TECHNICAL REPORT ONE

LEAH MATERN
LIGHTING/ELECTRICAL
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*AGI32 files can be found at P:\ltm5014\ThesisTech1AGI

Executive Summary

This report contains a detailed analysis of the lighting design in Crystal Lake Elementary School. This school is an education facility for students between grades K-5 and provides 720 student stations. The lighting design in the space needs to create a public and spacious environment where students feel comfortable in their learning environment. This report includes a detailed analysis of four different spaces within the school.

The spaces that are evaluated are the primary classroom, the multipurpose room, the lobby, and the covered entrance. For each of these spaces, the evaluation includes an architectural description of the special layout, a description of the current lighting design and existing equipment, the required design criteria as recommended by IESNA and ASHRAE Standard 90.1, and an evaluation and critique of the current lighting design. Throughout the school, the current lighting design in aimed to provide uniformity on the task plane and tends to neglect the need for a visually pleasing space.

For the primary classroom and the multipurpose room a computer based calculation is done using AGI32. This was used to determine if the existing lighting design meets the recommendations of IESNA and is successful in employing the desired psychological impression. Renderings are provided to show the levels of illuminance and the various surfaces in the rooms evaluated.

In general, IESNA illuminance recommendations were met; the existing conditions significantly exceed the recommendations of IESNA. Therefore, it is possible to significantly reduce the number of luminaires used and/or reduce the power in each space evaluated and still meet both IESNA and ASHRAE Standard 90.1.

General Lighting Critique

The lighting design for Crystal Lake Elementary School is centered on the need to be energy conscious and cost effective. Throughout the school the lighting design is mainly function, with a minimal focus on the aesthetics of the space. There is little to no integration with daylighting, which could help lower the cost even more.

In the classroom spaces, the luminaires could be changed. The current simplistic layout with one luminaire is inexpensive and efficient; however, there is too much light. Different luminaires could be used, with daylight integration for spaces on the perimeter of the building to reduce both energy cost and cost of luminaires.

The exterior lighting is currently minimal. The entrance should be inviting and highlight the architecture of the building, which the current design lacks. The lighting design should be revamped with more decorative fixtures and an inviting design.

Many of the luminaires are the same throughout the spaces. This does connect the spaces and provide easy transitions from space to space. However, non-expensive decorative fixture should be utilized in spaces where visual interest is important; such as, the multipurpose room, the lobby, the media/reading room.

The current lighting controls are based off switching. This is very cost effective and simplistic. To reduce in energy cost occupancy sensors should be used in spaces that are not always occupied, such as restrooms. Photosensors should be integrated into the design so that daylighting can be used to reduce the energy cost of the building.

Overall, the current lighting design is efficient and cost effective. Little consideration for aesthetics is present. Therefore, improvements can be made in finding an intriguing lighting design that is both cost effective and efficient.

A. Existing Conditions

1. **Description**

   Students and faculty can find themselves wondering through the various corridors on the first and second floor that direct them to many different classroom spaces. This primary classroom is a typical classroom space in Crystal Lake Elementary School that can accommodate 25 students. This particular classroom is located on the north side of the building on the first floor.

   This classroom is designed to provide a suitable learning environment for its students. Since this is a learning area, the primary tasks include reading and writing. With student desks, teaching equipment, and linear fluorescent luminaires, this space creates a good educational environment. Only students, faculty members, and admistrators are permitted in this space during school hours.

2. **Area:** 969 ft^2

3. **Dimensions:** Approximately 27'7" x 40'0" with 9' high ceilings

4. **Materials** (Manufacturer information was not provided. Reflectance levels are estimated based on finish schedule)

Location	Material	Reflectance
Ceiling	2x2 Acoustical Ceiling Tile	0.75
Walls	White Latex Paint	0.93
	Whiteboard	0.8
	Tack Board	0.17
	Vinyl Cove Base	0.83
	Combination of Windows (made with laminated, tinted glass that is solar gray with a U value of 1.10 in the winter 1.13 in the summer and has a shading coefficient of 0.64)	
	Light Gray Painted Door	0.8
Floor	Carpet	0.43
	Vinyl Composition Tile	0.83

Figure 1: Primary Classroom Surface Materials

5. Plans

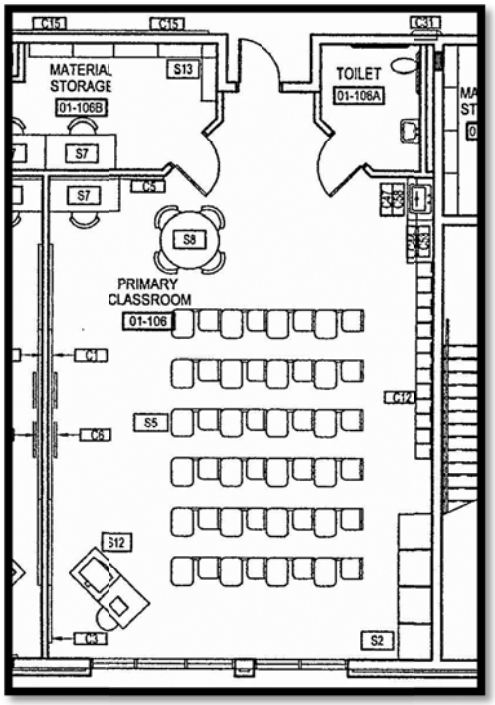


Figure 2: Primary Classroom Plan

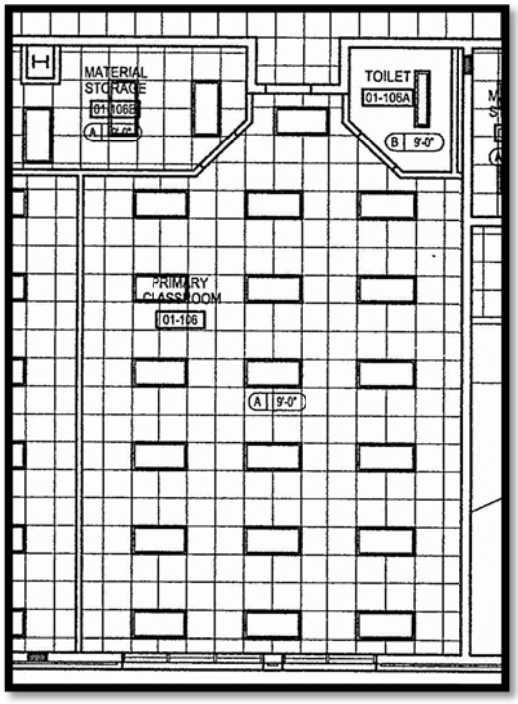


Figure 3: Primary Classroom Reflected Ceiling Plan

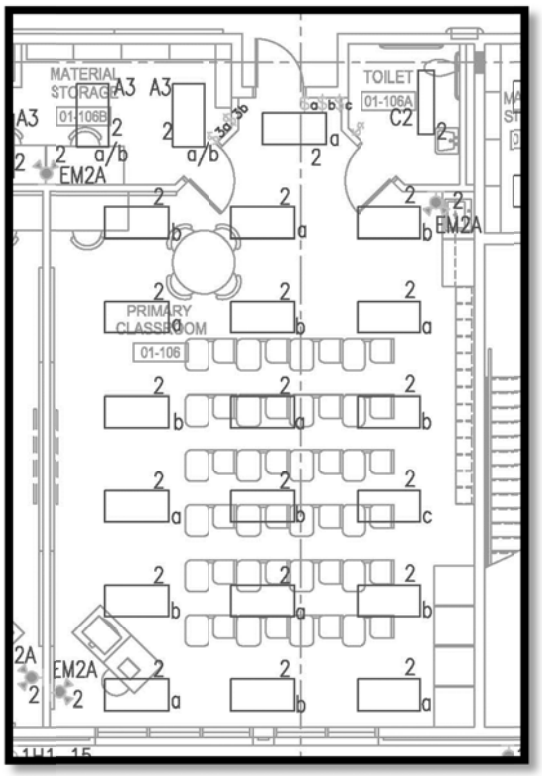


Figure 4: Primary Classroom Lighting Plan

6. Lighting Equipment

The general lighting equipment used in the primary classroom solely consists of ceiling recessed linear luminaires. In addition, there is wall mounted battery powered emergency lighting. The primary light source for these linear luminaires is T8 linear fluorescent lamps and the emergency light source consists of two 12 Watt Halogen lamps.

Existing Lighting in Primary Classroom							
Type	Quantity	Location	Mounting	Manufacturer/Catalog #	Lamp Type/Wattage	Ballast per Florida energy code	Description
A2	19	Classroom -Ceiling	Ceiling Recessed	Daybrite 2GT8-2(32) 21	(2) F32T8	Advance Rel-2P32-SC	Acrylic Prismatic Fluorescent recessed 2 ft. x 4 ft., with flat steel door, static, and .125 lens.
EM2A	2	Classroom -Wall	Wall Mounted	Chloride S25N-H12-W	(2) H12	N/A	Two Head Nickel Cadmium Battery powered emergency light with test switch and indicator light. Provides 90 minutes of emergency power.

Figure 5: Primary Classroom Luminaire Schedule

1. **Furniture** (Manufacturer information was not provided. Reflectance levels are estimated based on equipment schedule)

Label	Equipment	Reflectance
C1	1 Marker board	0.8
	2 Tack boards	0.17
C3	4' x 4' Tack Board	0.17
C5	8' x 4' Tack Board	017
C6	70" x 70" Wall Mounted Projection Screen	0.8
C12	Custom Cubby and Coat Hooks (Wood-Oak)	0.22
C44	TMI Base Unit- B2052 30" X 36" X 24" (Wood-Oak)	0.22
C47	TMI - B2542 30" X 36" X 24" (Wood-Oak)	0.22
C58	TMI WALL UNIT – W2052 32" x 36" x 14" (Wood-Oak)	0.22
S5	Student Chair/Desk (Wood-Oak)	0.22
S7	Desk and Chair (Wood top with metal base desk with plastic chairs)	Desk=0.5, Chair=0.62
S8	Table and Chair (Wood-Oak)	0.22

Figure 6: Primary Classroom Furniture Material and Reflectance

B. **Lighting Design Criteria**

Interior, Educational Facilities, Classrooms, General
Interior, Reading, Printed Tasks, 8-and10-point type
Interior, Handwritten Task, White boards (IESNA Handbook)

1. **Appearance of Space and Luminaires**-Somewhat Important
   The luminaires and furnishings within this space should provide a visual cue as to the function of the space. Since eyes are drawn to the brightness, the luminaires should create bright areas where students should direct their attention to learn, mainly the front room where the teacher will be teaching. The luminaires should provide suitable light, while not creating a distraction for the students.

2. **Color Appearance (and Color Contrast)**-Important
   For students to successfully complete their work environment needs to be visually pleasing. A CRI of 70 or above is desired to create an acceptable work environment with good color rendering.

