Kean Univeristy
Union, NJ

TECHNICAL REPORT #1

NEW JERSEY CENTER FOR SCIENCE, TECHNOLOGY AND MATHEMATICS EDUCATION BUILDING

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Kean Univeristy
Union, NJ

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EXECUTIVE SUMMARY

Technical Report #1 is the first of three reports for the Fall Semester 2008 in the AE Thesis Program. This report is a study of the existing lighting systems as well as criteria for a new design for the New Jersey Center For Science, Technology, and Mathematics Education (NJCSTME) Building. This report contains three parts as well as reference drawings. Tech. Report #1 is divided up by each space, and each space has its own three parts. There are four spaces examined in this report:

Classroom 3-07
Auditorium
Lower Lobby
Outdoor Space South Lawn

The NJCSTME Building is a 6 story educational building for Kean University in Union, NJ. There are many classrooms and labs for education. The building embraces the irregular layout and shapes of today's modern architecture. The lighting in this space is meant to create a pleasant atmosphere for occupants and visitors. It is mostly recessed luminaires leaving very clean ceilings to display the architect's work.

Part #1 of this report contains existing lighting and space conditions. Initially the space is described briefly. Next the luminaires and lamps are described. Each element of the space is detailed. Pictures of materials used were displayed if they were available online. Reflectances of materials were researched online, taken from the IESNA Handbook, or assumed.

Part #2 contains all the design considerations for each space. Architectural features and other points of interests were noted in this section. Illuminance criteria from the IESNA Handbook were used. Also criteria from ASHRAE Standard 90.1were considered. The information is bulleted and has explanations for some of the criteria.

Part #3 critiques the lighting design of the building. To check illuminance criteria, the programs AutoCad 2009 and AGI32 were utilized. The spaces were modeled in AutoCad and the lighting conditions were simulated in AGI. However, only two spaces were modeled, the auditorium and classroom. A quick spot check was performed for the walkway on the outdoor space. The lobby was not spot checked because its illuminance criteria were easily met with the amount of fixtures. The aesthetic part of the design is also critiqued. This part notes whether the design reinforces the architecture or not.

At the end of each space's section, reference drawings were included. None of the drawings are to scale. No legends were included due to the size of the schematics. Please review the cover page of each discipline in the attached plans if symbol discrepancies arise.

Classroom 3-07

1.) EXISTING SPACE AND LIGHTING CONDITIONS

Description of Space

This is a simple college classroom. It seats 42 students with a desk for the teacher in the front of the classroom. The room is rectangular with approximate dimensions of 26' X 41'(Length X Width).

Luminaire, Lamps, Ballast

The luminaire used the most in Classroom 3-07 is FT-6. This is the model Equation ™ manufactured by Focal Point©. Its catalog number is FEQ-14-B-1-T5HO-S-277-G2-AL-L835-WH-CRM-JNB. It is a 1' X 4' continuous linear recessed luminaire with a direct light distribution. The rails of the Equation ™ are natural anodized metal. The reflector and housing are made of 20 gauge steel finished in a matte satin white powder coat. There is also a prismatic acrylic lens.

This luminaire contains (1) 54 W T5 high output fluorescent lamp. The CCT of the lamp is 3500K. It is equipped with an electronic program start ballast with less than 10% total harmonic distortion.

The other luminaire used in this space is PB-3. This is the model Square Horizontal Lamp 6" Downlight manufactured by Kramer Lighting ™. Its catalog number is #KL-6-SQ-1-32PLT-2SL-FF-277-DM-MC. It is a 6" aperture square recessed downlight with a direct light distribution. PB-3 has a microprism glass lens and the lower cone is die formed, satin glow, pre-finished aluminum. The housing is made of black painted heavy duty steel.

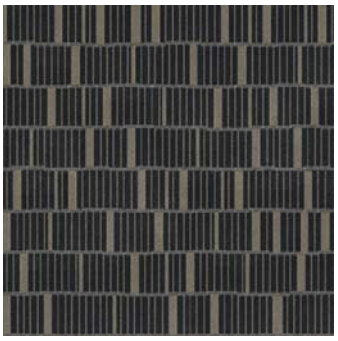
Luminaire PB-3 contains (1) 32 W triple twin tube fluorescent lamp. The CCT of the lamp is 3000K. It is equipped with a Power Line dimming ballast.

Glazing and Mullions

There are 2 ribbons of curtain wall glass across the one wall of this classroom, materials GL-1 and GL-3. GL-1 is a low emissivity glass with a clear glass substrate. It has a nominal visible light transmittance of 70%, so the reflectance is 30%. The glass is almost full height and is made mostly of GL-1. There is a small ribbon of type GL-3 glazing at the floor level. GL-3 is the same type as GL-1 only it is acid etched. The mullions have an aluminum sliver metallic finish with an assumed reflectance of 75% taken from pg. 1-22 of the IESNA Handbook.

