





A Lighting Study of the Walter Byers Auditorium

at the
National Collegiate Athletic Association Headquarters
Indianapolis, Indiana

Team 2:
Brian Garrett
Fred Grunert
Steve Karwan

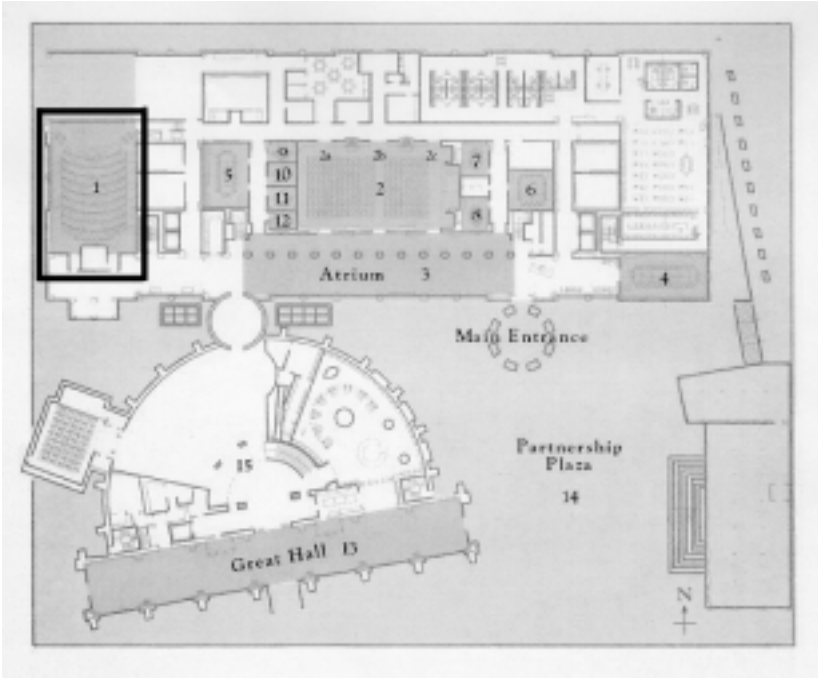
Center for Energy Research/ Education/Service (CERES)
Ball State University
Muncie, Indiana
Fall Semester 2001

Table of Contents

Map and Key Plan

NCAA Headquarters and
Hall of Champions

Figure 0.1 Location map, downtown Indianapolis, Indiana



1. Walter Byers Auditorium
2. Palmer E. Pierce Room
3. Theodore Roosevelt Atrium
4. Chancellors and Presidents Room
5. James Frank Room
6. Judith M. Sweet Room
7. Directors Room
8. Faculty Room
9. Membership Room
10. Scholar-Athlete Room
11. Alumni Room
12. Varsity Room
13. Hall of Champions Great Hall
14. Partnership Plaza
15. Hall of Champions

Figure 0.2 Key Plan, NCAA Headquarters

Abstract

This study examines the qualitative and quantitative aspects of the preset lighting conditions of the Walter Byers Auditorium at the National Collegiate Athletic Association (NCAA) Headquarters in The White River State Park in Indianapolis. The study compares seven preset lighting conditions in the space. Our team's intent is to demonstrate whether or not the space is "appropriately lit" for the seven different uses. We acknowledge that in using a multitude of settings that it is improbable that at each setting an optimum or ideal lighting condition is attained; instead, we will seek to ascertain that an appropriate compromise of seven different settings is obtained. The settings should be compromised so that the integrity of the lighting scheme of each setting is not compromised.

In each of the settings, our team inventoried the lighting of the room. Our team then developed a set of criteria to analyze each setting and space. We studied the qualitative aspects of the lighting at each setting through this established criteria. We situated ourselves in multiple, designated places at each setting, to examine these "immeasurable" qualities. The quantitative aspect of the lighting at each setting was examined through lighting measurements and visual field mapping. These findings were then analyzed based, again, on the established criteria. The findings and analyses of each preset setting were used to determine if the space at that particular setting was "appropriately lit". Finally, those determinations of each space were combined to determine if the whole lighting scheme, including each of the settings, was appropriate.

Upon analysis of the auditorium space at each of the seven settings, our team determined that the space is appropriately lit. Its multiple settings accommodate for a variety of functions. Each of the settings has only minor problems which do not distract from the activities taking place within the space. Finally, our report includes a list of recommendations our team has developed.

Introduction

Vital Signs VI, a course offered by the College of Architecture and Planning at Ball State University is administered by the Center for Energy Research/Education/Service. The course works in conjunction with the national Vital Signs Project established at the University of California, Berkley. Vital Signs is focused on learning about building design through the study of the performance of existing buildings.

The NCAA Headquarters and Hall of Champions, is part of the White River State Park in Indianapolis Indiana (Figure 0.1). Designed by Michael Graves, in partnership with Schmidt Associates of Indianapolis. It opened in 1999. The headquarters provides office space for approximately 400 workers, and provides 50,000 approximately +square feet of exhibition space in the Hall of Champions.

The focus of this study was within the Headquarters building. This four-story facility is highlighted by a southern full-height entrance atrium. The ground floor provides mostly multi-purpose rooms and specialized spaces. The upper three floors are general office space, and all overlook the atrium.

The Walter Byers Auditorium is at the West end of the first floor (See Figure 0.2). Seating approximately 150 people, it is used as a large meeting room, for press conferences, web casting, event conferences, and lectures. The auditorium is 48' 10" deep by 36'2" wide (See Plan, Figure 0.4). The floor is raked with stepped platforms front to back; each step contains a row of seats. The stage front is twenty-four inches above the lower floor level.

The multiple functions of the space predicate that different lighting conditions are used. A Lutron® lighting system controls the lighting for the space and includes seven preset conditions. These include:

1. "Full Stage"
2. "Slide Projection"
3. "Video Conferencing"
4. "House Lights"
5. "Stage Left - Lecture"
6. "Stage Right – Lecture"
7. "Stage Center – Lecture"

An eighth setting, for cleaning and maintenance is utilized sparingly, and was not studied.

The room is twenty-four feet tall above the finished floor at its tallest point, at the front of the stage (See Section, Figure 0.5). The floor steps higher, progressing to the back of the room. There are eight steps, each is eight inches in height with a tread of forty-nine and a half inches. A row of seating is located along each step. Each row seats fourteen people, except for the first two rows. The first row has permanent seating for eight and space for six wheelchairs or temporary seating. The second row seats eight people. Each row of seats has a common, eighteen-inch deep work surface finished with a maple laminate. Each row of seats parallels the projecting curve of the stage.

Introduction - Fixture Diagram and Inventory

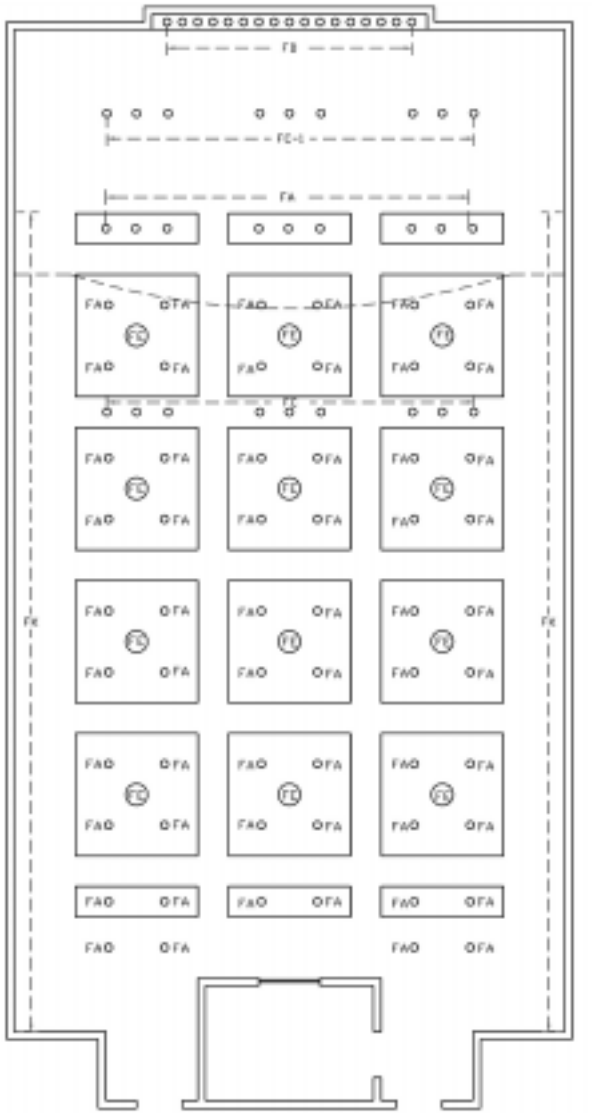


Figure 0.3 Reflected ceiling plan diagram

Fixture Type Description:

FA
The Darklite 30/5 is a 5-inch aperture downlight designed for use with 75 watt (maximum) PAR-30 spot or flood lamps.

FD
The Spredlite 38 PV/9 is an incandescent wallwasher that provides uniform illumination on vertical surfaces. The fixture is designed for use with PAR-38, 150-watt (maximum) spot lamps.

FC
The Darklite 38/40/6AA is a 6 inch aperture adjustable accent light designed for use with 250 watt (maximum), PAR-38 spot and flood lamps.

FC-1
The Darklite 38/40/6AA is a 6 inch aperture adjustable accent light designed for use with 250 watt (maximum), PAR-38 spot and flood lamps. (Angle mounted)

FK
The Bega 1140 120 is a recessed wall lamp that is designed to use a 20 watt, G4, 12 volt lamp.

FE
This lamp could not be identified as of yet due to a lack of shop drawings.

Room Plan and Section

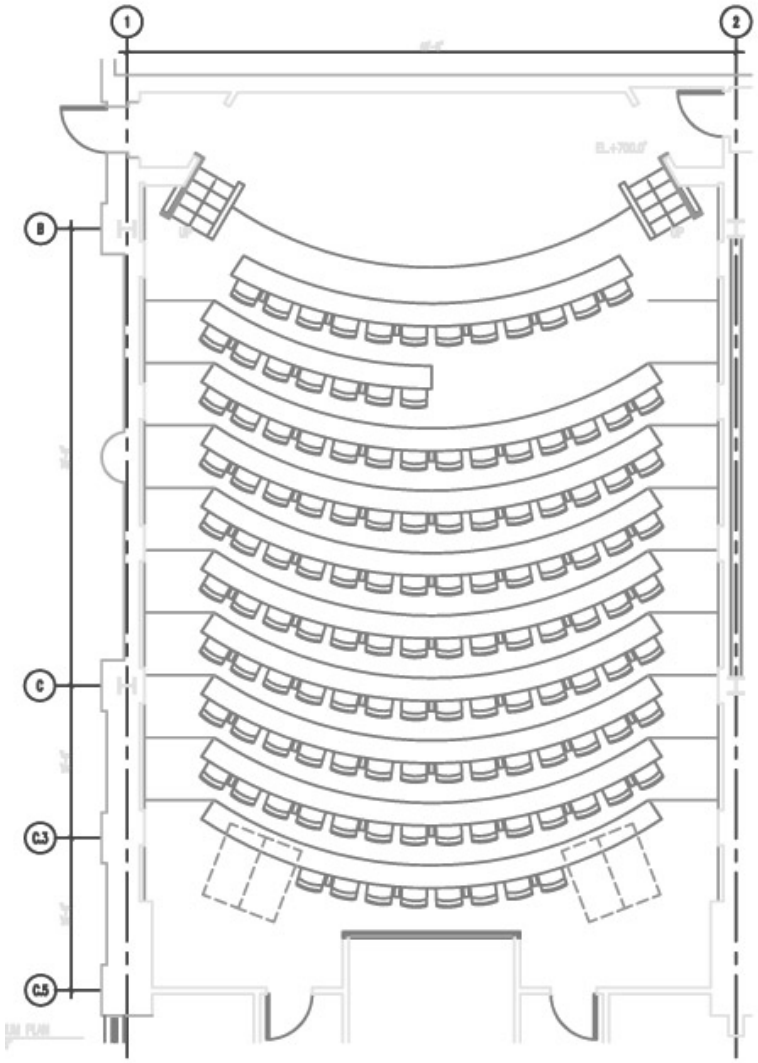


Figure 0.4 Room Plan
Note: Not to scale

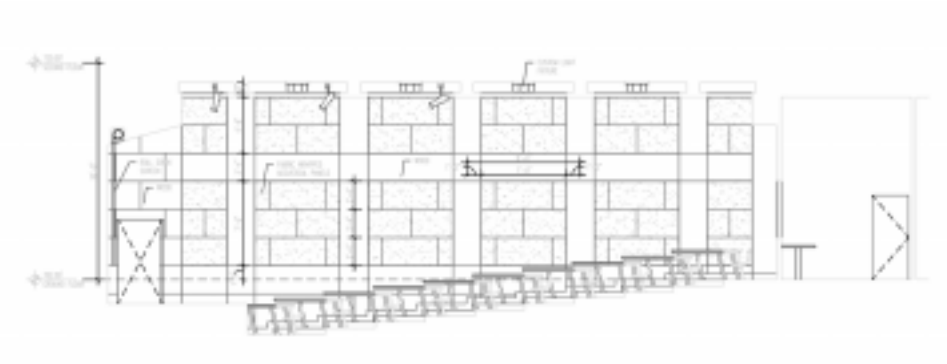


Figure 0.5 Section (from front to back of auditorium)
Note: Not to scale

Hypothesis

“The Walter Byers Auditorium is appropriately lit for seven different event uses.”