3. **Daylighting Integration and Control**-Important/Somewhat Important
   Having natural daylight present in the classroom will be good for the student's psychology. For this particular room we have north facing windows, so direct sunlight is not an issue for students after the early morning. However, shading devices will still be desired for the early morning hours to keep the hot sun from heating the room in the warmer months. It will be advantages to implement both photoelectric controls and dimming within the classroom to reduce the reliance on electric lighting.

4. **Direct Glare**-Important
   Direct glare will create an uncomfortable environment for students and affect their ability to complete tasks. Since direct light is needed to provide enough illuminance on the work plane a lens or parabolic reflector should be used to reduce this glare.

5. **Flicker (and Strobe)** –Important
   Flicker can be a distraction to the eye and affect students' ability to focus on their teacher and/or work. To reduce the flicker of the light source, high frequency electronic ballast can be used.

6. **Light Distribution on Surfaces**-Important
   Shadows from objects should be avoided, so not to affect visibility, comfort, or perception. Both the horizontal plane and instructional wall need to be uniformly lit to provide a good work environment. However, total uniformity within the space should be avoided so that there is some visual interest. The surfaces should not exceed the 3:1 luminance ratio.

7. **Light Distribution on Task Plane (Uniformly)** –Important
   The task plane is the student desks. Shadows should be avoided on the desks, so that it does not affect visibility, comfort, or perception. The task space should be 1.5 to 3 times brighter than the surrounding area in order to direct the students' attention to their tasks. A lighting layout that provides uniformity across the task plane should be utilized.

8. **Luminances of Room Surfaces** -Important
   Since this room is painted with white latex paint, the luminance of the room surface will be affected by the reflectance of this material. It is important that the whiteboard have uniform luminance to enhance the students' ability to clearly view the white board. The lighting design should assist in directing focus to the instructional wall by directing light to this wall by either grazing it or using wall washers. To reduce the shadows on the work plane created by hands, both direct and diffuse light should be incorporated.

9. **Modeling of Faces or Objects**- Somewhat Important
   The ability of the teacher to be able to effectively read the facial expressions of students is important to his/her effectiveness as a teacher. Therefore, it is important that the lighting enhance the areas around the mouth and eyes of the students. Concentrated downlighting should be avoided and multidirectional lighting should be implemented, while incorporating the reflected illuminance from the walls and ceilings to help model students' faces.

10. **Points on Interest**-Important
    The point of interest is the front center of the room, on the east wall, where teaching will occur and the whiteboard is present. The lighting design should create uniform illumination across the white board. In relationship to the surrounding surfaces, the instructional wall should draw the focus by having higher brightness

11. **Reflected Glare**-Very Important/Important
    Glare from the glossy surfaces and veiling reflections should be avoided. If possible matte surfaces should be used to reduce this glare.

12. **Shadows (Somewhat Important)** – Important/Somewhat Important
    Shadows on the work plane can cause issues in the ability for students to learn due to the distraction of the lighting design. Linear or area light sources should be used to create diffuse shadows.

13. **Source/Task/Eye Geometry**-Very Important/Important/Somewhat Important
    Occupants should not be able to have a clear view on the light source to prevent discomfort. The lighting design should make use of reflected light, and avoid having luminaire directly above the task plane

14. **Surface Characteristics**-Important
    Many of the surface materials in this task space have a high reflectance. This is desirable so that interreflection can occur to reduce the contrast of between the luminaires and the background, as well as, allow for the use of fewer luminaires at fewer watts. The lighting design should use the reflected light to create and the necessary wall light to enhance the environment.

15. **System Control and Flexibility**-Important/Somewhat Important
    The tasks in this space very and each task require different light levels. Therefore, having multiple lighting circuits is desired to allow for various lighting levels. Using dimmable lamps will help achieve the various light levels desired. Photosensors can also be used to reduce the need of electric lighting when natural light is available.

16. **Illuminance (Horizontal)**- Very Important/Important
    Category D: Performance of visual tasks of high contrast and large size, 30 fc.

17. **Illuminance (Vertical)** -Very Important
    Category B: Simple orientation for short visits, 5 fc

18. **Power Allowance** (ASHRAE/IESNA Std. 90.1)
    Space-by-Space Method: Classroom=1.4 W/ft^2

19. **Controls**
    In general, the classroom will only be used during the daytime hours. However, controls should be used in order to dim the electric light when daylight can be used. Also, since the tasks vary within this space, luminaires should be dimmable in order to vary the illuminance on the task space as the tasks change. Present controls for the various tasks are desired.

20. **Luminance Ratios**
    Luminance ratio between the task and the surrounding walls should not exceed 3:1
    Luminance ratio between the ceiling and walls should be 3:1

21. **Psychological Aspects**
    The primary classroom will be further investigated throughout the design to determine a suitable design to create the psychological impression of a public space.

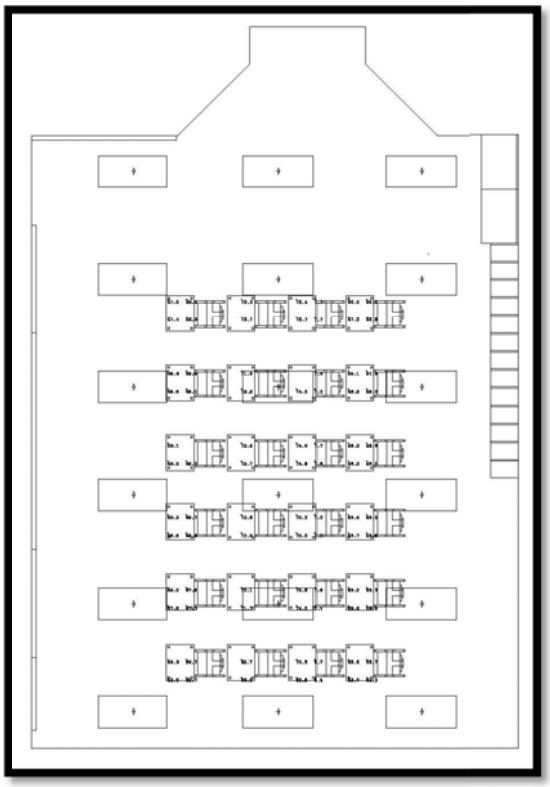
    Elementary school students are typically struggling to get used to the feeling of being at school and being away from their parents. Therefore, public is the feeling they should get when they are in one of their classrooms. There should feel that the space is open and inviting, so that they feel comfortable during their time within this space.

    The lighting design should work with the current furniture layout to enhance the learning environment and ultimately promote productivity. The design should complement the function of the space.

C. Evaluation and Critique of Existing Lighting Conditions

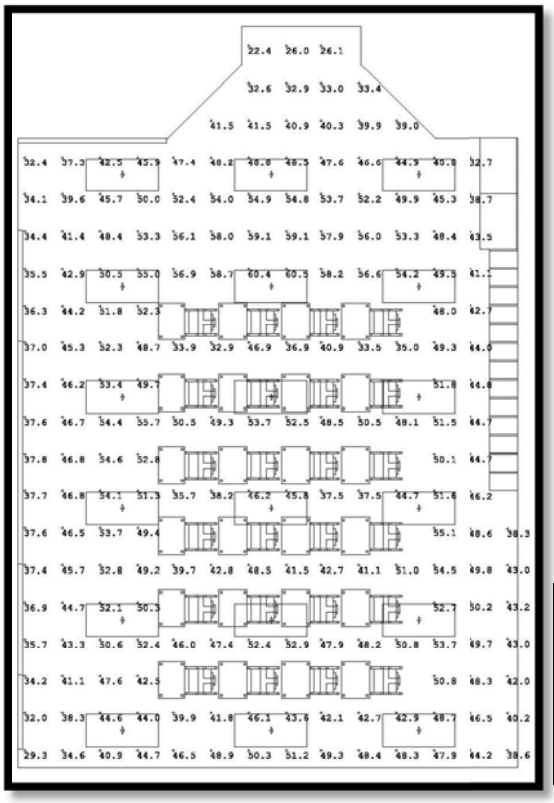
Type	BF	LLD	LDD	RSDD	Total LLF
A2	0.88	0.91	0.88	0.976	0.789
EM2A	1.0	0.89	0.88	0.976	0.764

Figure 7: Primary Classroom Light Loss Factors



Illuminance (fc)
Average: 69.5
Maximum: 75.2
Minimum: 62.7
Max/Min: 1.1

Figure 8: Illuminance values on the work plane (Student desks)



Illuminance (fc)
Average: 45.6
Maximum: 60.5
Minimum: 22.4
Max/Min: 2.03

Figure 9: Illuminance values on the floor in the primary classroom

Figure 10: Primary Classroom Gray Scale Rendering: Isometric View (Rendered Produced by AGI32)

