NCAA *Hall of Champions*

TEAM FOUR

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View of Vaulted Fourth Floor Office Looking West

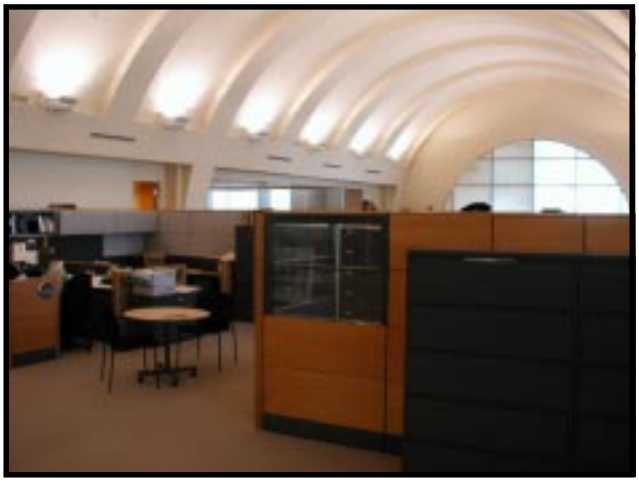
Abstract

This report presents a study of the fourth floor office of the NCAA Headquarters in Indianapolis, Indiana. The study contains conclusions developed during a semester-long analysis. This unique office space consists of 12,000 sq.ft. under an up-lit vaulted ceiling with the design intent of creating a consistent ambient light reaching all levels of the workspace. Natural daylighting is also admitted through adjacent side windows. Office layout and cubicle height are key components in measuring the quality and intensity of light reaching the workspace and were thoroughly documented. Lighting analyses were performed using a variety of light meters and data loggers. Lighting controls were also tested and reevaluated to determine the designs effective performance and efficiency. Monitored data indicate that the design intent of the up-lit barrel vaulted ceiling successfully provides a consistent ambient lighting throughout the office space. The field measurements also reveal that there is more than enough illuminance for standard office work environments and the installation of daylight sensors as well as an adjustment in lighting intensity would provide a more evenly distributed lighting system as well as reduced energy consumption.

Introduction

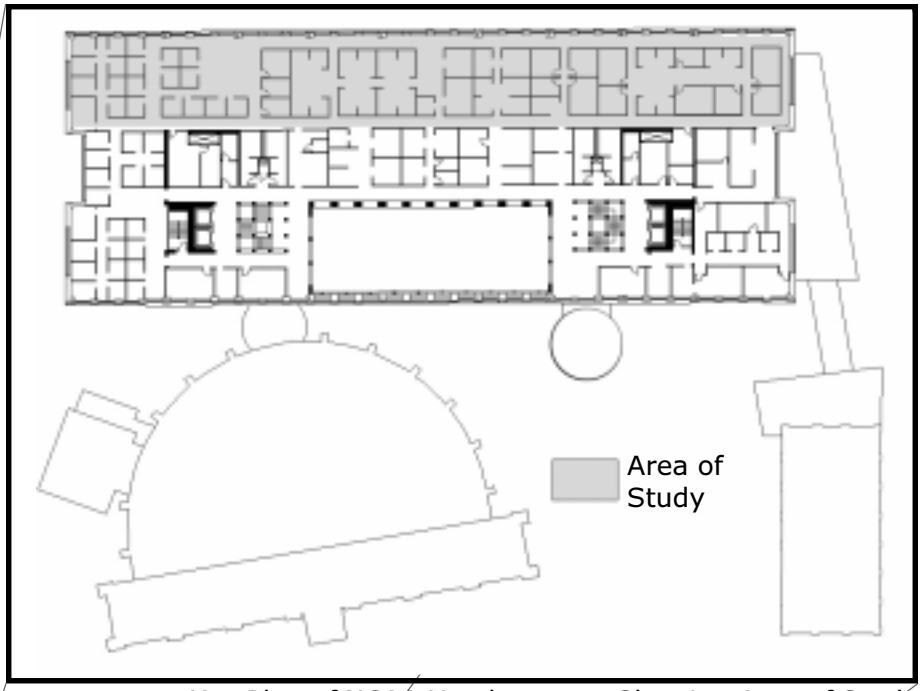
This lighting study of the NCAA Headquarters in Indianapolis, Indiana was conducted as part of the Vital Signs VI class at Ball State University. This course was offered through the Center for Energy Research/ Education/ Service (CERES), which is a university-level administrative unit housed in Academic Affairs, staffed by College of Architecture and Planning faculty and professionals; the course focuses on energy resource use, conservation, and alternatives. The Vital Signs course is the result of a program developed through the University of California at Berkeley's Center for Environmental Design. Funding for the Vital Signs program had originally been provided by the Energy Foundation, the National Science Foundation, and Pacific Gas and Electric.

The NCAA Headquarters is located in Indianapolis, Indiana, on the west side of the downtown. It is part of the White River State Park and can be found along the canal just west of the State Capitol. This complex serves as the national headquarters for the National Collegiate Athletic Association, houses an interactive museum known as the Hall of Champions, and accommodates the National High School Federation. The lighting study was primarily conducted in the office portion of the headquarters building. The headquarters consists of office spaces that have been designed to provide an open office floor plan, convention and press conference spaces, and several meeting rooms. The dominating feature of this building is the atrium, an open, four-story space providing each floor a balcony that overlooks the floor below.

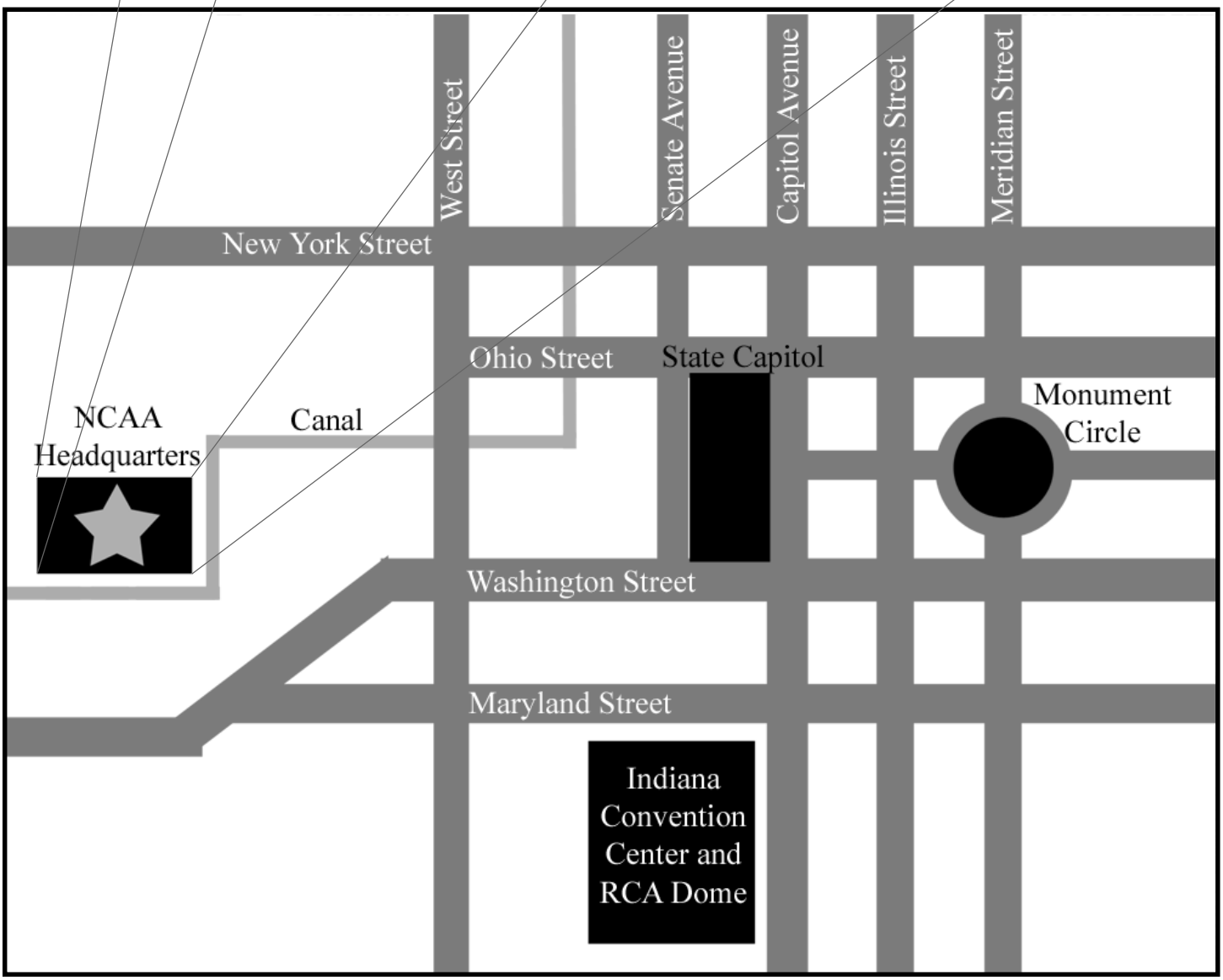


View of Low Partitions Looking Southwest

We concentrated our study on the fourth floor office space. The dominating feature of this space is a barrel vault that runs the length of the building. The electrical lighting is positioned to up-light the space; this produces indirect light with less direct glare than conventional down-lighting. The layout and design of the cubicles and workspaces have recently undergone a change in the west end of this space, while the east end has remained unchanged. The old workspace includes a four-foot corridor around the perimeter of the office space. The new workspace utilizes this space as additional office and work areas. In addition, the new workspace contains lower partition heights, which create more of an open office feel. We have focused our study and have drawn our hypothesis on the qualities of these two spaces.



