used after hours and that 44% in is consumed during working hours, which would certainly correlate to a large amount of unnecessary waste in those buildings (Masoso and Grober 2009).

Last, Wang and Huang (2010) determined that, for a commercial building in Shanghai, the HVAC systems consumed the most energy, at 45%, while lighting accounted

for slightly less than 10%. Although the report did include an attempt to correlate office occupancy rate and energy use for each year from 2005 to 2008, the correlation was found to be weak (Wang and Huang 2010). Moreover, calculation was done with occupancy rate as a percentage instead of as the total number of occupants, the latter of which was the approach taken during this thesis research; however, the current investigation did not involve determining a correlation, but instead included demonstrating that the types of building differ in their utility cost per occupant as well as empirically defining which building types are typically more efficient. Therefore each of these studies discussed is a variation on a theme.

Therefore, the methods used in this thesis apply to any building or set of buildings, but are best used in conjunction with a traditional energy audit such as the ones undertaken by Jackins and Scruggs (1983-a-e), Shetye (2006), and Gibbs (2009). Nonetheless, when used alone, studies on the dynamic conditions of a building, such as occupancy and relative lighting usage, can prove to be a more effective tool for immediate energy conservation and resultant monetary savings because the payback period is small or virtually nonexistent and involves only minor instrumentation costs and a far higher degree of repetition; as at least three "snapshots" at regular intervals are required per day to obtain a picture of the activity within the building, for a total of at least 21 surveys per week.

BACKGROUND

Overview

The study included a total of fourteen buildings on the UAB campus, all throughout the main campus or the professional schools. These buildings included the Education Building, the Hill University Center (HUC), the Business-Engineering Complex (BEC), the Humanities Building, the Hoehn Engineering Building, Campbell Hall, the University Boulevard Office Building (UBOB), the Ryals Public Health Building, the School of Nursing (SON) Building (formerly Richard M. Scrushy Building), Sterne Library, Lister Hill Library, the Henry B. Peters Building, the Center for Biological Sciences and Engineering (CBSE), and the Worrell Building. More details about these buildings are provided in Table 1.

Table 1. Building Characteristics (Pruitt, 2009)

Number on Map	Building Name	Year Acquired or Constructed	GSF	Number of Rooms	Occupancy Class: Administrative appears as "Admin"
1	Education Building	1971†	106,957*	284*	Classroom/Admin*
2	HUC	1983	138,925.89	403	Student Center
3	BEC	1983	138,841.47	418	Classroom/Admin
4	Ryals Building	1996	115,435.09	436	Classroom/Admin
5	Hoehn Building	1986	39,561.69	173	Classroom/Admin
6	Campbell Hall	1978	204,986.79	735	Classroom/Admin
7	Humanities Building	1972	64,171.91	231	Classroom/Admin
8	UBOB	2005	36,104.94	101	Classroom/Admin
9	Sterne Library	1972††	169,755.87	249	Library
10	SON	1971	125,498.12	344	Classroom/Admin
11	Lister Hill Library	1971	150,894.65	236	Library
12	Peters Building	1975	105,494.44	327	Laboratory
13	CBSE	1960s	77,663.40	298	Laboratory
14	Worrell Building	Unknown	42,451.95	254	Laboratory

*Energy Management Department 2007; †Jackins and Scruggs 1983-b; ††Jackins and Scruggs 1983-a

A map of the buildings on the UAB campus is given in Figure 4.

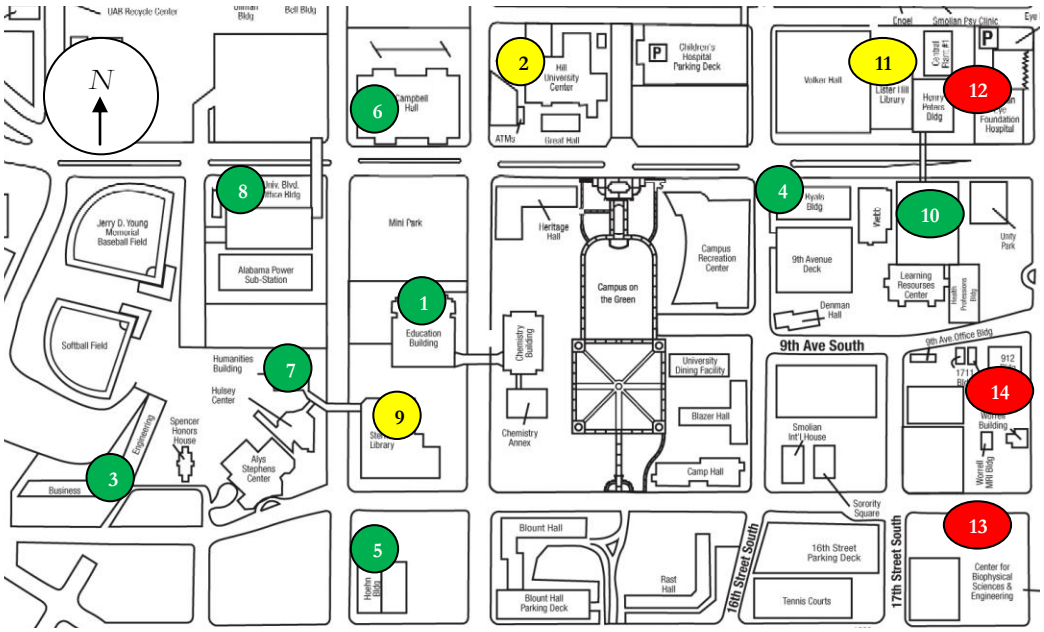

Figure 4. Locations of the 14 buildings on the UAB campus surveyed. (University of Alabama at Birmingham, 2010)

Atul Kajale (2010) discussed some of the criteria for selection of buildings. These criteria included reporting of a problem with operation of building resources by an occupant, high utility bill increases, and interest by Facilities Management or building staff in implementing energy conservation methods. More buildings were selected for this study than the ones mentioned here, but some were excluded at some point along the pre-survey process; in addition, a negative-feedback mechanism occurred because once the first or second batch of results was received, it was desired to discontinue the project and move toward one that more directly addressed the problem of energy consumption in buildings, namely a cost-benefit analysis examining the retrofitting of lighting fixtures and involving other campus buildings. This follow-up study is described in more detail in the Recommendations and Ties to Related/Future Work sections. It is also because the project was discontinued that the data are two to three years old and that no data that are more current are available.

Brief Building Descriptions

Education Building

At 106,957 GSF in internal area and constructed in 1971, the Education Building is one of the oldest buildings on the UAB main campus. It was also the first building to be surveyed as a part of this effort by the UAB Energy Management Department (2007) and is essentially two buildings in one. The older part of the building consists of the parking deck on the bottom, the entire first floor above the parking deck, and a few rooms and a corridor on the second floor. In general, no energy-saving mechanisms are found in these rooms and corridors, and older magnetic ballasts with T12 fluorescent bulbs are commonplace. However, the second floor contains a corridor and rooms that are not accessible from the main building and house the distance-learning center. Recently renovated, this space contains newer lighting fixtures using T8 fluorescent bulbs and occupancy sensors in a number of rooms, including restrooms; the area is actually considered part of Sterne Library.

Hill University Center (HUC)

Built in 1983 and encompassing 138,926 GSF of internal space among its five floors, HUC, surveyed in October and November 2007, also contains an elevator system controlled by the building staff that can restrict access to certain floors. Moreover, if floors were very sparsely occupied, only a few security lights could be left on in corridors to conserve energy. As a result, HUC was considered by the survey team an ideal model of optimal operation of a building. As with the Education Building, recently renovated portions of the building, such as the remodeled cafeteria, tend to contain advanced energy-saving features such as T8 fluorescent bulbs and motion sensors.

Business-Engineering Complex (BEC)

Encompassing 138,841 GSF, acquired in 1983, and surveyed in October and November 2007, the BEC is a boomerang-shaped building split into two wings: a business wing and an engineering wing. The main corridors were renovated during the 2009-2010 academic year and as such contain the T8 fluorescent bulbs and motion sensors that are key energy-saving features. Some recently renovated classrooms and computer laboratories also contain these bulbs and motion sensors.

Ryals Building

Surveyed primarily in November 2007, construction of the Ryals building was completed on October 29, 1996; the building contains 138,926 GSF among six floors, five of which were accessible in most surveys because the sixth floor requires keycard access beyond the elevator. A few rooms, such as some classrooms and conference rooms, have recently been renovated and contain newer, more energy-efficient features.

Hoehn Engineering Building

This building, home to the Civil, Construction, and Environmental Engineering Department, was constructed in 1986, was surveyed in October and November 2007, and contains 39,562 GSF among its three floors. Like those of the BEC, most corridors were renovated during the 2009-2010 academic year and now contain T8 electronic fluorescent bulbs and motion sensors; however, some of the classrooms, laboratories, and study areas have yet to be renovated and still contain T12 magnetic fluorescent bulbs.

Campbell Hall

Constructed in 1978, Campbell Hall is one of the largest buildings on the UAB campus and encompasses 204,987 GSF within its four floors. It was surveyed by two people at once during October and November 2007, whereas all other buildings during that time

frame only required one person to perform the bi-hourly surveys. Like the BEC and Hoehn buildings, Campbell Hall now contains energy-efficient corridor lighting features that were installed during the 2009-2010 academic year.

Humanities Building

Constructed in 1972, the Humanities building is almost as old as the Education building. Featuring four floors that total 64,172 GSF, this building was surveyed in November 2007. It has one unusual feature: The main corridors are open to the outside; and as a result, many of the lighting fixtures are specialized for outdoor use. Unlike the first and third floors, the second and fourth floors also contain interior corridors as well. Some rooms have occupancy sensors but most contain T12 magnetic fluorescent bulbs.

University Boulevard Office Building (UBOB)

This three-story building of 36,105 GSF was surveyed during October and November 2007 and, constructed just five years ago in March 2005, is the newest of all of the buildings surveyed. As such, its energy-management devices appeared to be generally up to date.

Sterne Library

The three-story 169,756 GSF Mervyn H. Sterne Library, constructed at the same time as the Education Building (1971), was surveyed during October-December 2007. Sterne Library surveys were different from all other surveys in that lighting condition was not noted. Instead, the goal with Sterne was to determine whether its meeting and study spaces could handle the load of closing down other nearby buildings during after-hours and weeknights. At the time of the surveys, the building could not have accommodated the extra traffic resulting from such a change; however, during the 2008-2009 and 2009-2010 academic years, many renovations were made, including establishing a Starbucks® Coffee

shop and extra computer units. Most renovations included T8 and T5 fluorescent lighting and motion sensors in newly remodeled rooms.

School of Nursing (SON) Building

Built in 1971, this four-story building of 125,498 GSF was surveyed during October and November 2007 by another graduate student, Anand Patel. As a result, the author of this thesis cannot comment on its energy-conserving features. In addition, it was never open on Friday nights or on weekends, and as such is not a factor in the weekend occupancy analysis in the Results and Discussion section.

Lister Hill Library

The Lister Hill Library of the Health Sciences was constructed in 1971 and contained three floors proper, as well as a basement and a ground floor that were also open to the public, for a total of 125,498 GSF. It was surveyed in April 2008, and one week's worth of surveys was done during the end of the normal semester; the other, week's worth, with fewer data points, was done during Finals week. The building appeared to be lacking in motion sensors and electronic ballasts, although the presence of layered lighting that could leave only a few bulbs on in large bookshelf areas was noted.

Henry B. Peters Building

This building was constructed in 1975 and constitutes a cornerstone of the School of Optometry. Surveyed during May 2008, it totals 105,495 GSF, contains a small basement with a parking deck, an extensive ground floor, and a central tower that contains Floors 1-5. The building had mostly T12 fluorescent bulbs, no layered lighting but on the Ground floor, and very limited window space on all floors but the tower's first and fifth floors; therefore, it appeared it was fairly energy inefficient.

Center for Biological Sciences and Engineering (CBSE)

The CBSE, which has an interesting history, was constructed in the 1960s as a performing arts building unaffiliated with UAB but was acquired in the 1990s and remodeled for its current use, according to one of its occupants, Jonathan Ray (2010). Moreover, it is the second of only two buildings that were surveyed by the team that this researcher has never entered. The building was surveyed during April and May 2008. Totaling 77,633 GSF, it has three stories proper and a ground floor, and the first and second floors are the largest. As with SON, commenting on the energy-saving features of the building is not possible because this researcher did not survey the building; however, unlike the SON, it was open on weekends, and as such is a factor in the weekend occupancy analysis in the Results and Discussion section.

Worrell Building

The last building of the occupancy surveys at UAB, this building was surveyed during May 2008. It has 42,452 GSF, but its construction date is unknown. It contains seven floors and a basement floor that was off-limits to the researchers. The building features a peculiar architectural design, possibly inspired by that of the Humanities building: The second, fourth, and sixth floors all have building space that juts out above the mezzanine, third, and fifth floors and creates balconies on the third and fifth floors. These exterior corridors contain mirrored windows that are believed to reflect sunlight and therefore keep down the interior temperature, thus reducing the cooling load on air conditioning systems to those floors in warmer months. Although these spaces are sometimes used as mere storage space on the second and fourth floors, they house a row of offices on the sixth floor. The sixth floor also contains a device that can turn on either 6, 15, or all 27 of the main corridor's fluorescent lights. Most fluorescent lights appear to use T12

bulbs, and no motion sensors were present throughout the building but in a conference room spanning the first floor and mezzanine, which also contained layered lighting.

Grouping Buildings by Occupancy Class

The occupancy classes provide a convenient way of dividing the buildings into groups. Because there is only one student center, and because its function is similar to those of the libraries, the buildings can be grouped together as follows:

- Type 1: Classroom/Administrative (Education, BEC, Humanities, Hoehn, UBOB, Ryals, SON).
- Type 2: Student Center or Library (HUC, Sterne, Lister Hill).
- Type 3: Laboratory (CBSE, Peters, Worrell).

These groups can be statistically compared for the various metrics to determine whether each metric indicates a greater-than-normal need for the recommendations.

PROJECT GOALS

The main goal and hypothesis of the project were as follows: By counting occupants of each of several buildings on the UAB campus, by summing the number of rooms that are fully lit when occupied, and by performing simple arithmetic (involving utility bill amounts, total number of accessible rooms, and total building area), metrics can be defined to determine which buildings and types of buildings were the most energy efficient, and which ones needed significant improvement. Of the three metrics defined in this fashion, two involved the results from one of the major tasks of the project. The three metrics included an average after hours hourly cost per occupant (HCPO), an average percentage of accessible rooms in the building that were fully lit and unoccupied (%Lit), and an average cost per gross square footage ($/GSF) for each building. These metrics are more clearly defined in the Procedures and Methodology section. Then the three groups of occupancy classes defined in the previous section will be compared to determine whether, in comparison with the other two groups, a specific group will benefit more from recommendations designed to treat that metric.

PROJECT TASKS

The data collection phase of the research only involved two major tasks that were completed as researchers walked through each building from room to room:

- A headcount of the number of occupants in each room if it was occupied.
- If it was unoccupied, a determination of whether any lights were unnecessarily left on and roughly what percentage. These data can also be used to identify "problem" rooms in which lights are left on unnecessarily all or almost all of the time.

The data and information recorded and processed in either of these situations are further defined in the Procedures and Methodology section. The metrics of energy efficiency comprise the interpretation of these results, and the conclusions and recommendations involve targeting each building that has a high value in one of the three metrics for a specific recommendation for improvement:

- High hourly utility cost per occupant: closure and HVAC setback during after hours.
- High percentage of unoccupied rooms fully lit: motion sensors.
- High monthly cost of electricity per GSF: installation of more energy-efficient lighting fixtures.

EXPERIMENTAL PROCEDURES AND METHODOLOGY

Experimental Procedure

The major procedure was as follows: Every two hours, at the nominal times of 6:15 p.m., 8:15 p.m., 10:15 p.m., and 12:15 a.m., a walk-through survey of the entire building was conducted. Ideally at these times, a single researcher entered the building equipped with a floor plan of the building as provided by the Facilities Management Department or, in some cases, with a table listing room in the building and including a space for observations. The researchers counted each person who could be seen in each room or corridor; if the rooms were unoccupied, observations were made about the percentage of lighting that could be estimated to be in use within the room or corridor. The recorded observations are defined as follows:

- If the room was occupied, the number of occupants was recorded.
- If the room was unoccupied and if no lights were on, a *0* was recorded. The switch would almost definitely be in the "off" position in this case.
- If the room was unoccupied and if 1-50% of its lights could be reasoned to be on, a *P* for *partial lighting* was recorded. Such an observation usually indicated that a few lights were designed to be left on for security purposes, even when the switch was in the "off" position. (Sometimes the switch was toggled to verify this likelihood.)
- If the room was unoccupied and if 51-100% of its lights could be reasoned to be on, a zero with a slash through it (*Ø*) was recorded. Such an observation usually showed

negligence on the part of the building occupants in leaving a light switch in the "on" position. This condition shall hereafter be defined as fully lit.