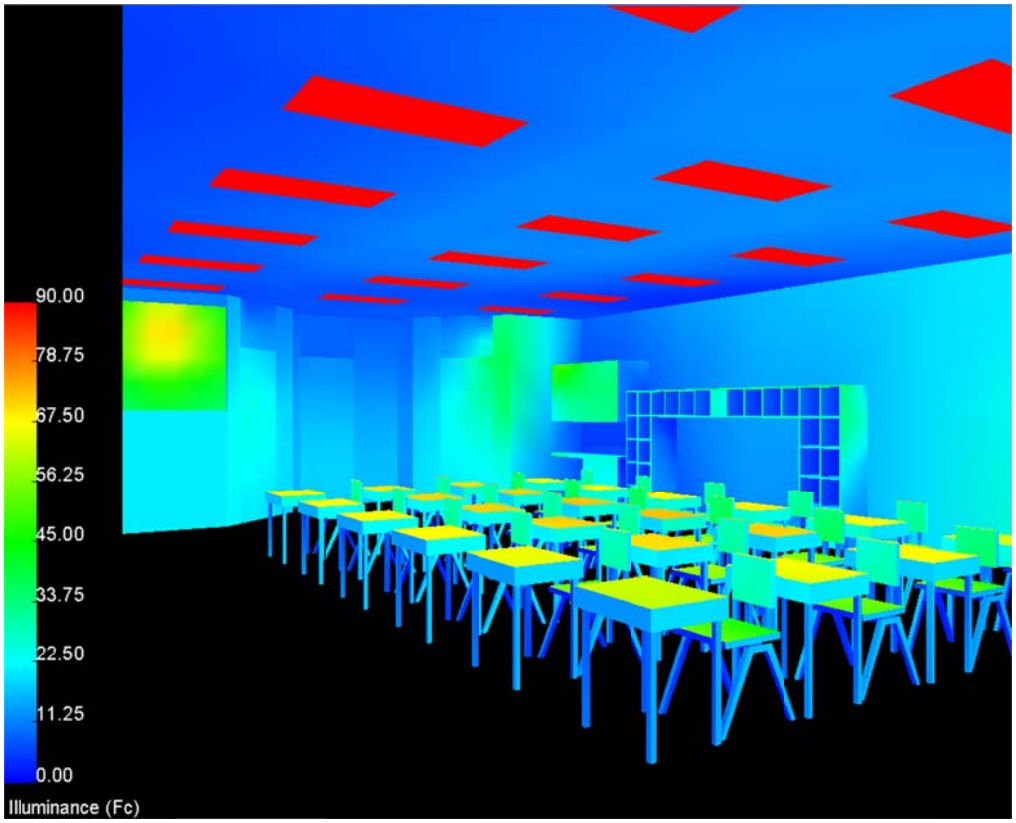


Figure 11: Primary Classroom Pseudo Color Rendering: Isometric View

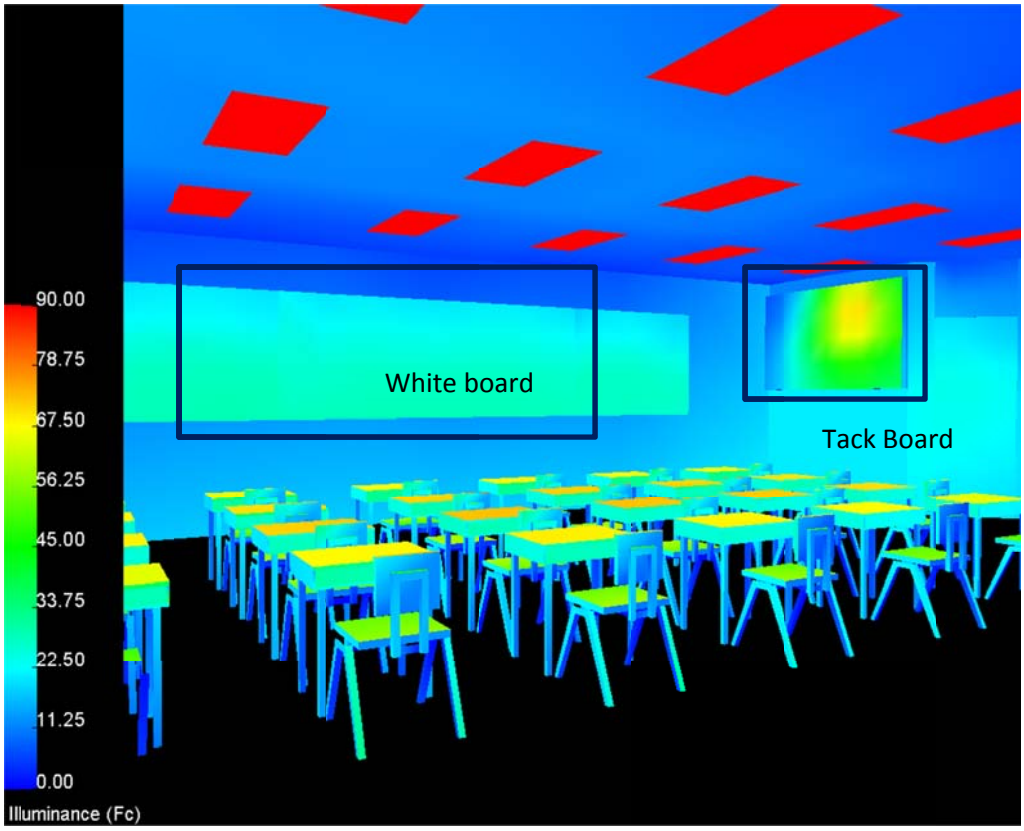


Figure 12: Primary Classroom Pseudo Color Rendering: Isometric View

1. Lighting Critique of Primary Classroom

   The lighting in the primary classroom should provide students with a comfortable environment for which learning can occur. The lighting design should provide uniform light with minimal shadows on the task planes so student activities are not hindered by the lighting design. The focal point of the rooms should be the white board in the front center of the room, as highlighted in Figure 12. The eye is drawn to the area of highest illuminance, and with the current lighting design the highest level of vertical illuminance is on the tack board, highlighted in Figure 12, which can be a distraction for the students.

   Despite the possible distraction from the high illuminance of the tack board, the main focus of the lighting design is to create a comfortable, visually pleasing task space for students, which this design succeeds at. Uniformity across the work plane is achieved, and the use of area sources helps limit the shadows on the work plane.

   The light is produced by a 2 x 4 ceiling recessed luminaire with 2 32W T8 fluorescent lamps. The average horizontal illuminance on the work plane is 69.5, which is well over the recommendations of IESNA.

Special Purpose Space | Multipurpose Room

A. Existing Conditions

1. **Description**

   The Multipurpose Room two main uses: assemblies and cafeteria area. Additionally, when necessary, this room is used as a hurricane shelter for the surrounding community. There are multiple entrances from the north, south and west. This room is located near the center of the building directly east of the main lobby, with direct access on the east side to the kitchen space. There is a large stage located on the west side. If necessary, there is a partition wall that can separate the space so that both dining and a presentation can occur concurrently.

   The Multipurpose Room is designed to be a suitable presentation space and lunch space on a regular basis. With tables and chairs, as well as, linear fluorescent luminaires this space is a suitable cafeteria space on a day by day basis. Typically, only students, faculty, and administrators have access to this room; however, in the chance of an emergency this space is open to the public.

2. **Area:** 5250 ft^2; Stage Area: 997ft^2 (Stage is elevated 2' off the floor)

3. **Dimensions:** Approximately 54'-0" x 68'-0" with 11'-1" high ceilings where acoustical ceiling tile is present and 10'-5" ceiling where Gypsum Wall Board is present.

4. **Materials** (Manufacturer information was not provided. Reflectance levels are estimated based on finish schedule)

Location	Material	Reflectance
Ceiling	Acoustical Ceiling Tile	0.75
	White Painted GWB	0.89
Walls	White Epoxy Paint	0.93
	Vinyl Cove Base	0.83
	Partition Wall	0.93
	Gray Painted Doors	0.80
Floor	Vinyl Composition Tile-Color A	0.87
	Vinyl Composition Tile-Color B	0.83
	Vinyl Composition Tile-Color C	0.83
	Vinyl Composition Tile-Color D	0.81
	Vinyl Composition Tile-Color E	0.78
	Vinyl Composition Tile-Color F	0.78
	Vinyl Composition Tile-Color G	0.77

Figure 13: Multipurpose Room Surface Materials

Location	Material	Reflectance
Ceiling	Acoustical Ceiling Tile	0.75
	White Painted GWB	0.89
Walls	White Epoxy Paint	0.93
	Vinyl Cove Base	0.83
Floor	Wood	0.56