Key Plan of NCAA Headquarters Showing Area of Study



Map of NCAA Hall of Champions Location

Hypothesis

Lowering the partitions in the office cubicle system and eliminating the corridor between the offices and windows allows more natural and artificial light to reach the work surface.

Instrumentation

General Electric Analog Light Meter

-This meter is an instantaneous meter that measures a wide range of footcandle values. It is capable of measuring values between 0 and 10,000 foot candles, making it useful in both interior and exterior light measurement readings. Its disadvantage is that it is the least accurate meter among those meters used due to human error while reading the analog values on the meter. This meter does include cosine and color correction.

Sylvania Digital Light Meter

-This meter is an instantaneous meter that displays an integral digital reading of footcandle level. It is more precise than the G.E. Analog Meter, but has a limited range of 0 to 2,000 footcandles. These qualities make this meter a better choice for precise, interior readings. This meter does include cosine and color correction.

HOBO Light Intensity Logger

-This meter is a long-term programmable data logger that measures footcandle levels at a specific interval over an extended period of time. Benefits include precise readings and a range of 1/100 to 15,000 foot candles; disadvantages include lack of cosine and color correction. This meter is best used to show patterns over time rather than specific lighting measurements.

StowAway Light Intensity Logger

-This long-term programmable data logger has many of the above qualities of the HOBO Light Intensity Logger, but has a few differences. Unlike the HOBO, it can be programmed to begin taking measurements at a specific time; it also has a trigger start so that it may be launched once it has been placed in the proper location. It has a smaller range of 1/1000 to 1,000 foot candles. Like the HOBO, this meter is best used to show patterns over a period of time.

Research Methodology

This report presents conclusions from an instrumented field study of the lighting qualities in the fourth floor offices of the NCAA Headquarters. This report discusses the general lighting characteristics and how these characteristics influenced the corresponding office layout and cubicle heights. The report also presents the natural and artificial lighting illuminance levels, lamp and fixture type, and occupancy factors.

The findings presented are sequenced to reflect the levels of increasing research engagements developed during the semester-long field study. We followed the research guidelines used by previous Vital Signs studies* of Ball State students which call for:

Indicative assessments reflect preliminary visits to the NCAA Hall of Champions in which we framed an awareness of the facility design and looked for field-research opportunities. Careful planning and mapping of research procedures as well as consideration and selection of appropriate resources were the two primary emphasis of the indicative phase.

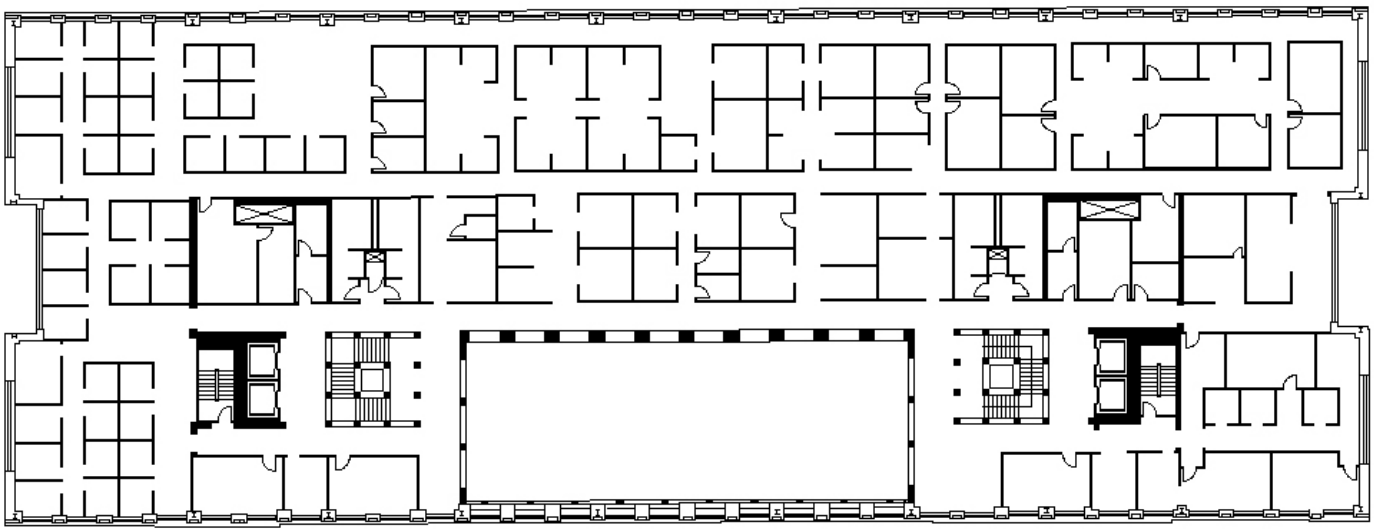
Investigative assessments reflect more detailed fact-finding and field-measured data gathering using short-term instrument sampling. Such work was conditioned on the experience of the first visits and reflected a fuller understanding of the lighting and building technologies in use. During this phase it was necessary to conduct light measurements and analysis of the spaces during the office hours, evenings, and nights; this allowed us to determine how much of the lighting was contributed by the artificial lights and how much was provided by exterior illumination. Initiating on-site data collection and monitoring/managing data collection and procedures were the two primary emphases for the investigative phase.

Diagnostic assessments reflect the use of longer-term data acquisition and more in-depth examination of such information. This phase of the research was conditioned by our hypothesis; it required significant field research and data analysis ability. The presentation of findings and recommended actions were the two emphases for the diagnostic phase.

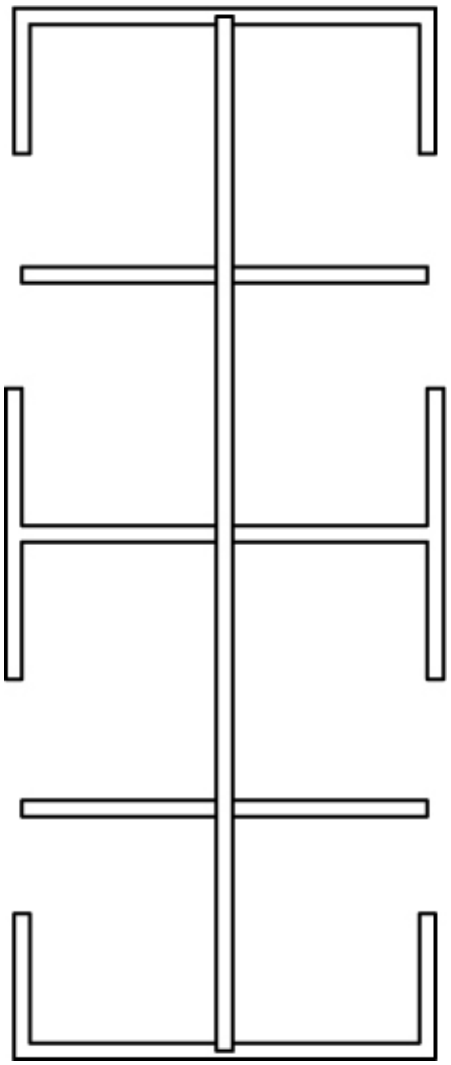
View of Fourth Floor Office Looking North-Northeast