- Finally, if the room was inaccessible, an *NA (no access)* was recorded.

For surveys conducted in 2008, the nominal times were changed slightly, and the frequency was slightly lowered; however, because occupancy counts were low for all buildings but Lister Hill were low, those alterations should not affect the data distribution and average results. After being collected, the data were analyzed in several ways: All the occupants of all rooms on each floor were summed, and the variation in occupancy from time to time and from day to day was observed. The same was done with the number of rooms that were fully lit and for the number of rooms that were partially lit. Last, all floors were summed to give an overall occupancy and an overall percentage fully lit, the averages of each which are used in the Results and Discussion section.

Methodology

First, statistical analysis involved checking the occupancy data should be checked for inconsistencies such as outliers and large statistical differences. In a university setting, the same 75-minute classes are often held on the same time on Mondays and Wednesdays; likewise for Tuesdays and Thursdays, so the schedule of classes on Mondays and Wednesdays differs most significantly from that on Tuesdays and Thursdays (see Appendix A), and logic dictates comparing those two major combinations of weeknight results with each other. Then, if they are found to be statistically equivalent, the first two major combinations of weeknight results as a whole can be compared with those collected on Fridays, and then all the results from weeknights can be compared with those from weekends.

Statistical comparison was done by using the following methods, which consisted essentially of the calculation and comparison of four different values. The first step involved comparing the variances between the population, which is generally the group with more surveys, and the sample, which is generally the group with less surveys. The null hypothesis, which states that they are equal, is written as

$$\sigma = s. \qquad \text{[Equation 1]}$$

The alternate hypothesis, which states that they are not equal, is written as

$$\sigma \neq s. \qquad \text{[Equation 2]}$$

The null hypothesis applies if an F-test is passed, that is, if the critical value for the numbers of degrees of freedom is greater than the calculated value for the variances, or squares of the standard deviations, of the two groups to be compared. The calculated value is determined by using the following equation:

$$F_{calc} = \frac{s_1^2}{s_2^2} \qquad \text{[Equation 3]}$$

in which $s_1 > s_2$. The critical value is determined via the Microsoft Excel® function FINV, in which the probability is 0.1 for the two-tailed 90% confidence level and in which the degrees of freedom are the number of surveys in each group corresponding to the standard deviations in the numerator and denominator, respectively, of Equation 3, minus one survey for each. This value is written as "F_{crit}" in the summary tables in the Results and Discussion section. The second step consists of comparing the means of the two groups; this step establishes the null hypothesis that the means are the same, as

$$\bar{x} = \mu \qquad \text{[Equation 4]}$$

and establishes the alternate hypothesis as

$$\bar{x} \neq \mu. \qquad \text{[Equation 5]}$$

The null hypothesis applies if a Student's t-test is passed, that is, if critical value for the numbers of degrees of freedom is greater than the absolute value of the calculated value for the means of the two groups to be compared. The calculated value is determined by using the following equation:

$$t_{calc} = \frac{\bar{x} - \mu}{s/\sqrt{n}} \qquad \text{[Equation 6]}$$

in which $\bar{x}$ and μ are the sample and population group means, respectively; in which s is the standard deviation of the sample group; and in which n is the number of surveys in the sample group. The critical value is determined via the Microsoft Excel® function TINV, in which the probability is 0.1 for the two-tailed 90% confidence level, and in which the degrees of freedom are the number of surveys in the sample group, minus one. This value will be written in the tables in the Results and Discussion section as "t_{crit}". More information is available by way of the t-test than by way of the F-test; for example, if the absolute value of the calculated value is greater than the critical value and if it is positive, then it can be said that

$$\bar{x} < \mu, \qquad \text{[Equation 7]}$$

whereas, if it is negative, it can be said that

$$\bar{x} > \mu. \qquad \text{[Equation 8]}$$

If there are proven to be no major statistical differences, the data can then used to define metrics that indicate and quantify each building's relative energy efficiency and then to rank each of them on a scale of 1 to n, where n is the number of buildings, with 1 being the best,

and *n* being the worst. Because the buildings were surveyed at essentially equal intervals, these metrics do not take into account the time of survey, and will average the occupancy counts and number of lights fully lit regardless of the nominal time of the survey. The metrics are defined as follows:

- Hourly cost per occupant (HCPO) is a parameter defined by dividing the total utility bill amount for the major month of the survey *b*, by the total number of hours in the month *h* and then by dividing the result by the average number of occupants *o* observed over all surveys within the month(s) in the survey. Mathematically, the formula is of the form

$$HCPO = \frac{b}{h * o} \qquad \text{[Equation 9]}$$

- Percent average after-hours fully lit (%Lit) is a parameter defined by dividing the average number of fully lit, unoccupied rooms over all surveys of a building by the average number of rooms that the team could survey (excluding times at which the building could not be entered).
- Cost per gross square foot ($/GSF) is a non-research-dependent parameter determined simply by dividing the average monthly bill amount for January 2006-February 2009 by the number of gross square feet within the building as defined in the Introduction section.

Once these parameters were determined, the building types were statistically compared similarly to the procedure given previously in this section with Equations 1-8; and each building was ranked from 1 to *n*, where 1 was the lowest and where *n* was the highest. Then, a rank score was determined for the building, by summing up the ranks of the building in each metric, and a total score was determined. For example, if a given building ranked 3 in

terms of HCPO, 5 in terms of %Lit, and 4 in terms of $/GSF, its rank score was 3+5+4=12. The rank score could also be called a golf score because, like in the game of golf, a low score is good, and a high score indicates a need for improvement. The means of improvement are defined in the Recommendations subsection of the Conclusions section.

This methodology gives a relative score for each building, but fails to fill in the "gaps" between the buildings; for example, if there is a 30% increase in HCPO from the building ranked 1 to the building ranked 2 and then only a 10% increase to the building ranked 3, that difference in increase would be lost in the ranks. Therefore, a second "weighted" methodology was developed to remedy this flaw; in that methodology each parameter was scaled thus: The building with the lowest rank in the first methodology was assigned 0, a situation with the parameter being reduced to 0 was assigned 100, and all other indices were assigned by the formula:

$$X = 100 * (1 - \frac{M_i}{M_n}) \qquad \text{[Equation 10]}$$

in which X is the index, M is the metric in question, i is the rank of the building, and n is the rank of the building with the lowest rank as defined above. These scores reflect the distance from one rank to the next, a feature missing from the first methodology. This procedure yields a score from 0 to 100 for the parameter, and those scores are added together to get a number from 0 to 300. For example, if a given building has an HCPO index of 95, a %Lit index of 50, and a $/GSF index of 52, its score would then be 95+50+52=196. Because the total score possible is 300, this score could be termed a bowling score. These two methodologies are shown in full in the Results and Discussion section.

RESULTS AND DISCUSSION

Analyzing Data Trends

Occupancy Results

As many as four occupancy surveys were completed each weeknight, depending upon the accessibility of the building (whether it was open or closed) and upon the availability of the researchers. In 2007 surveys, the first survey occurred ideally at the nominal time 6:15 p.m., the second at 8:15 p.m., the third at 10:15 p.m., and the fourth and final at 12:15 p.m. if the building was open. In 2008 surveys, those times changed slightly depending on the building, but in general were 5:00 p.m., 7:00 p.m., 9:00 p.m., and 11:00 p.m.; and similar survey restrictions caused by closed buildings also applied. The full occupancy results of the survey of each building are too numerous to be displayed here; they can be found (broken down by each floor of the building) in detail in Appendix B. Table 2 shows the averages, number of surveys (or samples), and standard deviations for each survey of the weeknight.

Table 2. Weeknight occupancy statistics at each instance of survey

Survey of the night	Nominal Time Ranges*	Mean, or Average	Number of Surveys	Standard Deviation
1st	5:00-7:00 p.m.	91.31	n = 61	133.18
2nd	7:00-8:30 p.m.	37.14	n = 58	71.46
3rd	8:30-10:30 p.m.	13.04	n = 52	24.12
4th	10:30 p.m. or later	8.03	n = 39	23.12

*Lister Hill Library's non-finals week run of surveys, from April 4-10, in which the nominal times for surveys were 5:30 p.m., 7:00 p.m., 8:30 p.m., and 10:30 p.m., is the reason for the disparity in length of the ranges.

If those results are plotted, and if different curve-fitting procedures are used to attempt to fit the data to an equation describing occupancy as a function of the survey number, the following graph (Figure 5) results. Please note that the bubble size represents the number of surveys taken at each survey number and corresponding nominal time range.

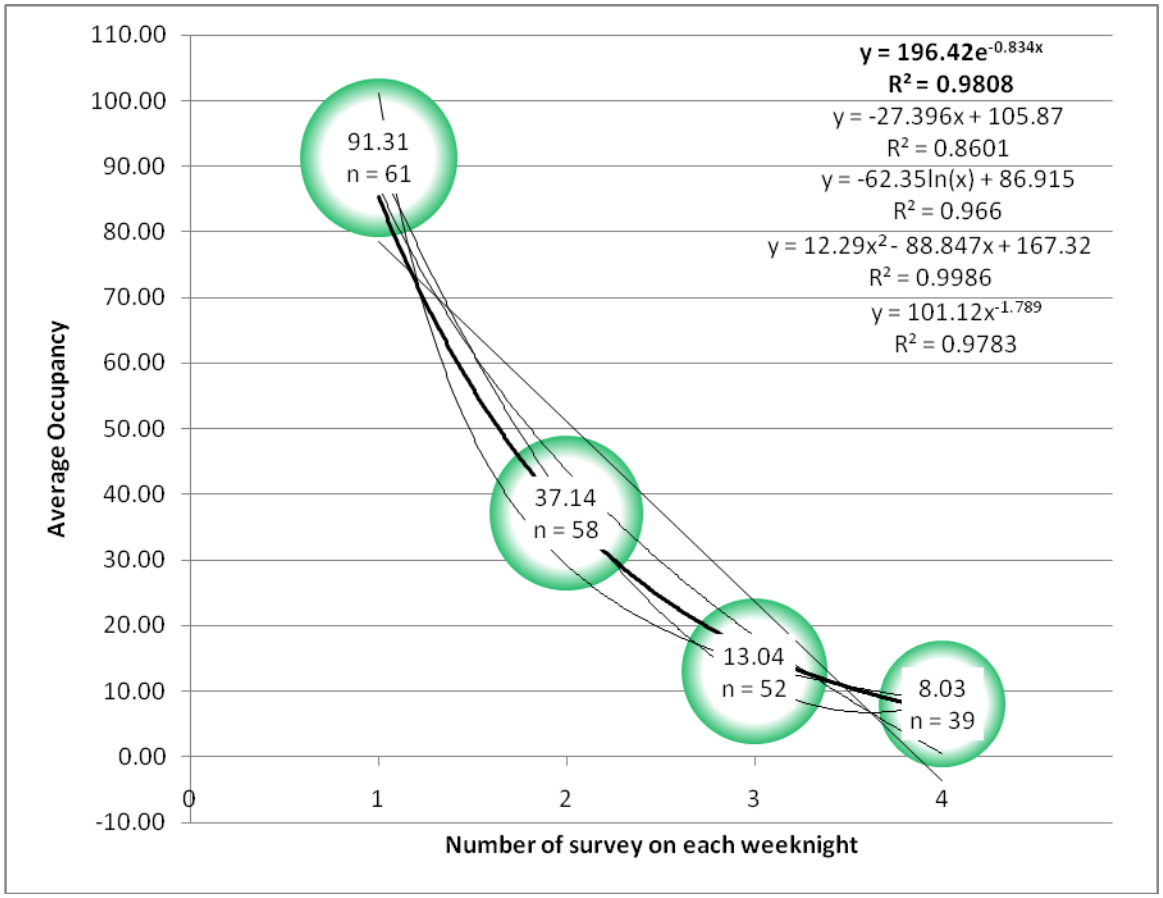

Figure 5. Average occupancy for each instance of survey on weeknights

A number of trendlines that can describe the function are listed in the right-hand corner; they are, from top to bottom, exponential, linear, logarithmic, 2nd-order polynomial, and power law. The r^2 (R^2) values indicate that the best fit is the 2nd-order polynomial expression, but this expression leads not only to more complex mathematics but also to a "dip" from the third to the fourth survey that would most likely not be exhibited and would be impossible in the case of an unoccupied building on the fourth survey. The second-best

fit, an exponential decay function, is the more likely scenario; therefore, the trendline and its corresponding equation and r^2 value are displayed in bold in Figure 5.

Weeknights can also be compared with each other using the statistical methods described in the previous section. The first step is the Monday/Wednesday versus Tuesday/Thursday comparison. The results of this comparison are given in Table 3.

Table 3. Results of Monday/Wednesday versus Tuesday/Thursday occupancy comparison.

Days of Week	Average	Number of Surveys	Standard Deviation
Monday and Wednesday	48.13	90	102.21
Tuesday and Thursday	43.52	82	88.84
F_{calc}	F_{crit}	t_{calc}	t_{crit}
1.32	1.32	-0.01	1.66

The variances are just barely equivalent, because the critical and calculated F-test values are equal. On the other hand, the absolute value of the calculated Student's t-test, is much lower than that of its critical counterpart; as a result, the two averages can be considered statistically equivalent. The next step is the Monday-Thursday versus Friday comparison. The results of this comparison are provided in Table 4.

Table 4. Results of Monday-Thursday versus Friday occupancy comparison.

Days of Week	Average	Number of Surveys	Standard Deviation
Monday-Thursday	39.04	172	82.30
Friday	21.42	38	38.51
F_{calc}	F_{crit}	t_{calc}	t_{crit}
4.57	1.27	-0.07	1.65381

The variances are not equivalent because the critical F-test value is much less than that of its calculated counterpart. However, as with the previous comparison, the absolute value of the calculated t-test value is much less than the critical value; therefore occupancy on Friday nights can be considered statistically equivalent to that on other weeknights. The final

occupancy comparison is weeknights as a whole versus weekends, and the results for this comparison are given in Table 5.

Table 5. Results of weeknights versus weekends occupancy comparison

Days of Week	Average	Number of Surveys	Standard Deviation
Weeknights	41.50	210	88.68
Weekends	18.44	159	28.00
F_{calc}	F_{crit}	T_{calc}	T_{crit}
10.029	1.213	-0.065	1.655

As with the Monday-Thursday versus Friday survey, the means but not the variances are equivalent. This finding indicates that although variation between the major weeknights (Monday-Thursday) is higher than that between the rest of the surveys (Fridays and weeknights), there is also no need to make a distinction between the day of the week when determining whether, on the basis of the three metrics, different types of buildings are more or less energy efficient than others.

Determination of Energy-Efficiency Metrics and Ranking of Buildings

This section is inspired by and in part follows the paper (or "extended abstract") and presentation given at the 2008 American Institute of Chemical Engineers National Meeting. (Lackey and Peters, 2008). The three metrics were defined and determined for the first time, but with a much smaller sampling of data. The current utility bill data used to create the metrics covers up to February 2009, or right before implementation of some of the energy-saving measures described in the Recommendations sub-section. Moreover, because some data were missing, some buildings could not be analyzed.

Average After-Hours Utility Cost Per Occupant

The breakdown for the first parameter of building efficiency, the average after-hours utility hourly cost per occupant (HCPO), is given in Table 6. The average after-hours

occupancy in the second column of the table is an average of all the occupancy totals for the entire building at all the survey times. If the building was closed, that zero value is left out of the average; while if it was open and a survey could not be made, the occupancy was estimated based on an average of the two nearest nominal time results (e.g.; 3:00 p.m. and 7:00 p.m. for the BEC). A sample calculation for the HCPO was provided in the Methodology sub-section.

Table 6. Average after-hours HCPO (UAB Facilities Management Department, 2009).