Our study tested the pre-set lighting control system of the room. An evaluation will be completed testing whether it is appropriately used and preset, based on both qualitative and quantitative criteria. Our team assumed that due to the variety of settings that one setting alone would not be optimum. Instead, a compromise between settings must be understood so that the complete system becomes acceptable.

Methodology

The study of the space was conducted in three phases: *indicative*, *investigative* and *diagnostic*. The indicative phase consisted of a tour of the facility to gather general impressions about the building related to lighting. Later, information and more in-depth impressions about the space were gathered and an indicative study of the selected auditorium space was completed. During the investigative phase, measurements and visual field mapping were completed, and data were collected. Qualitative aspects were also studied at this time. The diagnostic phase consisted of analyzing and retaking measurements (when necessary). Our data of both the qualitative and quantitative studies were compiled.

A list of criteria was developed to help define the term "appropriately lit" as it pertains to the Walter Byers Auditorium. The criteria consists of both qualitative and quantitative aspects and were developed into a matrix. The categories used to define "appropriately lit" include:

Comfortable/uncomfortable (the qualitative aspects)
- -Issues of glare (audience and stage)
- -Worksurface glare
- -Shadows
- -Worksurface shadows
- -Backlighting
- -Color of lighting
- -Lighting contrast

Adequate/inadequate (the quantitative aspects)
- -Light levels (based on accepted design standards)
- -General audience (ambient), stage, task surface, etc.
- -Footcandle levels
- -Uniformity of lighting levels

Methodology

When developing the criteria for the qualitative evaluation, these issues were addressed. If any of these issues became detracting or inhibitive to the function of the space, they were regarded as negative. If the issues were not distracting, or enhanced the function or quality of the space, they were regarded as positive. A brief description of the positive and negative aspects of each issue is as follows:

Glare: Glare should provide not be uncomfortable viewing of onstage activities. General glare should not detract from presentation/lecture/ performance on stage. Glare causes eyestrain: this is not appropriate.

Worksurface glare: Worksurfaces include audience worksurfaces and stage lectern. Worksurface glare should not disturb note taking, reading, etc. Worksurface glare should not inhibit the functions of the space. Worksurface glare is not wanted.

Shadows: Shadows should enhance (i.e. by providing depth to) activities and presentations onstage. Shadows should not inhibit views onstage and should not detract from focal points.

Worksurface shadows: Worksurfaces include audience worksurfaces and stage lectern. Shadows should not detract from note taking, reading, or any other activity that takes place at the worksurface.

Backlighting: (Dealt with specifically at the stage). Lighting should highlight focal points. Lighting should not detract from focal points.

Color of lighting: Color should enhance or not distract from the functions of the space. Colors should not be distracting and should not produce eyestrain.

Lighting contrast: Lighting contrast should not cause eyestrain. Sharp contrast that is necessary for the function of the space (i.e. slide projection) shall not become visually overbearing.

Indicative Visit

A first visit to the NCAA Headquarters provided us an opportunity to gather general impressions of the facility. We paid close attention to daylighting, task lighting, geometries of light, etc. It was during this initial visit that our team decided to further investigate the lighting in the Walter Byers Auditorium. We spent only a few minutes in this room during the initial visit, but the uniqueness of the preset lighting of the room, captured our interest.

During our second visit, our team's focus was on the Walter Byers Auditorium. Because our study was still being developed, we had no particular focus.

As we entered the auditorium, we assessed the transition of light from three key spaces: the atrium, the vestibule, and the auditorium. Day-lighting primarily affects the atrium; electrical lighting affects the vestibule and auditorium spaces. Using our light measurement instruments we gathered data showing that the atrium space received a significantly greater amount of light on the given day compared to the auditorium spaces. (Later, we determined that this transition was not significant enough to study. A small closed vestibule space allows for a comfortable progression. The room is set to one particular setting as the audience enters. The transition is not relevant to the other six settings, as there is no transition between the lobby space and the auditorium space with these settings. Consequently, we decided not to study this further.)

While doing a brief walkthrough of the auditorium, we observed the space during its seven different lighting settings. We documented the usage of particular lamps and patterning within the space.

It was after this visit that we decided to study each preset lighting condition and develop criteria by which we would evaluate each setting. We would then, as our study, evaluate each setting, and the system as a whole.

Procedure-Indicative Study

Our team gathered preliminary information by recording readings taken at designated points. The majority of the data collected were measured at the worksurface height of 30". Measurements in the seating and viewing area were taken along every other row and at 9 points across the room. The measurements were broken down as follows; data collected at both side walls, center of row, both ends of row and two points between center and edge of the rows.

After data were gathered, photographs were taken from several viewpoints to get the basic understanding of the space. (More detailed pictures were taken during our later investigative visits.) Pictures were taken during the various presets of the lighting and lighting changes were documented based on lighting configurations and stage illuminations.

The investigative segment of this paper is split into seven sections, each detailing one of the lighting conditions studied. Our team's findings related to each section will be described here.

During our investigative visits to the NCAA Hall of Champions and Headquarters, our team focused primarily on data collection. These data consist of lighting measurements (measured in footcandles), and visual field mapping (using digital images). Also during this phase, qualitative aspects of each setting were observed and documented based upon the designated criteria.

First, our team set the lighting of the room to Setting One, "Full Stage." While on this setting, we walked around the space starting in the right rear corner. We placed the light meter (Sylvania electronic photometer) on the 30" work surface at the center of every second seat, adjacent to an electrical/ data outlet. In addition, light levels at three points of the stage, center, right, and left (corresponding to the three locations of the lectern) were measured. While doing this we were consistent in making sure that we were below the light meter so that our readings were not disrupted.

After taking measurements in this manner for the entire eight rows, we proceeded to take photographs of the actual lighting conditions. To do so, we stood in the back center of the space and photographed the stage conditions. Photographs were then taken of the ceiling condition at a single point at the center of the fourth row.

The qualitative aspects of each lighting condition were observed and documented during this phase. During each setting, we observed the space from different locations: the center two seats of the fourth row, from the stage center looking towards the audience, from the center seats of the first row, and from the two end seats of the last row. These observations were then generalized into a set describing each preset condition.

The visual field mapping was conducted using a very simple technique. Initially we photographed the auditorium during all seven lighting stages, using a digital camera. We then took these digital images and manipulated them using Adobe Photoshop so that they could be used as visual field maps (see Appendix B). We then used a physical copy of these images to document luminance measurements during a later site visit; we used a Minolta Luminance Meter LS-100 to collect measurements of the actual visual field. To gather the measurements we initially stood in the center of the back row of the auditorium and used the Luminance Meter to gather what measurements we could capture within the Meter's visual field. We then moved up to the center of the fifth row and took measurements. Here we were able to collect the measurements that were too small for the meter to focus in on from the rear of the room. We completed this process for lighting Stages one through seven.

The measuring, collection and documentation of these data, was repeated for each setting, and proceeded in the same manner as described.

Setting 1: Full Stage

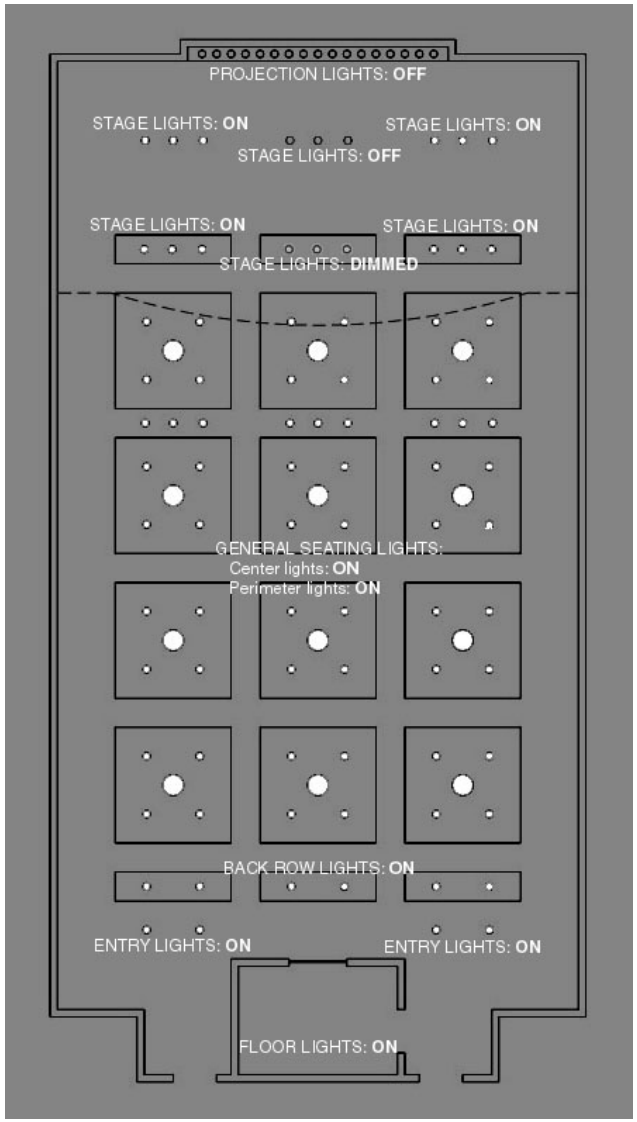


Figure 1.1 Setting One: Full Stage Fixture Status Diagram

This setting's lighting design intent does not seem to be as indicated. Rather than allowing for full lighting of the stage, it allows for the full lighting of the auditorium. The lights above the seating are all on, as is most of the lighting for the stage. Floor lights, vestibule lights, and entry lights deem this setting to be used for general usage. It also is to be used prior and after events, as it allows for the entry and exit of the large group of people. The plan diagram (Figure 1.1) indicates each fixture status within the space.

*Figure 1.*2 Setting One: Full Stage

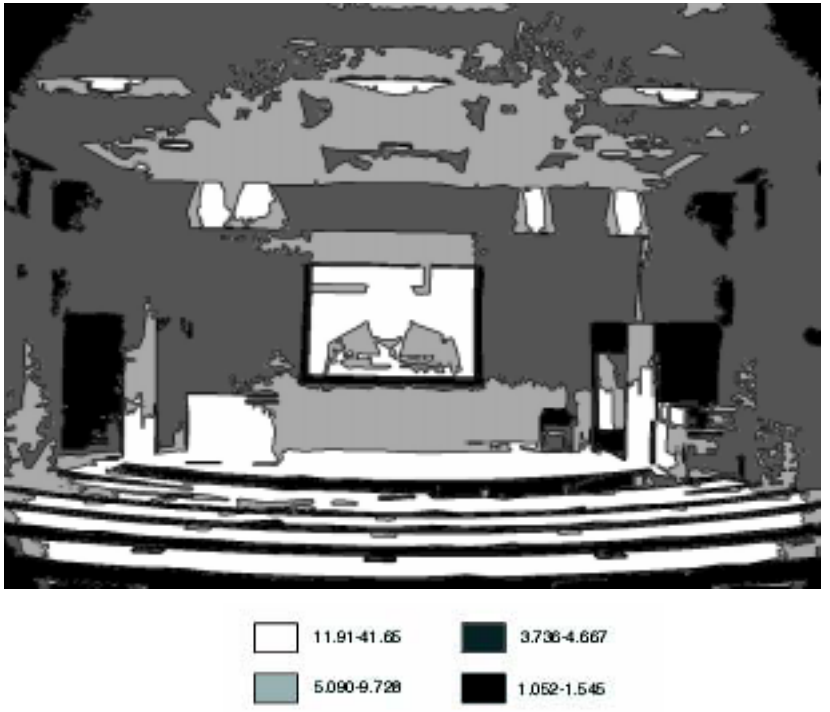


Figure 1.3 Visual field map, Setting One, Full Stage

Setting 1: Full Stage

Qualitative observations

An analysis of the qualitative criteria indicates a few minor problems.

Glare: Non-existent to minimal. Change in light levels from one surface to another is very subtle. There are no drastic changes for the eye.

Worksurface glare: Minimal glare due to matte plastic laminate finish of worksurface. Discomfort from glare was minimal. It was also considered that at this setting the usage of the worksurfaces would be minimal, further downplaying any problems.

Shadows: The few shadows at the stage were not distracting. Instead, they served to add contrast to the visual picture. All possible focal points at the stage were well lit.

Worksurface shadows: Worksurface shadows were created by the placement of multiple fixtures overhead. Because the light was fairly uniform, the shadows were not distracting. Again, the usage of the worksurface would be minimal at this setting.

Backlighting: Backlighting was not a distracting factor in this setting.

Lighting color: The "cool white" lamps of the coffered ceiling provide a comfortable color. These larger central fixtures drowned the other canister lights of the coffered ceiling out. The stage lighting provides a necessary coloration for the features onstage.

Lighting contrast: The levels of the seating and stage areas were relatively similar. The different coloration provided an appropriate contrast indicating a hierarchy within the space.

Overall Impression: The space was comfortably lit. The change of view from the worksurface to the stage was comfortable.

Quantitative observations

Lighting levels within this setting are indicated in Appendix C.1. A diagram (Figure 1.4) depicts the general light levels within the room. The darker areas indicate the areas of lower light levels within the setting; the lighter areas indicate areas of higher light levels within the setting.

A visual field map (Figure 1.3) was completed at this setting. It indicates that there are subtle differences in light levels throughout the visual field, lighting is uniform throughout the space, and allow for focus on task surface and general stage applications. The lighting levels range from 4.6fc (surrounding the slide projection screen) to 13.4fc (task surface areas/ general audience seating) and ranging from 41.6fc (lamp output from stage spot lights) to 27.3fc (floor level of general stage area). There is an even amount of spread between the various measurements that allow for the space to have effective lighting geometries.

