VITAL SIGNS

IV

Ball State University Alumni Center
Lighting Case Study
Fall 1998

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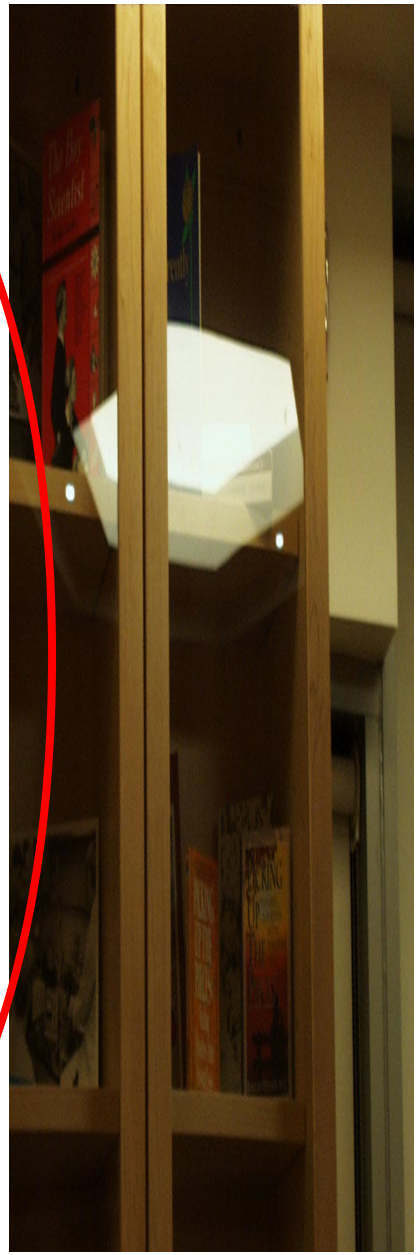
" The real subject of every painting is light."
-Claude Monet



ABSTRACT

"Architecture is the masterly correct and magnificent play of masses brought together in light. Our eyes are made to see forms in light; light and shade reveal these forms; cubes, cones, spheres, cylinders or pyramids are the great primary forms which light reveals to advantage."

-Le Corbusier

This report describes a semester long instrumented field study of the adequacy of the individual task lighting in the library/lounge area of the Ball State University Alumni Center in Muncie, Indiana. This hexagonal space consists of four individual areas; a television viewing area, a conversation area near the fireplace, and two curly maple round tables for reading or discussion. The walls are lined with glass cases containing Ball State University memorabilia. The library/lounge area is used primarily for relaxation and browsing through the extensive collection of historical items, or the occasional reception.

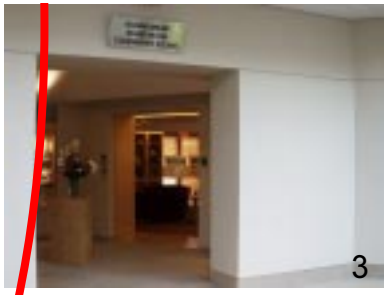
After an investigation of the space, we decided that the lighting qualities were inadequate for most of the tasks that were to be performed. Extreme problems with veiling reflection made it virtually impossible to view items in the display cases. The primary causes of this problem are the windows, doors, television, and cove lighting. The cove lighting causes another unpleasant situation. Because the lighting is aimed in the same vertical plane as the glass cases lining the walls, it reflects. This not only causes problems with veiling reflection, but also causes a high contrast. The high contrast is a major problem around the door and window areas. This contrast and its uncomfortable effects on the occupants of the room was the focus of our study. Once we had narrowed our study down, we took illuminance measurements, luminance measurements, and used our own sense of sight to prove or disprove our hypothesis. After all our data had been compiled, we compared them to Illuminance Engineering Society (IES) guidelines and found our hypothesis was supported.

There were many solutions we found to be plausible. The simplest was to correct the problem caused by the cove lighting. In order to do this, the lights must be angled toward the cases. This would not only eliminate the veiling reflection and contrast, but it would also illuminate the contents of each case. Ultimately, this would allow for the space to be used as it is set up: to comfortably browse through the memorabilia. Other solutions we considered were non-reflective glass, dim cove lighting, and backlights in each case. These, although they would eliminate the problems, would be more extreme and expensive options.

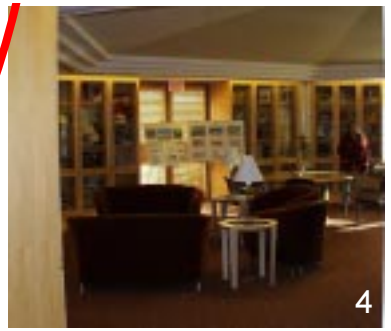
Entering the Alumni Lounge

Approaching the entrance

Entering the conservatory, looking toward lounge



Entering hallway adjacent to the Alumni lounge



Finally entering the Alumni lounge

INTRODUCTION

"All materials in nature, the mountains and the streams and the air and we, are all made of Light which has been spent, and this crumpled mass called material casts a shadow, and the shadow belongs to Light."
-Louis Kahn

The National Vital Signs Program originated at the University of California, Berkeley in 1988. This program has since generated a large number of Vital Signs case study groups throughout colleges in the United States. In 1996, Ball State University began offering courses based upon the Vital Signs curriculum. In the spring of 1997, a Vital Signs group studied the effects of natural lighting on the conservatory of the Alumni Center at Ball State University. In this study, they concluded that the contrasts of light levels in the room were not too great and the lighting is comfortable.

The Alumni Center, located on the campus of Ball State University, was designed by the architectural firm of Pei, Cobb, Freed, and Partners. This 50,000-square-foot facility was built to host a variety of receptions and banquets and to house the University's Alumni Association.

For our case study, we were to choose an area within the Alumni Center to study and report upon some aspect of lighting in that area. Our group chose the library/lounge area located directly off the conservatory as the focal point of our case study. This space has a variety of uses of artificial and natural lighting and we felt it would be an interesting area on which to concentrate our efforts. The library/lounge is hexagonal in plan, and contains many display cases along the perimeter. It also contains a large screen television, a fireplace, a 5' x 6' window, and two outside exits. The artificial lighting consists of a downlit perimeter ceiling configuration and a centrally located hexagonal lighting system that incorporates a series of incandescent bulbs and MR-16's which serve as accent lights. MR-16's are small lights that are focused straight down in a narrow beam and are often used to accent or highlight small areas. The primary sources of natural light are the windows located on the south façade and the two double doors on either side. Lighting control devices are in use on these apertures and include shades of 80% opacity on the windows and operable shutters on the doors.

The library/lounge is divided into four task areas that are accentuated by the furniture arrangement and perimeter cases. Two curly maple tables make up discussion/reading areas, while another two areas consist of a television viewing area and a conversation area near the fireplace. The arrangement and division of these areas was designed to provide one common space with a wide variety of private tasks. This variability of use in the Alumni Lounge creates a necessity for good lighting that will be adequate for all the different uses. We believe, however, that this need for the space is not being met adequately.