Building	Average After-Hours Occupancy	Study Month(s)	Hours in Average Month	Cost Per Hour ($)	Hourly Cost Per Occupant ($)	Rank
Education	60.26	2/07	672	37.72	0.63	4
Ryals	6.74	11/07	720	34.67	5.15	10
BEC	97.97	10/07, 11/07	732	49.80	0.51	3
Humanities	70.34	11/07	720	23.81	0.34	1
Hoehn	3.55	10/07, 11/07	732	12.34	3.47	9
UBOB	18.80	10/07, 11/07	732	22.53	1.20	5
SON	4.31	11/07	720	13.53	3.14	8
HUC	26.69	10/07, 11/07	732	51.21	1.92	6
Lister Hill	45.81	4/08	720	21.84	0.48	2
CBSE	3.70	4/08, 5/08	732	51.07	13.80	12
Peters	7.90	5/08	744	23.90	3.03	7
Worrell	2.67	5/08	744	29.14	10.93	11

As can be seen in Table 6, classroom buildings tended to be low in HCPO, mainly because they have higher average after-hours occupancy. The table also shows that research-oriented buildings were often occupied by fewer than 5 people after hours, and that, therefore, their HCPOs on average are higher; as a result, they are far more expensive to operate in their benefits to each occupant. The rank column, the last column on the right in Table 6 ranks the HCPO of the buildings from 1 to 12. The ranking indicates that the HCPO for Type 3 buildings is greater than those for Type 1 and Type 2 buildings, but a series of statistical analysis procedures similar to the ones undertaken to examine occupancy

was done to determine whether this finding holds true. These analyses are displayed in Table 7.

Table 7. HCPO comparison among the three building types.

Overall	Average	Number of Surveys	Standard Deviation	
Type 1	4.72	158	6.52	
Type 2	1.79	77	3.12	
Type 3	10.80	59	10.39	
	F_{calc}	F_{crit}	T_{calc}	T_{crit}
Type 1 vs. Type 2	4.372	1.300	-0.107	1.665
Type 1 vs. Type 3	2.539	1.306	0.076	1.672
Type 2 vs. Type 3	11.102	1.367	0.113	1.672

These results show that, although the standard deviations are all statistically different, the means are statistically equal; therefore, no specific type of building is being used less efficiently than the others. Nonetheless, the CBSE, Worrell, and Ryals buildings are clearly the most expensive to operate and, thus, would benefit the most from energy-saving measures such as the implementation of setback modes during after-hours times (see the Recommendations sub-section).

Average Percentage of Building Fully Lit in After-Hours

The next key parameter, the average percentage of the building that is fully lit after hours is an average of the percentages that were obtained by dividing the number of rooms that were found to be over 50% lit and unoccupied by the total number of rooms that were accessible throughout the building during that survey. In effect, inaccessible rooms are assumed to be fully lit in the same proportion in which the accessible portion was fully lit. These values are given in Table 8, with "n" in the third column representing the number of surveys. See Appendix C for more detailed information about the methods by which these values were obtained.

Table 8. Percent lighting (of unoccupied rooms) in after hours.

Building	AAHFL Rooms	n	Accessible Rooms	% Lighting	Rank
HUC	19.65	26	85	23.43%	3
BEC	52.36	34	153	34.44%	7
Humanities	18.50	32	70	26.37%	4
Hoehn	18.70	20	29	68.26%	11
Ryals	27.29	31	88	38.08%	8
UBOB	12.90	20	38	33.50%	6
Lister Hill	15.21*	47	83	18.72%*	1
SON	11.75	14	24	56.90%	9
CBSE	18.90	20	81	22.19%	2
Peters	16.90	30	66	28.07%	5
Worrell	28.20	25	51	59.29%	10

*Weighted average of the two runs of Lister Hill; see Appendix C-8 and C-9

The ranking tends to randomly fluctuate within the different building types on the bias of researcher about what constituted a fully lit room. For example, one researcher may have believed a room was fully lit when another believed it was partially lit, and this difference led to a large human error in the results. The criteria for a fully lit room, which typically indicated negligence on the part of occupants, and those for a partially lit room, which was indicative of necessary lighting for security measures, may not have been explained effectively or respected by all researchers, because this nuance was added by this author during the carrying out of the first few "pilot" surveys in the summer term after the original scope of the work was determined. Consequently, the correlation to the observation that research buildings have a higher after-hours HCPO is not absolute, because the second-best average is a research building (CBSE), and the worst average is a classroom building (Hoehn); this phenomenon is attributable to the human error discussed in this paragraph. Nonetheless, because the extrema (Lister Hill, Hoehn) correlate fairly well, there may be some merit in these results. Table 9 provides the results of statistical analysis used to determine whether any difference existed among the lighting in the three building types.

Table 9. Percentage fully lit comparison among the three building types.

Overall	Average	Number of Surveys	Standard Deviation	
Type 1	35%	189	17%	
Type 2	20%	67	14%	
Type 3	42%	55	19%	
	F_{calc}	F_{crit}	T_{calc}	T_{crit}
Type 1 vs. Type 2	1.436	1.313	-0.134	1.668
Type 1 vs. Type 3	1.241	1.304	0.050	1.674
Type 2 vs. Type 3	1.781	1.392	0.160	1.674

The data indicate that some of the variances are dissimilar but that the averages are the same.

Average Electricity Cost Per Gross Square Foot (GSF)

The third parameter for determining the relative energy efficiency of each campus building is the average (avg.) electricity cost (UAB Facilities Management Department 2009) per GSF (Pruitt 2009) and is the only parameter that does not rely on any survey results. The breakdown of each building's standing in terms of this parameter is given in Table 10.

Table 10. Average cost per gross square foot and rank for each building (UAB Facilities Management Department, 2009; Pruitt, 2009).

Building	Bill Period Start	Bill Period End	Bill Average	GSF	Avg. $/GSF	Rank
HUC	January 2006	February 2009	$24,443.96	138,925	$0.18	5
BEC	January 2006	February 2009	$25,990.40	138,841	$0.19	6
Humanities	January 2006	February 2009	$13,113.21	64,172	$0.20	7
Hoehn	March 2006	December 2007*	$10,290.19	39,562	$0.26	8
Ryals	January 2006	February 2009	$12,878.00	115,435	$0.11	4
UBOB	January 2006	February 2009	$10,184.31	35,295	$0.29	9
Lister Hill	January 2006	February 2009	$6,776.04	134,728	$0.05	1
SON	January 2006	February 2009	$5,633.80	75,783	$0.07	3
CBSE	January 2006	February 2009	$26,064.76	77,663	$0.34	10
Peters	January 2006	February 2009	$6,869.77	105,494	$0.07	2
Worrell	January 2006	February 2009	$14,495.73	42,452	$0.34	11

*n=22 (for all others, n=38)

Judging from the ranks alone, as with HCPO, the Type 2 buildings (library and administrative) appear to be the most cost-efficient, followed by Type 1 and then by Type 3.

However, there is certainly a non-correlation present in the fact that the second most cost-effective building in terms of electricity usage per gross square foot is a research building, the Peters Building. Nonetheless, a statistical comparison of the three values was done to determine whether difference exists in the building types; results of this analysis are provided in Table 11.

Table 11. Electricity cost per GSF comparison among the three different building types.

Overall	Average	Number of Surveys	Standard Deviation	
Type 1	$ 0.19	247	$ 0.07	
Type 2	$ 0.10	114	$ 0.06	
Type 3	$ 0.26	114	$ 0.15	
	F_{calc}	F_{crit}	T_{calc}	T_{crit}
Type 1 vs. Type 2	1.528	1.237	-0.146	1.658
Type 1 vs. Type 3	4.544	1.222	0.041	1.658
Type 2 vs. Type 3	6.944	1.274	0.096	1.658

Although all variances differ, the averages of the results for the three building types are clearly the same. Therefore, no building type is more likely than another building type to use more electricity per GSF.

Applying Methodologies

All three metrics were determined for each of 11 buildings. The summary of each building's value for each metric, as well as both the rank within all values, and the score, or sum of those ranks, is displayed in Table 12. Buildings with the lowest scores can be termed ideal models for effective use of energy, whereas the ones with the highest scores can be considered less efficient. As explained in the Methodology sub-section, the score is the rank score, or "golf" score, and is a general measure of each building's energy efficiency relative to other buildings, with each metric considered equal.

Table 12. Summary of each metric for each building and score (sum of ranks)

Building Type	Building Name	% Lighting	Rank	Avg $/GSF	Rank	HCPO	Rank*	Score
1	BEC	34.44%	7	$0.19	6	$0.51	3	16
1	Humanities	26.37%	4	$0.20	7	$0.34	1	12
1	Hoehn	68.26%	11	$0.26	8	$3.47	8	27
1	UBOB	33.50%	6	$0.29	9	$1.20	4	19
1	Ryals	38.08%	8	$0.11	4	$5.15	9	21
1	SON	56.90%	9	$0.07	3	$3.14	7	19
2	HUC	23.43%	3	$0.18	5	$1.92	5	13
2	Lister Hill	18.72%	1	$0.05	1	$0.48	2	4
3	CBSE	22.19%	2	$0.34	10	$13.80	11	23
3	Peters	28.07%	5	$0.07	2	$3.03	6	13
3	Worrell	59.29%	10	$0.34	11	$10.93	10	31

*HCPO ranks are different in this table and Table 6 because Education has no value for the other two metrics.

These data can also be determined by using a radar plot, also known as a "web plot," like the one seen in Figure 6. The building names and sum of ranks are displayed at the end of each spoke of the web, and the three metrics are each indicated by a different marker and line style. Each of the concentric polygons represents an odd-numbered rank, and the data points are placed accordingly for each building. Last, the building names are grouped by type, and lines are added between the spokes that divide the web into the different types.

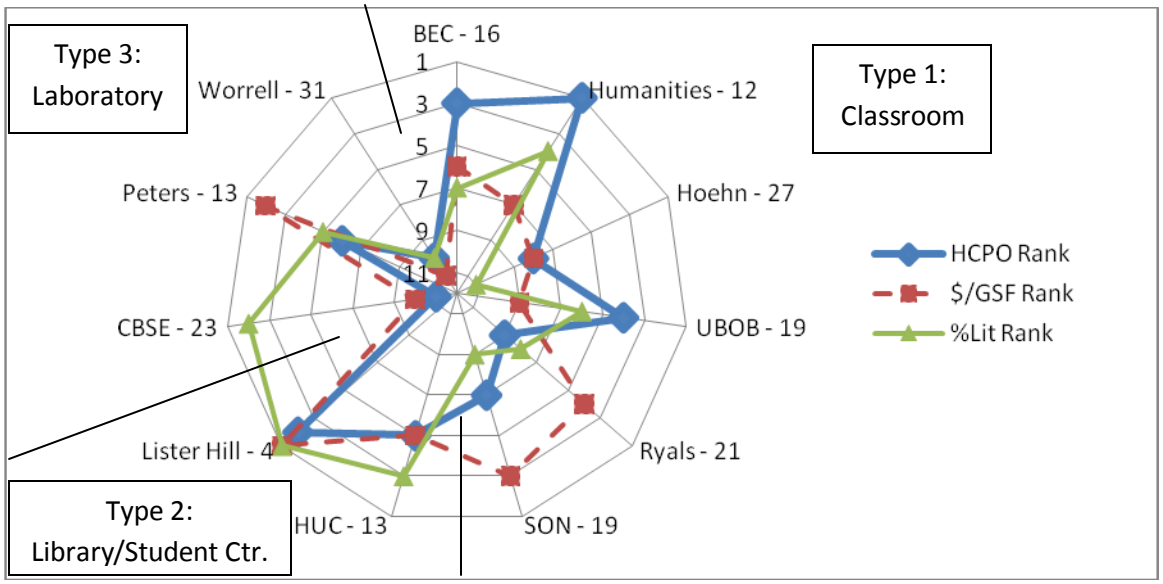

Figure 6. Rank-score of buildings surveyed based upon the three metrics.

Type 1 buildings have a fairly wide range of sums of ranks, but the widest range is actually found for Type 3. Also, the building with the highest score in Type 2 has the same score (13) as the lowest one in Type 3. Although an examination of the rank scores appears to indicate a difference among the building types, hypothesis testing had already revealed no significant difference between among the averages of the three building types. Therefore, although using a radar plot pinpoints exactly which buildings most need energy consumption improvement methods that are discussed in the Recommendations section, it cannot determine conclusively that a specific type of building based on occupancy class is more in need of these improvement methods. Figure 6 suggests only that the Worrell Building, the Hoehn Building, CBSE, and the Ryals Building will benefit the most from recommendations designed to decrease the values of these metrics, and that Lister Hill Library, the Humanities Building, the Peters Building, and HUC will benefit least.

The other methodology, the weighted "bowling" score, examines the buildings' standing in terms of the three metrics in terms of intervals among the buildings in each metric. The score is assigned using Equation 10, and results are given in Table 13.

Table 13. Indices for each of the three metrics and weighted score

Building	HCPO Index	$/GSF Index	%Lit Index	Weighted Score
BEC	96	45	50	191
Humanities	98	40	61	199
Hoehn	75	24	0	99
UBOB	91	15	51	158
Ryals	63	67	44	174
SON	77	78	17	172
HUC	86	48	66	200
Lister Hill	97	85	73	254
CBSE	0	2	67	69
Peters	78	81	59	218
Worrell	21	0	13	34

These results can also be depicted using a radar plot similar to the one used for the other methodology. This plot is displayed in Figure 7.

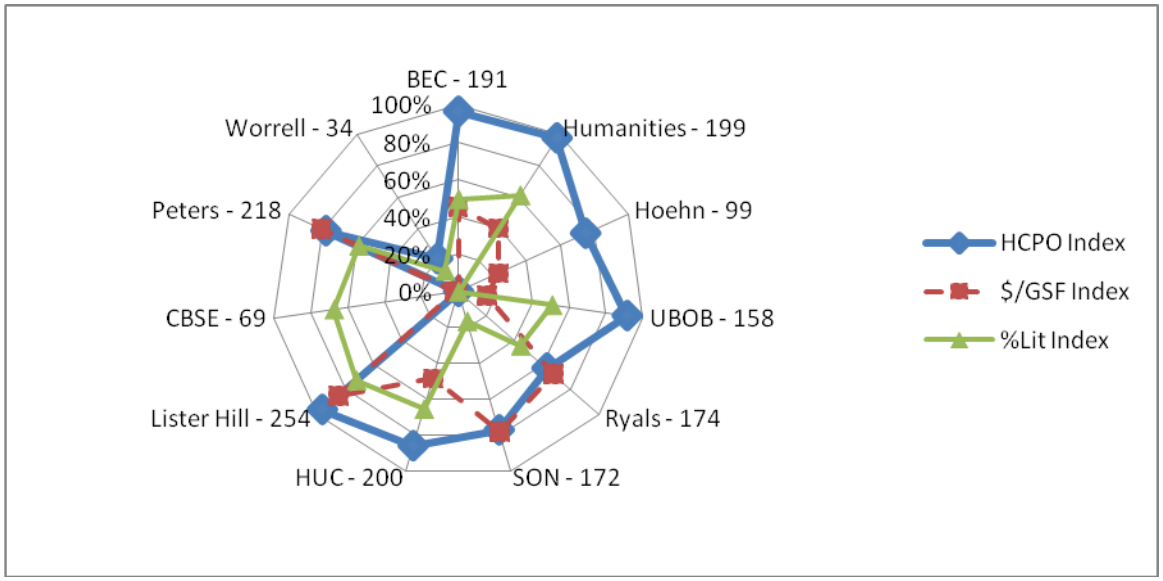

Figure 7. Weighted "Bowling" score of buildings surveyed for the three metrics

Refer to Figure 6 for the classification of the buildings by type; the buildings are listed in the same order. Although the two graphs appear similar, a few key differences exist. First, Hoehn is next to last with a rank-score of 27; but has a "bowling" score slightly higher than that of the CBSE, which received only a rank score of 23. The two methodologies are compared in Figure 8 by using a negative linear correlation.

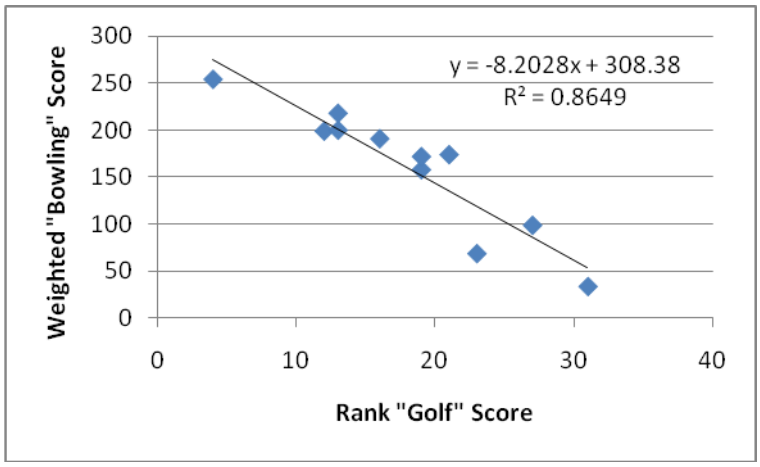

Figure 8. Comparison of the two methodologies with the use of a negative linear trendline.