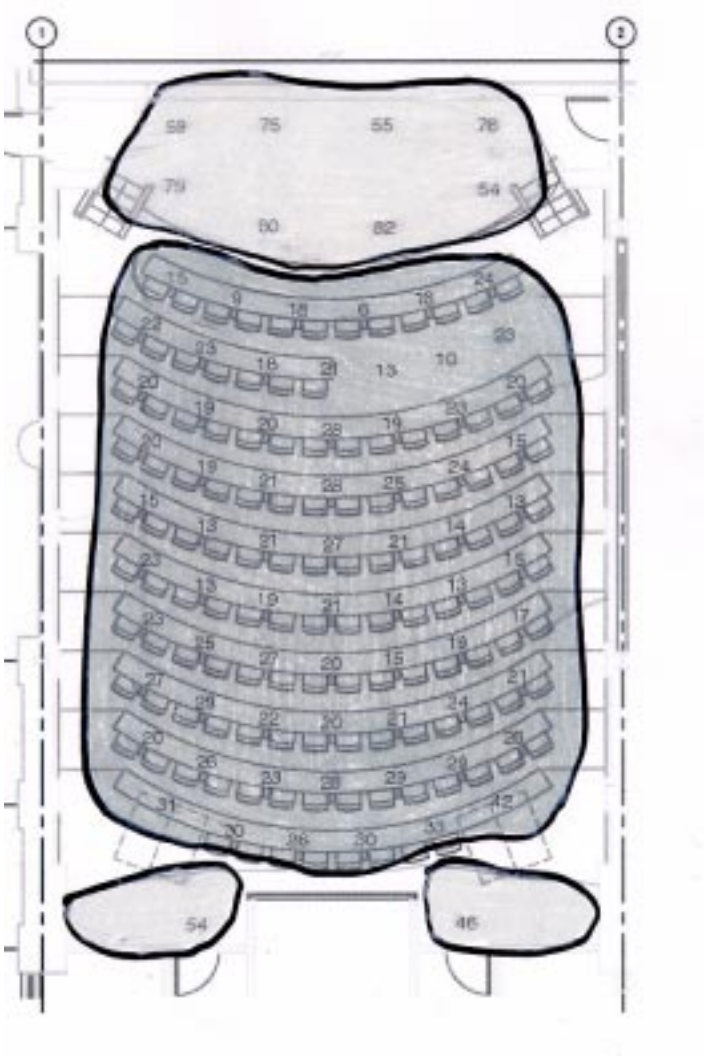


Figure 1.4 Lighting Levels Diagram, Setting One: Full Stage

Setting 2: Slide Projection

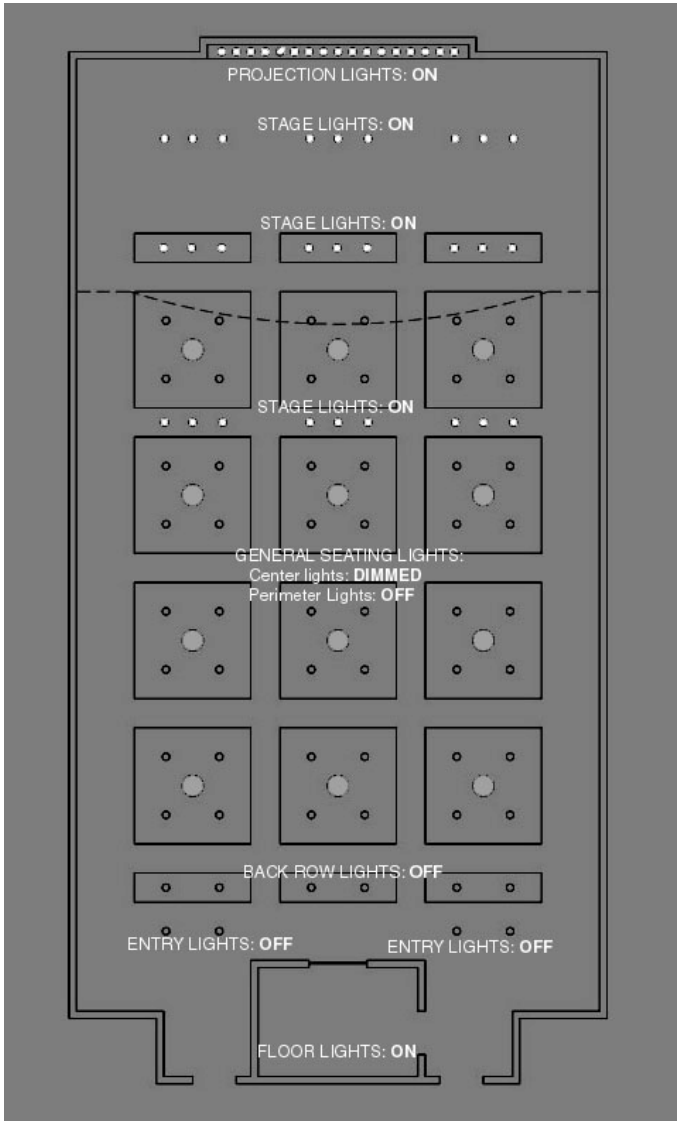


Figure 2.1 Setting Two: Slide Projection, Fixture Status Diagram

This setting is used as indicated, for slide and video projections. Dimmed general lighting allows for the screen to be easily seen. Sixteen fixtures hidden within a bulkhead at the rear projection wall are all lit in this setting. The plan diagram (Figure 2.1) indicates each fixture status within the space.

Setting 2: Slide Projection

Figure 2.2 Setting Two: Slide Projection

Figure 2.3 Visual field map, Setting Two, Slide Projection

Setting 2: Slide Projection

Qualitative criteria

An analysis of the qualitative criteria indicates few minor problems.

Glare: Minimal (at lectern onstage) and not distracting.
Worksurface glare: As the worksurface is not used in this dimmed setting, a study of this is not applicable.
Shadows: The absence of multiple competing light sources mitigated the shadows. Unnoticeable shadow created by sloped bulkhead above stage.
Worksurface shadows: As the worksurface is not used in this dimmed setting, a study of this is not applicable
Backlighting: Backlighting at the rear projection wall provided necessary illuminance for the projected images. Screen emitted additional lighting.
Lighting color: The dimmed "cool white" lamps of the coffered ceiling provide a comfortable color within the seating space. The screen produced a comfortable, whitish light. The stage lighting, combined with the laminate surfaces of the stage walls, produced a slightly uncomfortable yellow light.
Lighting contrast: The spread in contrast between the audience lighting and the stage lighting was severe (the transition of ones view from the stage to the worksurface was uncomfortable, there was to much light on stage as apposed to a lack of light on the audience).
Overall Impression: The space was comfortably lit. Only the transition of the view from the stage to the worksurface needed improvement.

Quantitative criteria

Lighting levels within this setting are indicated in Appendix C.2. A diagram (Figure 2.4) depicts the general light levels within the room. The darker areas indicate the areas of lower light levels within the setting; the lighter areas indicate areas of higher light levels within the setting.

A visual field map (Figure 2.3) was completed at this setting. Its results indicate that the light levels are focused toward the slide projection wall from the overall visual field. Lighting levels increase uniformly from general audience, task surface, areas to stage and slide projection wall. Lower levels of lighting range from 2.1fc (task surface areas) to 6.6fc (wall surface area surrounding projection screen). Higher levels of lighting, stage lamping, indicate levels ranging from 41.4fc to 23.1fc. The visual field map exemplifies the idea of a spot light effect where the innermost portion of the visual field reflects the highest level of illumination.

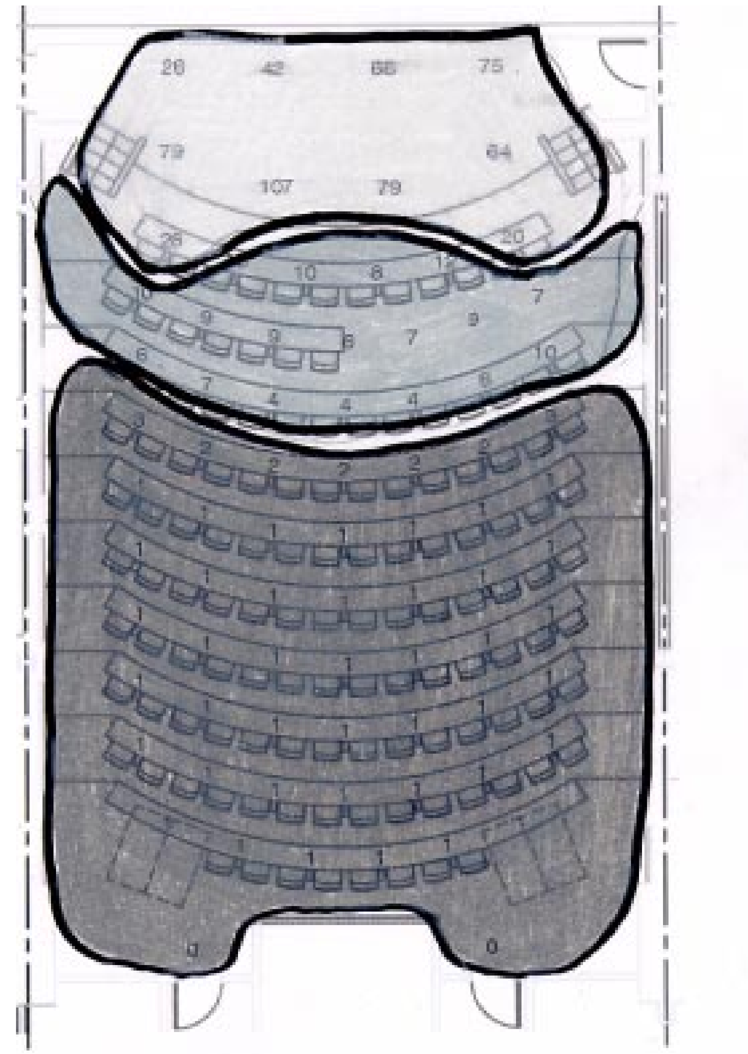


Figure 2.4 Lighting Levels Diagram, Setting Two: Slide Projection

Setting 3: Video Conferencing

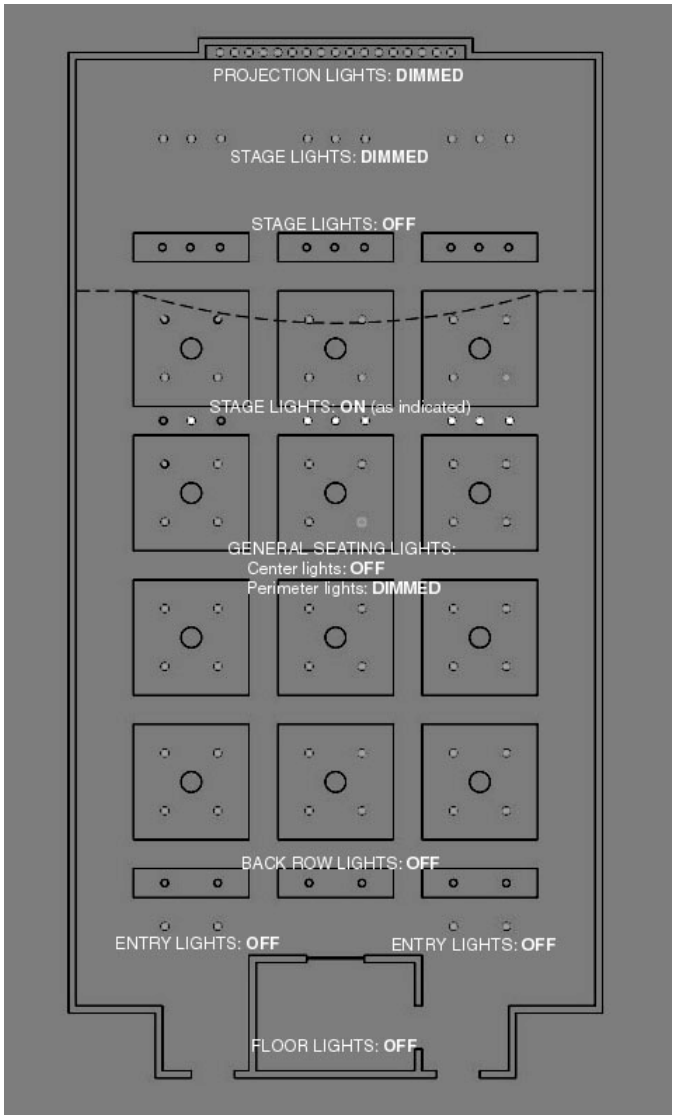


Figure 3.1 Setting Three: Video Conferencing, Fixture Status Diagram

This setting allowed for web-casting and video conferencing to be held within the space. Most of the lights (especially the stage lighting) were dimmed to allow for the video equipment necessary for the usages. General seating lighting was dimmed. The plan diagram (Figure 3.1) indicates each fixture status within the space.