Figure 14: Multipurpose Room Stage MaterialS

5. Plans

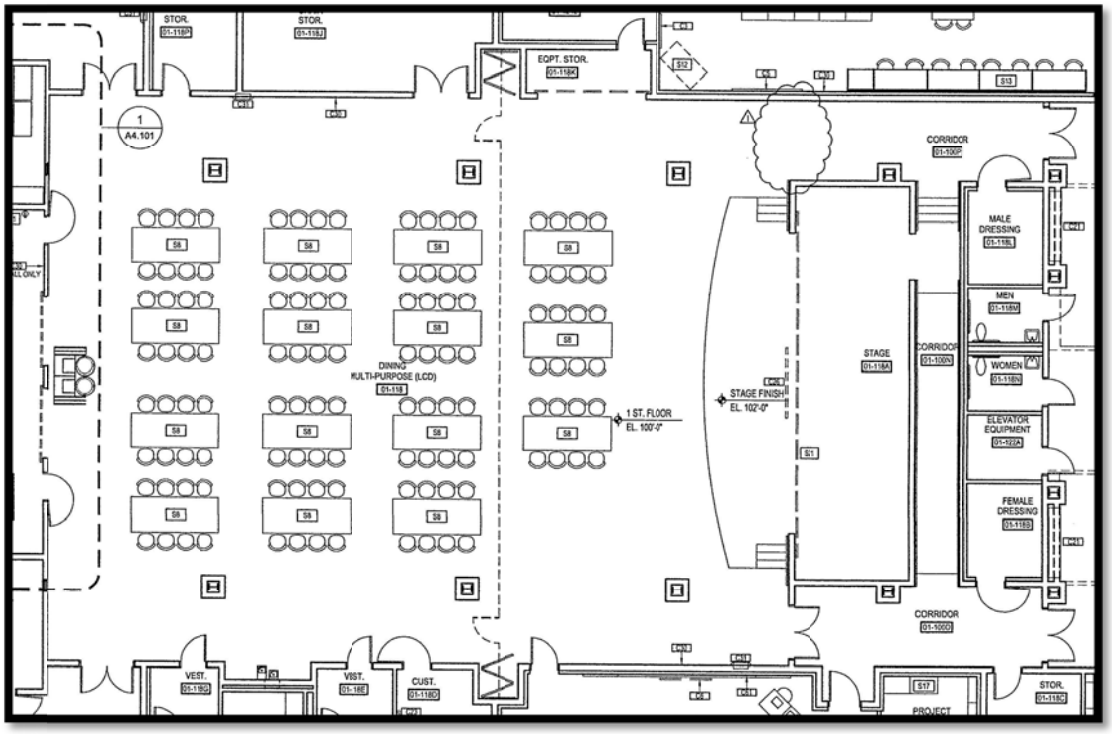


Figure 15: Multipurpose Room Equipment Plan

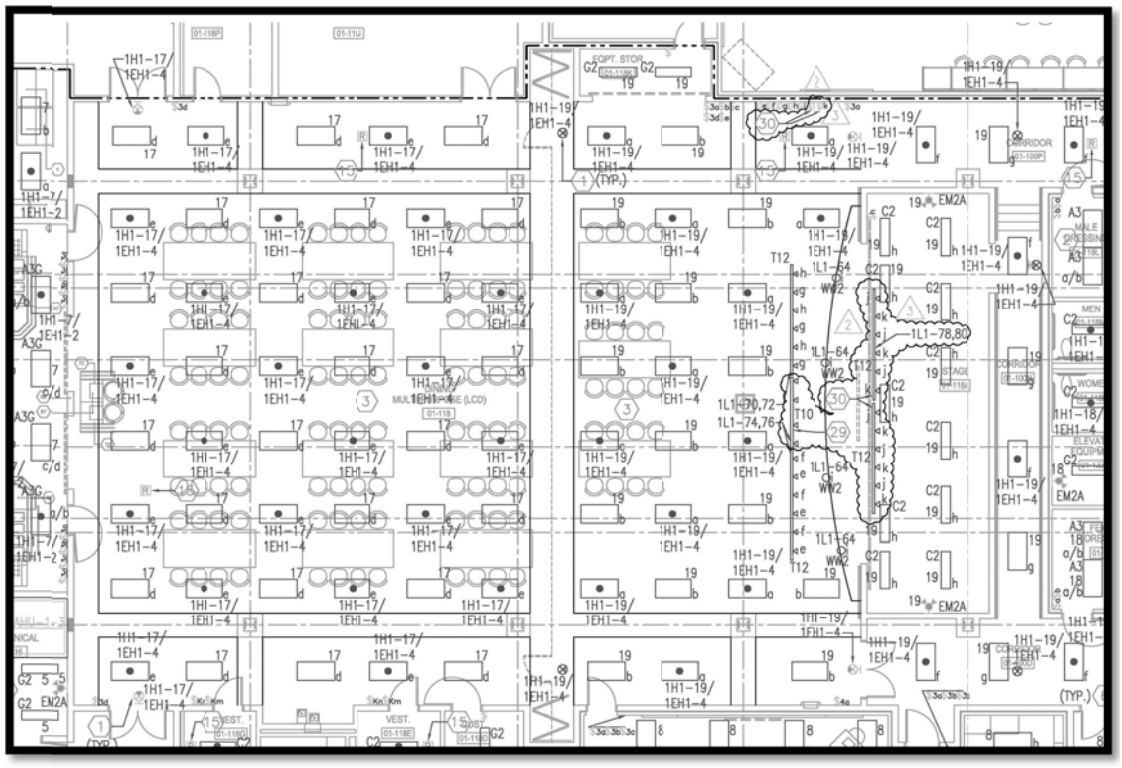


Figure 16: Multipurpose Room Lighting Plan

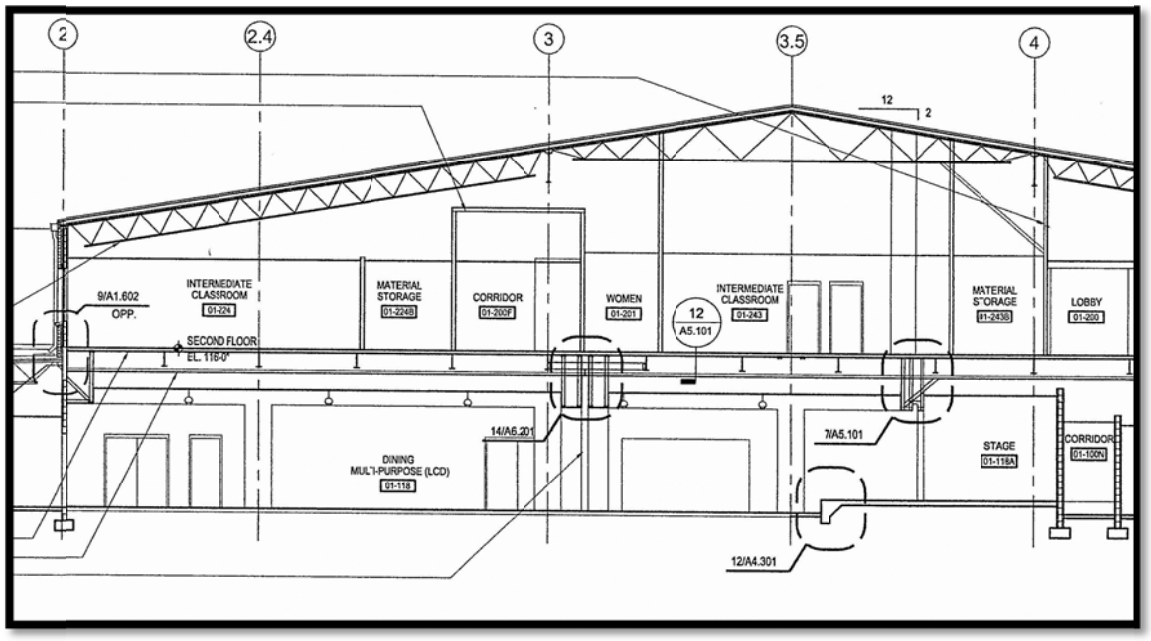


Figure 17: South View Section

6. Lighting Equipment

The lighting equipment used in the multipurpose room for ambient light consists of recessed linear luminaires. The stage has various luminaires: there are recessed fluorescent luminaire that provide ambient light on the stage as well as incandescent spot lights in the form of track lighting that helps model the faces of the speakers. The light sources consist of T8 linear fluorescent lamps, and incandescent par spot lights. The emergency light source consists of two 12 Watt Halogen lamps.

Existing Lighting in Multipurpose Room							
Type	Quantity	Location	Mounting	Manufacturer/ Catalog #	Lamp Type/Wattage	Ballast per Florida energy code	Description
A2	19	Multipurpose Room-Ceiling	Ceiling Recessed	Daybrite 2TG8-2(32)-21	(2) F32T8	Centium ICN-3P32-SC	Acrylic Prismatic Fluorescent recessed 2 ft. x 4 ft., with flat steel door, static, and .125 lens.
C2	11	Multipurpose Room-Ceiling	Ceiling Recessed	Daybrite 1TG8-2(32)-12	(2) F32T8	Centium ICN-3P32-SC	Acrylic Prismatic Fluorescent recessed 1 ft. x 4 ft. luminaire with a flat steel door, static, and .125 lens.
T10	1	Multipurpose Room-Ceiling	Ceiling Mounted	Capri CT12W with (6) CT2440KB3	(6) 100 W Par Spot	N/A	Surface Mounted Track light, 8 ft. long with (2) circuits and (4) barn door luminaires. Provide four sets of filters.
T12	4	Multipurpose Room-Ceiling	Ceiling Mounted	Capri CT12W with (4) CF3240KB3	(4) 100 W Par Spot	N/A	Surface Mounted Track light, 12 ft. long with (2) circuits and (6) barn door luminaires. Provide four sets of filters.
WW2	4	Multipurpose Room-Ceiling	Ceiling Recessed	Carpi CINAJ6250-2504	(1)100 W Par Spot	N/A	Recessed Incandescent adjustable wall washer with black alzak reflector, 40 degree lamp tilt, thermal protection, and white ceiling trim.
EM2A	2	Multipurpose Room-Wall	Wall Mounted	Chloride S25N-H12-W	(2) H12	N/A	Two Head Nickel Cadmium Battery powered emergency light with test switch and indicator light. Provides 90 minutes of emergency power.

Figure 18: Multipurpose Room Luminaire Schedule

7. **Furniture** (Manufacturer information was not provided. Reflectance levels are estimated based on equipment schedule)

	Label	Equipment	Reflectance
Multipurpose Room	C30	Acoustical Panel	0.75
	C31	Semi recessed fire extinguisher cabinet	0.85
	S8	Table and Chairs	0.22
Stage	C26	12' x 8' Ceiling Mounted Projection Screen	0.8
	S21	Changing Table	0.22

Figure 19: Multipurpose Room material and Reflectance

B. Lighting Design Criteria

Interior, Auditoriums, Assembly
Interior, Reading, Printed Tasks, 8-and10-point type
Interior, Food Services Facilities, Dining (IESNA Handbook)

1. **Appearance of Space and Luminaires**- Important/Somewhat Important
   Since this is a multipurpose space and the furniture layout has the ability to change, the use of a uniform lighting layout is desired to avoid "visual clutter" as the space changes. When this space is being used as an assembly area, the lighting on the stage should be brighter than the surrounding area to draw the attention of the audience. To achieve this, spot lights should be used and the lighting throughout the multipurpose room should be dimmable to help guide the focus of the audience. When the stage is not in use the multipurpose room should have perimeter lighting to create a focal point, take the focus off students as they are eating, and make the space visually pleasing.

2. **Color Appearance (and Color Contrast)-**Very Important/Important
   The appearance of skin tones, and food is critical in this space for both the stage and the general area; therefore, a CRI of greater than 80 should be used.

3. **Daylighting Integration and Control**- Important/Somewhat Important
   Although this is important per IESNA, this room is located on the first floor in the center of the building where windows and skylights are not possible. Therefore, daylighting integration and control cannot be utilized in this space.

4. **Direct Glare**-Important/Somewhat Important
   Direct glare should be avoided for all possible room uses. Luminaires should be chosen so that there is no direct line of sight to the lamps themselves. When necessary, lenses and shielding devices can be used to block the direct line of sight. The luminance of the luminaires chosen should not be more than 100 times the luminances of the surrounding surfaces.

5. **Flicker (and Strobe)**-Somewhat Important/Not Important
   Lamps should be chosen so that lamp flicker does not occur, since this will be distracting for both the audience and the speakers. Fluorescent lamps should be used within this space with electronic ballasts

6. **Light Distribution on Surfaces**-Somewhat Important/Not Important
   Shadows should be avoided as to not interfere with the visibility within the space and create a comfortable environment for all. The lighting should be designed in a regular pattern so that it is neither confusing nor distracting.

7. **Light Distribution on Task Plane (Uniformly)** –Somewhat Important/Not Important
   When this space is used as a cafeteria area the light distribution on the tables is somewhat important. There should be uniform lighting across the tables so that it is not distraction. When this space is used as a presentation room, the task plane is the floor and it is important that the aisles and walkways be uniformly illuminated.

8. **Luminances of Room Surfaces** –Somewhat Important/Not Important
   The ceiling should be a light color to allow the space to appear bright and there not be a great contrast between the brightness of the luminaire and the brightness of the ceiling. The walls should also be a light color so that the reflected light is diffuse and minimizes the possibility of shadows being present. The illuminance of the walls, ceilings, and furniture should be uniform to create visual comfort.

9. **Modeling of Faces or Objects**- Somewhat Important
   Face modeling is important for the nonverbal communication within the space and on the stage. Both vertical and horizontal illumination should be used to create depth in faces and objects. Some of this multidirectional Illumination can come from the reflected light off the different surfaces within the space. To achieve this on the stage spot lights, downlights and back lighting should be used.

10. **Points on Interest**-Important/Not Important
    When this is an assembly space it is important that the stage be the main focus. The illuminance of the stage should be higher than the surrounding areas. When this is used as a cafeteria space the perimeter should be the focus, to give some visual interest to students as they dine.

11. **Sparkle/Desirable Reflected Highlights**-Somewhat Important/Not Important
    To create some visual interest within the space, it is desirable that there are some areas on the wall that have high illuminance. The use of wall washers or wall grazing should be used to illuminate the perimeter

12. **System Control and Flexibility**-Very Important/Important
    This space has many functions; therefore, the system control needs to be able to create many different light levels for the various tasks. The lighting control should have different lighting settings for eating, presentations, and presentations utilizing the projection screen. Two or more lighting circuits should be used to create a wide variety of possible light levels. It is desirable for to have a dimmable lighting design.

13. **Illuminance (Horizontal)**- Important
    Category C: Working Spaces where simple visual tasks are performed, 10fc

14. **Illuminance (Vertical)** - Important
    Category A: Public Spaces, 3 fc

15. **Power Allowance** (ASHRAE/IESNA Std. 90.1)
    Space-by-Space Method: Multipurpose=1.3 W/ft^2

16. **Controls**
    There are three different zones controlled by switches at all 8 entrances to the room. The zones represent different number on 2 x 4 fluorescent luminaires on within the space. When all zones are on, all 2 x 4 luminaires are emitting light. The different zones and which luminaires they control can be seen in Figure 16. The controls for the stage lightings is located to the side of the stage through various switches

17. **Luminance Ratios**
    Ceilings and walls should have a 3:1 luminance ratio.