The correlation coefficient is less than 0.9, a finding indicating some significant differences between the results of the two methodologies. The CBSE appears to be an outlier, because it deviates the most from the linear correlation, but there is also a significant amount of deviation for the Worrell building. This deviation can best be explained by the fact that the rise in HCPO for those two buildings is more than double that of the next-highest building, which corresponds to a drop in this index from 63% for the Ryals Building (ranked ninth lowest) to 21% for the Worrell Building (ranked tenth lowest). There are no similar significant drop-offs in the other two indices relative to corresponding ranks.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Occupancy surveys of university buildings after hours on weeknights and weekends tend to follow a few patterns. Weeknight occupancy follows an exponential decay function, with the equation

$$y = Ae^{-bx}. \qquad \text{[Equation 11]}$$

The peak occupancy on weekends is much lower than that on weeknights. If buildings are used efficiently early on weeknights, they are not being used efficiently on weekends; therefore, early closure of most academic buildings and late closure of libraries are recommended.

Three metrics were defined in order to determine the relative energy efficiency of each building: average after-hours utility cost per occupant, average after-hours percentage of each building that is fully lit, and average after-hours cost per gross square foot. These metrics were derived from results of other studies described in detail in the Previous Studies section linking occupancy and lighting behavior to energy efficiency. The higher any of these three metrics, the less energy efficient the building must be; summing the ranks (in this case, from 1 to 11) of each of the three metrics yields a rank score representing the building's relative energy efficiency. Although one laboratory building, the Worrell Building, showed the highest rank score, the second-highest rank score was for the Hoehn Engineering Building, a classroom and administrative building. In fact, the only occupancy class that did not have a single building with a rank score above 13 was the class containing the libraries

and student center. Perhaps this explains why hypothesis testing performed on the results revealed that the rank scores of the three types of buildings do not differ from one another based on the data; however, human error in counting the number of rooms in each building that were fully lit may have been a factor in the determination of the average number of such rooms in each building. Therefore, the results of this metric may be somewhat inconclusive. Also considered was a second methodology that accounts for the differences among the buildings' metrics by using a numerical score based on the percentage of the value's distance from the building with the best metric. The linear correlation between results of this methodology and those of the first methodology appeared greater for the buildings with the lowest values of metrics, but this finding originated in a significant drop-off between the HCPO of the two lowest-ranked buildings and those of the rest of the buildings.

Recommendations

The primary recommendation gleaned from these surveys is that consists of earlier implementation of restricted access to buildings and of HVAC system setback between the hours of 10:00 p.m. and 4:00 a.m. on weekdays, as well as complete closure of the building on weekends, all of which were also suggested by Atul Kajale (2010). In addition, and classes and other activities be relegated to only a few buildings, including the library. These changes would bring about extra occupants to the open buildings which would lower the cost per occupant of operating them to acceptable amounts when the others are closed. As the metric showed, this recommendation would be especially useful in the Worrell Building and the CBSE, with the Ryals building a distant third.

Installing motion sensors, particularly in classrooms and major corridors, would significantly diminish problem of lights being left on when rooms are not in use. Motion sensors set to timeout after five minutes would save between 29% and 60%, depending

upon room type (Maniccia et al., 2000). The buildings that would benefit the most from the installation of these devices are those that had the highest after-hours percentage fully lit and therefore the lowest ranks for this parameter: the Hoehn building; the School of Nursing; and the Worrell building. During the Spring 2010 semester, hallway motion sensors were installed inside the Hoehn building, Campbell Hall, and the BEC; thus the first step toward meeting this recommendation has been taken.

Both informal surveys of the buildings involving only a glance at the lighting fixtures, and formal surveys of certain buildings involving using a ballast sensor to determine the types of lighting installed and their relative efficiency have revealed that a number of fixtures need to be replaced. Virtually all buildings still have magnetic ballasts fitted with T12 fluorescent bulbs throughout areas that have not recently been renovated. If these fixtures were replaced with electronic ballasts and T8 bulbs, a maximum of 70% of wattage could be saved in each lighting fixture by a reduction from a 174-watt 4-bulb T12 fixture with two magnetic ballasts to a 52-watt 2-bulb T8 fixture with a single electronic ballast (Riccio, 2009); this modification would greatly lessen the values of the cost per gross square foot metric, and would be especially useful in the CBSE, the UBOB, and the Worrell Building.

Note that although each recommendation was targeted specifically toward lowering the value of one of the three metrics, no one type of building is more in need of such improvements. However, one building, the Worrell Building, had high values (and thus low ranks) in all three metrics and could benefit from implementation of all three recommendations. The degree of need of the other buildings for each of these procedures must be determined on a case-by-case basis. Last, these recommendations are only examples of ways of lowering high values of each metric; other means may be just as effective.

Ties to Related/Future Work

Projects are under way to determine which buildings of a different, but overlapping, set are most in need of retrofits of their light fixtures. The ultimate measure of a recommended energy-saving procedure's feasibility is its payback period. Since June 2009, 14 buildings (a set different from the ones discussed in this thesis) have been surveyed by using a ballast sensor to determine whether an electronic or a magnetic ballast is installed. The buildings use four times as many fixtures with magnetic ballasts as they do those with electronic ballasts; also the payback periods for the retrofit, which includes replacing T12 fluorescent bulbs with T8 fluorescent bulbs, range from just over half a year to two years depending on the building, with a resulting carbon dioxide emission reduction of 128,000 metric tons a year (Kajale, et al. 2010). This information can also be used to determine which buildings have the highest priority for such a retrofit and which have the lowest. It was also suggested that an "after study", perhaps of one building of each type, be done once the retrofits have been completed, however, no such studies have currently been initiated.

Last, in an article in the September 7, 2010, issue of the UAB campus newspaper, the *Kaleidoscope*, Helena Corzan included a quote from Matt Winslett of the Energy Management Division of the Facilities Management Department, who stated that UAB has made such recommendations during the 2008-2009 and 2009-2010 school years, the data from the studies detailed in this thesis were given to Facilities Management, and one million dollars in energy-related utility savings resulted during the one-year time frame of October 2009 to September 2010 (Corzan 2010). Because roughly one million dollars a week is required to power UAB (Winslett 2009), this savings is actually a much smaller victory than it first appears to be; however, any savings is important in energy efficiency.

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APPENDIX A

CLASSROOM ENROLLMENT FROM UAB FALL 2007 SEMESTER FOR CLASSES ENDING AFTER 6:15 P.M.

- *Only classes that occurred during survey times (after 6:15 p.m.) are listed.*
- *All times are in the "Begin" and "End" columns in 24-hour (military) time, with colons omitted.*
- *ABBREVIATIONS FOR BUILDINGS INVOLVED IN THE STUDY:*
  - *BEC: Business and Engineering Complex*
  - *CH: Campbell Hall*
  - *EB: Education Building*
  - *HB: Humanities Building*
  - *HOEN: Hoehn Engineering Building*
  - *UBOB: University Boulevard Office Building*
- *OTHER BUILDING ABBREVIATIONS:*
  - *1055: 1055 Building*
  - *BELL THR: Bell Theater*
  - *CHEM: Chemistry Building*
  - *HC: Hulsey Center for Arts and Humanities*
  - *UW: Ullman West*
  - *VH: Volker Hall*
- *WEEKDAYS:*
  - *Mon: Monday*
  - *Tue: Tuesday*
  - *Wed: Wednesday*
  - *Thu: Thursday*
  - *Fri: Friday*
- *SOURCE:* (University of Alabama at Birmingham 2008)

Appendix A - Classroom Enrollment **Hours of use per weekday**

Building	Room	Enrollments	Begin	End	Mon	Tue	Wed	Thu	Fri
1055	108	**12**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
1055	108	**15**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
1055	108	**15**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
BEC	105	**18**	1900	2015	0.00	**1.25**	0.00	**1.25**	0.00
BEC	105	**37**	2030	2145	0.00	**1.25**	0.00	**1.25**	0.00
BEC	105	**73**	1630	1900	**2.50**	0.00	0.00	0.00	0.00
BEC	105	**49**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
BEC	105	**54**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
BEC	105	**59**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
BEC	105	**57**	1915	2145	**2.50**	0.00	0.00	0.00	0.00
BEC	106	**22**	1900	2015	0.00	**1.25**	0.00	**1.25**	0.00
BEC	106	**7**	2030	2145	0.00	**1.25**	0.00	**1.25**	0.00
BEC	106	**24**	1630	1900	**2.50**	0.00	0.00	0.00	0.00
BEC	106	**20**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
BEC	106	**23**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
BEC	106	**17**	1915	2145	**2.50**	0.00	0.00	0.00	0.00
BEC	107	**14**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
BEC	107	**10**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
BEC	107	**14**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
BEC	107	**12**	1915	2145	**2.50**	0.00	0.00	0.00	0.00
BEC	107	**12**	1915	2145	0.00	0.00	**2.50**	0.00	0.00
BEC	109	**61**	1630	1900	**2.50**	0.00	0.00	0.00	0.00
BEC	109	**61**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
BEC	109	**49**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
BEC	109	**60**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
BEC	109	**73**	1915	2145	**2.50**	0.00	0.00	0.00	0.00
BEC	109	**36**	1915	2145	0.00	**2.50**	0.00	0.00	0.00
BEC	109	**48**	1915	2145	0.00	0.00	**2.50**	0.00	0.00
BEC	109	**36**	1915	2145	0.00	0.00	0.00	**2.50**	0.00
BEC	114	**28**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
BEC	114	**4**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
BEC	114	**26**	1630	1900	**2.50**	0.00	0.00	0.00	0.00
BEC	114	**15**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
BEC	114	**15**	1915	2145	0.00	**2.50**	0.00	0.00	0.00
BEC	115	**35**	1630	1900	**2.50**	0.00	0.00	0.00	0.00
BEC	115	**27**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
BEC	115	**37**	1915	2145	**2.50**	0.00	0.00	0.00	0.00
BEC	115	**37**	1915	2145	0.00	0.00	**2.50**	0.00	0.00

Appendix A - Classroom Enrollment **Hours of use per weekday**

Building	Room	Enrollments	Begin	End	Mon	Tue	Wed	Thu	Fri
BEC	115	**29**	1900	2015	0.00	**1.25**	0.00	**1.25**	0.00
BEC	115	**36**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
BEC	116	**25**	1630	1900	**2.50**	0.00	0.00	0.00	0.00
BEC	116	**17**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
BEC	116	**29**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
BEC	116	**22**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
BEC	116	**28**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
BEC	116	**19**	1915	2145	0.00	**2.50**	0.00	0.00	0.00
BEC	116	**8**	1915	2145	0.00	0.00	0.00	**2.50**	0.00
BEC	116	**35**	2030	2145	**1.25**	0.00	**1.25**	0.00	0.00
BEC	117	**35**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
BEC	117	**16**	1915	2145	**2.50**	0.00	0.00	0.00	0.00
BEC	117	**33**	1915	2145	0.00	0.00	**2.50**	0.00	0.00
BEC	117	**40**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
BEC	117	**29**	1630	1900	**2.50**	0.00	0.00	0.00	0.00
BEC	117	**30**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
BEC	117	**40**	1915	2145	0.00	**2.50**	0.00	0.00	0.00
BEC	117	**33**	1915	2145	0.00	0.00	0.00	**2.50**	0.00
BEC	118	**34**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
BEC	118	**22**	1915	2145	**2.50**	0.00	0.00	0.00	0.00
BEC	118	**22**	1915	2145	0.00	0.00	**2.50**	0.00	0.00
BEC	118	**29**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
BEC	118	**19**	1915	2145	0.00	**2.50**	0.00	0.00	0.00
BEC	118	**29**	1915	2145	0.00	0.00	0.00	**2.50**	0.00
BEC	119	**37**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
BEC	119	**36**	1915	2145	**2.50**	0.00	0.00	0.00	0.00
BEC	119	**27**	1915	2145	0.00	0.00	**2.50**	0.00	0.00
BEC	119	**41**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
BEC	119	**30**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
BEC	119	**25**	1915	2145	0.00	**2.50**	0.00	0.00	0.00
BEC	119	**22**	1630	1900	**2.50**	0.00	0.00	0.00	0.00
BEC	157	**23**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
BEC	157	**19**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
BEC	157	**14**	2030	2145	0.00	**1.25**	0.00	**1.25**	0.00
BEC	157	**31**	2030	2145	**1.25**	0.00	**1.25**	0.00	0.00
BEC	157	**4**	1900	2150	0.00	0.00	0.00	0.00	**3.00**
BEC	157	**5**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
BEC	157	**12**	1900	2015	0.00	**1.25**	0.00	**1.25**	0.00
BEC	158	**35**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00

Appendix A - Classroom Enrollment **Hours of use per weekday**

Building	Room	Enrollments	Begin	End	Mon	Tue	Wed	Thu	Fri
BEC	158	**39**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
BEC	158	**17**	1530	1820	0.00	0.00	0.00	0.00	**3.00**
BEC	158	**36**	1900	2130	0.00	**2.50**	0.00	0.00	0.00
BEC	158	**11**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
BEC	158	**12**	1900	2150	0.00	0.00	0.00	0.00	**3.00**
BEC	211	**41**	1630	1900	**2.50**	0.00	0.00	0.00	0.00
BEC	211	**42**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
BEC	211	**30**	1915	2145	0.00	0.00	**2.50**	0.00	0.00
BEC	211	**41**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
BEC	211	**25**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
BEC	211	**42**	1915	2145	0.00	**2.50**	0.00	0.00	0.00
BEC	215	**49**	1630	1900	**2.50**	0.00	0.00	0.00	0.00
BEC	215	**40**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
BEC	215	**40**	1915	2145	**2.50**	0.00	0.00	0.00	0.00
BEC	215	**38**	1915	2145	0.00	0.00	**2.50**	0.00	0.00
BEC	215	**50**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
BEC	304	**25**	1915	2145	**2.50**	0.00	0.00	0.00	0.00
BEC	304	**27**	1915	2145	0.00	0.00	**2.50**	0.00	0.00
BEC	304	**25**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
BEC	304	**18**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
BEC	304	**32**	1915	2145	0.00	**2.50**	0.00	0.00	0.00
BEC	304	**18**	1915	2145	0.00	0.00	0.00	**2.50**	0.00
BEC	304	**15**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
BEC	315	**30**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
BEC	315	**38**	1915	2145	**2.50**	0.00	0.00	0.00	0.00
BEC	315	**39**	1915	2145	0.00	0.00	**2.50**	0.00	0.00
BEC	315	**43**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
BEC	315	**33**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
BEC	315	**46**	1915	2145	0.00	**2.50**	0.00	0.00	0.00
BEC	315	**47**	1915	2145	0.00	0.00	0.00	**2.50**	0.00
BEC	315	**25**	1730	2000	0.00	0.00	0.00	0.00	**2.50**
BEC	354	**24**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
BEC	354	**35**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
BEC	354	**26**	1900	2015	0.00	**1.25**	0.00	**1.25**	0.00
BEC	354	**7**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
BEC	354	**20**	1530	1820	0.00	0.00	0.00	0.00	**3.00**
BEC	355	**51**	1900	2130	0.00	0.00	0.00	**2.50**	0.00
BEC	355	**13**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
BEC	355	**43**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00

Appendix A - Classroom Enrollment **Hours of use per weekday**

Building	Room	Enrollments	Begin	End	Mon	Tue	Wed	Thu	Fri
BEC	355	**6**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
BELL	THR	**67**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
CH	157	**13**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
CH	157	**3**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
CH	157	**8**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
CH	157	**20**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
CH	204	**40**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
CH	204	**50**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
CH	204	**26**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
CH	205	**0**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
CH	205	**51**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
CH	205	**20**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
CH	205	**60**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
CH	301	**80**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
CH	301	**43**	1730	1820	**1.00**	0.00	0.00	0.00	0.00
CH	301	**80**	1900	1950	0.00	**1.00**	0.00	0.00	0.00
CH	320	**0**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
CH	320	**13**	1730	1920	**3.00**	0.00	0.00	0.00	0.00
CH	320	**23**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
CH	405	**104**	1730	1845	0.00	0.00	0.00	**1.25**	0.00
CH	405	**128**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
CHEM	101	**171**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
CHEM	101	**41**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
EB	126	**49**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	126	**17**	1900	1950	0.00	0.00	**1.00**	0.00	0.00
EB	126	**40**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
EB	127	**25**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	127	**5**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	127	**8**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	127	**20**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	128	**7**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	128	**16**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	128	**22**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	128	**12**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	129	**15**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	129	**9**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	129	**17**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	129	**12**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	130	**9**	1730	2000	**2.50**	0.00	0.00	0.00	0.00