Figure 3.2 Setting Three: Video Conferencing

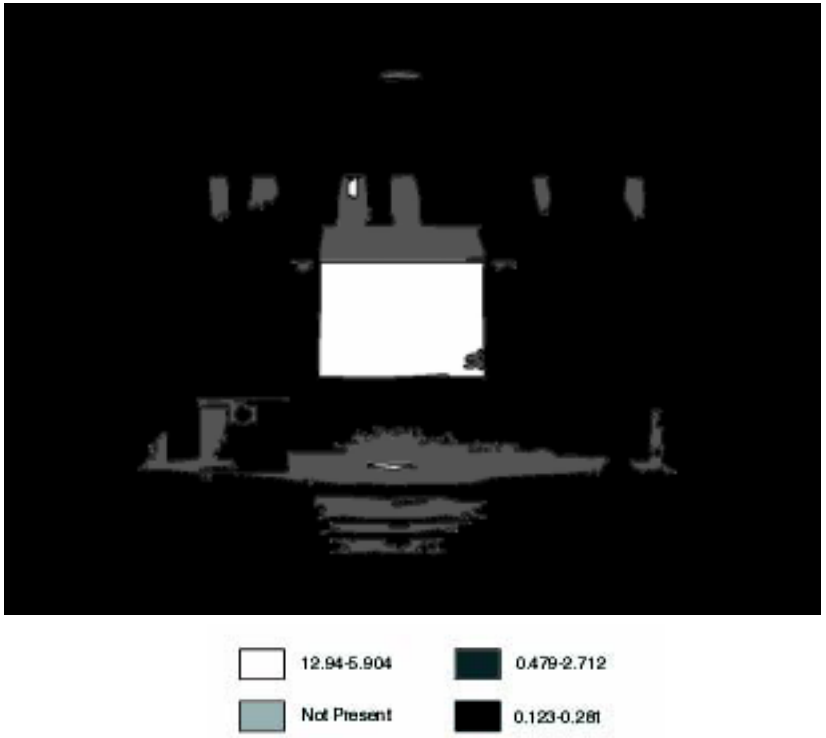


Figure 3.3 Visual field map, Setting Three: Video Conferencing

Setting 3: Video Conferencing

Qualitative criteria

An analysis of the qualitative criteria indicates few minor problems.

Glare: Non-existent. The setting's usage makes this a necessity; the issue was controlled adequately.
Worksurface glare: Glare is non-existent as the ambient seating lighting was dimmed.
Shadows: Minimal shadows (created by the stage bulkhead) were virtually unnoticeable and highlighted features onstage, providing an appropriate image.
Worksurface shadows: Worksurface shadows were minimal due to the multiple overhead fixtures. The strongest shadows were created from stage lights flowing into audience area. These were not distracting.
Backlighting: Backlighting served to provide more uniform lighting within the space necessary for the video equipment used in this setting.
Lighting color: The stage lighting, combined with the finishes of the stage walls produces an orange, distracting and uncomfortable coloration for the features onstage.
Lighting contrast: The audience area was dimly lit. The stage was lightly lit. This transition was comfortable.
Overall Impression: The audience area needed more light for necessary worksurface usage. The color of the stage lighting was very distracting and uncomfortable. The transition of view from stage to worksurface was comfortable.

Quantitative criteria

Lighting levels within this setting are indicated in Appendix C.3. A diagram (Figure 3.4) depicts the general light levels within the room. The darker areas indicate the areas of lower light levels within the setting; the lighter areas indicate areas of higher light levels within the setting.

A visual field map (Figure 3.3) was completed at this setting. Its results indicate that the light levels are minimal throughout the visual field. The primary focus is on the slide projection screen used for video conferencing and indicates a high level of contrast between screen illumination and the rest of the visual field. Lower levels of lighting range from 0fc to 5.9fc. Higher levels of lighting indicate a reading of 12.9fc, but improper re-lamping may have occurred in the specific region of the visual field. This observation was made as a result of non-uniformity light levels within the reflected ceiling mounted stage lights.

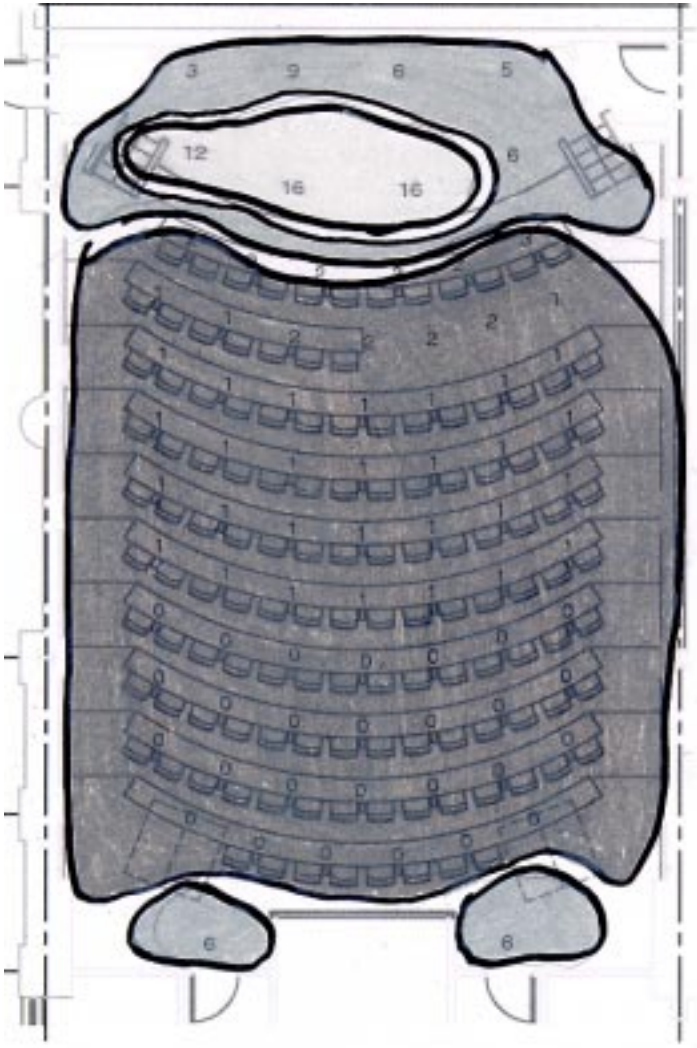


Figure 3.4 Lighting Levels Diagram, Setting Three: Video Conferencing

Setting 4: House Lights

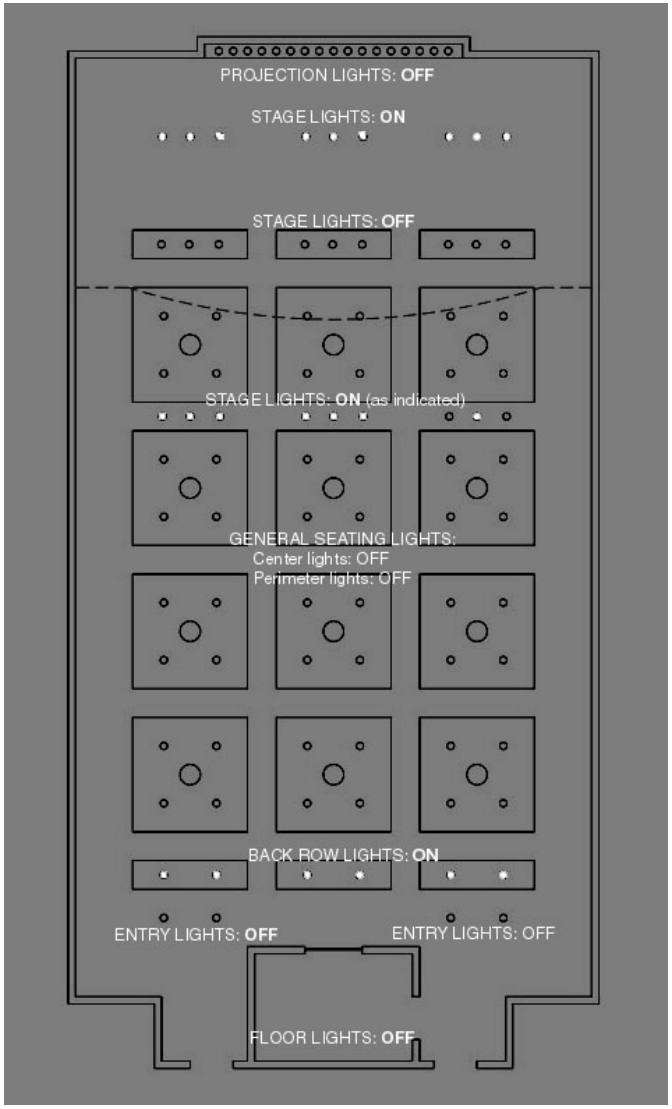


Figure 4.1 Setting Four: House Lights, Fixture Status Diagram

This setting seemed to be incorrectly indicated as the term "house lights" usually refers to a fully-lit atmosphere. Instead, in this setting there was no lighting in the seating area, and the stage was essentially completely lit. The plan diagram (Figure 4.1) indicates each fixture status within the space.

Figure 4.2 Setting Four: House Lights

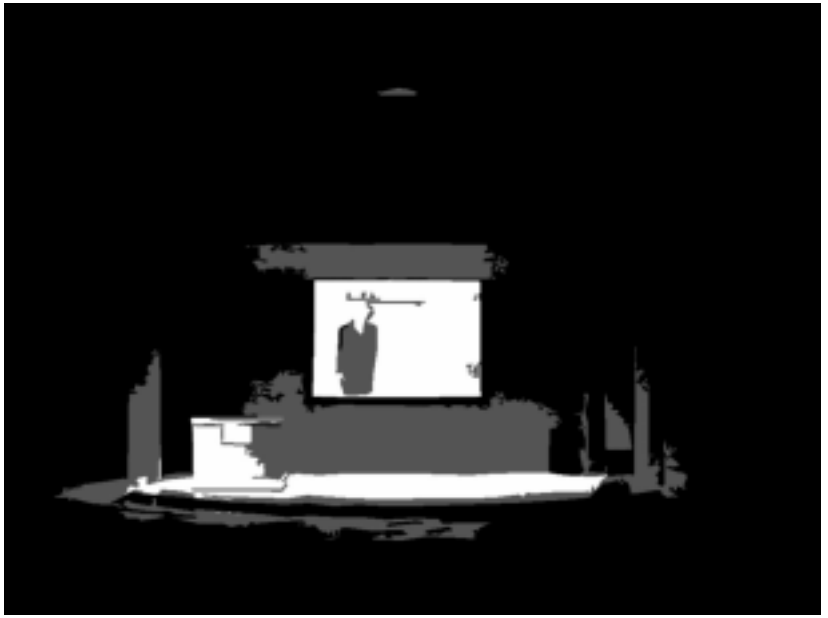


Figure 4.3 Visual field map, Setting Four: House Lights

Setting 4: House Lights

Qualitative criteria

An analysis of the qualitative criteria indicates few minor problems.

Glare: Non-existent to minimal.
Worksurface glare: Glare was non-existent. Lighting was inappropriate for worksurface usage.
Shadows: Shadows are present only in areas to the right and left of center stage. This is not distracting and helps to highlight center stage, which is the desired focus for this setting.
Worksurface shadows: Shadows are minimal. The general seating lights are not used, but the stage lights produced shadows that were not distracting.
Backlighting: Backlighting was appropriate and comfortable. Dimmed backlighting combined with heavy lighting of the lectern allowed the lectern to visually stand out.
Lighting color: The stage lighting, combined with the laminate surfaces of the stage walls, produced a yellow-orange light. This coloration was not distracting or uncomfortable.
Lighting contrast: The stage and lectern are strongly lit, and the audience area was weakly lit. It produced slight discomfort.
Overall Impression: The stage seemed too bright in comparison to the audience, although the stage lighting provided the only light available for notetaking.

Quantitative criteria

Lighting levels within this setting are indicated in Appendix C.4. A diagram (Figure 4.4) depicts the general light levels within the room. The darker areas indicate the areas of lower light levels within the setting; the lighter areas indicate areas of higher light levels within the setting.

A visual field map (Figure 4.3) was completed at this setting. Its results indicate that lighting levels were minimal to general audience areas and have a focus of maximum output levels for stage and lectern applications. Lighting levels, on stage surfaces, indicate a range of 2.9fc to 18.3fc (finished floor of stage level. The maximum lighting level has a reading of 27.0fc and was taken at the top region of the lectern. Lighting levels reflected toward general audience seating are focused to front-right and has a reading of 5.9. Therefore, general audience seating has no means of uniform lighting output.