* Post Occupancy Evaluation by Preiser/Rabinowitz/White

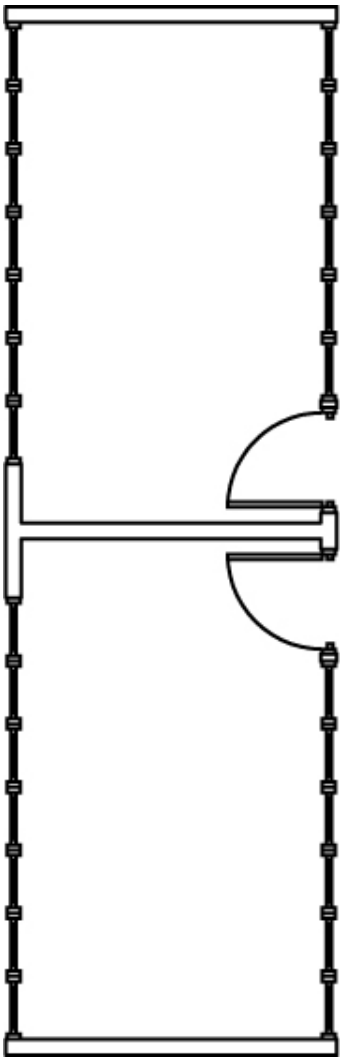
Graphic Illustrations of Spaces Studied



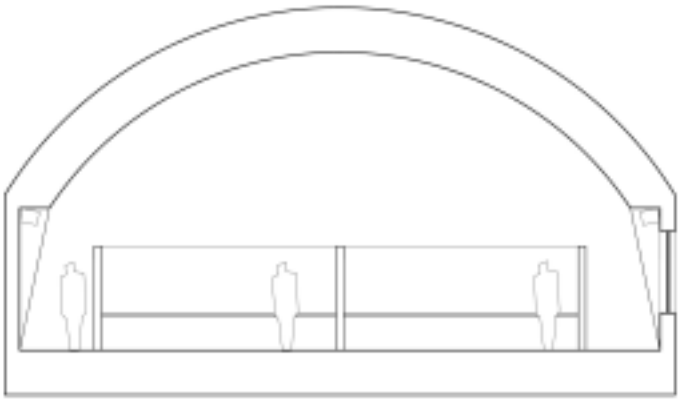
Floor Plan - Fourth Floor, Headquarters Building



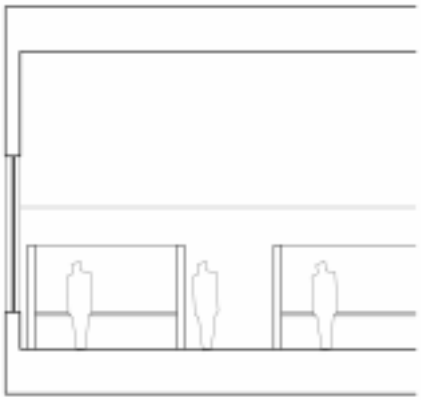
Typical Floor Plan, Low Partition



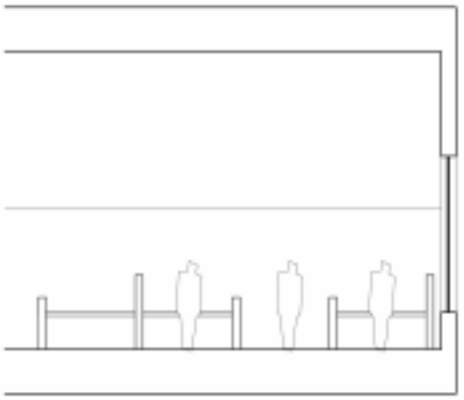
Typical Floor Plan, High Partition



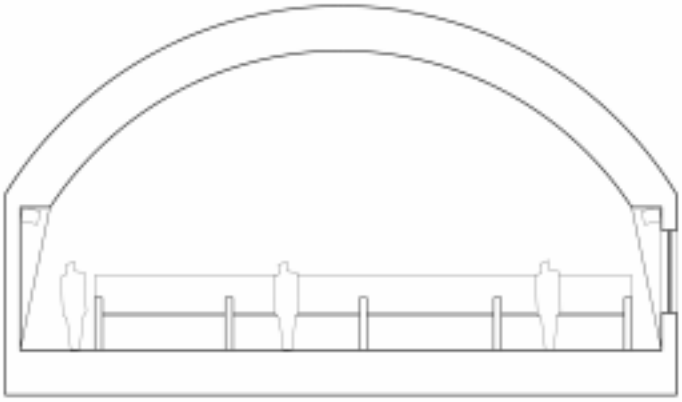
Typical North-South Section, High Partition



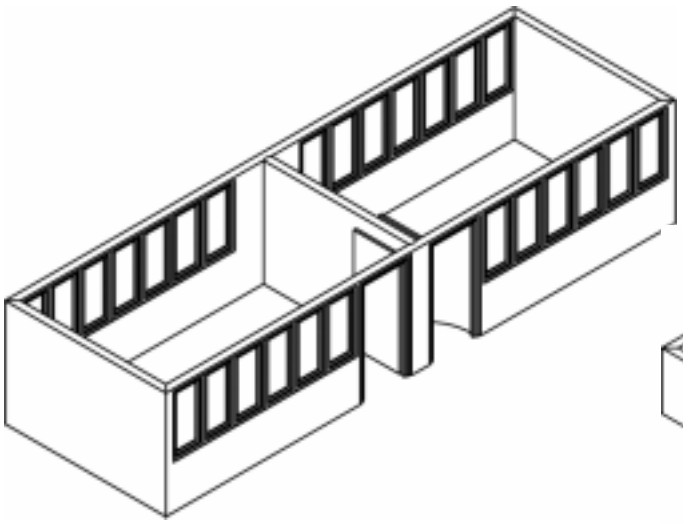
Typical East-West Section, High Partition



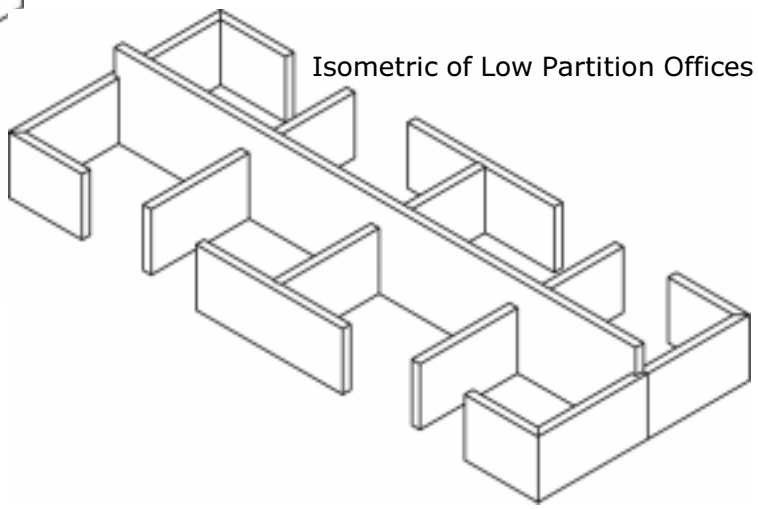
Typical East-West Section, Low Partition



Typical North-South Section, Low Partition



Isometric of High Partition Offices



Isometric of Low Partition Offices

View of Southern Corridor
Looking West

View of Fourth Floor Vaulted
Office Space Looking West

View of Southern Corridor
Looking East

Indicative Phase

Our indicative lighting assessment of the NCAA Hall of Champions lead us to study further the lighting characteristics of the fourth floor office space in the administration building. This office space has a barrel-vaulted ceiling utilizing up-lighting to provide a consistent ambient light source. There is also a considerable amount of natural light entering the space. Recently, half of the fourth floor office space received a new office partitioning system modification wherein the heights of the partitions were lowered. We were aware this change in height would have a proportional relationship to the quality and intensity of the light (natural and artificial) reaching the work surface. Our indicative assessment framed two questions that we felt must be answered: 1) which space allowed more natural and artificial light to reach the work surface, and 2) which space promoted a higher quality of light reaching the work surface.

Investigative Phase

During the investigative assessment of the NCAA Headquarters we measured the amount and quality of light reaching the work plane in both the low- and high-partitioned work areas. We logged each of our procedures for documenting the lighting characteristics to provide us with a thorough and detailed account of our investigation. We measured the daylight factor, the amount of light available inside as a result of natural lighting, by having the artificial lights shut off while quantitative measurements were taken at each of the work surfaces. In addition, we were able to measure and distinguish the amount of artificial light from the amount of incoming natural light by having the building supervisors leave the lights on throughout the night and into the following workday while HOBO dataloggers placed in each space in advance recorded illumination over the twenty-four hour period. These measurements gave us the precise magnitude of the available artificial light. This distinction allowed us to analyze more effectively the lighting contributions of both natural and artificial light. During this investigation we compared the lighting characteristics of each space with similar situations to better assess the quality and amount of available light. We studied the office layout, cubicle height and placement to determine the effect each has on the characteristics of the lighting. We carefully considered the placement and selection of each of the instruments for accurate and successful data documentation. Care was also taken when considering where each measurement would be acquired, what time of day, and sky and weather conditions. Thorough and rigorous documentation of the procedures taken was required for complete data collection and more precise analysis. In addition, other circumstances within the spaces were taken into consideration, including: the physical attributes, such as furnishings, finishes, subdivisions of spaces, glare, lighting control, light sources, and brightness/contrast ratios, as well as non-physical attributes such as user behavior, movement patterns, variety of user tasks/activities, and overall lighting needs. The variety of user tasks and activities was a key component to consider within this investigative process. Careful study of the specific activities and the location allowed us to assess more successfully the overall lighting requirements for each task. These lighting requirements were based on the IES Recommended Lighting Levels*. During this phase we also conducted informal interviews with the participants of the spaces, which provided us with the users' opinions and impressions of the space. These interviews provided us with a more precise "feel of the space."