Appendix A - Classroom Enrollment **Hours of use per weekday**

Building	Room	Enrollments	Begin	End	Mon	Tue	Wed	Thu	Fri
EB	130	**10**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	130	**22**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
EB	130	**12**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	131	**28**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	131	**55**	1730	1820	0.00	0.00	0.00	**1.00**	0.00
EB	131	**36**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	131	**9**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	133	**70**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
EB	133	**62**	1900	2045	**1.75**	0.00	**1.75**	0.00	0.00
EB	133	**36**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	134	**10**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	134	**9**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	134	**25**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	134	**25**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	135	**26**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	135	**8**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	135	**17**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	144	**38**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	144	**14**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	144	**29**	1730	2120	0.00	**4.00**	0.00	0.00	0.00
EB	144	**40**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	145	**51**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	145	**68**	1730	1820	**1.00**	0.00	0.00	0.00	0.00
EB	145	**64**	1900	1950	**1.00**	0.00	0.00	0.00	0.00
EB	145	**9**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	145	**65**	1730	1820	0.00	**1.00**	0.00	0.00	0.00
EB	145	**61**	1900	1950	0.00	**1.00**	0.00	0.00	0.00
EB	146	**58**	2030	2145	**1.25**	0.00	**1.25**	0.00	0.00
EB	146	**56**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
EB	146	**44**	1730	1915	0.00	**1.25**	0.00	**1.25**	0.00
EB	147	**6**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	147	**12**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	147	**3**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	147	**8**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	148	**17**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	148	**13**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	148	**32**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	149A	**4**	1700	2100	0.00	0.00	0.00	0.00	**4.00**
EB	149A	**7**	1915	2145	0.00	0.00	0.00	**2.50**	0.00

Appendix A - Classroom Enrollment **Hours of use per weekday**

Building	Room	Enrollments	Begin	End	Mon	Tue	Wed	Thu	Fri
EB	149A	**12**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	149A	**25**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
EB	149A	**23**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
EB	149A	**24**	1630	1900	**2.50**	0.00	0.00	0.00	0.00
EB	149A	**23**	1900	2150	0.00	0.00	**3.00**	0.00	0.00
EB	149F	**25**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
EB	149F	**6**	1915	2145	0.00	**2.50**	0.00	0.00	0.00
EB	149F	**12**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	149F	**27**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	149S	**30**	1730	1920	**2.00**	0.00	0.00	0.00	0.00
EB	149S	**5**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
EB	149S	**26**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
EB	149S	**28**	1915	2145	0.00	**2.50**	0.00	0.00	0.00
EB	149S	**6**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	151	**33**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
EB	151	**30**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
EB	151	**18**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	151	**14**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	225	**25**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
EB	225	**14**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	225	**15**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	225	**6**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	225	**8**	1915	2145	0.00	0.00	0.00	**2.50**	0.00
EB	230	**21**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
EB	230	**34**	1900	2015	0.00	**1.25**	0.00	**1.25**	0.00
EB	230	**15**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	230	**48**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	236	**11**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	236	**28**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	236	**16**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
EB	236	**6**	1630	1900	0.00	0.00	0.00	**2.50**	0.00
EB	237	**30**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	237	**18**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
EB	237	**22**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	238A7	**11**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
EB	238A7	**15**	1730	1820	0.00	0.00	0.00	**1.00**	0.00
EB	238A7	**12**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	238T3	**16**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
EB	238T3	**11**	1730	2000	0.00	0.00	**2.50**	0.00	0.00

Appendix A - Classroom Enrollment **Hours of use per weekday**

Building	Room	Enrollments	Begin	End	Mon	Tue	Wed	Thu	Fri
EB	238T3	**25**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
HB	105	**101**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
HB	105	**90**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
HB	105	**151**	1730	1820	0.00	**1.00**	0.00	**1.00**	0.00
HB	105	**147**	1900	2015	0.00	**1.25**	0.00	**1.25**	0.00
HB	234	**32**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
HB	234	**9**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
HB	234	**23**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
HB	234	**10**	1900	2130	0.00	0.00	**2.50**	0.00	0.00
HB	235	**28**	1900	2050	**2.00**	0.00	**2.00**	0.00	0.00
HB	235	**34**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
HB	235	**34**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
HB	235	**27**	1900	2015	0.00	**1.25**	0.00	**1.25**	0.00
HB	236	**11**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
HB	236	**30**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
HB	236	**30**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
HB	236	**2**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
HB	309	**39**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
HB	309	**44**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
HB	311	**48**	1730	1915	**1.25**	0.00	**1.25**	0.00	0.00
HB	311	**31**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
HB	312	**48**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
HB	312	**44**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
HB	424	**6**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
HB	424	**7**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
HB	427	**41**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
HB	427	**34**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
HB	427	**6**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
HB	429	**30**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
HB	429	**27**	1600	1750	**2.00**	0.00	**2.00**	0.00	0.00
HB	431	**36**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
HB	431	**32**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
HB	431	**15**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
HB	431	**24**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
HB	434	**25**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
HB	434	**19**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
HB	435	**25**	1900	2130	0.00	**2.50**	0.00	0.00	0.00
HB	435	**17**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
HB	435	**24**	1730	2000	**2.50**	0.00	0.00	0.00	0.00

Appendix A - Classroom Enrollment **Hours of use per weekday**

Building	Room	Enrollments	Begin	End	Mon	Tue	Wed	Thu	Fri
HB	436	**18**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
HB	436	**23**	1900	2015	0.00	**1.25**	0.00	**1.25**	0.00
HB	436	**16**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
HB	237A	**9**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
HB	237A	**14**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
HB	237A	**10**	1900	2130	0.00	0.00	**2.50**	0.00	0.00
HB	237A	**13**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
HC	108	**57**	1730	1820	0.00	**1.00**	0.00	0.00	0.00
HC	108	**118**	1900	2130	**2.50**	0.00	0.00	0.00	0.00
HOEN	120	**16**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
HOEN	152	**8**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
UBOB	108	**95**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
UBOB	108	**53**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
UBOB	108	**8**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
UBOB	208	**61**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
UBOB	208	**35**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
UBOB	208	**14**	1900	2130	0.00	**2.50**	0.00	0.00	0.00
UBOB	222	**8**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
UBOB	222	**7**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
UBOB	222	**10**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
UBOB	222	**6**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
UBOB	226	**23**	1730	2000	0.00	0.00	0.00	0.00	**2.50**
UW	126	**33**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
UW	126	**27**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
UW	126	**34**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
UW	126	**6**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
UW	127	**37**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
UW	127	**6**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
UW	130	**20**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
UW	130	**42**	1900	2015	0.00	**1.25**	0.00	**1.25**	0.00
UW	130	**23**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
UW	130	**39**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
UW	131	**24**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
UW	131	**30**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
UW	131	**41**	1900	2130	0.00	**2.50**	0.00	0.00	0.00
UW	132	**33**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
UW	132	**8**	1900	2130	0.00	**2.50**	0.00	0.00	0.00
UW	132	**39**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
UW	226	**7**	1730	2000	0.00	**2.50**	0.00	0.00	0.00

Appendix A - Classroom Enrollment **Hours of use per weekday**

Building	Room	Enrollments	Begin	End	Mon	Tue	Wed	Thu	Fri
UW	226	**24**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
UW	226	**5**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
UW	226	**14**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
UW	227	**28**	1900	2015	**1.25**	0.00	**1.25**	0.00	0.00
UW	227	**45**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
UW	227	**15**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
UW	227	**9**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
UW	228	**27**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
UW	228	**36**	1900	2130	0.00	0.00	**2.50**	0.00	0.00
UW	228	**36**	1900	2130	**2.50**	0.00	0.00	0.00	0.00
UW	228	**6**	1900	2130	0.00	0.00	0.00	**2.50**	0.00
UW	228	**20**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
UW	229	**22**	1900	2130	0.00	0.00	**2.50**	0.00	0.00
UW	229	**45**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
UW	229	**12**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
UW	229	**0**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
UW	230	**14**	1630	1900	0.00	0.00	**2.50**	0.00	0.00
UW	230	**27**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00
UW	230	**28**	1900	2130	0.00	0.00	0.00	**2.50**	0.00
UW	230	**10**	1900	2130	0.00	0.00	**2.50**	0.00	0.00
UW	230	**13**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
UW	231	**33**	1630	1900	0.00	**2.50**	0.00	0.00	0.00
UW	231	**39**	1530	1820	0.00	0.00	0.00	**3.00**	0.00
UW	231	**4**	1900	2130	0.00	0.00	**2.50**	0.00	0.00
UW	231	**23**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
UW	233	**16**	1730	2000	**2.50**	0.00	0.00	0.00	0.00
UW	233	**18**	1730	2000	0.00	**2.50**	0.00	0.00	0.00
UW	233	**18**	1730	2000	0.00	0.00	0.00	**2.50**	0.00
UW	233	**13**	1730	2000	0.00	0.00	**2.50**	0.00	0.00
VH	L101A	**173**	1730	1845	**1.25**	0.00	**1.25**	0.00	0.00
VH	L101A	**67**	1730	1845	0.00	**1.25**	0.00	**1.25**	0.00

APPENDIX B

SURVEY OCCUPANCY OBSERVATION RESULTS FOR ALL BUILDINGS AT EACH NOMINAL TIME, BROKEN DOWN BY FLOOR

- *LEGEND OF ABBREVIATIONS:*
  - *SUN, MON, TUE, WED, THU, FRI, SAT: Days of the week*
  - *NA: No Access*
  - *ND: No Data*

B-1 RYALS

Day of Week	Nominal Time	Date	1st Floor	2nd Floor	3rd Floor	4th Floor	5th Floor	TOTAL
SUN	7:00 AM	ND	0	0	0	0	0	0
SUN	9:00 AM	ND	0	0	0	0	0	0
SUN	11:00 AM	ND	0	0	0	0	0	0
SUN	1:00 PM	ND	0	0	0	0	0	0
SUN	3:00 PM	ND	0	0	0	0	0	0
SUN	5:00 PM	ND	0	0	0	0	0	0
SUN	7:00 PM	ND	0	0	0	0	0	0
SUN	9:00 PM	11/25/2007	5	2	3	0	1	11
SUN	11:00 PM	11/18/2007	2	0	0	0	0	2
MON	6:15 PM	11/5/2007	32	0	0	17	0	49
MON	8:15 PM	11/5/2007	7	0	1	0	0	8
MON	10:15 PM	11/5/2007	8	0	0	0	0	8
MON	12:15 AM	11/5/2007	4	0	0	2	0	6
TUE	6:15 PM	11/6/2007	14	0	0	4	1	19
TUE	8:15 PM	11/6/2007	0	0	0	3	0	3
TUE	10:15 PM	11/6/2007	2	0	0	2	0	4
TUE	12:15 AM	11/6/2007	2	0	0	2	0	4
WED	6:15 PM	11/7/2007	5	1	0	64	1	71
WED	8:15 PM	11/7/2007	5	0	0	1	0	6
WED	10:15 PM	11/7/2007	2	0	0	0	0	2
WED	12:15 AM	11/7/2007	0	0	0	0	0	0
THU	6:15 PM	11/8/2007	11	0	0	1	0	12
THU	8:15 PM	11/8/2007	2	0	0	4	0	6
THU	10:15 PM	11/8/2007	0	0	0	1	0	1
THU	12:15 AM	11/8/2007	0	0	0	2	0	2
FRI	6:15 PM	11/9/2007	6	0	0	0	0	6
FRI	8:15 PM	11/9/2007	2	0	0	0	0	2
FRI	10:15 PM	11/9/2007	0	0	0	0	0	0
FRI	12:15 AM	11/9/2007	0	0	0	0	0	0
SAT	7:00 AM	11/10/2007	0	0	0	0	0	0
SAT	9:00 AM	11/10/2007	0	0	0	0	0	0
SAT	11:00 AM	11/10/2007	2	0	5	1	1	9
SAT	1:00 PM	11/10/2007	1	1	0	2	1	5
SAT	3:00 PM	11/10/2007	7	0	0	1	0	8
SAT	5:00 PM	11/10/2007	1	0	0	3	1	5
SAT	7:00 PM	11/10/2007	3	0	0	0	1	4
SAT	9:00 PM	11/10/2007	1	0	0	0	1	2
SAT	11:00 PM	11/10/2007	1	0	0	0	0	1
	AVERAGE		4	0	0	4	0	8

B-2 BEC

Day of Week	Nominal Time	Date	1st Floor	2nd Floor Business	2nd Floor Engin-eering	3rd Floor Business	3rd Floor Engin-eering	TOTAL
SUN	7:00 AM	NA	0	0	0	0	0	0
SUN	9:00 AM	11/4/2007	0	0	0	0	0	0
SUN	11:00 AM	11/4/2007	3	0	0	0	1	4
SUN	1:00 PM	11/4/2007	16	0	2	0	5	23
SUN	3:00 PM	11/18/2007	65	0	7	6	22	100
SUN	5:00 PM	ND	*59*	*0*	*5*	*5*	*21*	*89*
SUN	7:00 PM	11/25/2007	52	0	2	4	20	78
SUN	9:00 PM	11/4/2007	21	1	0	1	1	24
SUN	11:00 PM	11/4/2007	21	1	3	1	2	28
MON	6:15 PM	11/5/2007	360	44	26	7	43	480
MON	8:15 PM	11/5/2007	260	45	3	75	41	424
MON	10:15 PM	11/5/2007	34	4	3	2	7	50
MON	12:15 AM	11/6/2007	24	4	3	0	7	38
TUE	6:15 PM	11/6/2007	281	10	23	40	39	393
TUE	8:15 PM	11/6/2007	143	24	11	61	39	278
TUE	10:15 PM	11/6/2007	39	0	3	3	5	50
TUE	12:15 AM	11/7/2007	28	0	0	1	7	36
WED	6:15 PM	10/24/2007	301	56	8	40	84	489
WED	8:15 PM	10/24/2007	111	11	6	23	14	165
WED	10:15 PM	10/24/2007	16	1	0	2	2	21
WED	12:15 AM	10/25/2007	3	1	0	1	2	7
THU	6:15 PM	11/1/2007	280	2	7	30	50	369
THU	8:15 PM	11/1/2007	94	0	1	35	35	165
THU	10:15 PM	ND	0	0	0	0	0	0
THU	12:15 AM	ND	0	0	0	0	0	0
FRI	6:15 PM	11/2/2007	26	0	0	0	5	31
FRI	8:15 PM	11/2/2007	9	0	1	1	4	15
FRI	10:15 PM	10/12/2007	5	0	0	0	3	8
FRI	12:15 AM	10/13/2007	2	0	0	0	0	2
SAT	7:00 AM	11/3/2007	8	1	0	0	0	9
SAT	9:00 AM	11/3/2007	54	7	0	0	3	64
SAT	11:00 AM	11/3/2007	76	5	0	0	0	81
SAT	1:00 PM	10/27/2007	42	0	0	0	6	48
SAT	3:00 PM	11/3/2007	54	0	0	0	7	61
SAT	5:00 PM	10/27/2007	18	0	0	4	4	26
SAT	7:00 PM	10/6/2007	18	0	0	3	8	29
SAT	9:00 PM	10/6/2007	16	0	0	1	8	25
SAT	11:00 PM	10/6/2007	9	0	1	2	1	13
		AVERAGE	67	6	3	9	13	98

Please note: data in italics for 5:00 p.m. Sunday were estimated as an average of the two nearest values.