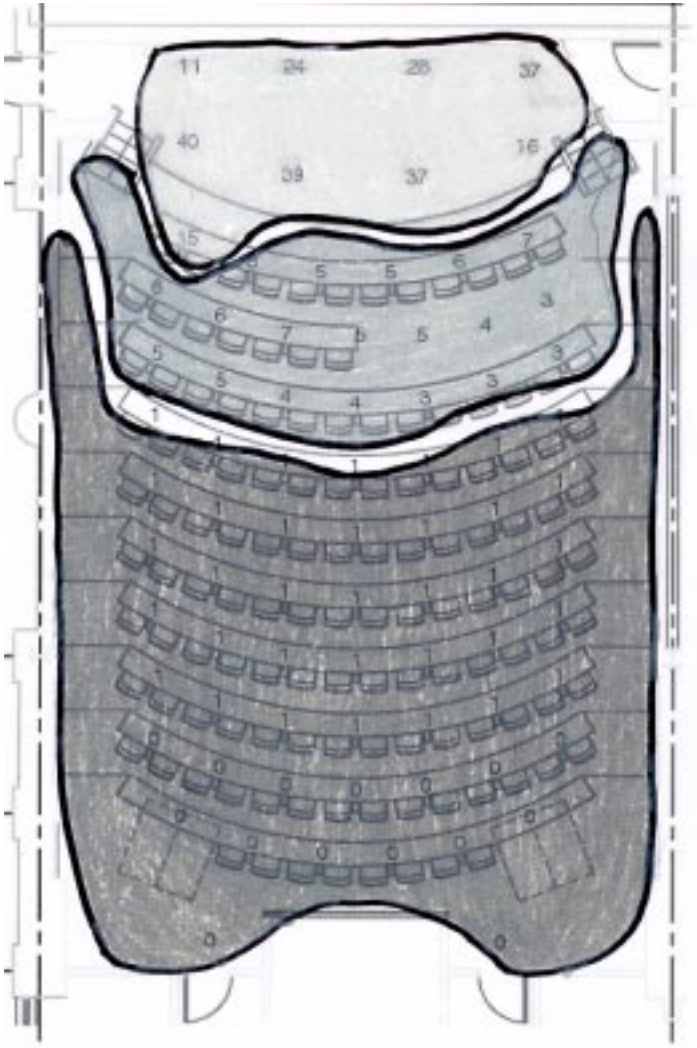


Figure 4.4 Lighting Levels Diagram, Setting Four: House Lights

Setting 5: Stage Left - Lecture

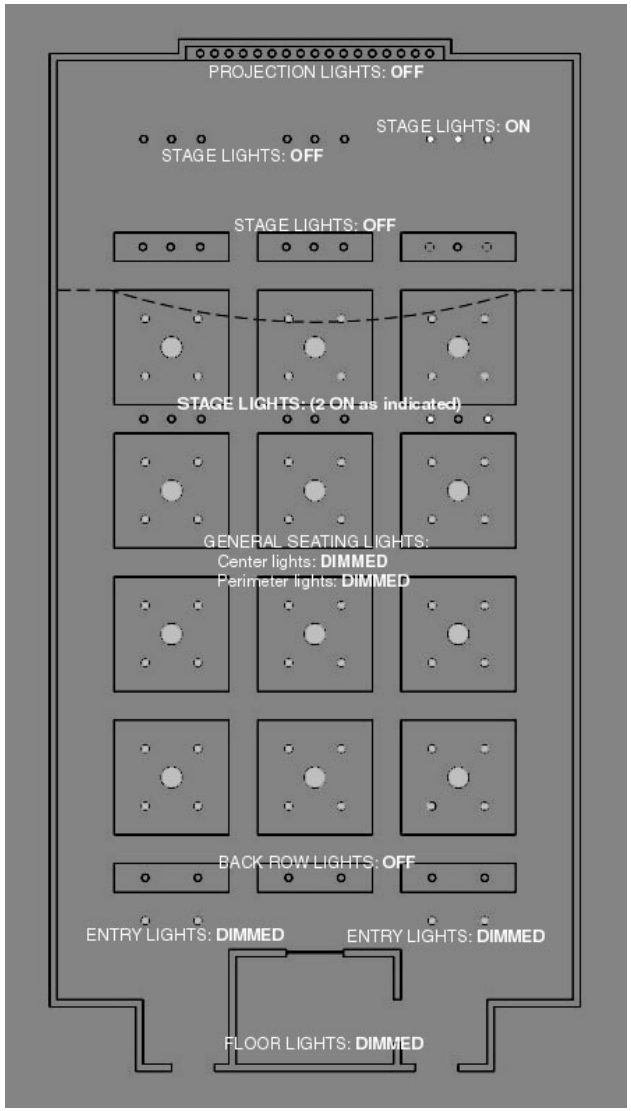


Figure 5.1 Setting Five: Stage Left - Lecture, Fixture Status Diagram

This setting was a specialized setting establishing a necessary placement of the lectern. Its atmosphere was appropriate for lectures as it highlighted activities onstage and allowed for note taking in the seating area. The plan diagram (Figure 5.1) indicates each fixture status within the space.

Setting 5: Stage Left - Lecture

Figure 5.2 Stage Five: Stage Left - Lecture

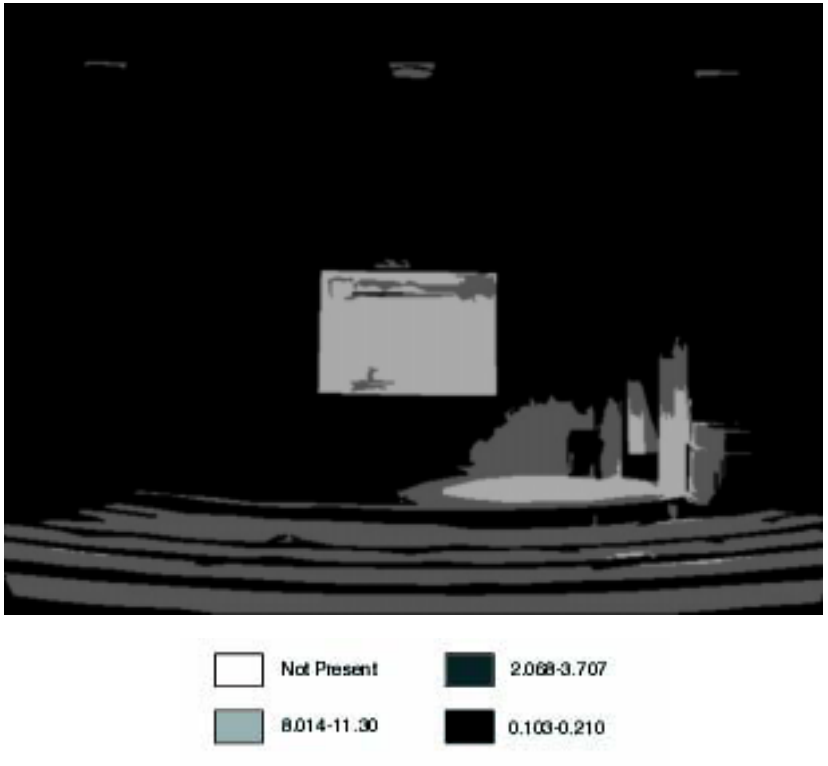


Figure 5.3 Visual field map, Setting Five: Stage Left - Lecture

Setting 5: Stage Left - Lecture

Qualitative criteria

An analysis of the qualitative criteria indicates few minor problems.

Glare: Non-existent. Space was uniformly lit throughout eliminating the existence of glare.
Worksurface glare: Glare was minimal. Worksurfaces were lit uniformly and appropriately lit for note taking. Only glare present was due to material quality of worksurface, but was not distracting.
Shadows: Shadows were minimal. Lighting of stage bulkhead produced shadow on rear wall of stage.
Worksurface shadows: Shadows are heavy due to multiple overhead fixtures. These geometries created multiple shadows from seated persons that are very distracting.
Backlighting: Backlighting was successful. The lecturn was appropriately backlit on stage that seemed to highlight the area of focus.
Lighting color: Lighting color was very appropriate. It was comfortable at the worksurface, not yellow or orange due to minimal overhead stage lights.
Lighting contrast: Stage seemed unbalanced. At the lecturn it was very well lit but contrasted deeply with the virtually unlit opposite side of the stage.
Overall Impression: The overall space was excellent except for the contrast from stage right to stage left. Stage right and stage left could be balanced a bit more to lessen the visual contrast. However, the transition from the audience to the stage was very successful and did not seem to cause contrast.

Setting 5: Stage Left - Lecture

Lighting levels within this setting are indicated in Appendix C.5. A diagram (Figure 5.4) depicts the general light levels within the room. The darker areas indicate the areas of lower light levels within the setting; the lighter areas indicate areas of higher light levels within the setting.

A visual field map (Figure 5.3) was completed at this setting. Its results indicate that lighting levels are minimal throughout the visual field. Lighting is uniform and illuminates all task surfaces within the general seating areas with readings between 2.3fc and 2.9fc. The lighting levels are at its maximum potential on stage left of the visual field with readings ranging from 3.2fc (wall surface) to 11.3fc (stage finished floor surface). Lighting levels from reflected ceiling surface are minimal to none with a maximum reading of 2.5fc.

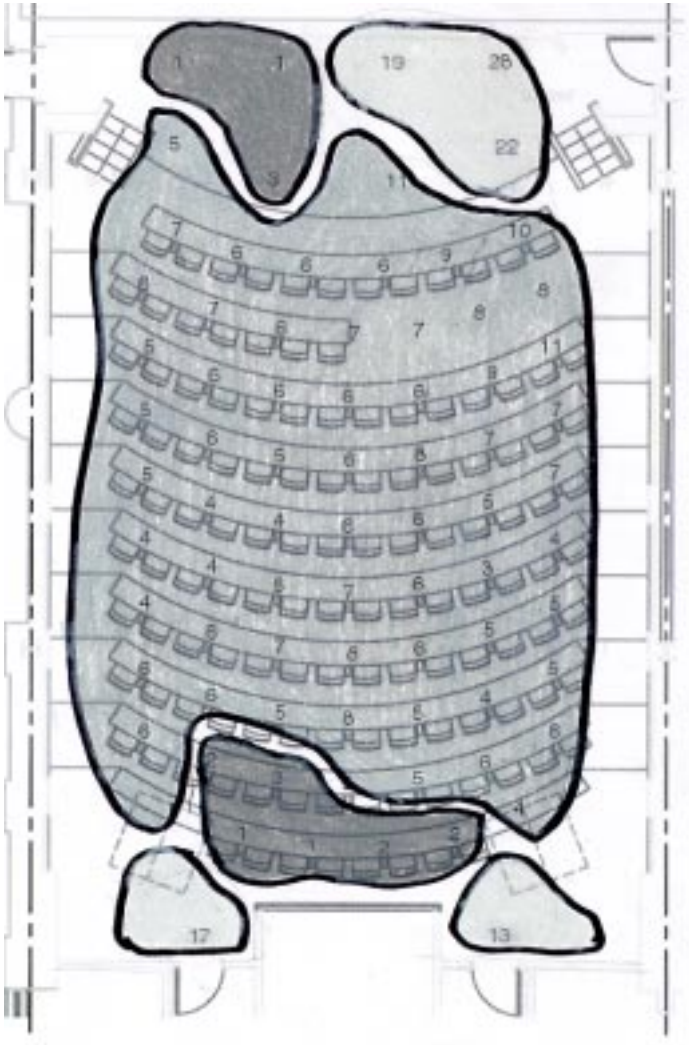


Figure 5.4 Lighting Levels Diagram, Setting Five: Stage Left - Lecture

Setting 6: Stage Right - Lecture

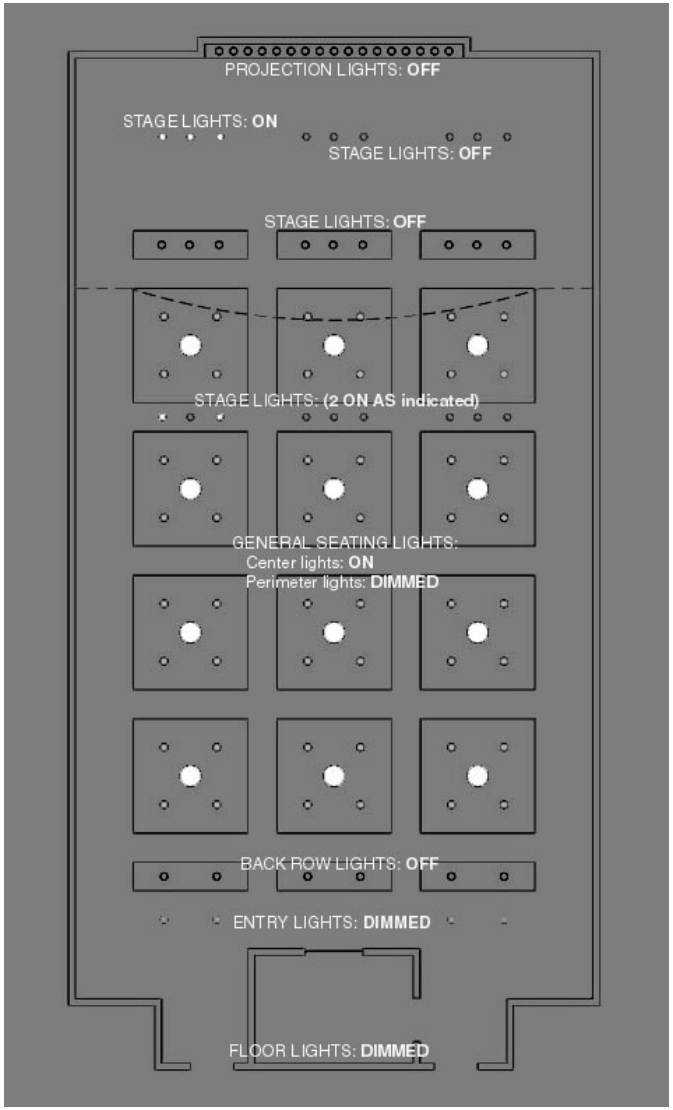


Figure 6.1 Setting Six: Stage Right - Lecture, Fixture Status Diagram

This setting was a specialized setting establishing a necessary placement of the lectern. Its atmosphere was appropriate for lectures as it highlighted activities onstage and allowed for note taking in the seating area. The plan diagram (Figure 6.1) indicates each fixture status within the space.