Diagnostic Phase

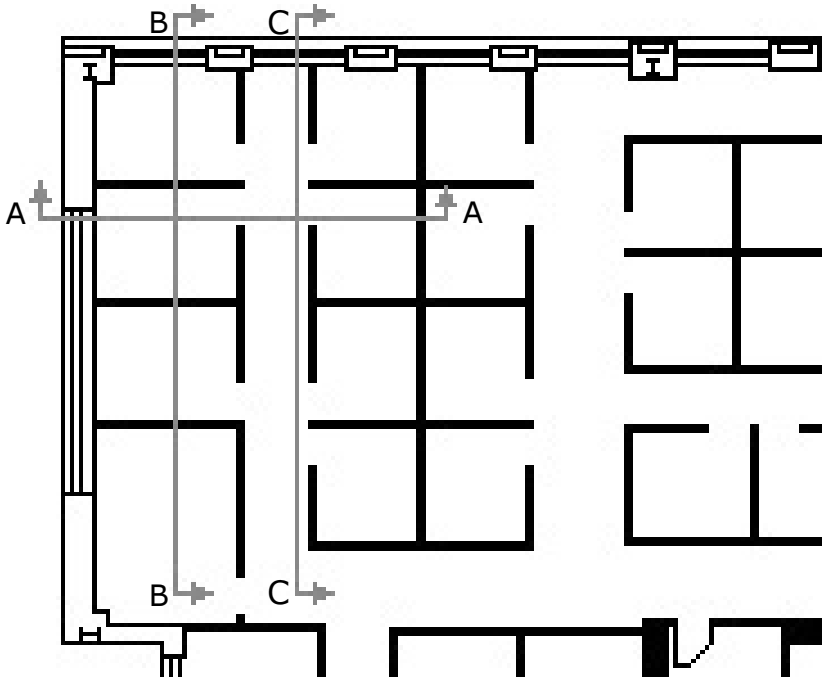
The diagnostic assessment phase reflects the use of long-term data acquisition (HOBOS) and more in-depth examination of such information. During this phase we finalized our hypothesis and used the data to prove the validity of its claims. Comparison and further analysis of collected data, as well as formalization and implementation with other tools such as charts and graphs, allowed us to reach a conclusion in response to our hypothesis.

* IES Recommended Lighting Levels Available in Appendix B

Findings

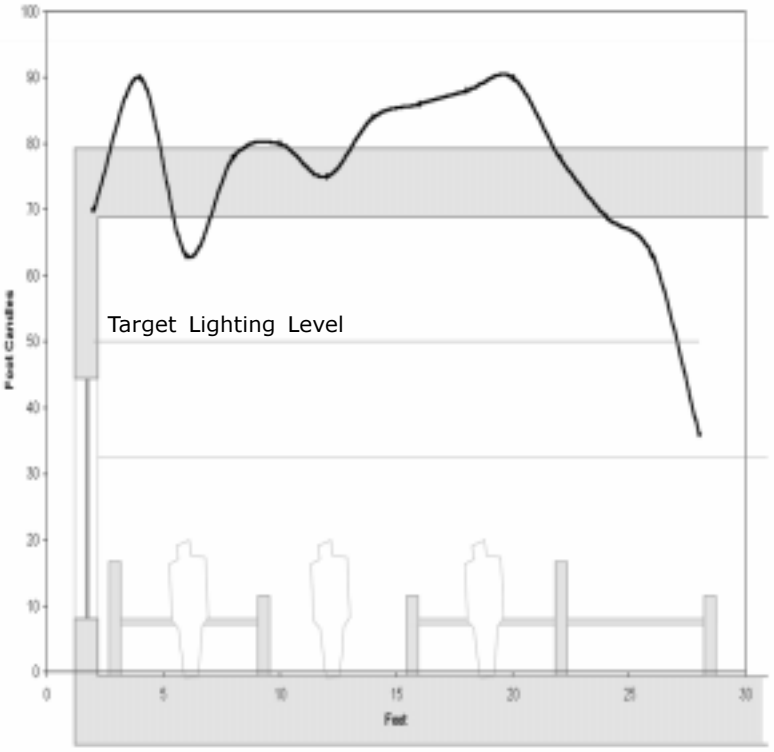
Sectional Illumination Profiles - Low Partitions

Measurements were taken throughout the office spaces in order to acquire an overall assessment of available lighting. Specific measurements were also taken in both the low partition office space and the high partition office space. Sections were cut through each space to analyse the light level distribution.

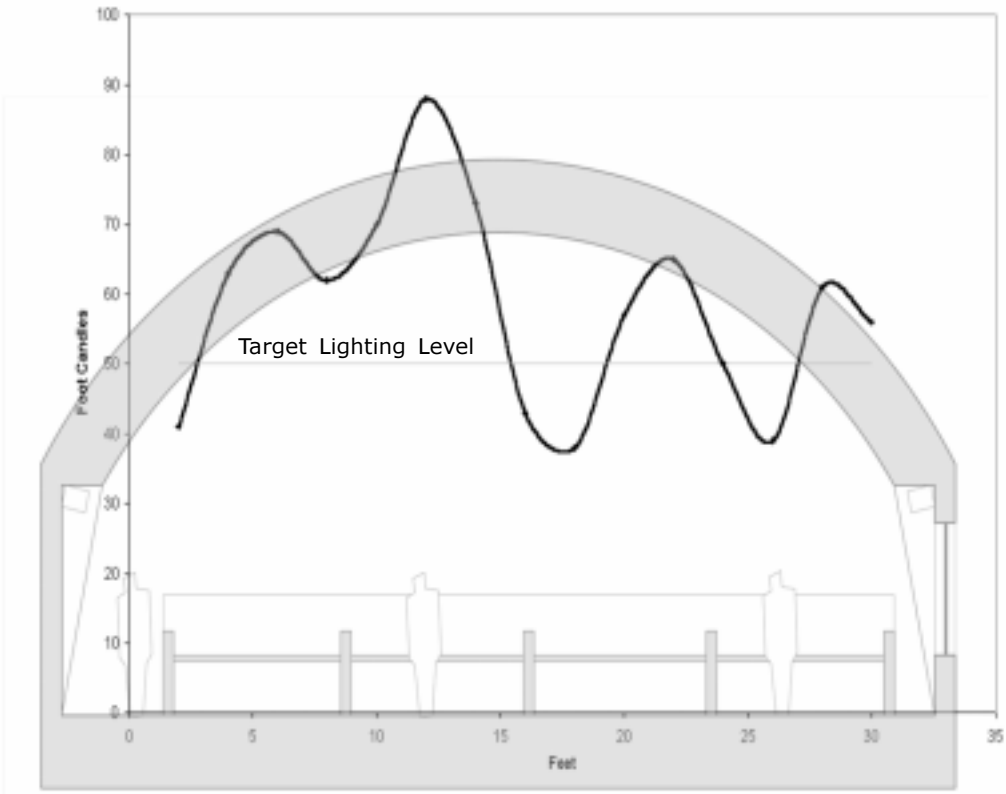


Location of Sectional Cuts

The east-west section cut through two low partition cubicles and a walkway (see section AA). Using a Sylvania meter, we measured illuminances that decreased as we neared partitions and rose again as we passed them. This was typical of both the east and west section and the north to south section (see section BB).