B-3 HUC

Day of Week	Nominal Time	Date	1st Floor	2nd Floor	3rd Floor	4th Floor	5th Floor	TOTAL
SUN	7:00 AM	NA	0	0	0	0	0	0
SUN	9:00 AM	NA	0	0	0	0	0	0
SUN	11:00 AM	NA	0	0	0	0	0	0
SUN	1:00 PM	11/11/2007	5	0	0	4	0	9
SUN	3:00 PM	11/4/2007	6	0	0	2	0	8
SUN	5:00 PM	11/18/2007	4	0	0	6	0	10
SUN	7:00 PM	11/4/2007	2	3	0	27	0	32
SUN	9:00 PM	11/4/2007	1	3	0	3	0	7
SUN	11:00 PM	NA	0	0	0	0	0	0
MON	6:15 PM	10/29/2007	2	0	0	33	2	37
MON	8:15 PM	11/19/2007	42	0	0	1	0	43
MON	10:15 PM	11/19/2007	28	0	0	0	0	28
MON	12:15 AM	NA	0	0	0	0	0	0
TUE	6:15 PM	10/23/2007	29	3	0	35	3	70
TUE	8:15 PM	ND	0	0	0	0	0	0
TUE	10:15 PM	ND	0	0	0	0	0	0
TUE	12:15 AM	NA	0	0	0	0	0	0
WED	6:15 PM	10/3/2007	42	0	7	14	6	69
WED	8:15 PM	10/3/2007	26	0	0	15	3	44
WED	10:15 PM	11/28/2007	3	0	0	0	0	3
WED	12:15 AM	NA	0	0	0	0	0	0
THU	6:15 PM	11/1/2007	13	0	0	15	1	29
THU	8:15 PM	11/1/2007	3	0	0	0	0	3
THU	10:15 PM	ND	0	0	0	0	0	0
THU	12:15 AM	NA	0	0	0	0	0	0
FRI*	6:15 PM	10/5/2007	22	0	12	11	0	45
FRI*	8:15 PM	10/5/2007	116*	0	0	2	0	118*
FRI*	10:15 PM	10/5/2007	148*	0	0	0	0	148*
FRI*	12:15 AM	10/5/2007	137*	0	0	0	0	137*
FRI	6:15 PM	ND	0	0	0	0	0	0
FRI	8:15 PM	10/12/2007	5	0	0	1	0	6
FRI	10:15 PM	10/26/2007	1	0	0	1	0	2
FRI	12:15 AM	NA	0	0	0	0	0	0
SAT	7:00 AM	NA	0	0	0	0	0	0
SAT	9:00 AM	11/3/2007	3	0	0	27	0	30
SAT	11:00 AM	10/27/2007	11	0	2	3	0	16
SAT	1:00 PM	10/27/2007	10	0	0	0	0	10
SAT	3:00 PM	10/27/2007	6	0	0	1	0	7
SAT	5:00 PM	10/27/2007	3	0	0	3	0	6
SAT	7:00 PM	11/11/2007	8	0	0	5	0	13
SAT	9:00 PM	11/11/2007	10	0	0	0	0	10
SAT	11:00 PM	11/11/2007	181*	0	0	0	0	181*
		AVERAGE	12	0	1	7	1	22

* Indicates a special event such as BlazerNight or Diwali

B-4 HUMANITIES

Day of Week	Nominal Time	Date	1st Floor	2nd Floor	3rd Floor	4th Floor	TOTAL
SUN	7:00 AM	ND	0	0	0	0	0
SUN	9:00 AM	ND	0	0	0	0	0
SUN	11:00 AM	ND	0	0	0	0	0
SUN	1:00 PM	ND	0	0	0	0	0
SUN	3:00 PM	ND	0	0	0	0	0
SUN	5:00 PM	ND	0	0	0	0	0
SUN	7:00 PM	11/25/2007	1	0	2	1	4
SUN	9:00 PM	11/11/2007	2	0	0	2	4
SUN	11:00 PM	11/11/2007	0	0	3	0	3
MON	6:15 PM	11/12/2007	18	69	39	33	159
MON	8:15 PM	11/12/2007	7	3	9	0	19
MON	10:15 PM	11/12/2007	0	0	7	0	7
MON	12:15 AM	11/13/2007	1	0	0	0	1
TUE	6:15 PM	11/13/2007	29	30	7	26	92
TUE	8:15 PM	11/13/2007	7	0	2	16	25
TUE	10:15 PM	11/13/2007	3	0	0	0	3
TUE	12:15 AM	11/14/2007	2	0	0	0	2
WED	6:15 PM	11/7/2007	33	102	23	15	173
WED	8:15 PM	11/14/2007	10	19	1	0	30
WED	10:15 PM	11/7/2007	0	0	2	0	2
WED	12:15 AM	11/8/2007	0	0	0	0	0
THU	6:15 PM	11/8/2007	24	37	6	105	172
THU	8:15 PM	11/8/2007	10	0	16	0	26
THU	10:15 PM	11/8/2007	0	0	6	0	6
THU	12:15 AM	11/9/2007	0	0	1	0	1
FRI	6:15 PM	11/16/2007	58	0	0	0	58
FRI	8:15 PM	11/16/2007	0	0	0	0	0
FRI	10:15 PM	11/16/2007	0	0	0	0	0
FRI	12:15 AM	11/17/2007	0	0	0	0	0
SAT	7:00 AM	11/10/2007	1	1	0	1	3
SAT	9:00 AM	11/10/2007	2	10	0	0	12
SAT	11:00 AM	11/3/2007	19	0	0	0	19
SAT	1:00 PM	11/3/2007	9	0	0	1	10
SAT	3:00 PM	11/3/2007	2	0	0	1	3
SAT	5:00 PM	11/17/2007	0	0	0	0	0
SAT	7:00 PM	11/17/2007	0	0	0	0	0
SAT	9:00 PM	11/17/2007	0	0	0	0	0
SAT	11:00 PM	11/17/2007	0	0	0	0	0
		AVERAGE	7	8	4	6	26

B-5 HOEHN

Day of Week	Nominal Time	Date	1st Floor	2nd Floor	3rd Floor	TOTAL
SUN	7:00 AM	NA	0	0	0	0
SUN	9:00 AM	NA	0	0	0	0
SUN	11:00 AM	NA	0	0	0	0
SUN	1:00 PM	11/18/2007	0	4	2	6
SUN	3:00 PM	11/18/2007	0	1	1	2
SUN	5:00 PM	11/18/2007	0	2	1	3
SUN	7:00 PM	11/25/2007	0	0	0	0
SUN	9:00 PM	11/25/2007	0	0	0	0
SUN	11:00 PM	NA	0	0	0	0
MON	6:15 PM	10/22/2007	6	5	1	12
MON	8:15 PM	10/22/2007	0	4	1	5
MON	10:15 PM	10/22/2007	0	3	0	3
MON	12:15 AM	10/22/2007	0	0	0	0
TUE	6:15 PM	10/30/2007	1	2	0	3
TUE	8:15 PM	10/16/2007	0	8	3	11
TUE	10:15 PM	10/16/2007	0	2	2	4
TUE	12:15 AM	10/16/2007	0	0	0	0
WED	6:15 PM	10/10/2007	6	11	1	18
WED	8:15 PM	10/10/2007	0	8	1	9
WED	10:15 PM	NA	0	0	0	0
WED	12:15 AM	NA	0	0	0	0
THU	6:15 PM	10/18/2007	0	5	1	6
THU	8:15 PM	10/18/2007	0	4	2	6
THU	10:15 PM	10/18/2007	0	3	2	5
THU	12:15 AM	10/18/2007	0	0	0	0
FRI	6:15 PM	10/26/2007	0	3	0	3
FRI	8:15 PM	10/26/2007	0	0	0	0
FRI	10:15 PM	10/26/2007	0	0	0	0
FRI	12:15 AM	10/26/2007	0	0	0	0
SAT	7:00 AM	11/17/2007	0	0	0	0
SAT	9:00 AM	11/17/2007	0	0	0	0
SAT	11:00 AM	11/17/2007	0	0	0	0
SAT	1:00 PM	11/17/2007	0	0	8	8
SAT	3:00 PM	11/17/2007	0	3	8	11
SAT	5:00 PM	11/17/2007	0	1	4	5
SAT	7:00 PM	11/17/2007	0	3	8	11
SAT	9:00 PM	11/17/2007	0	2	0	2
SAT	11:00 PM	11/17/2007	0	2	0	2
		AVERAGE	0	2	1	4

B-6 UBOB

Day of Week	Nominal Time	Date	1st Floor	2nd Floor	3rd Floor	TOTAL
SUN	7:00 AM	NA	0	0	0	0
SUN	9:00 AM	ND	0	0	0	0
SUN	11:00 AM	ND	0	0	0	0
SUN	1:00 PM	ND	0	0	0	0
SUN	3:00 PM	11/4/2007	0	28	0	28
SUN	5:00 PM	11/18/2007	0	0	0	0
SUN	7:00 PM	11/4/2007	0	34	0	34
SUN	9:00 PM	11/4/2007	0	12	0	12
SUN	11:00 PM	ND	0	0	0	0
MON	6:15 PM	11/19/2007	16	20	3	39
MON	8:15 PM	11/5/2007	0	2	0	2
MON	10:15 PM	NA	0	0	0	0
MON	12:15 AM	NA	0	0	0	0
TUE	6:15 PM	11/6/2007	43	20	9	72
TUE	8:15 PM	ND	0	0	0	0
TUE	10:15 PM	NA	0	0	0	0
TUE	12:15 AM	NA	0	0	0	0
WED	6:15 PM	11/14/2007	28	4	25	57
WED	8:15 PM	10/31/2007	0	2	0	2
WED	10:15 PM	10/31/2007	0	0	0	0
WED	12:15 AM	11/1/2007	0	0	0	0
THU	6:15 PM	11/15/2007	7	34	0	41
THU	8:15 PM	11/15/2007	0	12	1	13
THU	10:15 PM	11/15/2007	0	0	0	0
THU	12:15 AM	11/16/2007	0	0	0	0
FRI	6:15 PM	11/2/2007	0	20	0	20
FRI	8:15 PM	11/2/2007	0	0	0	0
FRI	10:15 PM	11/2/2007	0	0	0	0
FRI	12:15 AM	11/3/2007	0	0	0	0
SAT	7:00 AM	11/10/2007	0	0	0	0
SAT	9:00 AM	11/10/2007	13	0	0	13
SAT	11:00 AM	ND	0	0	0	0
SAT	1:00 PM	11/3/2007	0	0	0	0
SAT	3:00 PM	11/17/2007	0	21	0	21
SAT	5:00 PM	11/17/2007	0	22	0	22
SAT	7:00 PM	11/17/2007	0	0	0	0
SAT	9:00 PM	11/17/2007	0	0	0	0
SAT	11:00 PM	11/17/2007	0	0	0	0
		AVERAGE	4	9	1	14

B-7 NURSING

Day of Week	Nominal Time	Date	1st Floor	2nd Floor	3rd Floor	4th Floor	TOTAL
SUN	7:00 AM	NA	0	0	0	0	0
SUN	9:00 AM	NA	0	0	0	0	0
SUN	11:00 AM	NA	0	0	0	0	0
SUN	1:00 PM	NA	0	0	0	0	0
SUN	3:00 PM	NA	0	0	0	0	0
SUN	5:00 PM	NA	0	0	0	0	0
SUN	7:00 PM	NA	0	0	0	0	0
SUN	9:00 PM	NA	0	0	0	0	0
SUN	11:00 PM	NA	0	0	0	0	0
MON	6:15 PM	11/19/2007	0	20	2	2	24
MON	8:15 PM	11/19/2007	0	0	2	1	3
MON	10:15 PM	11/19/2007	0	0	2	1	3
MON	12:15 AM	11/19/2007	0	0	2	1	3
TUE	6:15 PM	11/13/2007	0	20	2	0	22
TUE	8:15 PM	11/13/2007	0	0	2	0	2
TUE	10:15 PM	11/13/2007	0	0	2	0	2
TUE	12:15 AM	11/13/2007	0	0	2	0	2
WED	6:15 PM	11/7/2007	0	0	0	0	0
WED	8:15 PM	11/7/2007	0	0	0	0	0
WED	10:15 PM	ND	0	0	0	0	0
WED	12:15 AM	ND	0	0	0	0	0
THU	6:15 PM	11/15/2007	0	0	2	0	2
THU	8:15 PM	11/15/2007	0	0	2	0	2
THU	10:15 PM	11/15/2007	0	0	2	0	2
THU	12:15 AM	11/15/2007	0	0	2	0	2
FRI	6:15 PM	NA	0	0	0	0	0
FRI	8:15 PM	NA	0	0	0	0	0
FRI	10:15 PM	NA	0	0	0	0	0
FRI	12:15 AM	NA	0	0	0	0	0
SAT	7:00 AM	NA	0	0	0	0	0
SAT	9:00 AM	NA	0	0	0	0	0
SAT	11:00 AM	NA	0	0	0	0	0
SAT	1:00 PM	NA	0	0	0	0	0
SAT	3:00 PM	NA	0	0	0	0	0
SAT	5:00 PM	NA	0	0	0	0	0
SAT	7:00 PM	NA	0	0	0	0	0
SAT	9:00 PM	NA	0	0	0	0	0
SAT	11:00 PM	NA	0	0	0	0	0
		AVERAGE	0	3	2	0	4

B-8 LISTER HILL

Day of Week	Nominal Time	Date	Basement Floor	Ground Floor	1st Floor	2nd Floor	3rd Floor	TOTAL
Mon	5:30 PM	4/7/2008	0	13	37	14	2	66
Mon	7:00 PM	4/7/2008	0	11	47	12	0	70
Mon	8:30 PM	4/7/2008	0	5	34	4	0	43
Mon	10:30 PM	4/7/2008	0	4	7	0	0	11
Tue	5:30 PM	4/8/2008	1	14	41	14	34	104
Tue	7:00 PM	4/8/2008	0	10	30	8	0	48
Tue	8:30 PM	4/8/2008	0	6	27	6	0	39
Tue	10:30 PM	4/8/2008	0	3	16	0	0	19
Wed	5:30 PM	4/9/2008	0	7	31	10	0	48
Wed	7:00 PM	4/9/2008	0	12	25	7	0	44
Wed	8:30 PM	4/9/2008	0	7	21	8	0	36
Wed	10:30 PM	4/9/2008	1	3	13	4	0	21
Thu	5:30 PM	4/10/2008	0	8	41	9	0	58
Thu	7:00 PM	4/10/2008	0	12	30	8	0	50
Thu	8:30 PM	4/10/2008	0	7	14	9	0	30
Thu	10:30 PM	4/10/2008	0	1	15	0	0	16
Fri	5:30 PM	4/4/2008	0	5	21	3	0	29
Fri	7:00 PM	4/4/2008	0	4	13	1	0	18
Sat	9:30 AM	4/12/2008	0	3	14	3	0	20
Sat	11:30 AM	4/12/2008	0	6	35	6	0	47
Sat	1:30 PM	4/12/2008	0	11	45	11	0	67
Sat	3:30 PM	4/12/2008	0	10	38	10	0	58
Sat	5:30 PM	4/12/2008	0	7	30	4	0	41
Sun	12:30 PM	4/13/2008	0	2	27	6	0	35
Sun	2:45 PM	4/13/2008	0	10	50	17	0	77
Sun	5:00 PM	4/13/2008	0	5	38	12	0	55
Sun	7:15 PM	4/13/2008	0	4	50	14	0	68
Sun	9:30 PM	4/13/2008	0	5	19	10	0	34
		AVERAGE	0	7	29	8	1	45

B-9 LISTER HILL FINALS

Day of Week	Nominal Time	Date	Basement Floor	Ground Floor	1st Floor	2nd Floor	3rd Floor	TOTAL
Thu	6:30 PM	4/24/2008	0	18	28	6	0	52
Thu	8:30 PM	4/24/2008	0	13	16	8	0	37
Thu	10:30 PM	4/24/2008	0	8	15	1	0	24
Fri	6:30 PM	4/25/2008	0	10	30	7	0	47
Sat	9:30 AM	4/26/2008	0	1	8	0	0	9
Sat	1:30 PM	4/26/2008	0	8	28	12	0	48
Sat	5:30 PM	4/26/2008	1	10	32	6	0	49
Sun	1:30 PM	4/27/2008	0	7	57	13	0	77
Sun	5:30 PM	4/27/2008	2	13	50	18	0	83
Sun	9:30 PM	4/27/2008	0	8	11	6	0	25
Mon	6:30 PM	4/28/2008	0	12	33	14	0	59
Mon	8:30 PM	4/28/2008	0	6	46	13	0	65
Mon	10:30 PM	4/28/2008	0	2	29	5	0	36
Tue	6:30 PM	4/29/2008	1	8	39	9	0	57
Tue	8:30 PM	4/29/2008	0	8	51	13	0	72
Tue	10:30 PM	4/29/2008	0	5	30	8	0	43
Wed	6:30 PM	4/30/2008	1	4	34	8	0	47
Wed	8:30 PM	4/30/2008	0	5	37	9	0	51
Wed	10:30 PM	4/30/2008	0	3	16	1	0	20
		AVERAGE	0	8	31	8	0	47