Setting 6: Stage Right - Lecture

Figure 6.2 Setting Six: Stage Right - Lecture

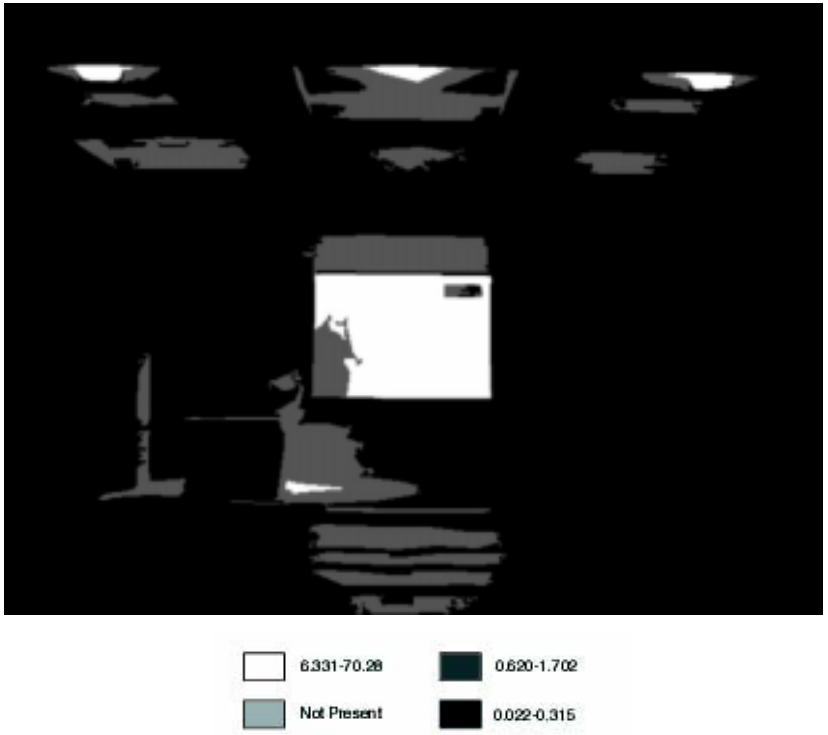


Figure 6.3 Visual field map, Setting Six: Stage Right - Lecture

Setting 6: Stage Right - Lecture

Qualitative criteria

An analysis of the qualitative criteria indicates few minor problems.

Glare: The space contained highly lit center lights that produced some overall glare, however, it wasn't within the visual image.
Worksurface glare: Worksurface glare was non-existent.
Shadows: Shadows were present within the ceiling grids, however they were not distracting. They actually added to the spatial feel giving some accent to its depth.
Worksurface shadows: Contained multiple shadows from the many overhead lights. This was not distracting however.
Backlighting: Backlighting was present on rear of stage and was adequate; however, lectern was not accentuated as much as it could have been.
Lighting color: The lighting color was a yellowish gray in the audience area. This was comfortable for detailed note taking. The stage was a yellowish yet was comfortable.
Lighting contrast: The stage from right to left dimmed yet was well-lit and comfortable on eyesight. It provided a focal point at the stage and blended into the audience very well enhancing visual comfort in the audience.
Overall Impressions: The setting was very comfortable. Stage right to left was much more comfortable than previous settings. However, the lectern should be brightened up a bit but the audience lighting was appropriate.

Quantitative criteria

Lighting levels within this setting are indicated in Appendix C.6. A diagram (Figure 6.4) depicts the general light levels within the room. The darker areas indicate the areas of lower light levels within the setting; the lighter areas indicate areas of higher light levels within the setting.

A visual field map (Figure 6.3) was completed at this setting. Its results indicate that lighting levels are minimal throughout the space. Lighting is uniform on general audience, task surface, areas with a focus to the center of all rows instead of a uniform spread throughout. Readings indicate levels between .7fc and .8fc. The lighting levels are at its maximum potential on stage right of the visual field with readings ranging from 1.7fc (wall surface) to 6.3fc (stage finished floor surface). The majority of the lighting for stage right is focused behind the lectern providing lower levels of contrast throughout the space. Lighting levels from reflected ceiling surface are minimal but increased compared to stage left setting and have readings ranging from .6fc (dimming stage lights) and 60.0fc (center general audience lights).

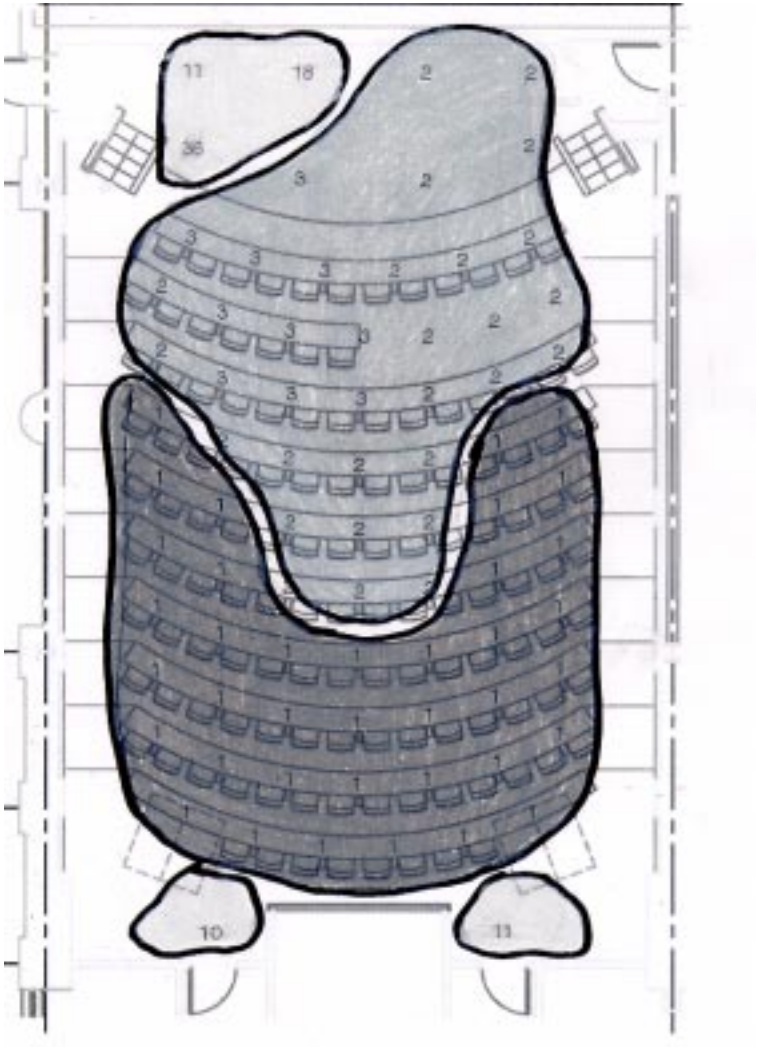


Figure 6.4 Lighting Levels Diagram, Setting Six: Stage Right - Lecture

Setting 7: Stage Center - Lecture

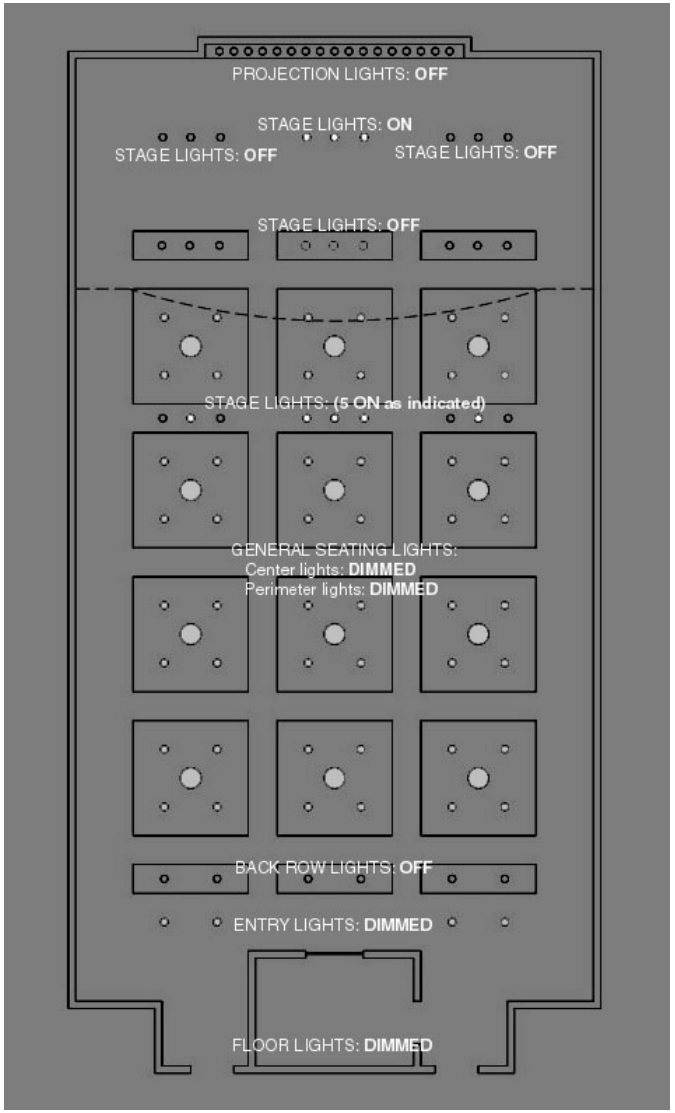


Figure 7.1 Setting Seven: Stage Center - Lecture, Fixture Status Diagram

This setting was a specialized setting establishing a necessary placement of the lectern. Its atmosphere was appropriate for lectures as it highlighted activities onstage and allowed for note taking in the seating area. The plan diagram (Figure 7.1) indicates each fixture status within the space.

Setting 7: Stage Center - Lecture

Figure 7.2 Setting Seven: Stage Center - Lecture

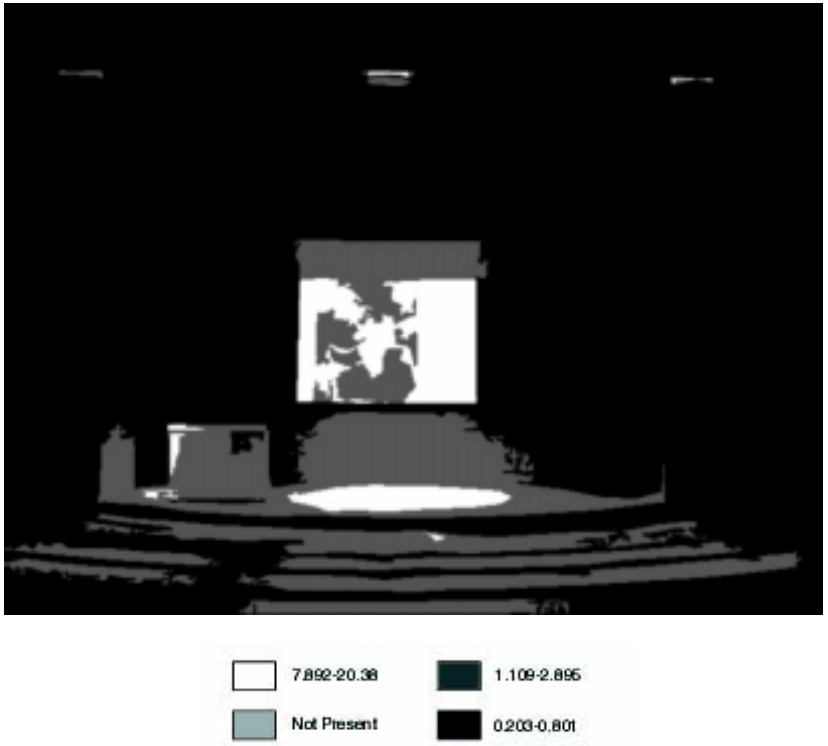


Figure 7.3 Visual field map, Setting Seven: Stage Center - Lecture

Setting 7: Stage Center - Lecture

Qualitative criteria

An analysis of the qualitative criteria indicates few minor problems.

Glare: Minimal (at stage).
Worksurface glare: Worksurface glare was minimal and not discomforting.
Shadows: The stage bulkhead created shadows, yet were minimal and not discomforting.
Worksurface shadows: Worksurface shadows were again multiple due to the many overhead lights. This created a slight discomfort in note taking.
Backlighting: Stage was appropriately backlit, which highlighted the stage center.
Lighting color: The stage lighting was direct and not bouncing off the laminate of the wing walls, and therefore was white while the audience lighting was yellowish. This contrast made it slightly uncomfortable since you eye picked up on the visual change.
Lighting contrast: Overall it was centrally lit, dimly lit on the right and left and blended into the audience slowly. This allowed the contrast to be very minimal and was very comfortable for the visual field.
Overall Impression: The setting was very comfortable. The low contrast of overall stage lighting and audience lighting was very appropriate and was very comforting on the eyes. The setting allowed for individuals to adjust quickly and easily from the worksurface to the stage setting.

Quantitative criteria

Lighting levels within this setting are indicated in Appendix C.7. A diagram (Figure 7.4) depicts the general light levels within the room. The darker areas indicate the areas of lower light levels within the setting; the lighter areas indicate areas of higher light levels within the setting.

A visual field map (Figure 7.3) was completed at this setting. Its results indicate that the lighting levels are minimal and have a uniform spread to general audience, task surface, areas of the visual field. Readings indicate levels ranging from 1.6fc to 2.8fc. Lighting levels are at its maximum potential at stage center and have readings ranging from 2.5fc (wall surface) to 20.3fc (stage finished floor surface). Lighting levels from reflected ceiling surface are minimal with readings ranging from 0.2fc to 1.4fc. Lectern surface indicates a maximum reading of 7.8fc indicating a lamp used for task lighting applications.