Development of the Ball State University Alumni Center

Figures 1-3 show the Alumni Center under construction

The final product

HYPOTHESIS

"When a man says that he believes that natural light is something we are born out of, he cannot accept a school which has no natural light. He cannot even accept a movie house, you might say, which must be in darkness, without sensing that there must be a crack somewhere in the construction which allows enough natural light to come in to tell how dark it is. Now he may not demand it actually, but he demands it in his mind to be that important."

-Louis Kahn

The perimeter lighting within the Alumni Lounge creates an uncomfortable amount of contrast and veiling reflection . These lighting problems make it difficult for occupants to use this area for its intended purpose.

The general purpose of the Alumni Lounge as described by the Project Architect, Tom Baker, is for the gathering of alumni and general relaxation. The varying light levels and high amounts of contrast (Refer to Figures 3 & 4) within the room make it uncomfortable to relax and browse through the collected memorabilia. Looking from any of the four defined task areas at the glass memorabilia cases that line the walls, there is veiling reflection (Refer to Figures 1 & 2) and high contrast of lighting that causes discomfort.

In the Alumni Lounge, the best overall lighting conditions can be seen from the table areas by the windows. From these areas it can be observed that the light levels affect the comfort of the occupant due to the veiling reflection and contrast they create. An occupant in this area can neither view the memorabilia throughout the room, due to numerous veiling reflections on the glass surfaces, nor relax visually, due to the high contrast levels presented from both the artificial and natural lighting.

Various lighting disabilities within the Alumni Lounge.


1


2


3


4

RESEARCH METHODOLOGY

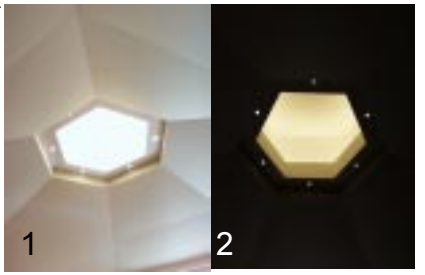
"Structure is the giver of light. When I choose an order of structure that calls for column alongside of column, it presents a rhythm of no light, light, no light, light, no light, light."
-Louis Kahn

Before we began our study, we looked at several preliminary things to get a feel for the space in which we would be working. First, we looked at the different task areas in detail to see how the light in the space affected the occupants' comfort and the disabilities that were created because of the lighting. After we made a list of the problems caused by the light (such as veiling reflection and glare), we decided to focus our study on the contrast on the glass memorabilia cases located around the perimeter of the space. This contrast appeared to be caused by the daylight entering the space, plus the perimeter cove lighting.

Before taking any measurements, we took an inventory of all the artificial lights in the room. This gave us a basic idea as to what sort of light levels we could expect once we took illuminance measurements. To do this, we marked out a 4' x 4' grid on the floor (refer to Fig. 3) and took illuminance measurements with a hand-held digital light meter placed on a box 30" high so as to avoid shadows cast by the furniture (refer to Fig. 4). This procedure was repeated under three different lighting conditions; first, during mid-day with the blinds and shades closed; second, during mid-day with the blinds and shades open; and finally, at night when only the artificial light was a factor. We performed this procedure twice, once on a cloudy day and the second on a sunny day. All measurements were taken with all artificial lights turned on, including the television. After all measurements were taken, contour maps of the entire space were drawn, diagramming how the light was dispersed.

Our next step was to use a digital camera to take a panoramic view of the display cases. These pictures were taken from the center of the room and the exposure on the digital camera was always set on the same wall before each photo was taken. This kept the exposure the same for each photo, regardless of lighting conditions. These photographs were then gray-scaled in Adobe Photoshop and broken down into different areas of contrast. The luminance of each contrast area was measured using a luminance gun (refer to Fig. 5).

Once all our measurements were taken, we researched the human eye to see how large contrast differences affect our comfort. We then took this research and applied it to our case study.



Figures 1 & 2 look at contrast differences, the aim of our investigation

Brandy and Brent marking off a 4'x4' grid

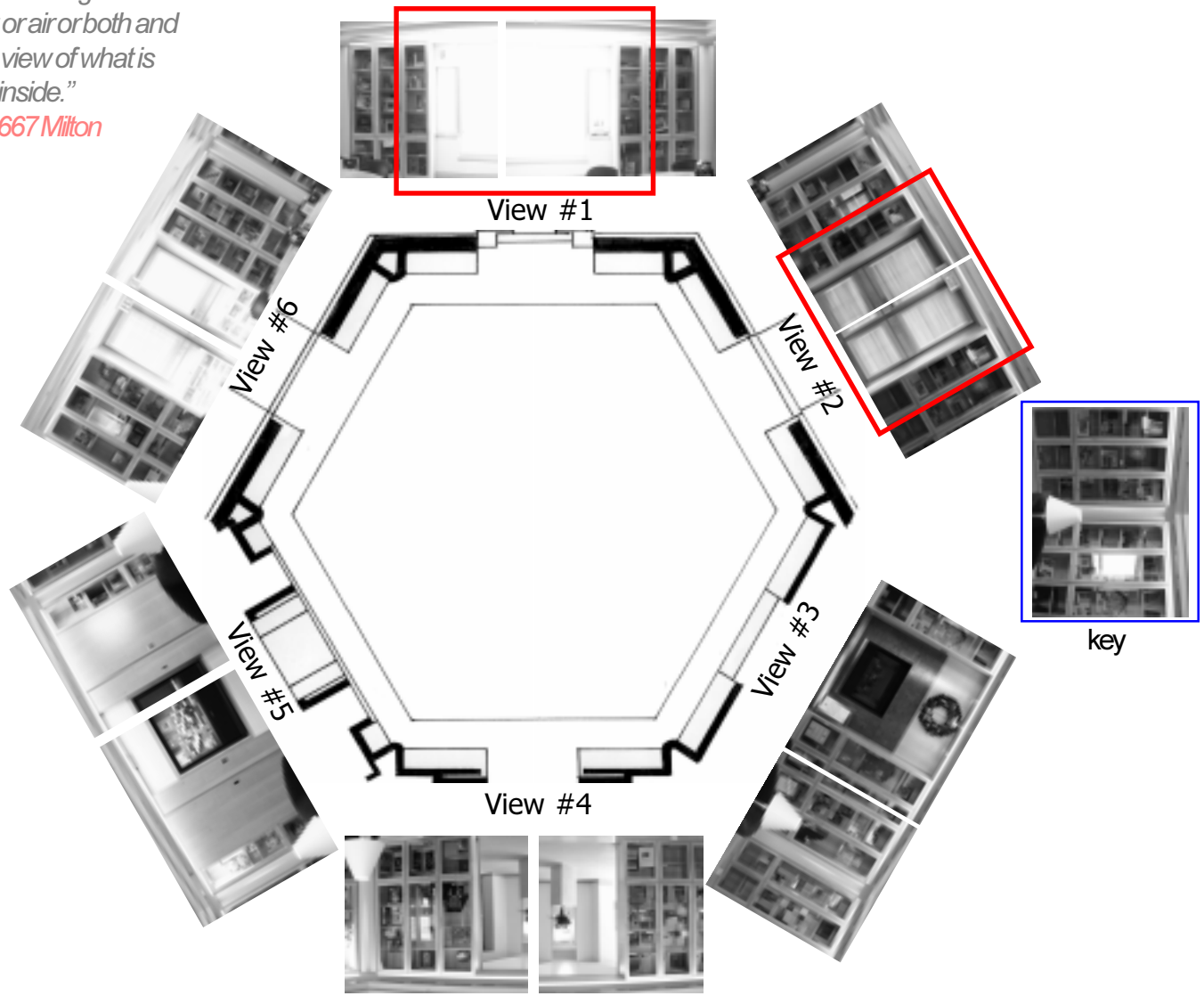
Digital light meter placed on 30 inch high box