B-10 CBSE

Day of Week	Nominal Time	Date	Ground Floor	1st Floor	2nd Floor	3rd Floor	TOTAL
SUN	9:00 AM	?	0	0	1	0	1
SUN	11:00 AM	?	0	0	3	0	3
SUN	1:00 PM	?	0	3	3	0	6
SUN	3:00 PM	?	0	1	5	0	6
SUN	5:00 PM	?	0	1	0	0	1
SUN	7:00 PM	?	0	0	0	0	0
SUN	9:00 PM	?	0	0	0	0	0
MON	5:00 PM	5/5/2008	0	11	10	2	23
MON	7:00 PM	5/5/2008	0	3	5	0	8
MON	9:00 PM	5/5/2008	0	1	2	0	3
MON	11:00 PM	5/5/2008	0	0	0	0	0
TUE	5:00 PM	?	0	0	0	0	0
TUE	7:00 PM	?	0	0	0	0	0
TUE	9:00 PM	?	0	0	0	0	0
TUE	11:00 PM	?	0	0	0	0	0
WED	5:00 PM	4/16/2008	1	7	3	0	11
WED	7:00 PM	4/16/2008	0	2	2	0	4
WED	9:00 PM	4/16/2008	0	0	0	0	0
WED	11:00 PM	4/16/2008	0	0	0	0	0
THU	5:00 PM	?	0	0	0	0	0
THU	7:00 PM	?	0	0	0	0	0
THU	9:00 PM	?	0	0	0	0	0
THU	11:00 PM	?	0	0	0	0	0
FRI	5:00 PM	?	0	0	0	0	0
FRI	7:00 PM	?	0	0	0	0	0
FRI	9:00 PM	?	0	0	0	0	0
FRI	11:00 PM	?	0	0	0	0	0
SAT	9:00 AM	?	0	0	0	0	0
SAT	11:00 AM	?	0	0	0	0	0
SAT	1:00 PM	?	0	1	2	0	3
SAT	3:00 PM	?	0	2	3	0	5
SAT	5:00 PM	?	0	0	0	0	0
SAT	7:00 PM	?	0	0	0	0	0
SAT	9:00 PM	?	0	0	0	0	0
		AVERAGE	0	1	1	0	2

B-11 PETERS

Day of Week	Nominal Time	Date	Base-ment Floor	Ground Floor	1st Floor	2nd Floor	3rd Floor	4th Floor	5th Floor	TOTAL
Thu	5:00 PM	5/8/2008	1	38	2	2	6	1	2	52
Thu	7:00 PM	5/8/2008	0	0	0	3	6	0	0	9
Thu	9:00 PM	5/8/2008	0	0	0	3	8	0	0	11
Thu	11:00 PM	5/8/2008	0	0	0	0	3	0	0	3
Fri	5:00 PM	5/9/2008	0	27	8	6	26	2	4	73
Fri	7:00 PM	5/9/2008	0	0	0	0	0	0	0	0
Fri	9:00 PM	5/9/2008	0	0	0	0	0	0	0	0
Fri	11:00 PM	5/9/2008	0	0	0	0	0	0	0	0
Sat	9:00 AM	5/10/2008	0	0	0	0	0	0	0	0
Sat	12:00 PM	5/10/2008	0	0	0	1	2	0	0	3
Sat	3:00 PM	5/10/2008	0	0	0	1	3	0	0	4
Sat	6:00 PM	5/10/2008	0	0	0	0	3	0	0	3
Sat	9:00 PM	5/10/2008	0	0	0	0	5	0	0	5
Sun	9:00 AM	5/11/2008	0	0	0	0	2	0	0	2
Sun	12:00 PM	5/11/2008	0	0	0	0	4	0	0	4
Sun	3:00 PM	5/11/2008	0	0	0	0	2	0	0	2
Sun	6:00 PM	5/11/2008	0	0	0	2	2	0	0	4
Sun	9:00 PM	5/11/2008	0	0	0	0	0	0	0	0
Mon	5:00 PM	5/12/2008	0	10	3	1	5	0	0	19
Mon	7:00 PM	5/12/2008	0	0	2	0	2	0	0	4
Mon	9:00 PM	5/12/2008	0	0	2	0	0	0	0	2
Mon	11:00 PM	5/12/2008	0	0	0	0	0	0	0	0
Tue	5:00 PM	5/13/2008	0	5	2	1	2	0	0	10
Tue	7:00 PM	5/13/2008	0	0	2	0	0	1	0	3
Tue	9:00 PM	5/13/2008	0	0	0	0	0	0	0	0
Tue	11:00 PM	5/13/2008	0	0	0	0	0	0	0	0
Wed	5:00 PM	5/14/2008	0	10	2	1	4	0	3	20
Wed	7:00 PM	5/14/2008	0	0	0	0	3	0	1	4
Wed	9:00 PM	5/14/2008	0	0	0	0	0	0	0	0
Wed	11:00 PM	5/14/2008	0	0	0	0	0	0	0	0
		AVERAGE	0	3	1	1	3	0	0	8

B-12 WORRELL

Day of Week	Nominal Time	Date	1st Floor	Mez-zanine Floor	2nd Floor	3rd Floor	4th Floor	5th Floor	6th Floor	TOTAL
Fri	5:00 PM	5/16/2008	0	0	1	0	0	0	0	1
Fri	7:00 PM	5/16/2008	1	0	0	0	0	0	1	2
Fri	9:00 PM	5/16/2008	0	0	0	0	0	0	0	0
Fri	11:00 PM	5/16/2008	0	0	0	0	0	0	0	0
Sat	9:00 AM	5/17/2008	3	0	0	0	0	0	3	6
Sat	12:00 PM	5/17/2008	0	0	0	0	0	0	3	3
Sat	3:00 PM	5/17/2008	2	0	0	0	0	0	4	6
Sat	6:00 PM	5/17/2008	0	0	0	3	1	0	0	4
Sat	9:00 PM	5/17/2008	0	0	0	1	0	0	0	1
Sun	9:00 AM	5/18/2008	0	0	0	0	0	0	1	1
Sun	12:00 PM	5/18/2008	0	0	0	0	0	0	0	0
Sun	3:00 PM	5/18/2008	1	0	0	0	0	0	2	3
Sun	6:00 PM	5/18/2008	0	0	0	0	0	0	0	0
Sun	9:00 PM	5/18/2008	0	0	0	0	0	0	1	1
Mon	5:00 PM	5/19/2008	2	1	0	1	1	0	2	7
Mon	7:00 PM	5/19/2008	1	0	2	0	0	0	1	4
Mon	9:00 PM	5/19/2008	0	0	2	0	0	0	0	2
Mon	11:00 PM	5/19/2008	0	0	0	0	0	0	0	0
Tue	5:00 PM	5/20/2008	2	0	0	2	0	1	1	6
Tue	7:00 PM	5/20/2008	0	0	0	0	0	0	0	0
Tue	9:00 PM	5/20/2008	0	0	0	0	0	0	0	0
Tue	11:00 PM	5/20/2008	0	0	0	0	0	0	0	0
Wed	5:00 PM	5/21/2008	4	0	2	2	0	1	3	12
Wed	7:00 PM	5/21/2008	0	0	2	0	0	1	0	3
Wed	9:00 PM	5/21/2008	1	0	0	0	0	0	1	2
Wed	11:00 PM	5/21/2008	0	0	0	0	0	0	0	0
Thu	5:00 PM	5/22/2008	1	4	0	3	0	0	5	13
Thu	7:00 PM	5/22/2008	0	2	0	0	0	0	1	3
Thu	9:00 PM	5/22/2008	0	0	0	0	0	0	0	0
Thu	11:00 PM	5/22/2008	0	0	0	0	0	0	0	0
		AVERAGE	1	0	0	0	0	0	1	3

APPENDIX C

SURVEY LIGHTING OBSERVATION RESULTS FOR ALL BUILDINGS AT EACH NOMINAL TIME

- *LEGEND OF ABBREVIATIONS:*
    - *SUN, MON, TUE, WED, THU, FRI, SAT: Days of the week*
- *Percentages are number of fully lit rooms divided by number of* accessible *rooms. Inaccessible rooms are assumed to be fully lit or not based upon the percentage of fully lit rooms found among the accessible rooms.*
- *Some results, indicated with an asterisk "*", were for a survey in which no inaccessible rooms were recorded, and the resulting percentage of fully lit rooms was improbably low; as a result that data was not incorporated into the calculation of the AAHFL that was used in the energy-efficiency metric and corresponding ranking.*

C-1	RYALS					
Day of Week	Nominal Time	Date	Fully Lit Rooms	Partially Lit Rooms	Number of Accessible Rooms	Percent Rooms Fully Lit
SUN	9:00 PM	11/25/2007	23	9	84	27.38%
SUN	11:00 PM	11/18/2007	21	9	79	26.58%
MON	6:15 PM	11/5/2007	34	0	89	38.20%
MON	8:15 PM	11/5/2007	34	0	89	38.20%
MON	10:15 PM	11/5/2007	35	0	89	39.33%
MON	12:15 AM	11/5/2007	35	0	89	39.33%
TUE	6:15 PM	11/6/2007	36	0	88	40.91%
TUE	8:15 PM	11/6/2007	37	0	88	42.05%
TUE	10:15 PM	11/6/2007	36	0	88	40.91%
TUE	12:15 AM	11/6/2007	34	0	88	38.64%
WED	6:15 PM	11/7/2007	34	0	88	38.64%
WED	8:15 PM	11/7/2007	35	0	88	39.77%
WED	10:15 PM	11/7/2007	35	0	88	39.77%
WED	12:15 AM	11/7/2007	35	0	88	39.77%
THU	6:15 PM	11/8/2007	39	0	88	44.32%
THU	8:15 PM	11/8/2007	35	0	88	39.77%
THU	10:15 PM	11/8/2007	38	0	88	43.18%
THU	12:15 AM	11/8/2007	37	0	88	42.05%
FRI	6:15 PM	11/9/2007	34	0	88	38.64%
FRI	8:15 PM	11/9/2007	33	0	88	37.50%
FRI	10:15 PM	11/9/2007	35	0	88	39.77%
FRI	12:15 AM	11/9/2007	35	0	88	39.77%
SAT	7:00 AM	11/10/2007	33	0	88	37.50%
SAT	9:00 AM	11/10/2007	33	0	88	37.50%
SAT	11:00 AM	11/10/2007	32	0	88	36.36%
SAT	1:00 PM	11/10/2007	30	0	88	34.09%
SAT	3:00 PM	11/10/2007	32	0	88	36.36%
SAT	5:00 PM	11/10/2007	31	0	88	35.23%
SAT	7:00 PM	11/10/2007	32	0	88	36.36%
SAT	9:00 PM	11/10/2007	32	0	88	36.36%
SAT	11:00 PM	11/10/2008	32	0	88	36.36%
		AVERAGE	**33.45**	**0.58**	**87.71**	**38.08%**

C-2	BEC					
Day of Week	Nominal Time	Date	Fully Lit Rooms	Partially Lit Rooms	Number of Accessible Rooms	Percent Rooms Fully Lit
SUN	9:00 AM	11/4/2007	61	9	149	40.94%
SUN	11:00 AM	11/4/2007	60	9	148	40.54%
SUN	1:00 PM	11/4/2007	56	6	148	37.84%
SUN	3:00 PM	11/18/2007	48	9	159	30.19%
SUN	5:00 PM	*No Data*	*46.5*	*10*	*0*	*0.00%**
SUN	7:00 PM	11/25/2007	45	11	212	21.23%
SUN	9:00 PM	11/4/2007	43	18	149	28.86%
SUN	11:00 PM	11/4/2007	45	16	149	30.20%
MON	6:15 PM	11/5/2007	58	9	182	31.87%
MON	8:15 PM	11/5/2007	53	8	174	30.46%
MON	10:15 PM	11/5/2007	57	10	170	33.53%
MON	12:15 AM	11/6/2007	56	10	168	33.33%
TUE	6:15 PM	11/6/2007	60	10	161	37.27%
TUE	8:15 PM	11/6/2007	56	8	160	35.00%
TUE	10:15 PM	11/6/2007	62	9	154	40.26%
TUE	12:15 AM	11/7/2007	63	9	155	40.65%
WED	6:15 PM	10/24/2007	52	6	149	34.90%
WED	8:15 PM	10/24/2007	54	9	146	36.99%
WED	10:15 PM	10/24/2007	64	10	149	42.95%
WED	12:15 AM	10/25/2007	65	10	146	44.52%
THU	6:15 PM	11/1/2007	28	2	127	22.05%
THU	8:15 PM	11/1/2007	23	2	121	19.01%
FRI	6:15 PM	11/2/2007	56	1	305*	18.36%*
FRI	8:15 PM	11/2/2007	57	1	305*	18.69%*
FRI	10:15 PM	10/12/2007	53	11	144	36.81%
FRI	12:15 AM	10/13/2007	56	11	144	38.89%
SAT	7:00 AM	11/3/2007	56	1	305*	18.36%*
SAT	9:00 AM	11/3/2007	54	1	305*	17.70%*
SAT	11:00 AM	11/3/2007	51	1	305*	16.72%*
SAT	1:00 PM	10/27/2007	53	11	151	35.10%
SAT	3:00 PM	11/3/2007	50	1	305*	16.39%*
SAT	5:00 PM	10/27/2007	47	11	150	31.33%
SAT	7:00 PM	10/6/2007	50	9	142	35.21%
SAT	9:00 PM	10/6/2007	52	9	140	37.14%
SAT	11:00 PM	10/6/2007	52	10	140	37.14%
		AVERAGE	**52.36**	**9.38**	**153.11**	**34.44%**

C-3	HUC					
Day of Week	Nominal Time	Date	Fully Lit Rooms	Partially Lit Rooms	Number of Accessible Rooms	Percent Rooms Fully Lit
SUN	1:00 PM	11/11/2007	19	22	82	23.17%
SUN	3:00 PM	11/4/2007	22	25	80	27.50%
SUN	5:00 PM	11/18/2007	16	22	77	20.78%
SUN	7:00 PM	11/4/2007	25	30	101	24.75%
SUN	9:00 PM	11/4/2007	14	30	80	17.50%
MON	6:15 PM	10/29/2007	25	0	310*	8.06%*
MON	8:15 PM	11/19/2007	13	25	79	16.46%
MON	10:15 PM	11/19/2007	7	22	63	11.11%
TUE	6:15 PM	10/23/2007	43	19	165	26.06%
WED	6:15 PM	10/3/2007	35	23	131	26.72%
WED	8:15 PM	10/3/2007	23	27	96	23.96%
WED	10:15 PM	11/28/2007	8	23	59	13.56%
THU	6:15 PM	11/1/2008	28	18	112	25.00%
THU	8:15 PM	11/1/2008	12	9	54	22.22%
FRI	6:15 PM	10/5/2007	43	27	135	31.85%
FRI	8:15 PM	10/5/2007	19	10	47	40.43%
FRI	10:15 PM	10/5/2007	18	10	44	40.91%
FRI	12:15 AM	10/5/2007	16	10	44	36.36%
FRI	8:15 PM	10/12/2007	14	24	77	18.18%
FRI	10:15 PM	10/26/2007	22	21	78	28.21%
SAT	9:00 AM	11/3/2007	22	24	81	27.16%
SAT	11:00 AM	10/27/2007	19	33	135	14.07%
SAT	1:00 PM	10/27/2007	12	24	99	12.12%
SAT	3:00 PM	10/27/2007	14	23	78	17.95%
SAT	5:00 PM	10/27/2007	15	22	79	18.99%
SAT	7:00 PM	11/11/2007	22	22	85	25.88%
SAT	9:00 PM	11/11/2007	16	26	79	20.25%
SAT	11:00 PM	11/11/2007	13	19	61	21.31%
		AVERAGE	**19.65**	**21.85**	**85.35**	**23.43%**