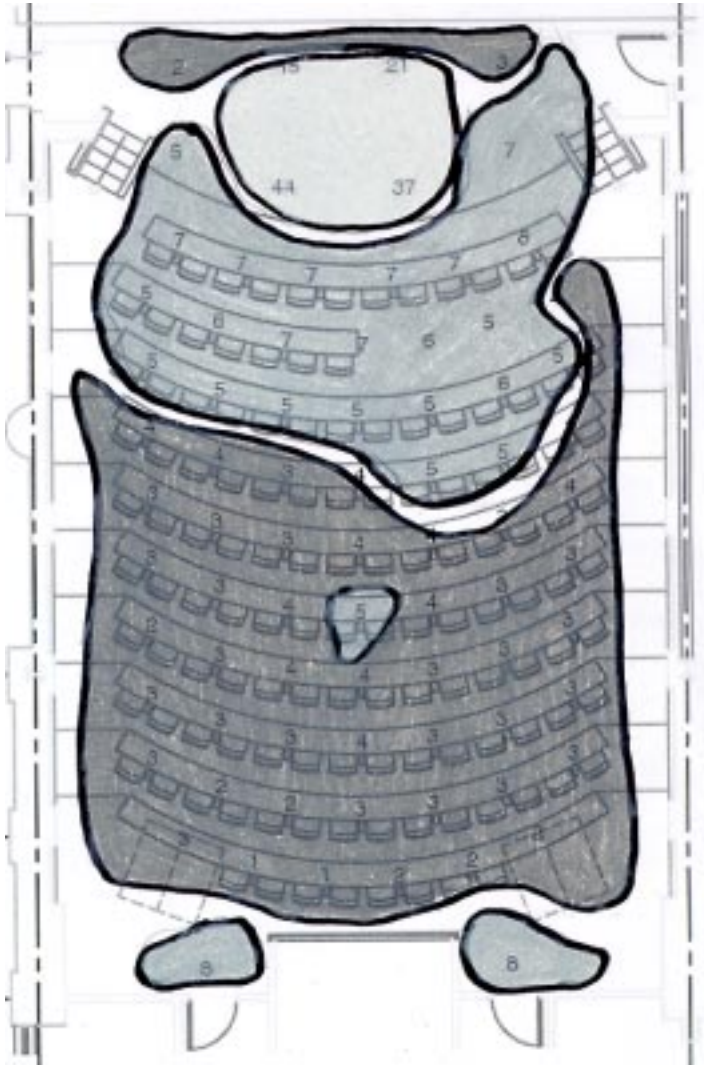


Figure 7.4 Lighting Levels Diagram, Setting Seven: Stage Center - Lecture

The findings of our study prove our hypothesis. The Walter Byers Auditorium is appropriately lit for seven different uses. The problems discovered are minimal and do not distract from any of the functions of the space. The system provides appropriate lighting conditions for lectures, video-conferencing, slide projections, and many other typical uses. The system allows for manipulation as the space changes, or if more functions are added to the space.

However, the lighting system could be enhanced. Some suggestions to provide better lighting conditions for the space include:

-A new labeling for the preset lighting system's settings.

While the lighting system provided necessary settings to accommodate for a variety of uses, these setting did not necessarily correspond to the apparent titles.

-A proactive approach to relamping.

Problems with burnt-out lamps were the most apparent problem and disturbed the lighting quality of the space. Some luminaries had not been replaced; others had been replaced with lamps that did not correspond to the other lamps, and did not correspond with the lighting design specifications.

-The finishes of the stage, in particular, could be changed to lessen glare and to create a more comfortable coloration of light.

The laminate wall finishes produced a discomforting yellow-orange light in some settings. It also produced some amount of glare; a new matte finish could be selected to address issues of glare and coloration.

-The finish of the worksurfaces in the audience could be a matte finish.

The issues of worksurface glare were minimal yet the laminate at the worksurface produces much more glare than desired. The laminate should have more of a matte finish to reduce the amount of reflective glare on its surface.

-The presence of glare on the stage could be reduced to provide a more comfortable visual field.

The presence of glare from stage right to stage left on many of the settings was visually uncomfortable. The progression of vision from bright spots to dark spots is very drastic and could be handled in a more gradual progression.

Acknowledgements

The guidance of Professor Robert Koester was invaluable. Jeff Culp's provided assistance with computer techniques. Professor Robert Fisher guided us with technical writing techniques.

At the NCAA Headquarters, David Clendenin acted as a liaison between our team and the organization. Other assistance was provided onsite by Michael Hays and Jose Roscillo of REI Real Estate Management.

The people at REI Real Estate Management, and the people at the NCAA all provided the necessary assistance needed. All were enjoyable to work with.

A special thank you to Mr. Wayne Leonard, CEO of Entergy Corporation for his company's endowment of the Ball State University Vital Signs Program which has helped finance the student scholarship documented in this report.

Nick Rajkovich, a graduate student at the University of Oregon, familiar to the Vital Signs project, provided guidance for our study. His graduate work includes these types of studies.

Ron Fisher, a managing partner at Schmidt Associates (the architecture firm of record) provided us with firsthand knowledge of the design process of the building.

Appendix A - Light Fixture Inventory

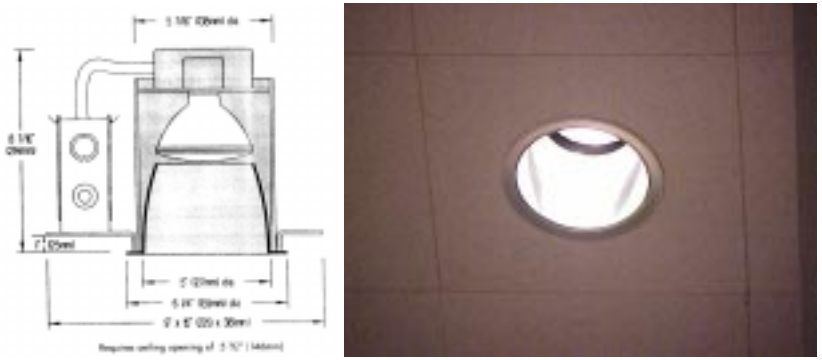


Figure A.1a Fixture FA

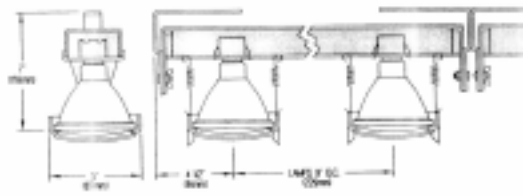


Figure A.1b Fixture FD

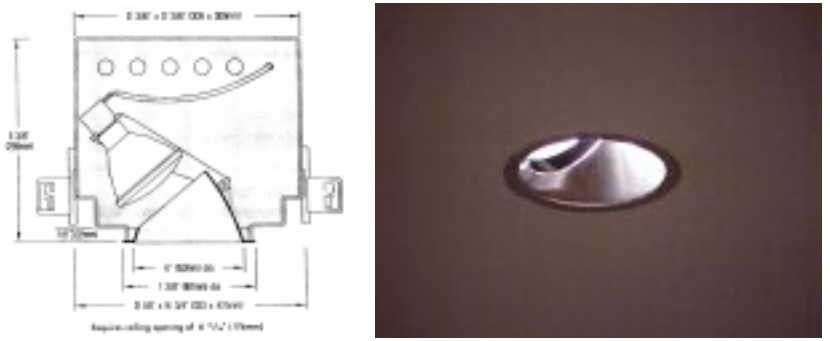


Figure A.1c Fixture FC-1

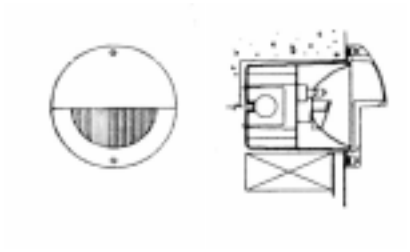


Figure A.1d Fixture FK

Figure A.1e Fixture FE

Appendix A - Light Fixture Inventory

Below is a list of specifications for the lighting fixtures used in the Walter Byers Auditorium.

The FA fixtures (see Figure A.1a) are used for an assortment of applications within the space and are the most common in the lighting control program. The FA fixtures are mounted in ceiling for stage light applications and use incandescent spot lamps. There are a set of three fixtures in each grouping and three groups, each recessed in a coffer. Within the seating area, the FA lamps are mounted as a grouping of 4 units within each bay having a centralized FE fixture (see description below) as the primary lamp of focus. These FA fixtures are equipped with 100-watt incandescent spot lamps and have an illuminance level adjustment controlled by the preset functions. The FA lamps are mounted in the ceiling of the control room and vestibules.

The FD units (see Figure A.1b) were used for the illumination of the projection screen and its wall surface at the rear of the stage and help reduce distracting reflections that may occur on the surface. Three fixtures (of six, four and six lamps) were used in a single row.

FC units (see Figure A.1c) are installed between the first and second row of coffers from stage front to accent stage lighting during all control settings. These fixtures are installed in sets of three and grouped into three separate areas resulting in one row of 9 fixtures. The two outside fixtures are equipped with 90-watt incandescent flood lamps and the other 7 fixtures are equipped with 250-watt incandescent spot lamps. FC-1 units are similar to the FC units but are mounted at a 45-degree angle (within a sloped bulkhead) to illuminate the stage. The lamps in the fixture are parallel to the floor, although the fixture itself is sloped. This allows for direct illumination to the finished floor and worksurfaces on stage.

The FK units (see Figure A.1d) were used along the two side aisles leading down to side stage. The units are mounted 2'-0" above the finished floor to illuminate and accent the walkways on both sides of the seating area and remain at a constant level of illumination during all cycles of the control settings. These fixtures were not studied as they were always on but never in the visual field.

The FE lamps (see Figure A.1e) are the centralized lamps of each coffer in the seating area of the auditorium. There are a total of twelve fixtures which house an incandescent cool light lamp that provides a diversity of illumination levels based on the preset controls. Insufficient records were kept by the facility's management to detail these any further.

For additional information on described fixtures, see reflected ceiling plan for placement and labeling of lamp types.

Appendix B - Visual Field Map Production Procedure

Vital Signs

11 October 2001

Rough Outline of Image manipulation procedure

Photograph desired scene(s).

In Photoshop 5.0:

1. File -> Open "file.jpg"
2. File -> Save as "bas.psd"
3. Image -> Mode -> Indexed Color
   Palette – adaptive, colors-8?, dithering- none
4. Image -> Mode -> Greyscale
5. Filter -> Artistic -> Cutout (optional? – must have 8 or less colors)
   Levels- same as number of colors above, edge simplicity-5, edge fidelity-3
6. Image -> Adjust -> Levels (optional – can adjust to use full black-white ranges)
7. File -> Save as "tones.psd"
8. Filter -> Stylize -> Find edges
9. File -> Save as "edges.psd"

Print both tones and edges and go take luminance measurements.
Record measurements on edges printout.

Back in Photoshop 5.0

10. File -> Open "tones.psd" and "edges.psd"

In "edges.psd"

11. Select -> Color Range…
    Select – highlights, image, invert
12. Edit -> Copy

In "tones.psd"

13. Edit -> Paste
14. Close "edges.psd"
15. Add text layers (may need to render then merge text layers as you go)
16. Confirm text visibility
17. File -> Save as "final.psd" (can go back to this one for editing)
18. Delete layers as needed to achieve desired appearance.
19. Layers -> Flatten Image
20. Save as "final.jpg" .tif?, .gif? (this one is for inclusion in publication)

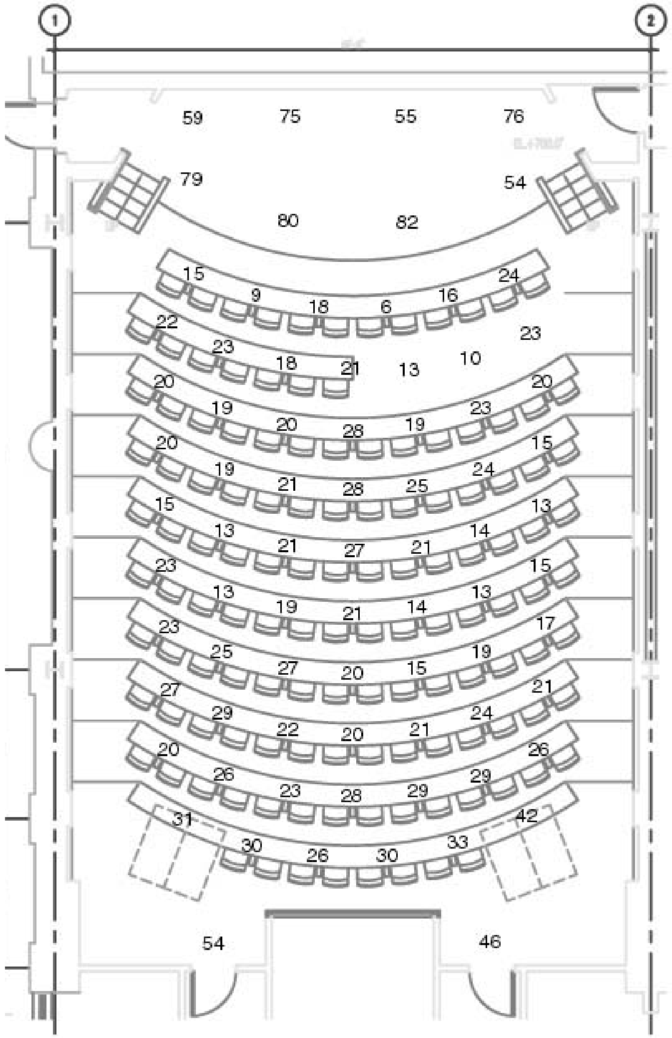


*Figure C.*1 Setting One:Full Stage

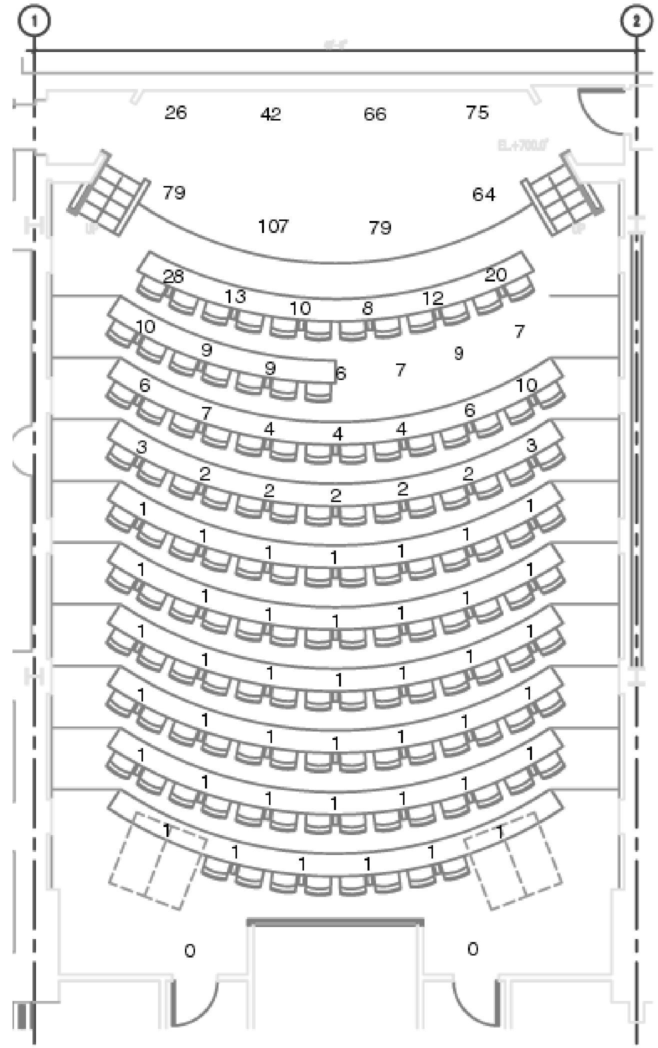


Figure C.2 Setting Two:Slide Projection

Appendix C - Data Collections (Footcandles)