Brandy taking luminous light measurements

FINDINGS (A) - PANORAMIC OF LOUNGE WITH BLINDS/SHUTTERS CLOSED

"Window...an opening in a wall or side of a building...to admit light or air or both and to afford a view of what is outside or inside."

-1667 Milton

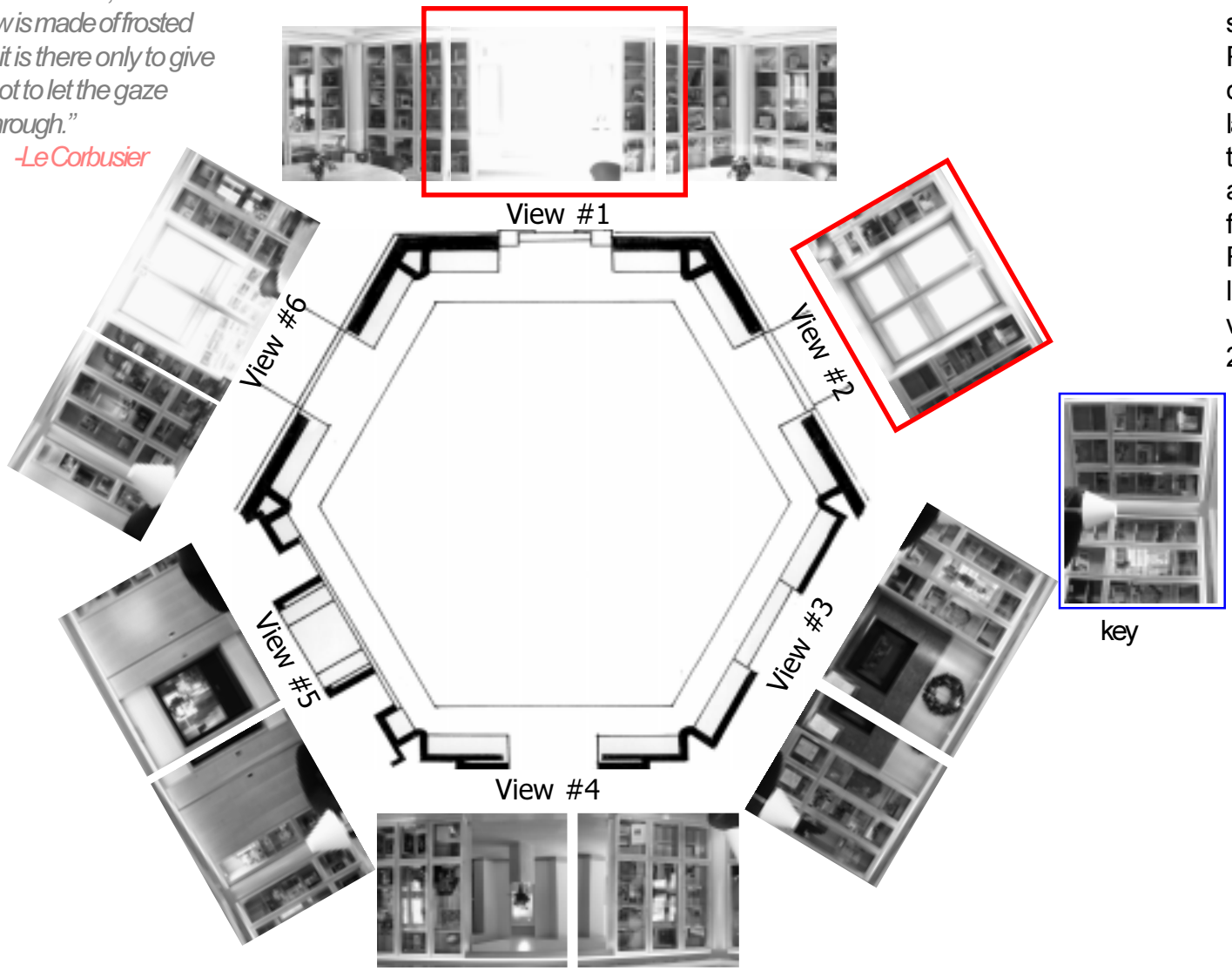


The following two pages contain panoramic photos of the Alumni Lounge / Library during two different settings; first, with all the blinds and shutters closed, and second with all the blinds and shutters open. These were then used to make side by side comparisons of the contrast differences during the two different settings. These panoramic photos were taken from the center of the room and f-stop/ aperture of the digital camera was kept constant by setting the exposure on the key (the key appears in the blue box to the right). This gave us information about the contrast difference throughout the room, regardless of the lighting conditions.

These photos were taken on November 19, 1998 during a sunny afternoon (12:00 PM-1:00 PM) with all the blinds and shades closed. We found that even though the blinds and shutters were closed, a large contrast difference appears at the window and door areas. This presents a comfort problem for a user in the space. Refer to pages 8 & 9 for detailed luminance measurements and visual field mapping of Views 1 & 2.