C-4	HUMANITIES					
Day of Week	Nominal Time	Date	Fully Lit Rooms	Partially Lit Rooms	Number of Accessible Rooms	Percent Rooms Fully Lit
SUN	7:00 PM	11/25/2007	24	3	93	25.81%
SUN	9:00 PM	11/11/2007	16	2	70	22.86%
SUN	11:00 PM	11/11/2007	15	3	69	21.74%
MON	6:15 PM	11/12/2007	20	1	79	25.32%
MON	8:15 PM	11/12/2007	22	2	75	29.33%
MON	10:15 PM	11/12/2007	23	4	74	31.08%
MON	12:15 AM	11/13/2007	16	1	61	26.23%
TUE	6:15 PM	11/13/2007	17	2	77	22.08%
TUE	8:15 PM	11/13/2007	22	2	75	29.33%
TUE	10:15 PM	11/13/2007	24	2	75	32.00%
TUE	12:15 AM	11/14/2007	22	2	75	29.33%
WED	6:15 PM	11/7/2007	17	1	80	21.25%
WED	8:15 PM	11/14/2007	18	3	72	25.00%
WED	10:15 PM	11/7/2007	19	2	71	26.76%
WED	12:15 AM	11/8/2007	19	2	71	26.76%
THU	6:15 PM	11/8/2007	13	2	76	17.11%
THU	8:15 PM	11/8/2007	17	2	70	24.29%
THU	10:15 PM	11/8/2007	20	2	70	28.57%
THU	12:15 AM	11/9/2007	20	2	70	28.57%
FRI	6:15 PM	11/16/2007	18	3	61	29.51%
FRI	8:15 PM	11/16/2007	17	3	61	27.87%
FRI	10:15 PM	11/16/2007	15	3	55	27.27%
FRI	12:15 AM	11/17/2007	15	3	55	27.27%
SAT	7:00 AM	11/10/2007	14	3	71	19.72%
SAT	9:00 AM	11/10/2007	15	3	70	21.43%
SAT	11:00 AM	11/3/2007	16	2	64	25.00%
SAT	1:00 PM	11/3/2007	19	2	68	27.94%
SAT	3:00 PM	11/3/2007	19	1	68	27.94%
SAT	5:00 PM	11/17/2007	20	2	68	29.41%
SAT	7:00 PM	11/17/2007	20	3	69	28.99%
SAT	9:00 PM	11/17/2007	20	3	69	28.99%
SAT	11:00 PM	11/17/2007	20	3	69	28.99%
		AVERAGE	**18.50**	**2.31**	**70.34**	**26.37%**

C-5	HOEHN					
Day of Week	Nominal Time	Date	Fully Lit Rooms	Partially Lit Rooms	Number of Accessible Rooms	Percent Rooms Fully Lit
SUN	1:00 PM	11/18/2007	17	0	137*	12.41%*
SUN	3:00 PM	11/18/2007	18	0	137*	13.14%*
SUN	5:00 PM	11/18/2007	19	0	137*	13.87%*
SUN	7:00 PM	11/25/2007	14	0	33	42.42%
SUN	9:00 PM	11/25/2007	14	0	33	42.42%
MON	6:15 PM	10/22/2008	23	2	32	71.88%
MON	8:15 PM	10/22/2008	22	2	32	68.75%
MON	10:15 PM	10/22/2008	21	2	32	65.63%
MON	12:15 AM	10/22/2008	22	2	32	68.75%
TUE	6:15 PM	10/30/2007	19	1	38	50.00%
TUE	8:15 PM	10/16/2008	15	0	19	78.95%
TUE	10:15 PM	10/16/2008	16	0	19	84.21%
TUE	12:15 AM	10/16/2008	18	0	19	94.74%
WED	6:15 PM	10/10/2007	15	2	40	37.50%
WED	8:15 PM	10/10/2007	18	2	42	42.86%
THU	6:15 PM	10/18/2008	19	1	24	79.17%
THU	8:15 PM	10/18/2008	19	1	24	79.17%
THU	10:15 PM	10/18/2008	19	1	24	79.17%
THU	12:15 AM	10/18/2008	20	1	24	83.33%
FRI	6:15 PM	10/26/2008	22	1	27	81.48%
FRI	8:15 PM	10/26/2008	22	1	27	81.48%
FRI	10:15 PM	10/26/2008	18	1	27	66.67%
FRI	12:15 AM	10/26/2008	18	1	27	66.67%
SAT	7:00 AM	11/17/2007	12	0	137*	8.76%*
SAT	9:00 AM	11/17/2007	13	0	137*	9.49%*
SAT	11:00 AM	11/17/2007	13	0	137*	9.49%*
SAT	1:00 PM	11/17/2007	17	0	137*	12.41%*
SAT	3:00 PM	11/17/2007	19	0	137*	13.87%*
SAT	5:00 PM	11/17/2007	19	0	137*	13.87%*
SAT	7:00 PM	11/17/2007	15	0	137*	10.95%*
SAT	9:00 PM	11/17/2007	16	0	137*	11.68%*
SAT	11:00 PM	11/17/2007	16	0	137*	11.68%*
		AVERAGE	**18.70**	**1.05**	**28.75**	**68.26%**

C-6	UBOB					
Day of Week	Nominal Time	Date	Fully Lit Rooms	Partially Lit Rooms	Number of Accessible Rooms	Percent Rooms Fully Lit
SUN	3:00 PM	11/4/2007	20	0	45	44.44%
SUN	5:00 PM	11/18/2007	9	0	40	22.50%
SUN	7:00 PM	11/4/2007	17	2	39	43.59%
SUN	9:00 PM	11/4/2007	16	4	37	43.24%
MON	6:15 PM	11/19/2007	14	1	51	27.45%
MON	8:15 PM	11/5/2007	15	3	35	42.86%
TUE	6:15 PM	11/6/2007	10	3	38	26.32%
WED	6:15 PM	11/14/2007	12	3	43	27.91%
WED	8:15 PM	10/31/2008	15	2	48	31.25%
WED	10:15 PM	10/31/2008	16	2	48	33.33%
THU	6:15 PM	11/15/2007	13	2	43	30.23%
THU	8:15 PM	11/15/2007	14	2	39	35.90%
FRI	6:15 PM	11/2/2007	14	4	32	43.75%
FRI	8:15 PM	11/2/2007	13	4	34	38.24%
SAT	9:00 AM	11/10/2007	13	1	34	38.24%
SAT	3:00 PM	11/17/2007	16	2	44	36.36%
SAT	5:00 PM	11/17/2007	19	3	46	41.30%
SAT	7:00 PM	11/17/2007	4	0	19	21.05%
SAT	9:00 PM	11/17/2007	4	0	19	21.05%
SAT	11:00 PM	11/17/2007	4	0	19	21.05%
		AVERAGE	**12.90**	**1.90**	**37.65**	**33.50%**

C-7	SON				
Day of Week	Nominal Time	Date	Fully Lit Rooms	Number of Accessible Rooms	Percent Rooms Fully Lit
MON	6:15 PM	11/19/2008	13	24	54.17%
MON	8:15 PM	11/19/2008	14	25	56.00%
MON	10:15 PM	11/19/2008	14	25	56.00%
MON	12:15 AM	11/19/2008	14	25	56.00%
TUE	6:15 PM	11/13/2008	13	22	59.09%
TUE	8:15 PM	11/13/2008	14	22	63.64%
TUE	10:15 PM	11/13/2008	14	22	63.64%
TUE	12:15 AM	11/13/2008	14	22	63.64%
WED	6:15 PM	11/7/2008	11	23	47.83%
WED	8:15 PM	11/7/2008	11	23	47.83%
THU	6:15 PM	11/15/2008	14	26	53.85%
THU	8:15 PM	11/15/2008	14	24	58.33%
THU	10:15 PM	11/15/2008	14	24	58.33%
THU	12:15 AM	11/15/2008	14	24	58.33%
		AVERAGE	**11.75**	**23.64**	**56.90%**

C-8	LISTER HILL					
Day of week	Date	Nominal Time	Full Lighting	Partial Lighting	Number of Accessible Rooms	Percent Rooms Fully Lit
MON	4/7/2008	5:30 PM	13	8	85	15.29%
MON	4/7/2008	7:00 PM	14	10	85	16.47%
MON	4/7/2008	8:30 PM	13	9	86	15.12%
MON	4/7/2008	10:30 PM	3	10	80	3.75%
TUE	4/8/2008	5:30 PM	11	9	97	11.34%
TUE	4/8/2008	7:00 PM	33	2	80	41.25%
TUE	4/8/2008	8:30 PM	33	3	80	41.25%
TUE	4/8/2008	10:30 PM	4	13	89	4.49%
WED	4/9/2008	5:30 PM	17	7	91	18.68%
WED	4/9/2008	7:00 PM	28	2	80	35.00%
WED	4/9/2008	8:30 PM	32	2	79	40.51%
WED	4/9/2008	10:30 PM	7	11	94	7.45%
THU	4/10/2008	5:30 PM	17	6	89	19.10%
THU	4/10/2008	7:00 PM	35	1	79	44.30%
THU	4/10/2008	8:30 PM	38	2	78	48.72%
THU	4/10/2008	10:30 PM	14	9	88	15.91%
FRI	4/4/2008	5:30 PM	36	1	71	50.70%
FRI	4/4/2008	7:00 PM	34	2	70	48.57%
SAT	4/12/2008	9:30 AM	6	6	71	8.45%
SAT	4/12/2008	11:30 AM	6	6	71	8.45%
SAT	4/12/2008	1:30 PM	8	6	71	11.27%
SAT	4/12/2008	3:30 PM	8	6	71	11.27%
SAT	4/12/2008	5:30 PM	5	8	71	7.04%
SUN	4/13/2008	12:30 PM	8	7	67	11.94%
SUN	4/13/2008	2:45 PM	4	7	69	5.80%
SUN	4/13/2008	5:00 PM	8	7	69	11.59%
SUN	4/13/2008	7:15 PM	7	7	70	10.00%
SUN	4/13/2008	9:30 PM	8	6	70	11.43%
		AVERAGE	**16.07**	**6.18**	**78.61**	**20.54%**

C-9	LISTER HILL	FINALS				
Day of week	Date	Nominal Time	Full Lighting	Partial Lighting	Number of Accessible Rooms	Percent Rooms Fully Lit
THU	4/24/2008	6:30 PM	16	8	95	16.84%
THU	4/24/2008	8:30 PM	31	5	81	38.27%
THU	4/24/2008	10:30 PM	9	10	96	9.38%
FRI	4/25/2008	6:30 PM	10	11	94	10.64%
SAT	4/26/2008	9:30 AM	46	5	81	56.79%
SAT	4/26/2008	1:30 PM	30	5	81	37.04%
SAT	4/26/2008	5:30 PM	9	9	92	9.78%
SUN	4/27/2008	1:30 PM	7	5	79	8.86%
SUN	4/27/2008	5:30 PM	7	5	79	8.86%
SUN	4/27/2008	9:30 PM	7	6	79	8.86%
MON	4/28/2008	6:30 PM	11	8	94	11.70%
MON	4/28/2008	8:30 PM	11	7	95	11.58%
MON	4/28/2008	10:30 PM	9	9	96	9.38%
TUE	4/29/2008	6:30 PM	9	8	93	9.68%
TUE	4/29/2008	8:30 PM	11	8	94	11.70%
TUE	4/29/2008	10:30 PM	7	10	95	7.37%
WED	4/30/2008	6:30 PM	12	7	92	13.04%
WED	4/30/2008	8:30 PM	13	7	92	14.13%
WED	4/30/2008	10:30 PM	10	9	94	10.64%
		AVERAGE	**13.95**	**7.47**	**89.58**	**16.03%**

Note on the calculation of the value used in the metric:

$$\mu_{TOTAL} = \frac{(\mu * n)_{normal} + (\mu * n)_{finals}}{n_{TOTAL}} = \frac{20.54\% * 28 + 16.03\% * 19}{47} = 18.72\%$$

C-10	CBSE					
Day of week	Date	Nominal Time	Full Lighting	Partial Lighting	Number of Accessible Rooms	Percent Rooms Fully Lit
SUN	?	9:00 AM	12	19	68	17.65%
SUN	?	11:00 AM	12	19	68	17.65%
SUN	?	1:00 PM	13	17	71	18.31%
SUN	?	3:00 PM	17	16	70	24.29%
SUN	?	5:00 PM	11	18	66	16.67%
SUN	?	7:00 PM	11	19	65	16.92%
SUN	?	9:00 PM	11	19	65	16.92%
MON	5/5/2008	5:00 PM	47	9	97	48.45%
MON	5/5/2008	7:00 PM	25	21	80	31.25%
MON	5/5/2008	9:00 PM	16	24	74	21.62%
WED	4/16/2008	5:00 PM	53	12	107	49.53%
WED	4/16/2008	7:00 PM	40	17	97	41.24%
WED	4/16/2008	9:00 PM	37	21	94	39.36%
SAT	?	9:00 AM	5	18	62	8.06%
SAT	?	11:00 AM	5	18	62	8.06%
SAT	?	1:00 PM	16	31	93	17.20%
SAT	?	3:00 PM	14	31	93	15.05%
SAT	?	5:00 PM	11	33	93	11.83%
SAT	?	7:00 PM	11	33	93	11.83%
SAT	?	9:00 PM	11	33	93	11.83%
		AVERAGE	**18.90**	**21.40**	**80.55**	**22.19%**

C-11	PETERS					
Day of week	Date	Nominal Time	Full Lighting	Partial Lighting	Number of Accessible Rooms	Percent Rooms Fully Lit
THU	5/8/2008	5:00 PM	35	10	136	25.74%
THU	5/8/2008	7:00 PM	7	3	20	35.00%
THU	5/8/2008	9:00 PM	8	3	19	42.11%
THU	5/8/2008	11:00 PM	8	3	19	42.11%
FRI	5/9/2008	5:00 PM	37	14	147	25.17%
FRI	5/9/2008	7:00 PM	13	6	40	32.50%
FRI	5/9/2008	9:00 PM	13	6	41	31.71%
FRI	5/9/2008	11:00 PM	11	3	33	33.33%
SAT	5/10/2008	9:00 AM	11	3	33	33.33%
SAT	5/10/2008	12:00 PM	12	3	40	30.00%
SAT	5/10/2008	3:00 PM	12	4	42	28.57%
SAT	5/10/2008	6:00 PM	12	4	51	23.53%
SAT	5/10/2008	9:00 PM	13	7	53	24.53%
SUN	5/11/2008	9:00 AM	7	5	32	21.88%
SUN	5/11/2008	12:00 PM	7	4	32	21.88%
SUN	5/11/2008	3:00 PM	6	4	22	27.27%
SUN	5/11/2008	6:00 PM	9	4	22	40.91%
SUN	5/11/2008	9:00 PM	10	5	22	45.45%
MON	5/12/2008	5:00 PM	36	16	154	23.38%
MON	5/12/2008	7:00 PM	16	12	81	19.75%
MON	5/12/2008	9:00 PM	16	13	82	19.51%
MON	5/12/2008	11:00 PM	16	13	81	19.75%
TUE	5/13/2008	5:00 PM	46	6	110	41.82%
TUE	5/13/2008	7:00 PM	18	10	80	22.50%
TUE	5/13/2008	9:00 PM	19	12	81	23.46%
TUE	5/13/2008	11:00 PM	20	12	81	24.69%
WED	5/14/2008	5:00 PM	38	8	126	30.16%
WED	5/14/2008	7:00 PM	17	8	97	17.53%
WED	5/14/2008	9:00 PM	17	9	98	17.35%
WED	5/14/2008	11:00 PM	17	9	98	17.35%
		AVERAGE	**16.90**	**7.30**	**65.77**	**28.07%**

C-12	WORRELL					
Day of week	Date	Nominal Time	Full Lighting	Partial Lighting	Number of Accessible Rooms	Percent Rooms Fully Lit
FRI	5/16/2008	5:00 PM	22	1	30	73.33%
FRI	5/16/2008	7:00 PM	17	1	24	70.83%
FRI	5/16/2008	9:00 PM	18	1	23	78.26%
SAT	5/17/2008	9:00 AM	20	1	31	64.52%
SAT	5/17/2008	12:00 PM	20	1	28	71.43%
SAT	5/17/2008	3:00 PM	20	1	28	71.43%
SAT	5/17/2008	6:00 PM	22	8	62	35.48%
SAT	5/17/2008	9:00 PM	24	9	71	33.80%
SUN	5/18/2008	9:00 AM	22	2	30	73.33%
SUN	5/18/2008	12:00 PM	23	2	30	76.67%
SUN	5/18/2008	3:00 PM	27	6	48	56.25%
SUN	5/18/2008	6:00 PM	34	5	52	65.38%
SUN	5/18/2008	9:00 PM	33	6	78	42.31%
MON	5/19/2008	5:00 PM	43	9	73	58.90%
MON	5/19/2008	7:00 PM	36	8	66	54.55%
MON	5/19/2008	9:00 PM	36	9	87	41.38%
TUE	5/20/2008	5:00 PM	33	4	52	63.46%
TUE	5/20/2008	7:00 PM	25	2	40	62.50%
TUE	5/20/2008	9:00 PM	25	2	40	62.50%
WED	5/21/2008	5:00 PM	38	7	77	49.35%
WED	5/21/2008	7:00 PM	35	9	69	50.72%
WED	5/21/2008	9:00 PM	34	10	89	38.20%
THU	5/22/2008	5:00 PM	36	3	59	61.02%
THU	5/22/2008	7:00 PM	31	4	50	62.00%
THU	5/22/2008	9:00 PM	31	4	48	64.58%
		AVERAGE	**28.20**	**4.60**	**51.40**	**59.29%**