18. **Psychological Aspects**
    Visual Clarity and Spaciousness are the impressions that visitors to this space should get as they enter the multipurpose room. Since there is a uniform lighting design that creates uniform illumination throughout the space, with little to no shadowing, it will be spacious and provide a clear view of all components within the space. However, to assist with the spaciousness of the room, there should be perimeter lighting included within the lighting design. It is desirable that the walls be washed or grazed to provide visual interest on the perimeter.

C. Evaluation and Critique of Existing Lighting Conditions

Type	BF	LLD	LDD	RSDD	Total LLF
A2	0.88	0.91	0.88	0.976	0.688
C2	0.88	0.91	0.88	0.976	0.688
T10	1.0	0.71	0.88	0.976	0.610
T12	1.0	0.71	0.88	0.976	0.610
WW2	1.0	0.71	0.88	0.976	0.610
EM2A	1.0	0.89	0.88	0.976	0.764

Figure 20: Multipurpose Room Light Loss Factors

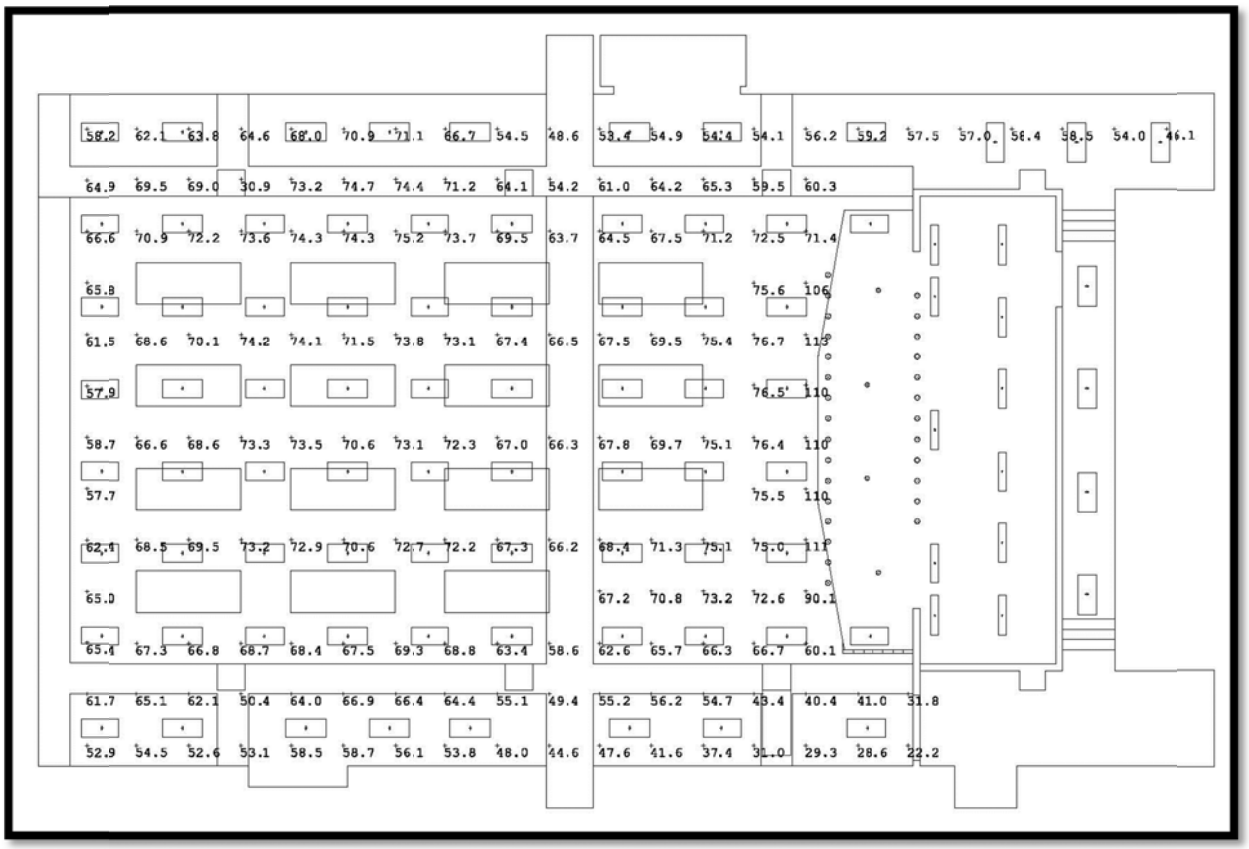


Figure 21: Illuminance Values on Floor in Multipurpose Room

Illuminance (fc)
Average: 64.9
Maximum: 113
Minimum: 22.2
Max/Min: 5.07

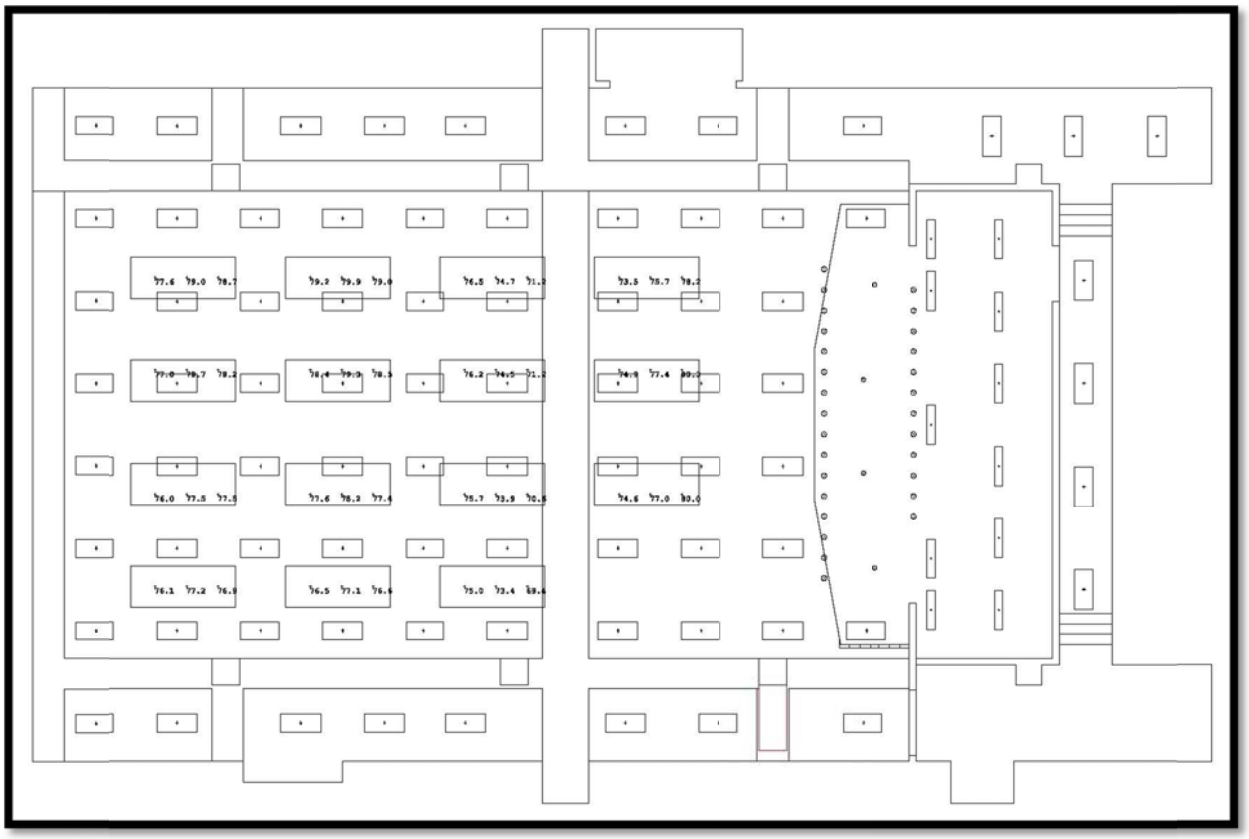


Figure 22: Illuminance Values on Task Plane in Multipurpose Room

Illuminance (fc)
Average: 76.5
Maximum: 80.3
Minimum: 69.4
Max/Min: 1.16

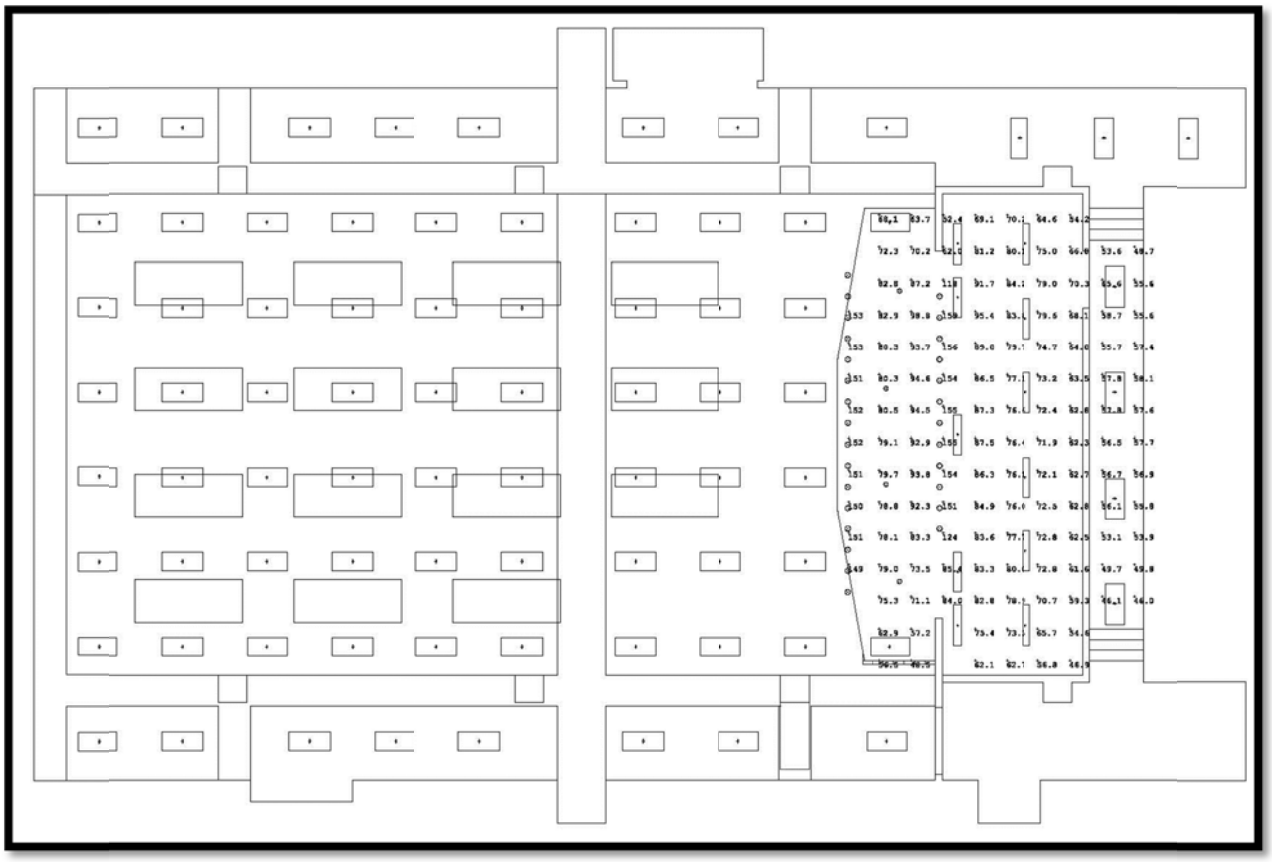


Figure 23: Illuminance Values on the stage in Multipurpose Room

Illuminance (fc)
Average: 81.16
Maximum: 159
Minimum: 46
Max/Min: 3.45

Figure 24: Multipurpose Room Gray scale Rendering: Isometric View

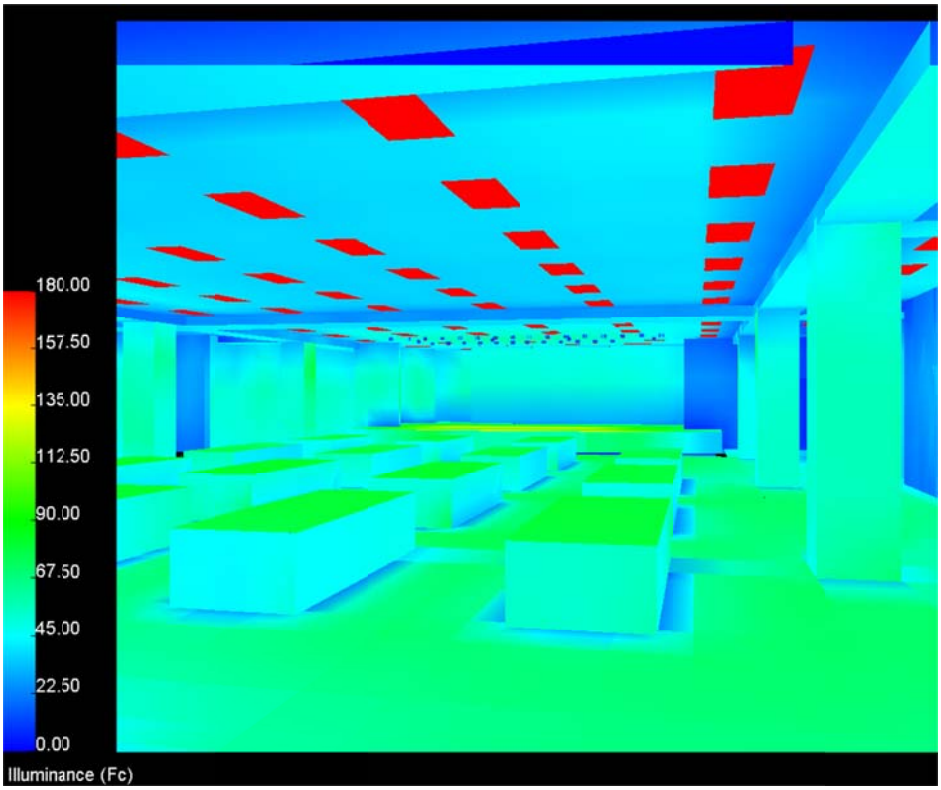


Figure 25: Multipurpose Room Pseudo Color Rendering: Isometric View

1. Lighting Critique of Multipurpose Room

The lighting in the multipurpose room should provide enough light on the stage so that speakers are seen clearly, with the focal point as the stage. Also, students must feel comfortable when they enter this large space to enjoy their lunches; the lighting design should make the students feel at ease. The lighting design should be uniform on the tables so that hard shadows are not formed.