FINDINGS (B) - PANORAMIC OF LOUNGE WITH BLINDS/SHUTTERS OPEN

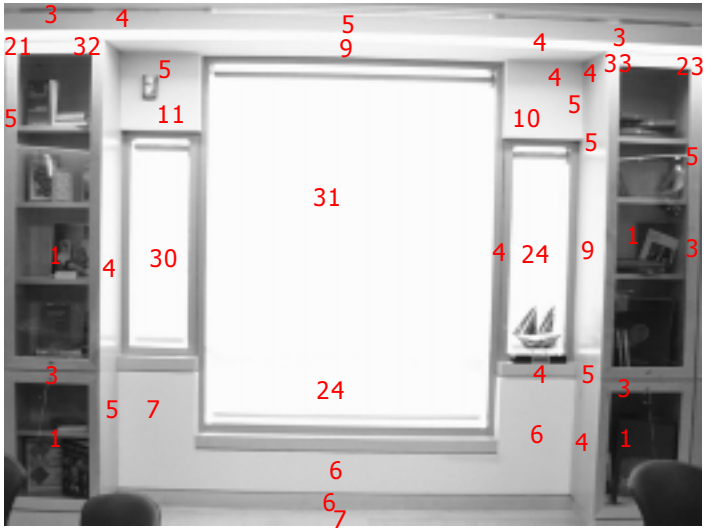
"A cultivated man does not look out of the window; his window is made of frosted glass; it is there only to give light, not to let the gaze pass through."
-Le Corbusier



These photos were taken on November 19, 1998 during a sunny afternoon (12:00 PM-1:00 PM) with all the blinds and shades open. Looking at these photos, a large contrast difference is very noticeable at the window and door areas. This presents a greater comfort problem for a user in the space. Refer to pages 8 & 9 for detailed luminance measurements and visual field mapping of Views 1 & 2.

FINDINGS(C) - VISUAL FIELD MAPPING OF VIEW # 1

Digital photogragh with blinds closed



Grayscaled image with blinds closed

Digital photogragh with blinds open

Grayscaled image with blinds open

In View 1 of the visual field mapping of the library/lounge area, we noticed that a uncomfortable glare exists in both settings (with blinds open and closed). On a sunny day the southern facing window allows too much light to enter into the space, creating a high contrast situation when viewed next to the unlit shelves. This back lit situation also causes a silhouette effect such that the viewer cannot focus on any details of an object in front of this aperture.

When the blinds are closed there is approximately a 30% reduction in the luminance measurements. High contrast occurs whether the blinds are open or closed. Luminance measurements range from .977 fL to 105 fL with a contrast ratio of 104.023 fL when the blinds are open. When the blinds are closed, luminance measurements range from .732 fL to 30.86 fL with a contrast ratio of 30.128 fL.

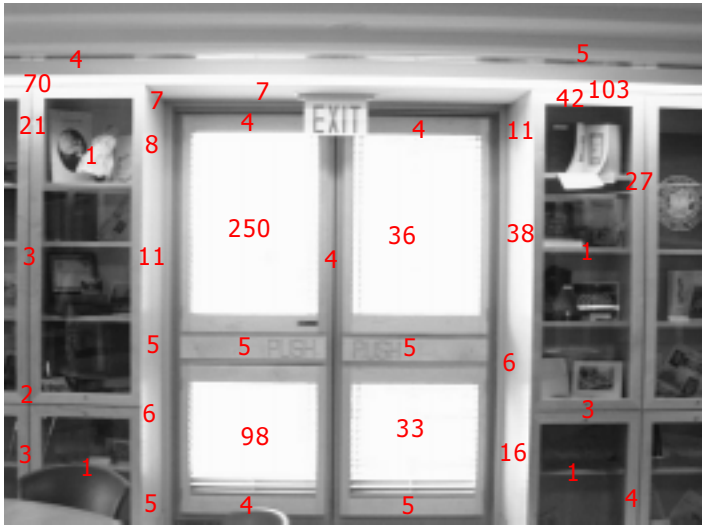
Although the difference between the foot Lambert measurements are great when comparing the two situations, problems still exist.

FINDINGS(D) -VISUAL FIELD MAPPING OF VIEW #2

Digital photogragh with shutters closed

Grayscaled image with shutters closed

Digital photogragh with shutters open



Grayscaled image with shutters open

In View 2 of the visual field mapping of the library/lounge area, discomfort glare only exists when the shutters are open. It is only in this situation that the backlit silhouette effect occurs and high contrast differences are apparent.

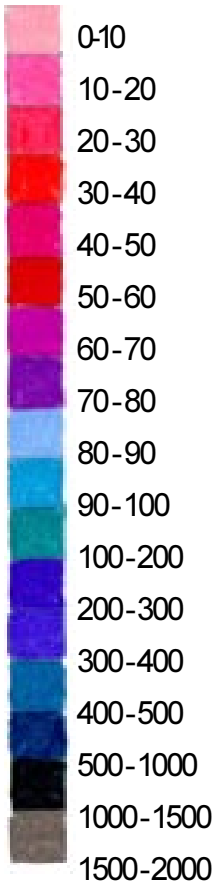
When the shutters are closed, there is a large difference in the amount of the foot Lambert measurements entering the space. High contrast only occurs when the shutters are open, with a range of 1.5 fL to 250 fL and with a contrast ratio of 248.5 fL. The range of foot Lambert measurements for the closed shutter setting is .389 fL to 10.52 fL with a contrast ratio of 10.134 fL.

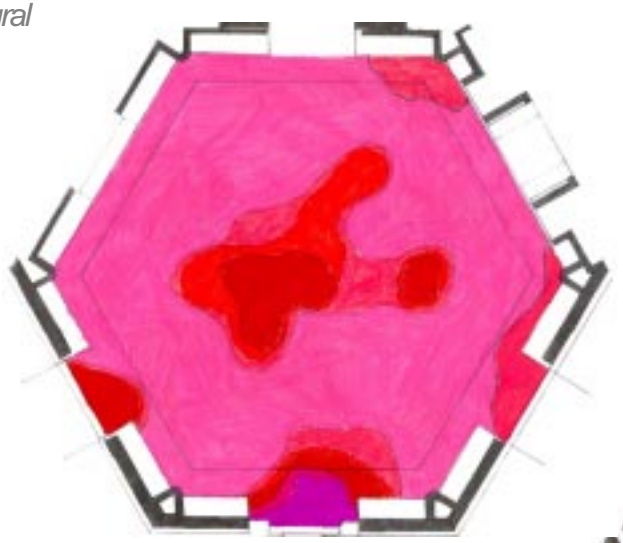
The differences of the foot Lambert measurements are great and the shutters do solve the problems, but the shutters are always closed offering no view outside.

FINDINGS (E)-CONTOUR MAPPING OF ILLUMINATION LEVELS

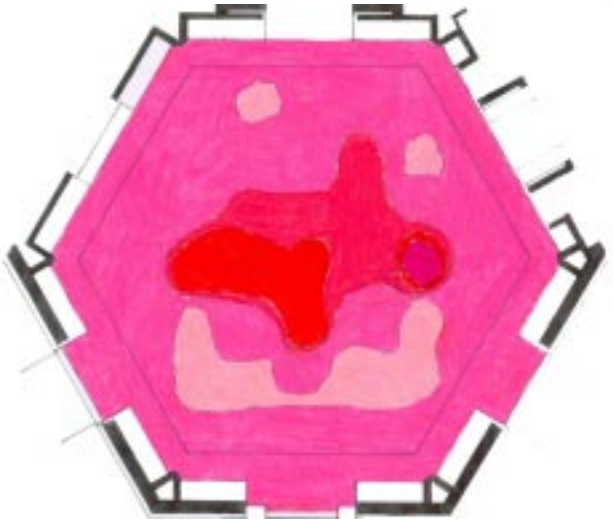
"No space, architecturally, is a space unless it has natural light..."