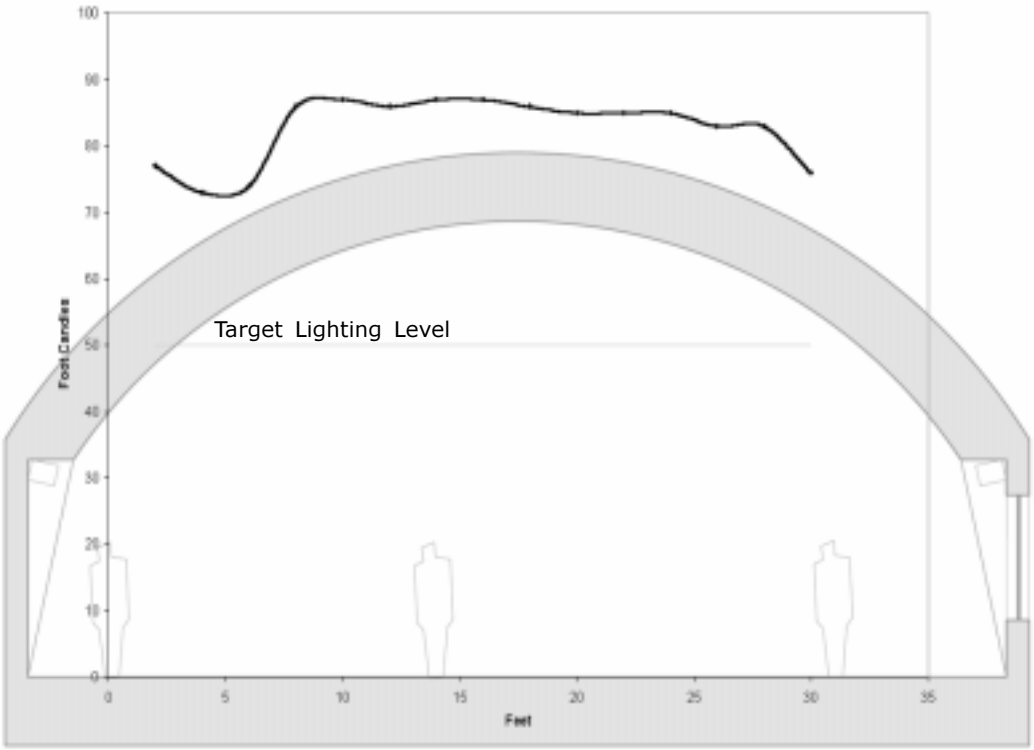


Section AA - East West-Profile



Section BB - North-South Profile
Office

The North-South office profile shows a significant fluctuation in illuminance levels across the overall office space. Illuminance levels decreased corresponding to each partition and increased above the target lighting level for each workspace.

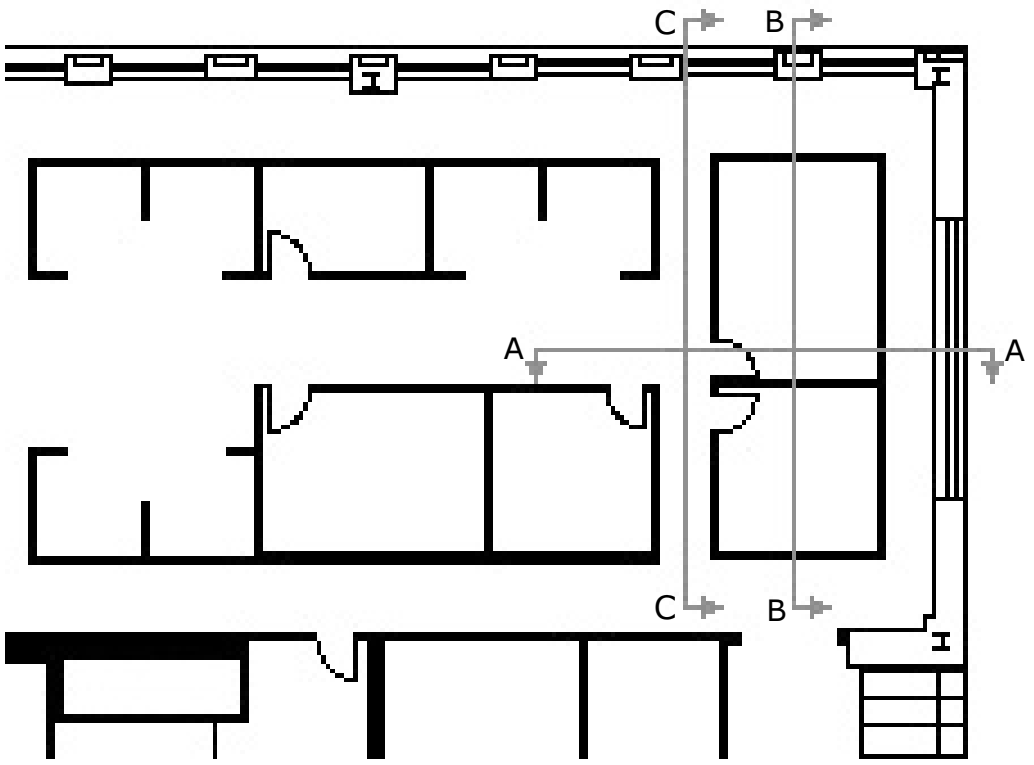


Section CC - North-South Profile
Walkway

Their were no partitions in the section through the walkway which allowed for an increase in overall illuminance (see section CC). The light intensity initially decreased for the first five feet away from the windows and then sharply increased and maintained an even distribution throughout the space. The lighting levels decreased again once passed the threshold of daylight penetration (which occured between 25-30 feet).

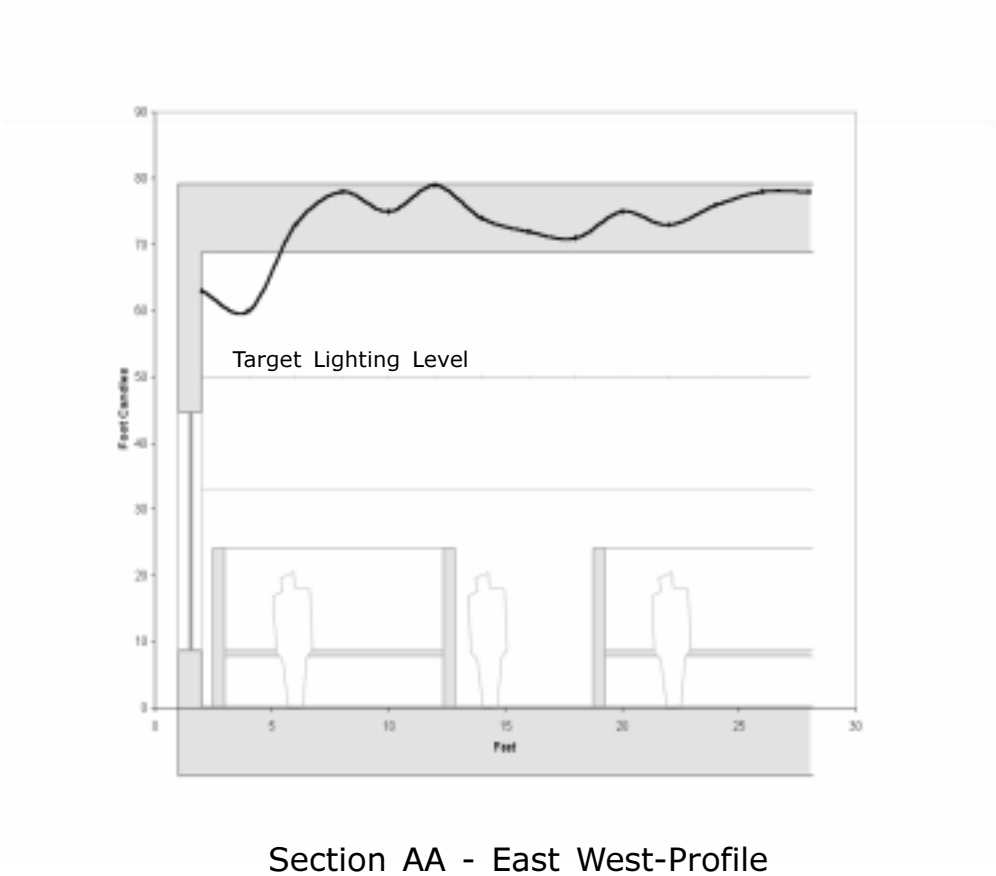
Sectional Illumination Profiles - High Partitions

The high and low partition offices spaces both had relatively equal intensities. The overall illuminance of the high partition office space was slightly higher than the low partition office space even though both measurements were taken at the same height above the floor (30 inches). Similar to the lower partitions on the previous page section AA refers to an east to west profile, section BB to a north south profile, and section CC to a north south profile through a walkway.