This lighting design successfully draws the attentions of occupants to the stage by having a much higher illuminance on the stage than any other part of the room. Also the task plane has uniform illuminance, and fluorescent light sources were used as an area source to reduce shadowing on the task plane.

The ambient light is produced by 2 x 4 ceiling recessed luminaires with 2 32 W T8 fluorescent lamps. These luminaires produce an average illuminance of 76.5 fc on the task plane, which is well over the IESNA recommendation. There is an unnecessary amount of light in this space, which should be reduced to save energy and possible reduce the number of luminaires needed in the space.

Lobby | Circulation Space

A. Existing Conditions

1. **Description**
   Upon entrance into the school, the lobby is the first space that people encounter. It is the connects all the corridors in the building and also host the main staircase and elevator. It has direct access into the administrative offices in the north side.

   The main purpose of this space is to welcome students and visitors to the school, as well as, guide them to their desired destination. The rectangular layout of this space combined with the high ceilings is welcoming. The high ceilings create a spacious feel as students and visitors enter and helps accentuate the main architectural featur of this space: the central staircase Throughout the space, students works are displayed and meant to attract the attention of passing people.

2. **Area:** 2342 ft^2

3. **Dimensions:** 45'4" x 52'8" with 28' high ceilings

4. **Materials** (Manufacturer information was not provided. Reflectance levels are estimated based on finish schedule)

	Material	Reflectance
Ceiling	Acoustical Ceiling Tile	0.75
	White Painted Gypsum Wall Board	0.89
Walls	White Epoxy Paint	0.93
	Vinyl Cove Base	0.83
	Gray Painted Doors	0.80
Floor	Vinyl Composition Tile-A	0.87
	Vinyl Composition Tile-B	0.83
	Vinyl Composition Tile-C	0.83
	Vinyl Composition Tile-D	0.81
	Vinyl Composition Tile-E	0.78
	Vinyl Composition Tile-F	0.78
	Vinyl Composition Tile-G	0.77