-Louis Kahn





1. Shutters and blinds open



2. Shutters and blinds closed

3. Nighttime

The contour maps of the daytime settings were taken once with the blinds and shutters open (fig. 1) and once with the blinds and shutters closed (fig. 2). This enabled us to compare these measurements to each other and to the artificial nighttime lighting condition (fig. 3). These daytime measurements were taken on Tuesday, 3 November 1998 from 2:10 PM to 2:39 PM. The average measurement was 725fc outside. The weather conditions were cloudy and overcast.

Fig. 1, shutters and blinds open, shows the brightest lighting conditions in the space occurring at the southern facing window (67fc), the table top lamp (46fc), the southwestern exits (43fc), and the center of the room (43fc). The perimeter of the space has a general lighting condition in the 10-20fc range. There also exists a pooling of light around the central area due to the placement of the MR-16's.

Fig. 2, shutters and blinds closed, shows the brightest lighting conditions in the space occurring at the table top lamp (45fc), in the center of the room (39fc), and the centrally located pool of light. The general perimeter lighting still exists but does contain a few pools of light that drop below the 10fc mark.

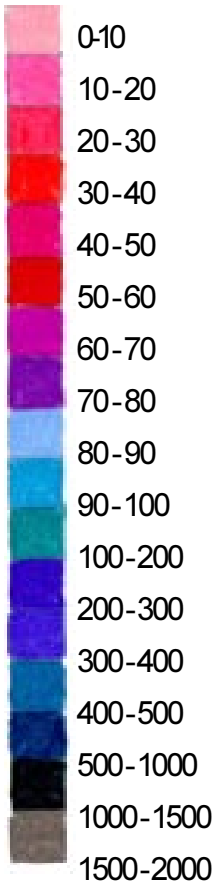
In the comparison of Fig. 1 & Fig. 2, notice the change in the lighting situation of the entire space by the closing of the shutters and blinds. It seems that the light from these southern apertures effect the entire space. The only lighting mechanism that seems to remain unchanged is the eastern tabletop lamp.

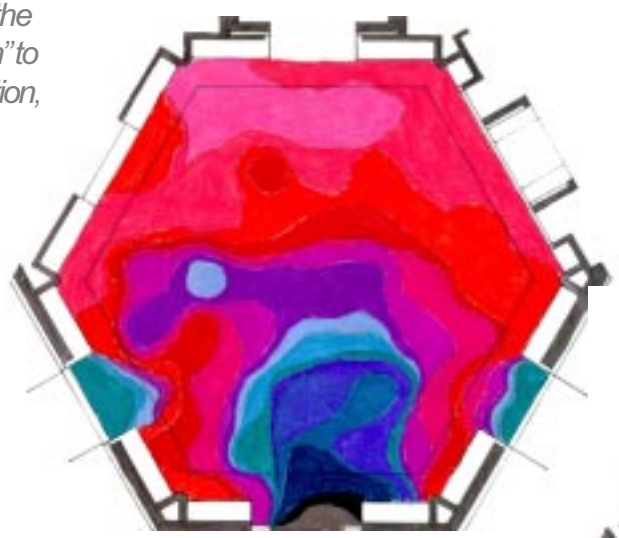
In the comparison of Fig. 1 and Fig. 2 to Fig. 3, there is an almost direct similarity in the contours of the nighttime setting (Fig. 3) to the blinds and shutters closed setting (Fig. 2). The main differences in the lighting of the space are the fireplace lights are on at night (Fig. 3) and the centrally located light is brighter at night in comparison to the daytime setting. This leads us to believe that the light is connected to a dimmer switch.

FINDINGS (F)-CONTOUR MAPPING OF ILLUMINATION LEVELS

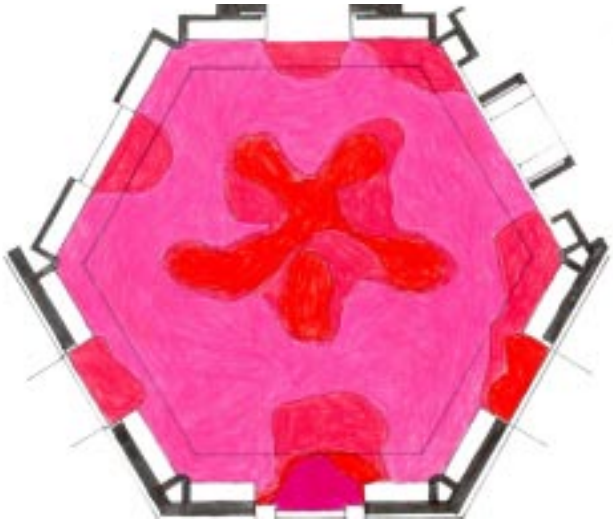
"The more light, the less sight, and the less there is in the interior that allows "man" to find comfort and protection, to find a ground from which to look."

-Tom Keenan

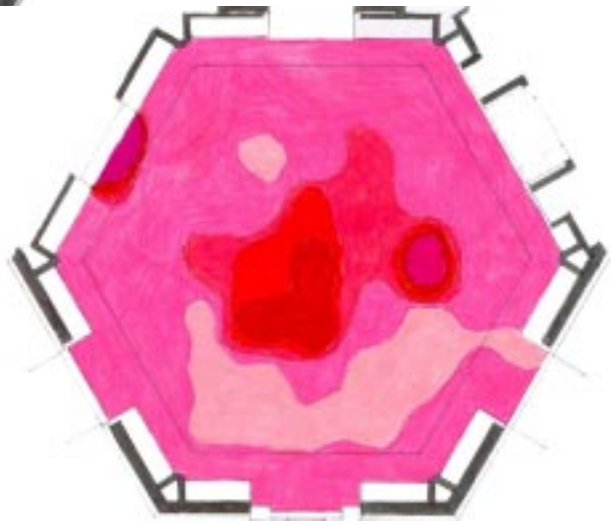




1. Shutters and blinds open



2. Shutters and blinds closed



3. Nighttime

The contour maps of the daytime settings were taken once with the blinds and shutters open (Fig. 1) and once with the blinds and shutters closed (Fig. 2). This allowed us to compare these measurements and to the artificial nighttime lighting condition (Fig. 3). These daytime measurements were taken on Tuesday, 11 November 1998 from 2:00 PM to 2:50 PM. The average outside measurement was 5000fc. The weather conditions were partly cloudy.

Fig. 1, shutters and blinds open, showed the brightest lighting conditions in the space occurring at the southern facing window (1701fc) and the southwestern and southeastern exits (299fc and 180fc respectively). The perimeter of the room was so flushed with daylight that there were no measurements concurring solely with the artificial lighting.