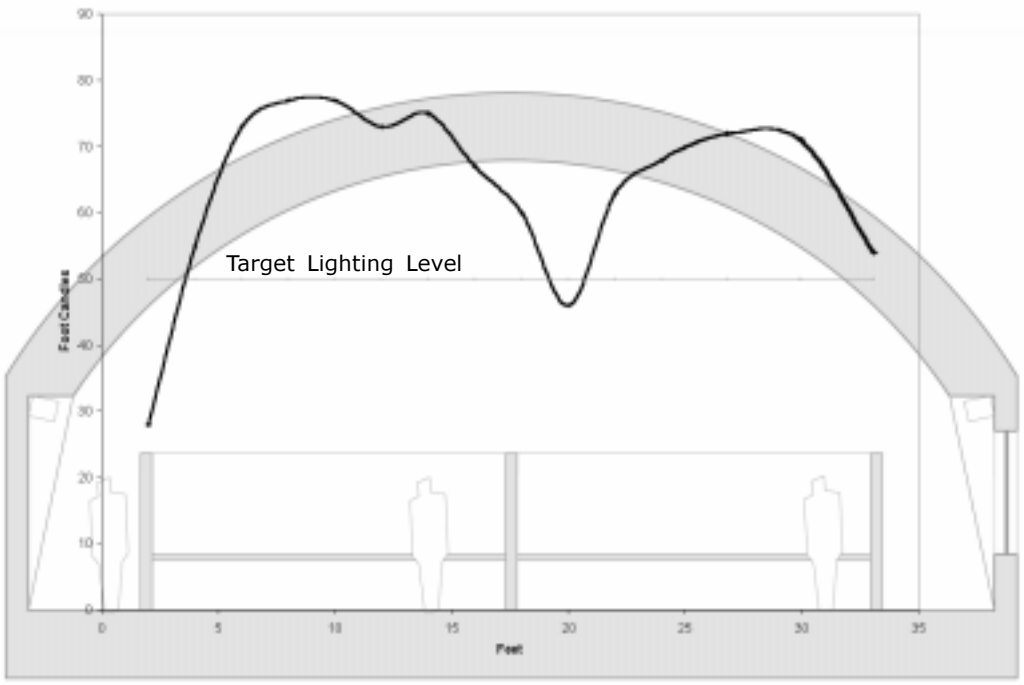


Location of Sectional Cuts

The east-west section cut through two low partition cubicles and a walkway (see section AA). Using a Sylvania meter, we measured illuminances that maintained overall more consistent levels than the lower partition office spaces.

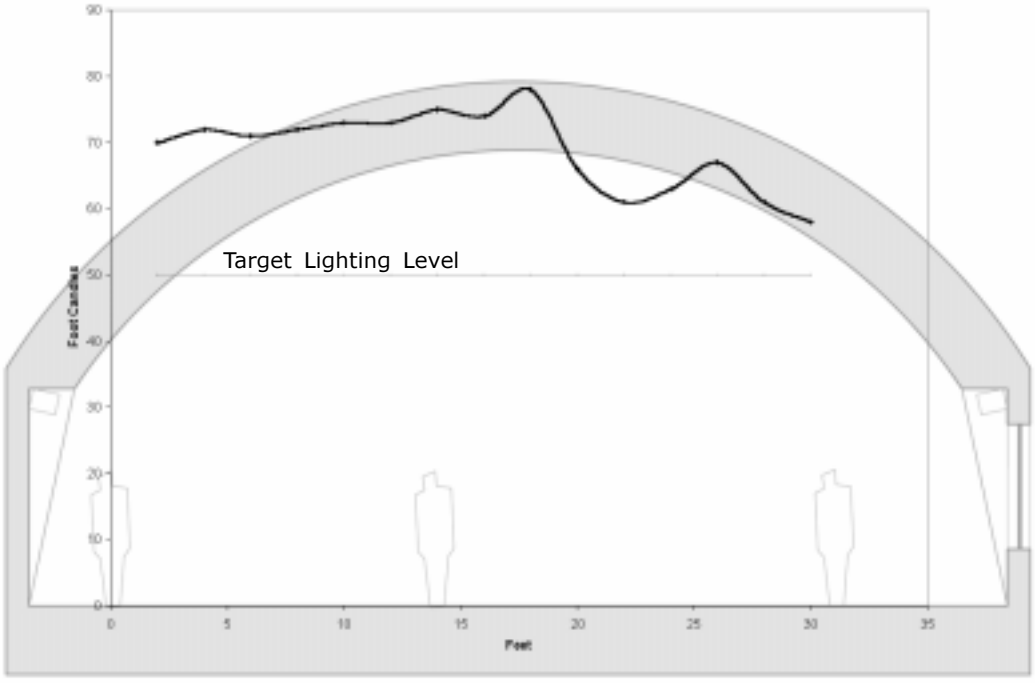


Section AA - East West-Profile



Section BB - North-South Profile
Office

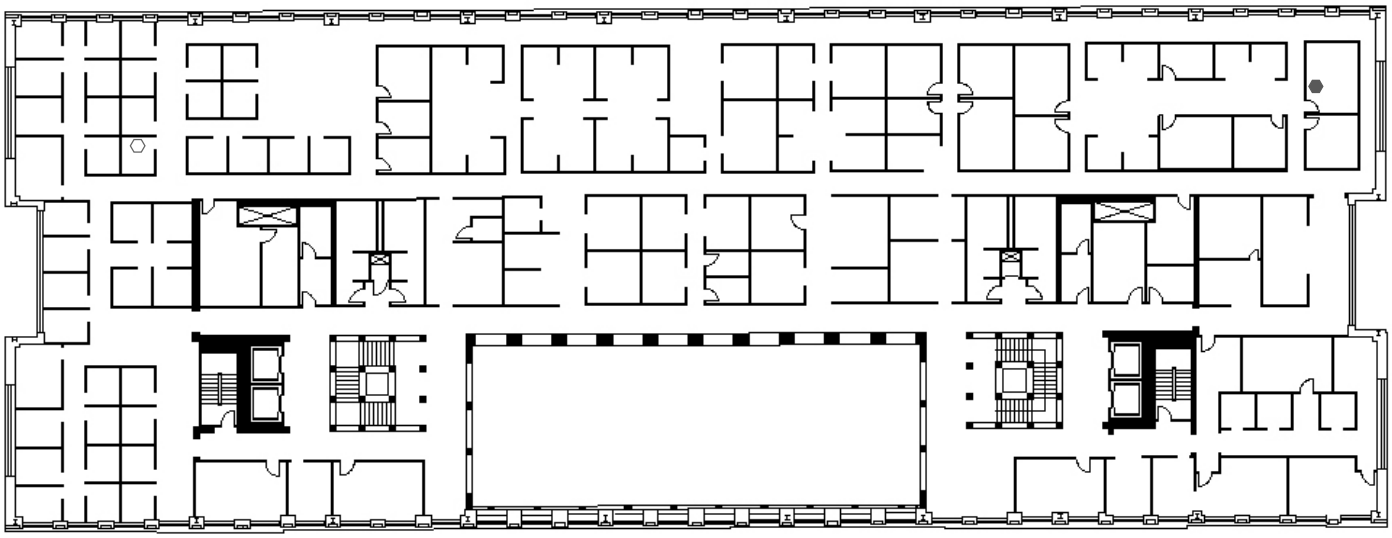
The North-South office profile (Section BB) shows a significant decrease in illuminance levels corresponding to each partition. The illuminance levels still measured substantially higher than the target lighting level throughout each workspace.



Section CC - North-South Profile
Walkway

The North-South walkway profile (Section CC) showed a more consistent illuminance level across the overall space due to the absence of partition walls.