Figure 26: Lobby Surface Materials

7. Plans

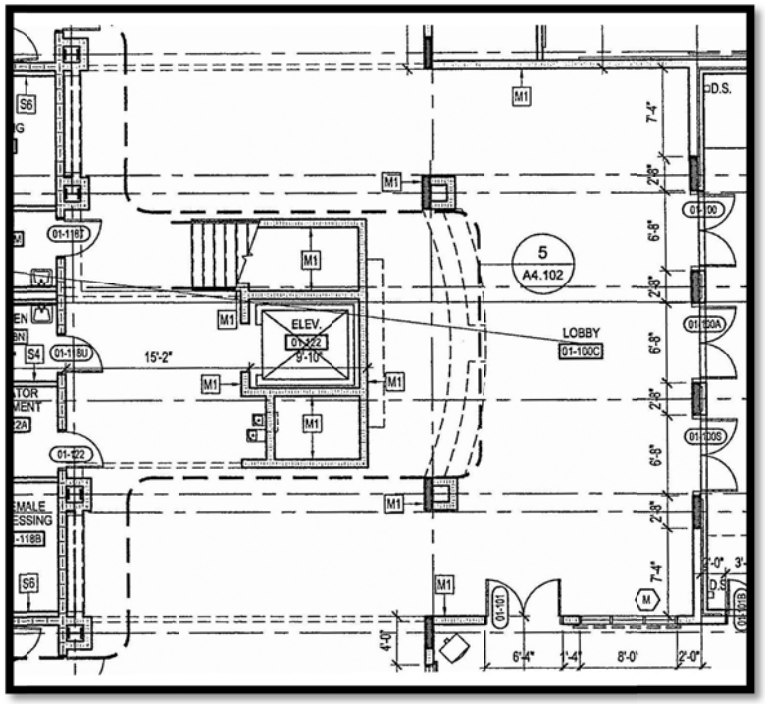


Figure 27: Lobby Plan

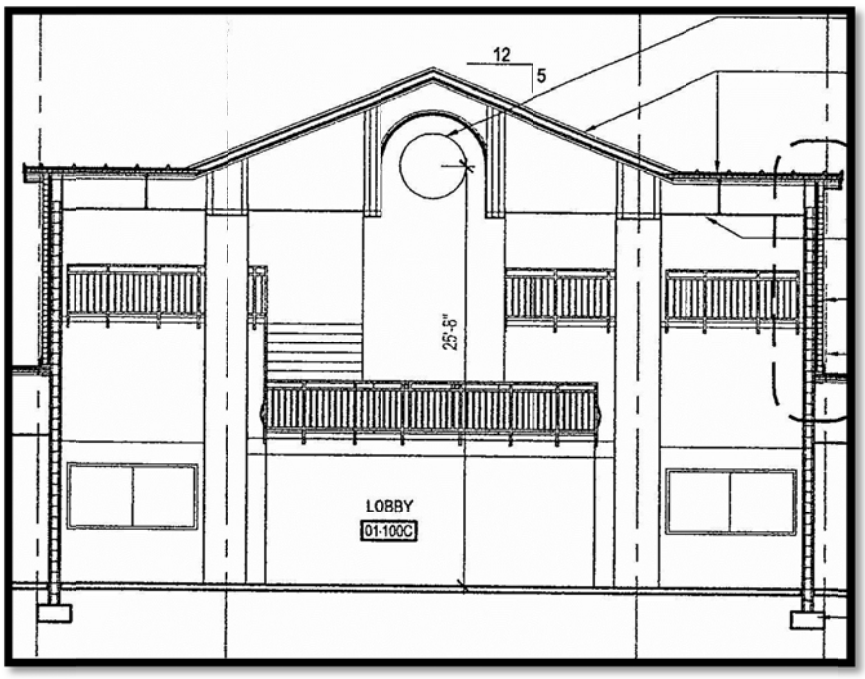


Figure 28: Lobby East View Section Cut

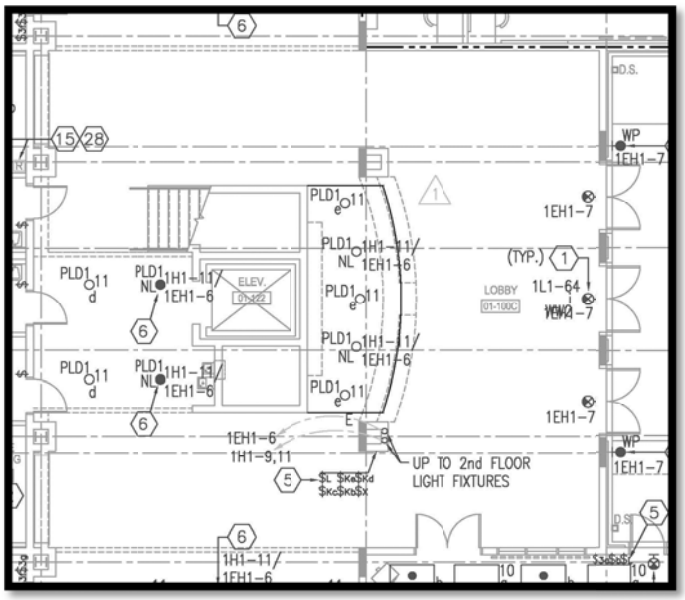


Figure 30: Lobby First Floor Lighting Plan

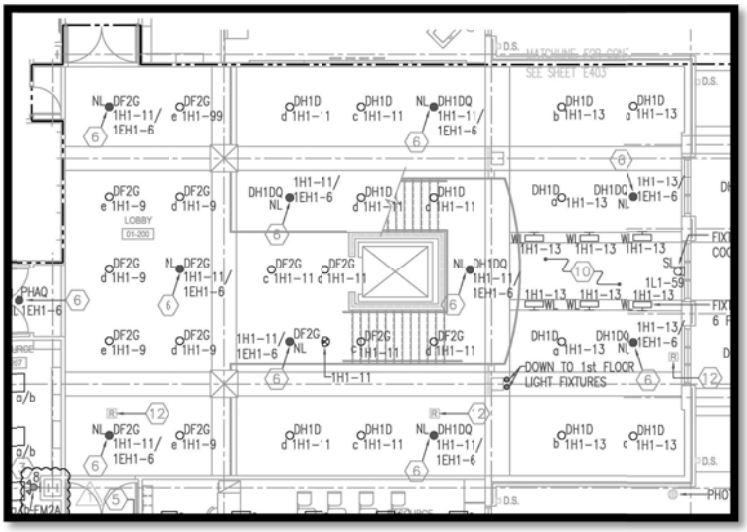


Figure 30: Lobby Second Floor Lighting Plan

8. Lighting Equipment

The ambient light in the lobby consists of four different types of circular recessed downlights. In addition, there are six wall mounted luminaires that provide uplight to emphasize the high ceiling height and create the spacious feeling. The recessed downlights located in between the main entrance and the staircase consists of Metal Halide lamps and all other luminaires within this space are fluorescent light sources.

Existing Lighting in Primary Classroom							
Type	Quantity	Location	Mounting	Manufacturer/Catalog #	Lamp Type/Wattage	Ballast per Florida energy code	Description
PLD1	9	Lobby-Ceiling	Ceiling Recessed	Capri CMB-F218-U-H85BC	(2) CFQ18W PL	Ballast Built in	Recessed fluorescent PL downlight with a clear reflector, black baffle, glass l, HPF Built in ballast, and a white ceiling trim
WL	6	Lobby-Wall	Wall Mounted	Elliptipar F126-X239-E-02-2-V00	(2) 39W Fluorescent	Ballast Built in	Wall mounted adjustable fluorescent uplight with an aluminum canopy and an integral electronic ballast.
DH1D	12	Lobby-Ceiling	Ceiling Recessed	Capri MH17-V*F-T061M-DL	(1) 250W ED17 MH	Ballast Built In	Recessed HID downlight with a clear alzak reflected. Built in metal halide ballast. Safety shielded with a grooved baffle. Quartz restrike and U.L. damp label.
DH1DQ	6	Lobby-Ceiling	Ceiling Recessed	Capri MH17-VF-T061M-DL-EC1	(1) 250W ED17 MH and (1) 150W QTZ	Ballast Build In	Recessed HID downlight with a clear alzak reflected. Built in metal halide ballast. Safety shielded with a grooved baffle. Quartz restrike and U.L. damp label.
DF2G	15	Lobby-Ceiling	Ceiling Recessed	Capri CMB-F242-H85BF	(2) 42 W PL	Ambistar RCF-2S26-H1-LD-QS	Recessed fluorescent downlight with a regressed Fresnel lens, clear reflector, and black stepped baffle.

Figure 31: Lobby Luminaire Schedule

9. Furniture

Label	Equipment
C21	Glass Display Case

Figure 32: Lobby Furniture Schedule

B. Lighting Design Criteria

Interior, Educational Facilities, Corridors
Interior, Service Spaces, Stairways and corridors (IESNA Handbook)

1. **Color Appearance (and Color Contrast)-**Somewhat Important/Not Important
   The lobby should welcome visitors in and give them direction to where they are headed in the building. Therefore, the color appearance is important to ensure the visibility and aesthetics of the space, while assuring that circulation is smooth. A CRI of 80 or more should be used to accentuate the appearance of skin tones, and surrounding displays.

2. **Daylighting Integration and Control**-Very Important/Important
   The ability to have daylight is good for both psychological and physiological reasons. Daylight can enter the space through the large windows and glass doors on the west wall. Photosensors should be used so that the natural sunlight can be used to help limit the need for electrical light. The walls should have high reflectance to reduce the contrast between the natural light through the windows and the walls.

3. **Direct Glare**-Very Important/Important
   Direct glare can cause visitors to feel uncomfortable in the space and can affect their visibility within the space. Therefore, people should not be able to have a direct line of sight to the lamp. To prevent this lensed luminaires should be used.

4. **Light Distribution on Surfaces**-Very Important/Important
   Circulation throughout the space needs to be smooth and uninhibited. The luminaires should be placed to avoid shadows on the floor so that visibility is not affected. The different surfaces should not have significant variations in brightness, but pure uniformity should be avoided so that there is some visual interest. Wall washers should be used on the perimeter to both highlight student work and create a variation in surface illuminances.

5. **Luminances of Room Surfaces** –Important/Not Important
   The luminance of the various surfaces can affect how a person perceives the brightness in the room. Lighter, reflective surfaces appear brighter. Luminaires specifically designed to illuminate the ceiling and walls should be used to increase the room surface luminance. To create a comfortable space both direct and diffuse light will be used to reduce shadows and help model faces.

6. **Modeling of Faces or Objects**- Very Important/Important
   Objects and faces need to be modeled in order to see depth and texture. Nonverbal communication is very important for faculty and administrators to successfully help students. To achieve this, both vertical and horizontal illumination is needed. Along with downlight and angled lighting to fully model the objects and faces, reflected light of the surfaces can to utilized.

7. **Points on Interest**-Very Important/Not Important
   The main point of interest in this room is the student artwork displays on the walls. Therefore, wall washing luminaire should be used so walls have a higher illuminance level to draw the attention of passing people.

8. **Reflected Glare**-Somewhat Important/Not Important
   Reflected glare can reduce the visibility in the space. For the staircase, it is important to avoid reflected glare so that people can safely walk. Luminaires above the stairs should not be placed so that light emitted causes veiling reflections.

9. **Shadows–**Very Important/Not Important
   Shadows can affect a person's ability to move though the space uninhibited. To avoid this linear luminaires or area sources should be used to create diffuse shadows. Fluorescent lamps with white reflectors are recommended as the area source.

10. **Illuminance (Horizontal)-** Important
    Category B: Simple orientation for short visits, 5 fc

11. **Illuminance (Vertical)** -Very Important
    Category C: Working spaces where simple visual tasks are performed, 10 fc

12. **Power Allowance** (ASHRAE/IESNA Std. 90.1)
    Space-by-Space Method: Lobby=1.3 W/ft^2

13. **Controls**
    Photosensors can be used to reduce the use of electric light when the sun can provide ample amount of natural light throughout the space. Also, preset controls can be utilized to create two scenes within the space: a daytime and a nighttime lighting design.

14. **Luminance Ratios**
    Luminance ratio between the ceiling and walls should be 3:1

15. **Psychological Aspects**
    Students first time in school is in Elementary school, so it is expected that student will be scared and uneasy to be away from the parents for the first time. The first interior space the students see is the lobby. Therefore, the psychological impression should be spacious and public. Students and visitors should feel welcome and comfortable upon entrance inside the school. The lighting design should assist in making them feel at ease and create an environment where they feel safe.

C. Evaluation and Critique of Existing Lighting Conditions

Type	BF	LLD	LDD	RSDD	Total LLF
PLD1	1.0	0.89	0.88	0.964	0.755
WL	1.0	0.83	0.86	0.964	0.688
DH1D	1.0	0.83	0.88	0.964	0.704
DH1DQ	1.0	0.83	0.88	0.964	0.704
DF2G	1.0	0.89	0.88	0.964	0.755

Figure 33: Lobby Light Loss Factors

1. **Discussion**
   The lighting design in the lobby should be inviting, and effectively display students work on the perimeter walls. The main purpose of this space is for circulation, so the lighting design should be intriguing to create visual interest within the space. The lighting layout should not affect the circulation of people. The focal point is the architectural staircase in the center of the room and the displays on the perimeter of the space.

   This lighting design does successfully draw people into the space and makes them feel welcome. The luminaires in the front section of the lobby are the same luminaires that are used in the covered entrance way. Therefore, there is a smooth transition from the outdoor space into the building. Once a person has fully entered the space the luminaires remain similar, but the light sources change from metal halide to fluorescent, which will remain the main light source of this building.

The ambient light in this space comes from the recessed circular downlights of both metal halide and fluorescent light sources, which should provide ample amount of light on the task plane. At the entrance of this space, there are wall mounted fluorescent light sources that provide uplight to highlight the ceiling height and create a spacious, welcoming sense in visitors. Since there are such high ceilings the uplight makes the space feel more open and inviting.

Although this space is successful in giving off the psychological impression desired. It does lack perimeter lighting. Since this space is used as a display space for the school, attention should be drawn to the perimeter walls.

A. Existing Conditions

1. **Description**
   The covered entrance is located in the center of the west facing wall. It is an architectural focal point that can be seen by any person approaching the building. This is a good transition space that connects the interior and outdoor spaces. There are six columns that are both functional and aesthetically pleasing that support the structure.

   The entrance to the building consists of three sets of double doors with large windows above each set of doors, which is visually pleasing. There is also one door on the north side of this space that gives direct access into the administrative offices. All visitors must enter the bulding through this space, since it is the only public entrance to the school.