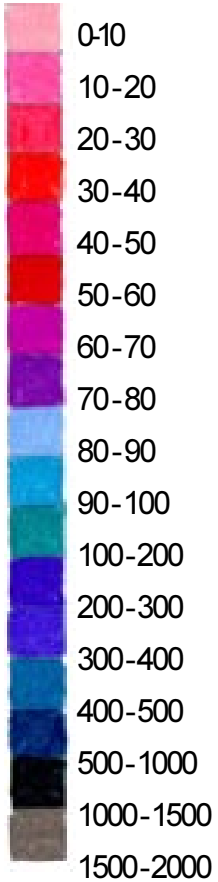
Fig. 2, shutters and blinds closed, showed the brightest lighting conditions in the space occurring at the southern facing window (50fc), the southwestern and southeastern exits (38fc and 30fc respectively), and the fireplace area (23fc). There was also a brighter pooling of light ranging from 42fc to 23fc located in the center of the room.

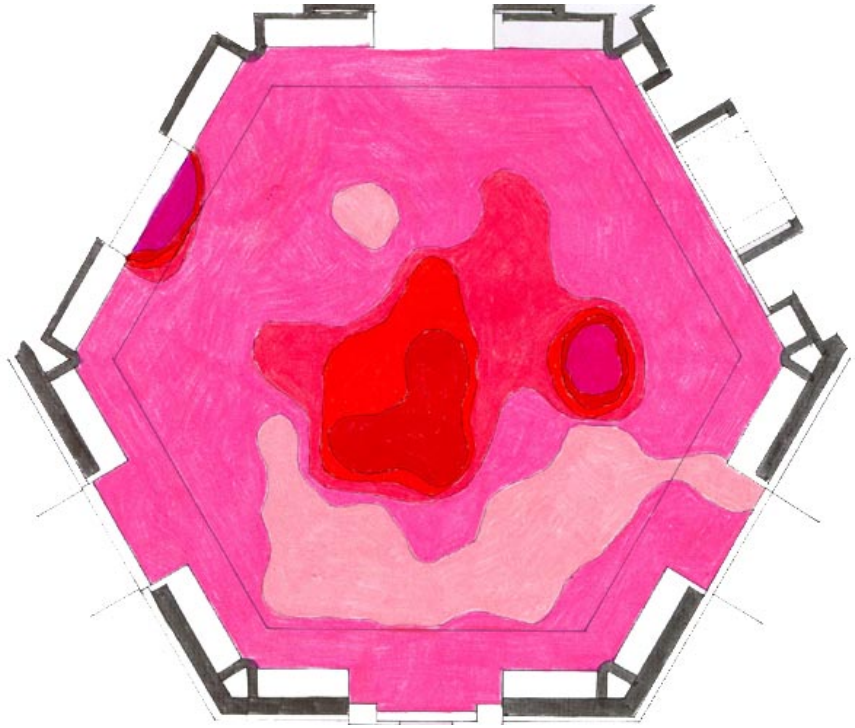
In the comparison of Fig. 1 and Fig. 2., notice the drastic change in the lighting situation of the entire space by the closing of the blinds and shutters. The light from these apertures reach to all regions of the space.

In the comparison of Fig. 1 and Fig. 2 to Fig. 3, there is a direct similarity in the contours of the nighttime setting (Fig. 3) to the situation with the blinds and shutters closed (Fig. 2). The main differences include the fireplace, which is turned on at night but not during the day (Fig. 3), and the centrally located lighting, which is brighter at night than during the daytime. This may be due to the light being connected to a dimmer switch.

FINDINGS(G)-CONTOUR MAPPING OF ILLUMINATION LEVELS

"It is the dark diaster that carries the light."
-Paul Virilil





Nighttime study

The contour map of the nighttime setting is to enable us to gather information on the artificial lighting systems in the space. There was no outside natural or artificial lighting affecting the interior space. The measurements were taken on Tuesday, 3 November 1998 from 7:00 PM to 7:45PM.

The contour map shows that the brightest artificial lighting conditions in this space occur in the fireplace area (196fc), the table top lamp (50fc), and directly in the center of the room (44fc). The perimeter of the room has a general lighting condition in the range of 10fc-19fc with an area that drops below the 10fc mark in the southern perimeter of the space. There exists a pooling of light around the centrally located light well.

The artificial lighting conditions in this space seem to be placed to accentuate the architecture of the room (down lighting in the fireplace and centrally located down lighting) rather than be designed for functionality.

CONCLUSIONS

"The well-known 'glare of publicity' is precisely this light..."glare," after all, shares its root with "glass," and is nothing other than "an intense and blinding light."

-Wimsatt & Beardsley

Based upon the data we have collected, the analysis of that data, and the various observations we have made about the Alumni Lounge, we conclude that the lighting of the room is not visually comfortable for most occupants. The large amounts of glare produce high levels of contrast. These contrast levels lead to distraction within one's visual field and creates visual discomfort while trying to utilize this area for its intended purpose.

The major problem with the lighting of the Alumni lounge is the high levels of contrast. These levels of contrast are present in several different areas of the room, but especially on the south wall; e.g., the doors and window. The brightness of these apertures have such stark difference with the rest of the room that it makes it difficult to see the details of the surrounding walls, let alone focus comfortably.

We like to propose a number of different solutions for correcting the problem of high contrast around the window and door areas. One solution would be to incorporated some type of exterior overhang that decreases the amount of light entering through the windows and doors. The light would enter the space low, therefore dispersing evenly thorughout the room. Similar to an exterior overhang would be the use of light shelves. Another possibility would be to incorporate a operable louvre system on the exterior of the building. This would allow the users of the space to directly control the light entering through the apertures. The louvres could direct the light to produce an evenly lit space. Finally, another possibility would have been to deep set the windows and doors.

The second major problem with the lighting in the Alumni Lounge is the veiling reflections(glare) caused by the cove lighting (refer to Diagram 1). The veiling reflections inhibit the occupant to view objects in the display cases and cause visual discomfort. Visual comfort, as defined by the Vital Sign course handbook, is "the absence of a sensation of physiological pain, irritation, or distraction." For us to determine whether the glare in the Alumni Lounge effected the occupants, we needed to understand how the eye perceives glare. When the eye receives information that has high contrast levels of large amounts of glare, the pupil of the eye generally shrinks to allow less of the offending light into the eye. In some case however the eye does not view the glare as a hazard. If the glare is of a lesser intensity or in the peripheral vision of the eye, the pupil will not react as much, leading to discomfort of the eye. The intensity of the glare within the Alumni Lounge in enough to adversely effect the eye and, therefore the comfort of the occupant.

One solution that we would like to propose as a means of lessening this problem is a correction in the placement of the lighting. In discussing this problem amongst ourselves and with Marc Schiler, we decided that the most effective way to reduce the glare and veiling reflections on the vertical glass surfaces was to light the inside of the display cases. This could be done with small directional light similar to those encircling the large hexagonal light. We believe that an investment in this extension of the Alumni Lounge lighting system would provide more visual comfort for users, greatly reduce the glare, and enhance the overall attractiveness of the room.