HOBO Light Intensity Logger Data

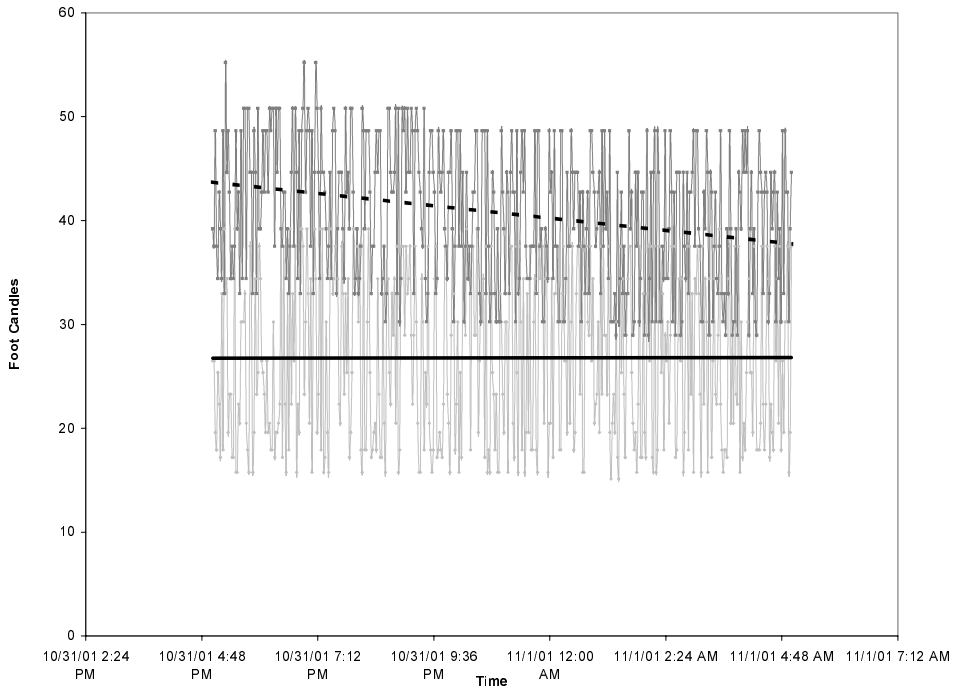


Legend
High Partition HOBO
Low Partition HOBO

Location of HOBO Light Intensity Meters

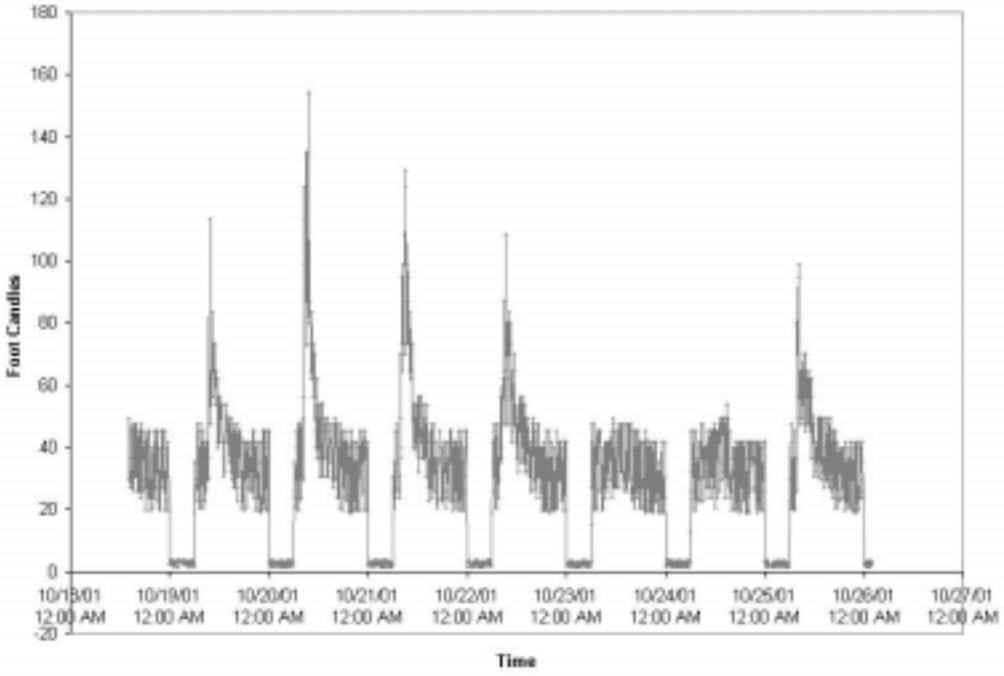
The HOBO light meters were used to take measurements overnight (see bottom left graph) and also look at lighting levels over the course of seven days (see the two graphs to the right).

The overnight readings allowed us to isolate the artificial/electrical lights from the available daylight. The walls of the higher partitions had glazing and permitted an overall higher intensity of light to reach inside the work space.

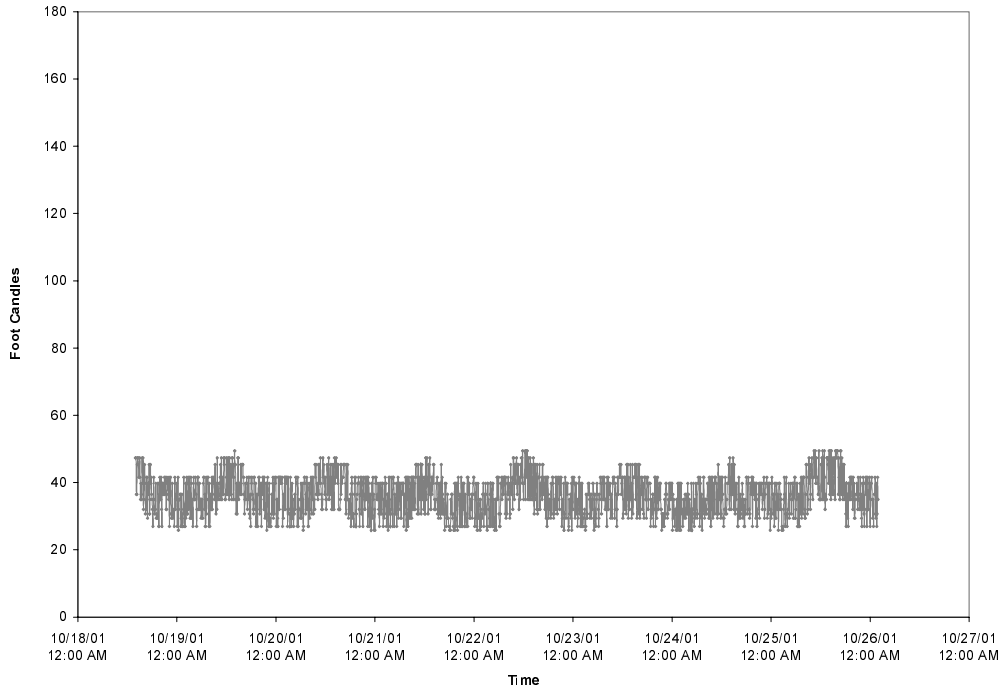


Legend
– – – – High Partition
——— Low Partition

Overnight Illumination Readings (Color Corrected)



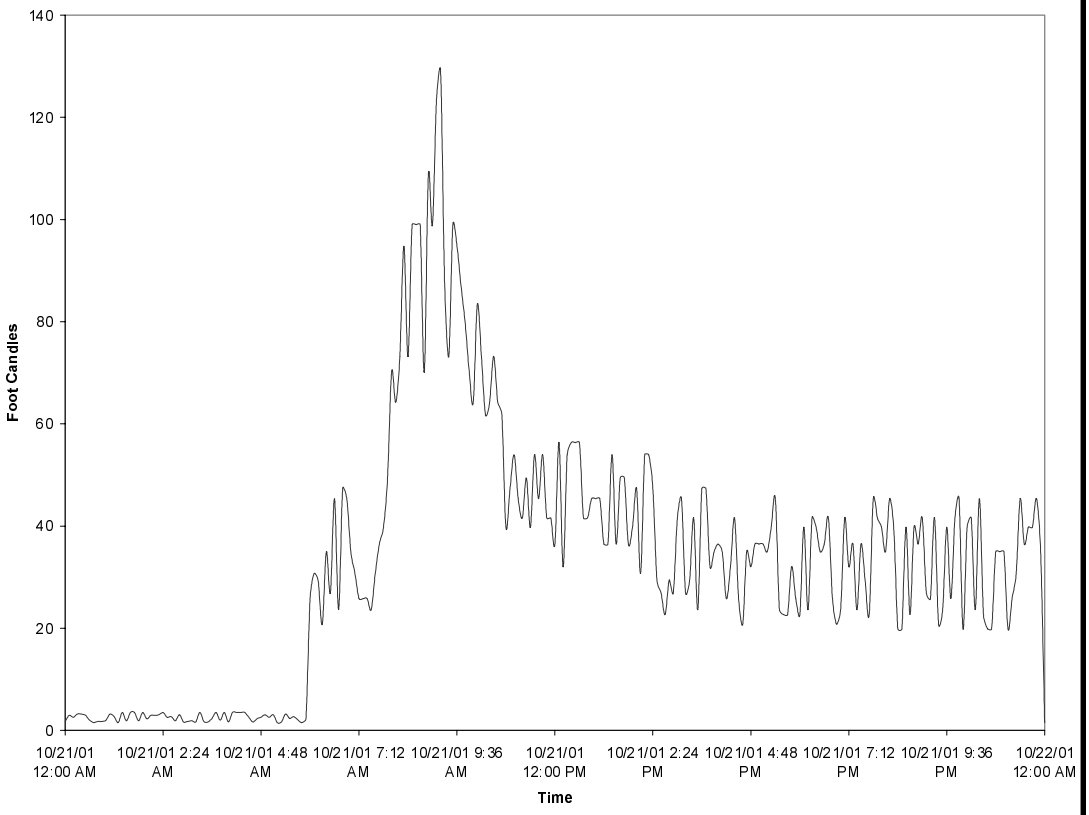
Seven Day Light Intensity Reading
High Partitions