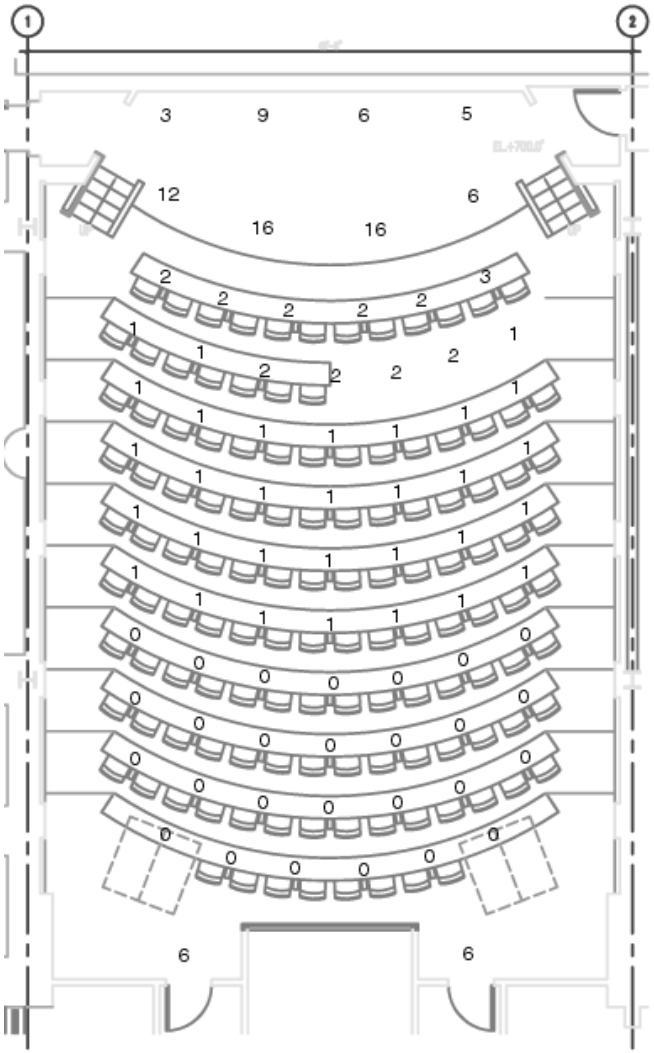


Figure C.3 Setting Three: Video Conferencing

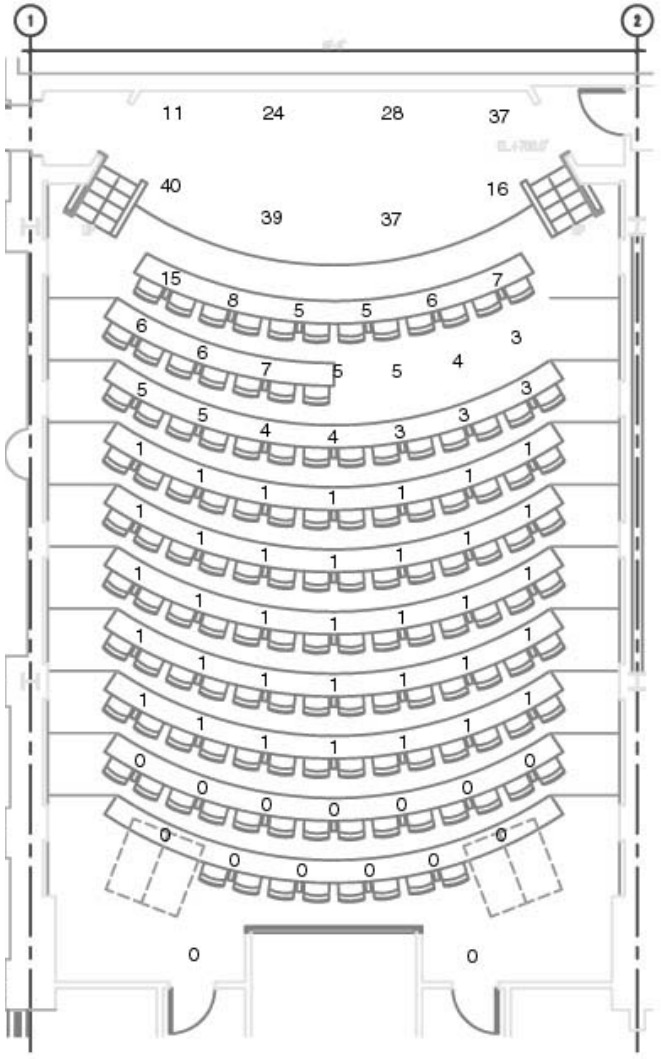


Figure C.4 Setting Four: House Lights

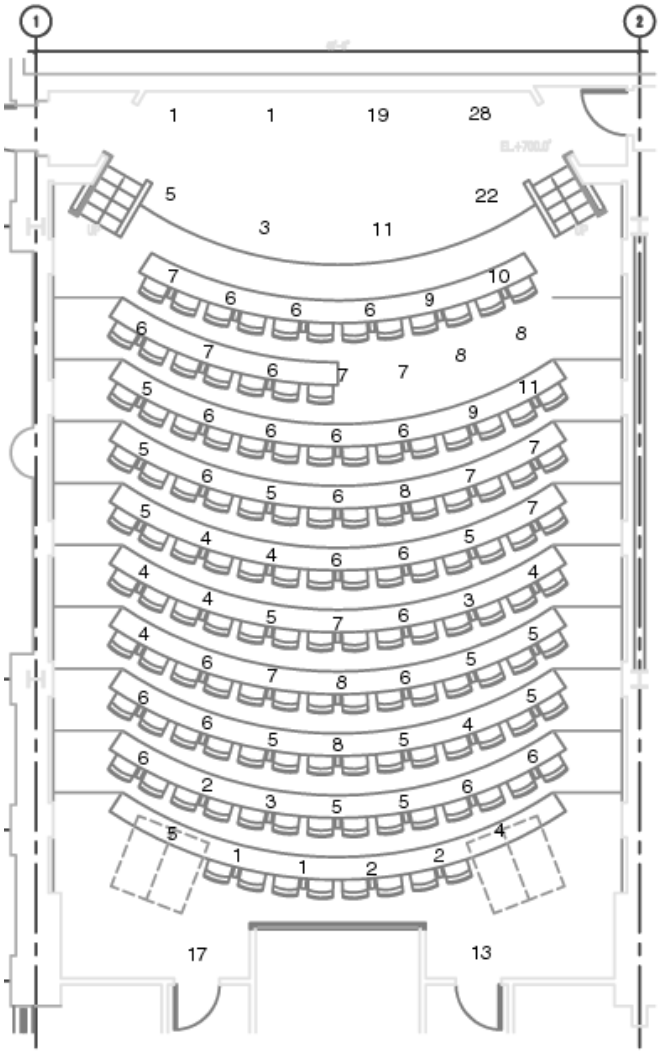


*Figure C.*5 Setting Five:Stage Left - Lecture

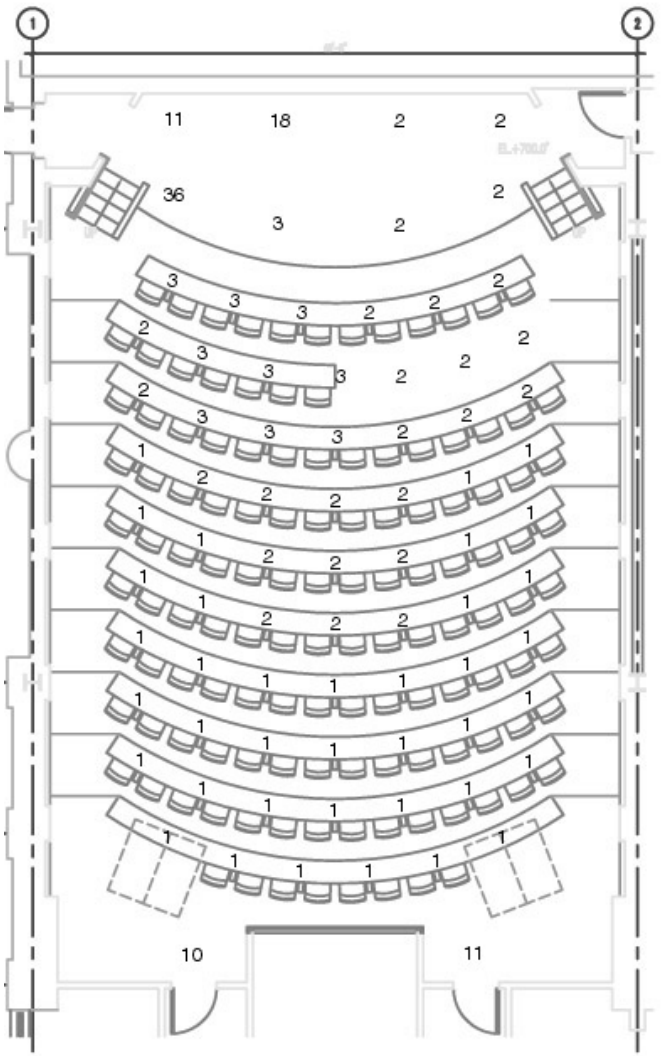


Figure C.6 Setting Six:Stage Right - Lecture

Appendix C - Data Collections (Footcandles)

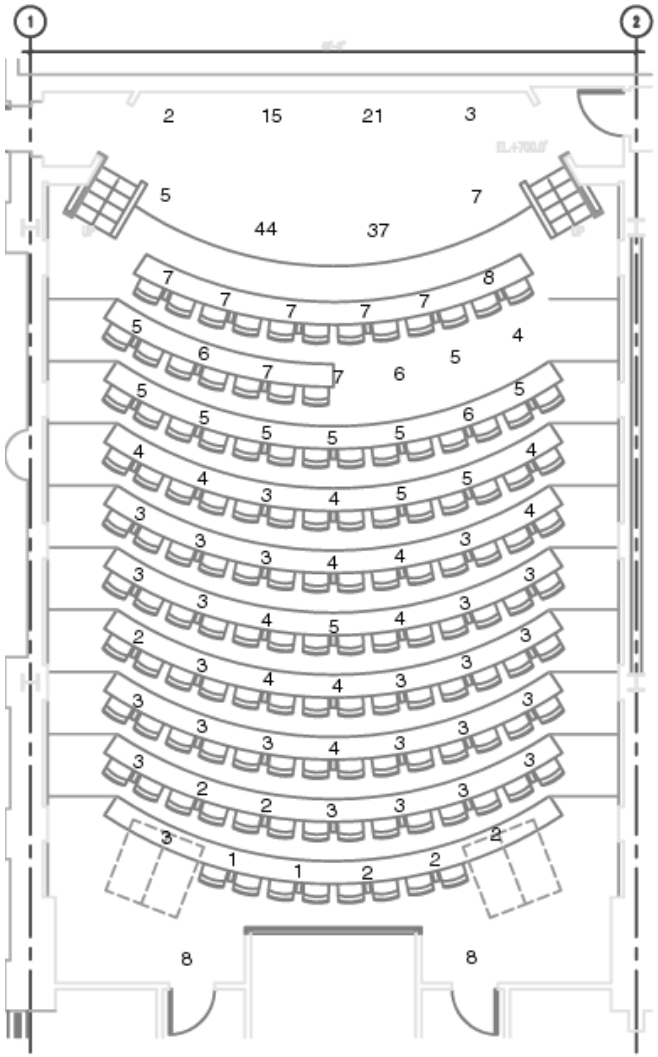


Figure C.7 Setting Seven: Stage Center - Lecture