As previously stated, the intended purpose for the Alumni Lounge is for Ball State Alumni to relax, gather and view the various items of memorabilia throughout the room. The overall design of the room is good. The designers used high quality materials, which are richly displayed by the lighting. This same lighting, however, prevents the occupants of the room from viewing the numerous articles of memorabilia.

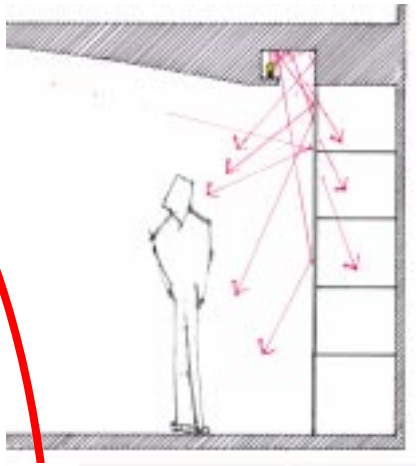


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Diagram 1 shows the problem of veiling reflections caused by the cove lighting

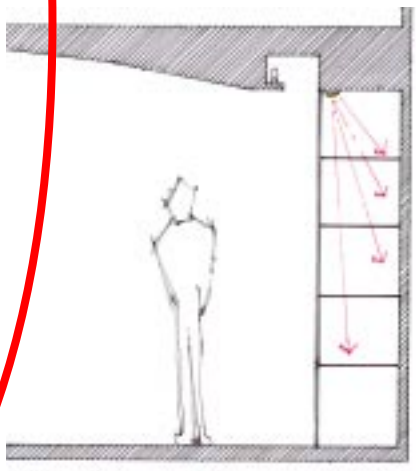

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Diagram 2 shows how the problem of veiling reflections could be solved by lighting the display cases from the inside

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"A great American poet once asked the architect, 'What slice of the sun does your building have? What light enters your room?' - as if to say the sun never knew how great it is until it struck the side of a building."

-Louis Kahn

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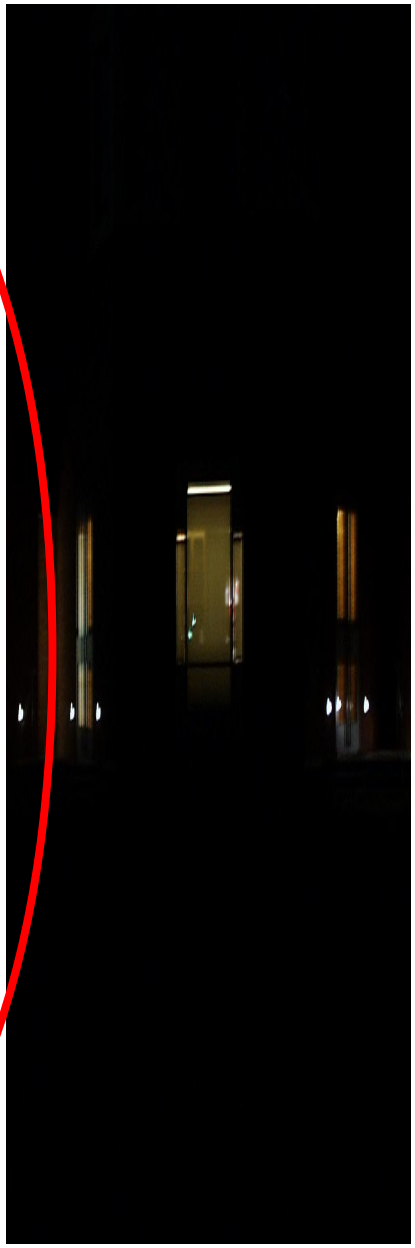
Telephone Interview

Baker, Tom. Former Project Architect at Pei Cobb Freed and Partners.



ACKNOWLEDGEMENTS

"What is at stake for us in thinking that we look out, that we gaze (know, dominate), from a ground and behind a window, and in forgetting the entrance or the "gift" of that light? What does such light disturb? Where does the light come from, and what can we do about it?"

-Tom Keenan

Team Members

Brandy Coahran, Third-year Architecture Student
Brent Daugherty, First-year Computer Science Student
Robin Freeman, Third-year Aquatic Biology and Fisheries Student
David Rizzi, Fifth-year Architecture Student

We would like to thank:

Ball State University Faculty:

Jeffery D. Culp - Operations Manager
Robert A. Fisher - Resident Fellow, Professor of Architecture
Robert J. Koester- Professor of Architecture; Director of Center for Energy Research / Education / Service

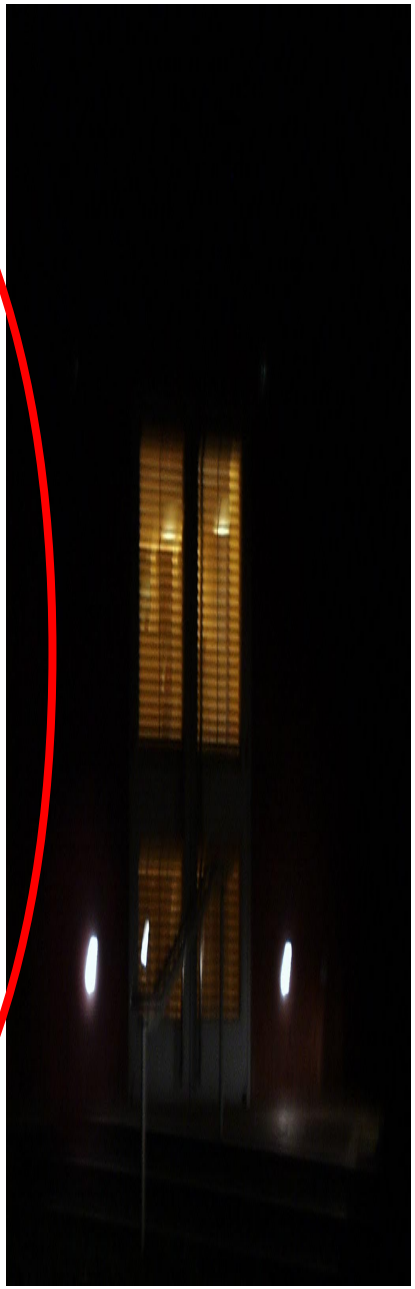
Visiting Scholars:

Bruce Haglund- Program Chair, Department of Architecture, University of Idaho
Alison Kwok- Assistant Professor of Architecture at University of Oregon
Joel Loveland- Associate Professor of Architecture at University of Washington
Jeff Sailer- Graduate student, University of Florida
Marc Schiler- Associate Professor of Architecture at University of Southen California (USC)

Architect:

Tom Baker, AIA. Former Project Architect at Pei Cobb Freed and Partners

A special note of appreciation goes out to Matt Stevenson; The Director of the Ball State University Alumni Center, and all of the Alumni Center Staff.