Seven Day Light Intensity Reading
Low Partitions

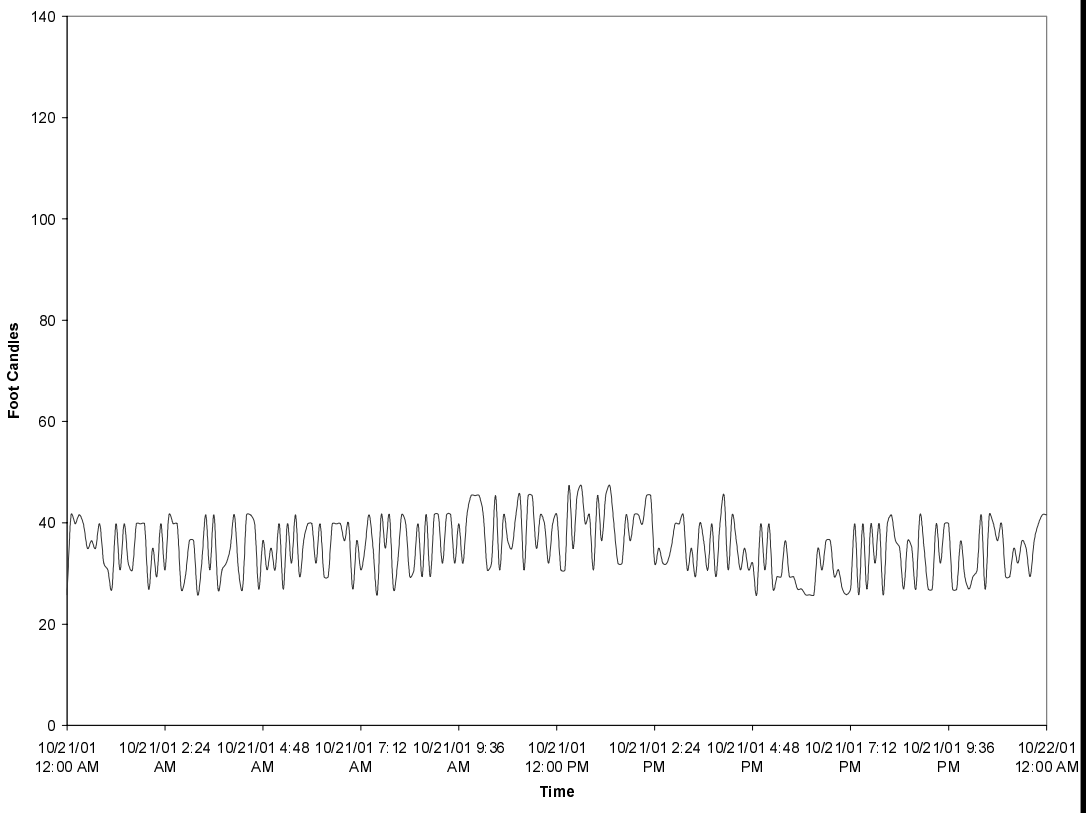
The Seven Day Light Intensity Reading graph allowed us to see the overall pattern of light intensity throughout the work week and weekend as well as the influence of daylight on both spaces. The overall light intensity was higher during the day and decreased at night. The seven day graphs suggest that interior artificial lighting does not need to be on or could be dimmed during the times when substantial daylight is available. Artificial light , if controlled proportionately with the available daylighting, would lead to energy savings and a more consistent lighting level.

The Typical One Day Light Intensity Reading graphs further analyze the overall illuminance readings recorded over the seven-day period. The high partition graph illustrates the absence of artificial light between 12 and 6 a.m. There is a significant illuminance increase around 9 a.m. when the sunlight penetrates through the eastern wall glazing and then levels off to a more consistent overall lighting pattern for the remainder of the day ranging between 20 and 50 footcandles.



Typical One Day Light Intensity Reading
High Partitions

The low partition One Day Intensity Reading graph indicates an overall consistent illuminance level throughout the twenty-four hour period ranging between 25 and 45 footcandles. This observation indicates that artificial light was left on throughout the night. This graph also illustrates a decreased overall illuminance compared to the high partition readings.



Typical One Day Light Intensity Reading
Low Partitions

Conclusion

Our on-site observations and digitally recorded illuminance readings were thoroughly analyzed and support a series of conclusions. The design intent of the up-lit vaulted ceiling in the fourth floor office space successfully provides a consistent ambient light throughout the workspace. We found that there is no gain in natural or artificial light intensity with the shorter cubicle partitions. This observation disproved our hypothesis. The higher partitions have built-in windows, which provide the same illuminance as the smaller version. The lower partitions proved to have no distinct lighting advantage over the higher partitions. In both locations the lighting levels were found to be considerably higher than the standard 50 footcandles as required by the Illuminating Engineering Society (IES).

We have compiled three recommendations for the management of the NCAA Headquarters. The first recommendation is the installation of daylight sensors. Daylight sensors will more evenly distribute the amount of used artificial light as the sun moves from east to west throughout business hours. Daylight sensors would also minimize energy consumption. Second, the lowering of wattage or intensity of the light fixtures would bring the overall lighting level down to the standard set by the IES. This additional change will also reduce the amount of energy consumption. Third, the success of the up-lit barrel vaulted ceiling at providing a consistent ambient light allows freedom of cubicle height and arrangement and that workspace lighting levels should not give cause for any change in office layout.

Acknowledgements

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-David Clendenin - Administrative Assistant, Finance & Information Services

REI Real Estate Services
-Milt Grissom - Senior Property Manager
-Michael F. Hay - Maintenance Supervisor, NCAA National Headquarters

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Appendix A

Group Reactions:

"Initially I was intrigued by the spatial and aesthetic effect of the up-lit barrel vault within the office spaces. The up-lighting located between each of the ribs provided the long narrow space with a gentle rhythm and evenly distributed ambient light. During the investigative phase I enjoyed the professionalism exchanged between each of the members of the inquiry. I also felt the process of data collection and analysis was energetic and inquisitive. This led to an up-beat atmosphere and a more successful project. Finally during the diagnostic and post analysis stage I learned a great deal from the process of generating a hypothesis, conducting field measurements and analysis, and disproving our own theory. I found as much, if not more, can be learned and acquired through the disproval of a hypothesis as with the successful support of its claims."

-Johnathan Sticht

"When I first entered the NCAA Headquarters, I was immediately intrigued by the large, open atrium and its barrel vault. Upon hearing that the office partitions on the fourth floor, which also contains a barrel vault, had been lowered in order to create a more open office, I began to consider the multiple implications of such a change. For instance, how would the new space affect the acoustics of the office? For our particular study, we decided to analyze the ways in which the new office partitioning system would affect the lighting of the office, hypothesizing that the lower partitions would provide more usable light to the work surface. Although we disproved our hypothesis, the process of collecting and analyzing data, followed by the creation of conclusions and recommendations was an invaluable learning process that we are each sure to use in the future. Moreover, this process will certainly cause each of us to think about the real-world implications of our designs in our future projects."

-William Carr

"Going to the NCAA Headquarters in Indianapolis for the first time, I had several high expectations. This was a Michael Graves building. It has to be one of the most amazing works of architecture and design in the world. But, upon entering and touring the facility, I found that my expectations were maybe set a little too high. The building was exceptional, but not some masterpiece to architecture like the Mona Lisa is to art. I was, however, intrigued by the fourth floor office space. The atmosphere seemed like it would be a pleasant space in which to work. I thoroughly enjoyed spending our research time up there, from indicative to investigative to diagnostic. Although our hypothesis was proven wrong, much more was learned from this wonderful experience. It has given me valuable information that will give me a head start in the professional world."

- Jonah Garoutte

Appendix B

IES Recommended Lighting Levels

Illuminance Categories and Illuminance Values for Generic Types of Activities in Interiors

Type of Activity	*Illuminance Category*	*Ranges of Illuminances*	
		Lux	*Footcandles*
General lighting throughout spaces			
Public spaces with dark surroundings	A	20–30–50	2–3–5
Simple orientation for short temporary visits	B	50–75–100	5–7.5–10
Working spaces where visual tasks are only occasionally performed	C	100–150–200	10–15–20
Illuminance on task			
Performance of visual tasks of high contrast or large size	D	200–300–500	20–30–50
Performance of visual tasks of medium contrast or small size	E	500–750–1000	50–75–100
Performance of visual tasks of low contrast or very small size	F	1000–1500–2000	100–150–200
Illuminance on task, obtained by a combination of general and local (supplementary) lighting			
Performance of visual tasks of low contrast and very small size over a prolonged period	G	2000–3000–5000	200–300–500
Performance of very prolonged and exacting visual tasks	H	5000–7500–10000	500–750–1000
Performance of very special visual tasks of extremely low contrast and small size	I	10000–15000–20000	1000–1500–2000

Courtesy of Illuminating Engineering Society of North America.