2. **Area:** 1,397 ft^2

3. **Dimensions:** 37'6" x 31'6" with 23' high ceilings

4. **Materials** (Manufacturer information was not provided. Reflectance levels are estimated based on finish schedule)

Location	Material	Reflectance
Ceiling	Exterior Drywall	0.89
Column	White Latex Paint	0.93
	Brick Veneer	0.1
Floor	Reinforced Concrete Slab	0.25
Building Façade Wall	Windows	
	Doors	0.8
	Brick Veneer	0.1

Figure 34: Covered Entrance Surface

5. Plans

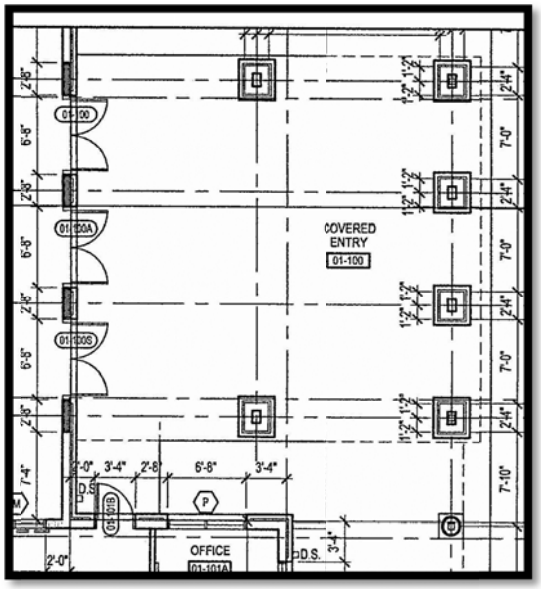


Figure 35: Covered Entrance Plane

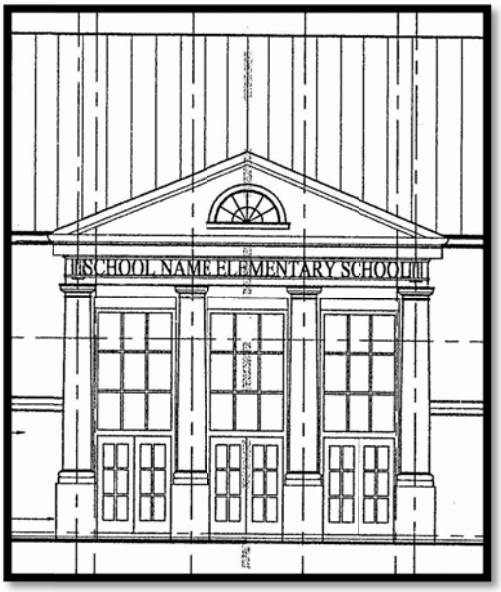


Figure 36: Covered Entrance West Elevation

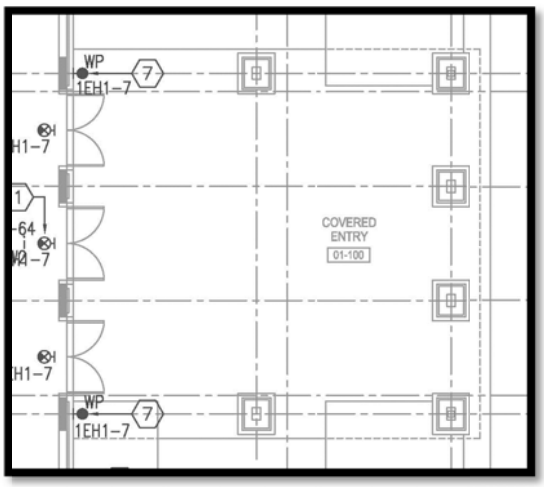


Figure 37: Covered Entrace First Floor Lighting Plan

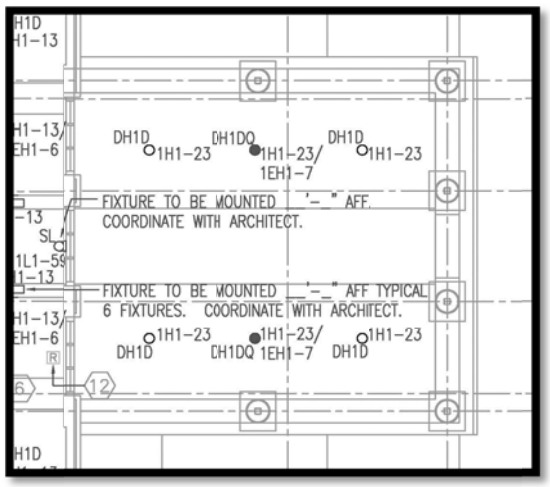


Figure 38: Covered Entrance Second Floor Lighting Plan

6. Photos

Figure 38: Covered Entrance

Figure 39: Covered Entrance

1. Lighting Equipment

The lighting equipment used in this outdoor space is very minimal. There are only two wall mounted luminaires that are located on the exterior façade of the building, as highlighted in purple in Figure 39 on the previous page. In addition, there are six recessed HID downlights located in the ceiling of the covered entry for ambient light within the space, as highlighted in blue in Figure 39 on the previous page.

Existing Lighting in Primary Classroom							
Type	Quantity	Location	Mounting	Manufacturer/Catalog #	Lamp Type/Wattage	Ballast per Florida energy code	Description
WP	2	Covered Entrance-East Wall	Wall Mounted	Bega 2756P	(1)26W PL	Ambistar RCF-2S26-H1-LD-QS	Wall mounted square luminaire with injection molded polycarbonate plastic lens housing. U.L. listed for wet location
DH1D	4	Covered Entrance-Ceiling	Ceiling Recessed	Capri MH17-V*F-T061M-DL	(1) 250W ED17 MH	Ballast Built In	Recessed HID downlight with a clear alzak reflected. Built in metal halide ballast. Safety shielded with a grooved baffle. Quartz restrike and U.L. damp label.
DH1DQ	2	Covered Entrance-Ceiling	Ceiling Recessed	Capri MH17-VF-T061M-DL-EC1	(1) 250W ED17 MH and (1) 150W QTZ	Ballast Build In	Recessed HID downlight with a clear alzak reflected. Built in metal halide ballast. Safety shielded with a grooved baffle. Quartz restrike and U.L. damp label.

Figure 40: Covered Entrance Luminaire Schedule

2. **Furniture**
   None.

B. **Lighting Design Criteria**
Outdoor, Educational Facilities, Building Exteriors, Entrances, Active (pedestrian/conveyance)-(IESNA Handbook)

1. **Appearance of Space and Luminaires**-Very Important
   The entrance is the first space visitors, faculty, and students see as they approach the school. Therefore, the entrance must enhance the design and architecture of the space to create a welcoming environment. The lighting should direct the circulation of people into the building entrance and not create "visual clutter" that might distract the visitors. The lighting layout should be uniform and create a pattern that helps direct the flow of pedestrian traffic into the building.

2. **Color Appearance (and Color Contrast**)-Very Important
   When this building is being used for events at night the only exterior lighting on the building is in the covered entrance. It is important that the color rendering enhance the visibility of visitors. The space should have a CCT of around 4100K and a CRI of around 80 to create a welcoming atmosphere within the space.

3. **Direct Glare**-Very Important
   Direct glare should be avoided at any spot within the space. Therefore, luminaires should be chosen so that there is not a direct line of sight to the bare lamp. Lenses on all luminaires should be used to help prevent this.

4. **Light Distribution on Surfaces**-Important
   Excessive brightness and noticeable shadows should be avoided. The layout of luminaires should follow a pattern throughout the space. Uniform brightness should be avoided. The lighting design should help draw people in. Since this space is open to the exterior on three sides the use of reflected light is limited. There needs to be both direct and indirect lighting within this space to limit shadowing.

5. **Light Pollution/Trespass**-Very Important
   The light from this exterior space must not trespass into the surrounding properties or interfere with the natural dark sky. Luminaires that have cutoff optics should be used to avoid lighting being emitted into the sky.

6. **Modeling of Faces or Objects**- Very Important
   It is important to model faces so that facial expressions can be seen. Multidirectional lighting should be used to help model faces by creating depth, shape, and texture. It is important to have both horizontal and vertical illuminance in this space.

7. **Peripheral Detection**-Very Important
   Anyone within this spaces needs to have to ability to see an oncoming threat in the dark. The lighting design should illuminate the perimeter of the covered entrance so that anyone within this space can see an oncoming threat in their peripheral vision. Uplighting on the columns should be used to add perimeter lighting.

8. **Point(s) of Interest**-Very Important Modeling
   The points of interest are the Crystal Lake Elementary School Sign on the exterior of this space as well as the entrance to the building. Both of these should be clearly visible to attract attention. Spot lights should be used to illuminate the school sign and wall sconces should be used to highlight the entrance to the building.

9. **Reflected Glare**-Very Important
   Reflected glare from surrounding polished or glossy surfaces should be avoided so that circulation is not inhibited. The large amount of glass on the façade of the building has the potential to produce reflected glare. Luminaires should not be aimed toward the glass.

10. **Shadows**-Very Important
    Harsh shadows should be avoided so that they do not interfere with the circulation through the space. The use of linear or area light sources should be used to minimize sharp shadows.

11. **Source/Task/Eye Geometry**-Very Important
    The source should not obstruct the person's ability to walk clearly though the space. It is important to use lenses on the luminaires so that the source does not have an effect on pedestrians.

12. **Sparkle/Desirable Reflected Highlights**-Important
    To make the space visually pleasing, there should be small points of visual interest. The use of decorative luminaires, such as wall sconces, to highlight the texture of the building façade is desirable.

13. **Surface Characteristics**-Very Important
    This space is used as both a school and a hurricane shelter. Therefore, at times of emergency this entrance will be the main circulation space to move people in and out of the building. It is important that the lighting be designed so that the quick movement of large numbers of people is smooth and easy.

14. **Illuminance (Horizontal)-** Very Important
    Category B: Performance Simple orientation for short visits, fc.

15. **Illuminance (Vertical)** -Very Important
    Category A: Public Spaces, 3 fc

16. **Power Allowance** (ASHRAE/IESNA Std. 90.1)
    Space-by-Space Method: Main Entries=30 W/linear ft. of door width
    : Canopies and Overhangs=1.25W/ft^2

17. **Controls**
    Lighting is only needed in this space during the nighttime hours. Minimal lighting at all nighttime hours would be desired for safety and more lighting will be desired for nighttime activities at the school. Therefore, there should be a timer or photosensor to turn on the minimal lighting for safety every evening. All other lighting will only be used when needed and can simply use an on/off switch.

18. **Luminance Ratios**
    Ceilings and walls should have a luminance ratio of 3:1

19. **Psychological Aspect**
    The space should feel open, welcoming, and public. It should be a good transition from the wide open outdoors into the building. The lighting design should give visitors a sense of excitement as they enter the space.

    Visual Clarity is very important to this space. It is necessary that the lighting design create uniformity on the floor for circulation and provide good perimeter lighting for safety.

C. Evaluation and Critique of the Existing Lighting Conditions

Type	BF	LLD	LDD	RSDD	Total LLF
WP	1.0	0.95	0.88	0.964	0.806
DH1G	1.0	0.83	0.88	0.964	0.704
DH1DQ	1.0	0.83	0.88	0.964	0.704

Figure 41: Light Loss Factors for Covered Entrance

1. Discussion

The Covered Entrance lighting should provide a focal point for oncoming visitors. The space is an extension of the indoor space and transitions people indoors. This space needs to be both functional and aesthetically please.

The Covered Entry currently does appear to have enough lighting the façade of the building or successfully lighting the perimeter of the space. The lighting does not intrigue visitors as they approach this space. There is some downlight available to help model faces, and provide some ambient light, but a more visually pleasing design is needed.

The main architectural feature of this building is the six architectural columns on the perimeter of the space. To assist with the need for perimeter lighting and draw attention to this space, there should be uplight on the columns.