APPENDIX (A) - INITIAL IMPRESSIONS OF ALUMNI CENTER

"Teamwork is the ability to work together toward a common vision. The ability to direct individual accomplishment toward organizational objectives. It is the fuel that allows common people to attain uncommon results."
-Successories

I noticed the Alumni Center as it was being built. The form was very interesting and very different than any other campus building. I really didn't understand why the building was so different than the other buildings on campus. Shouldn't a building that is part of an institution reflect that instution in some way? I also noticed the floating white squares in the windows. I wasn't sure what these were until we took the tour of the building for the first time. They were shades.

The building's form is very dynamic and exciting to the eye. It does catch your attention. I was even more impressed with the interior. Every space has some outside envelope. Every room was very glossy and new. Each space had "high-tech" ammenities.

Brandy Coahran Architecture Major

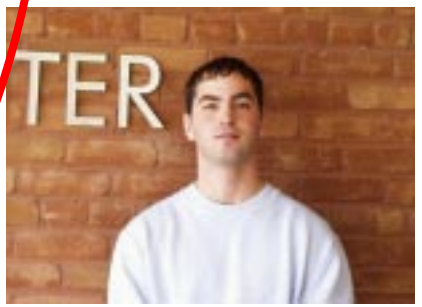
My first impression of the Alumni Center building was that it is quite grand. The arching facade of the entrance areas combined with the stone and brick exterior make the outside of the building rather impressive. The inside of the building is equally impressive. One area that impressed me was the Board Room. This oval shaped room containing the massive meeting table is particularly interesting. Another room of much interest is the Alumni Lounge. This hexagonal shaped library/lounge is intriguing because it is intended to be used for a myriad of activities and events.

Choosing the area of the Alumni Lounge will be an interesting undertaking as we explore different lighting areas within the room. I I look forward to the completion of this case study and the result of our hard work.

Brent Daugherty Computer Science Major

When I first walked into the Alumni Center here at Ball State, I was surprised at the brightness of the atrium. It cast a mood on the building that seemed to say "You're here. Get moving!" This flood of light seemed to spread throughout the building and make each individual area as tense and busy as the next. Toward the end of the tour, we were shown the lounge area. this hexagonal room was dim and seemed to enable the visitor to relax and enjoy the surroundings. The shadows gave the sense of comfort and repose. This is what caught my attention the most. The way that the room let you get away from all the bustle and activity going on in the offices above was something much more to my liking and caused me to suggest the lounge as the focus of our case study.

Robin Freeman Aquatic Biology and Fisheries Major



I had the opportunity to witness the Alumni Center as it evolved into an architectural landmark for Ball State University. From the beginning-the steel frame being put into place-to the finished piece of architecture that you see today, the form of the building has always been intriguing to me. Why the geometric shape? Why the overpowering triangules with the subtle curves breaking the planes? I feel that the materials used also emphasize this geometric idea. The contrast of the brick to the stainless steel paneling highlights the rigidness and malleability of the shapes. Perhaps the shape was influenced by one of the chief architects of Pei Cobb Freed & Partners-I.M. Pei. I have noticed in a lot of Pei's work that he plays with geometric shapes and forms; it is one of his trademarks as a designer. But usually shapes of that geometry are very hard to deal with when laying out the footprint. I feel that the designers were very successful in dealing wth the interior spaces because there was hardly any wasted space in the building. I felt that the interior spaces received ample amounts of light and that the conservatory set the stage for the whole lighting scheme thoughout the building. The light created a kind of ambience that played on the spaces and forms.

I was interested in dealing with a space that was more public than private. The library/lounge presented a place that many people would come to perform a variety of tasks from watching T.V. to reading to looking at Ball State memorabilia.

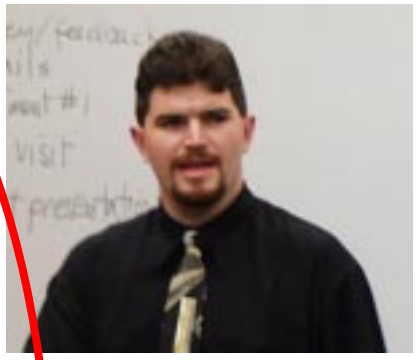
David Rizzi Architecture Major

APPENDIX (B) - VISITING SCHOLAR CONTRIBUTIONS

"He jests at scares that never felt a wound. But soft what light through yonder window breaks."
-Romeo & Juliet

Jeff Sailer:

Our first visiting scholar, Jeff Sailer, gave us an introduction of what to expect during the semester. Jeff had himself been a student in the Vital Signs course at Ball State University. He told us about his ongoing project involving alligators. The main purpose of his presentation was to give us an overview of the scientific method needed to form our hypothesis, compile our research and make conclusions on our case study.



Alison Kwok:

Unfortunately, due to time conflicts, our group was unable to meet, as a whole, with our second visiting scholar, Alison Kwok. Through her class lecture, she was able to give us some direction and a good sense of what the whole project was about. Alison gave us a number of good suggestions for ways to collect data and begin our project and helped us get our project started.

Bruce Haglund:

We had the opportunity to meet with Bruce Haglund, our third visiting scholar, over lunch. He asked us what we thought of the room. He encouraged us to spend some time in the lounge and to use the best tools we have to analyze the space, our eyes. He got us thinking more about our hypothesis and if we could accomplish all that was involved in our original hypothesis. He suggested that we narrow down our study. His suggestions were a big help to our formation of the hypothesis and continuation of the project.

APPENDIX (B) - VISITING SCHOLAR CONTRIBUTIONS

"For the rest of my life I want to reflect on what light is."
-Albert Einstein

Joel Loveland:

Joel Loveland, our fourth visiting scholar, helped us to realize the need to set goals for the remaining time of our case study and to think about what we were trying to get out of the course. Joel encouraged us to work more as a team and to make sure we were working on the same project. Joel's encouragement and suggestions for the completion of our project helped us greatly.

Marc Schiler:

Marc Schiler, our fifth and final visiting scholar, spoke to us about the glare and the more difficult issue of veiling reflections in the Alumni Lounge. He spoke about the high quality of the materials used, but mentioned the improper lighting of the room. One of the things that troubled him about the room was the fact that the wood on the walls was well lit by the cove lighting to bring out the details in the wood, but the contents of the display cases was ignored. Another thing that he mentioned was the high intensity of light in the middle of the room illuminating nothing but carpet. The design of the light in the center of the room was to direct light downward instead of spreading it throughout the room. With these observations, Marc supported our perceptions of the room and gave of confidence about our study. Marc also suggested that if we'd like to touch on the problem of veiling reflections in the space that we might use a histogram to analyze an object. Marc was helpful and supportive in our continuing case study.