Floor

The floor is covered with 3'x3' CPT-1 carpet tiles in the color 708 stone. It is tufted and textured loop pile carpet made of nylon. Assume its reflectance value is 0.06



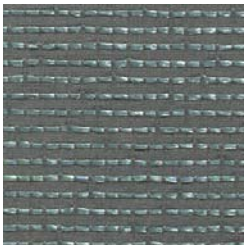
CARPET TILES

Ceiling

The ceiling is made of 2' X 4' ACT with 1' gaps between for placement of the Equation ™ 1' X 4' luminaires. The majority of the ceiling is at a height of 9'6". Near the blackboard the ceiling steps down to 8'0"and is made of white painted gypsum wall board. There is a 24" wide slot that is 12" height along the curtain wall. This slot is tucked in above the 9'6" ceiling height and holds the shade for the glazing. Assume its reflectance value is 0.75

Walls and Doors

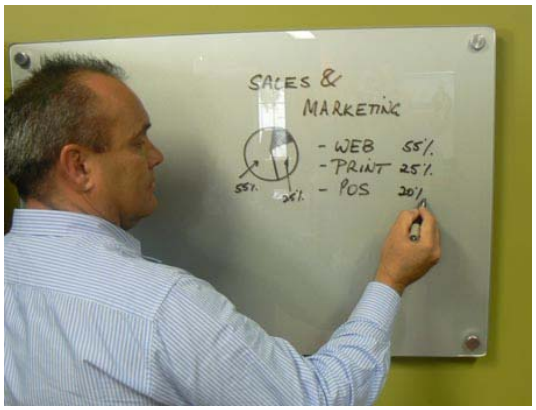
The east and west wall of the classroom is made of fabric wall panel. The material is mostly comprised of polyester Assume its reflectance value is 0.17.



PALLADIUM FABRIC WALL PANEL

A small portion near the adjacent to the glass board wall is white painted gypsum wall board. Assume its reflectance value is 0.5. The doors are made of metal with some glazing and a stainless steel kick plate near the bottom. Assume its reflectance value is 0.4

The north wall is made of painted white gypsum board. The doors on this wall are wooden with a hollow metal core type. Assume the reflectance value of these doors is 0.5. There is back painted glass writing board on the wall. Assume its reflectance value is 0.5



BACK PAINTED GLASS

The south wall is a full height glass curtain wall with silver metallic aluminum mullions. The glazing is described before in the "Glazing and Mullions" section.

Furniture

Not much information was given about the furniture in the schematics. There are tables that seat 6 people across. There are 7 of these tables which seat 42 people. Assume the tables are made out of plastic laminate with a reflectance of 0.35 and produce a diffuse light distribution. Assume the teacher's desk at the front of the classroom is made of polished wood and has a semi-specular distribution. Also an assumption was made that its reflectance is 0.4.

2.) LIGHTING DESIGN CRITERIA (Classroom 3-07)

Type of space

- Classroom-General Reading

Appearance of Space

- The appearance of the space will be very bright with full height curtain wall and white ACT ceiling
- The luminaires should be some sort of white finish to blend in with the white ACT ceiling
- Should have appearance of visual clarity
- The ceiling height drops down 1'6" right near the professor's desk and writing board in the front of the classroom

Color Appearance (Color Contrast)

- There is major contrast between the dark carpet and some of the painted white gypsum walls
- There is also contrast between the white ACT ceiling and the palladium fabric walls
- There should be a luminance contrast between the glass writing board and the other walls to draw attention (no more than 10:1)
- The lamps should have a cool CCT to keep the students awake and not feeling tired
- Warmer CCT for modeling of teacher and glass writing board at the front of the room to draw attention because daylight and the other fixture are at higher CCT's
- Luminaires should be rectangular to go along with architecture of room

Daylight Integration and Control

- This is a very important criteria seeing how the client desires a LEED certified building
- There are solar shades on the south facade for the summer so the daylight levels will be variable
- Indoor shades could be controlled as well
- Photo sensors could be installed to detect daylight levels seeing how this project will be certified LEED Gold

Direct Glare

- Will be a problem with full height south facing curtain wall
- Solar shades will be used and retractable shades indoors
- Luminaires should avoid causing veiling reflections for reading and writing tasks
- Important for projector screen because it will make trouble for students to see
- Luminaires should have prismatic lenses or louvers to properly deal with glare

Flicker and Strobe

- Not a problem with mostly indoor fluorescent lighting

Light Distribution on Surfaces

- Back painted glass writing board needs to be illuminated close to uniformity
- Walls do not have to be lit uniformly considering how classrooms will mostly be used during the day

Light Distribution on Task Plane

- Light distribution should be as uniform as possible

Luminances of Room Surfaces

- Might be a concern with darker fabric walls, because not as much diffuse light will provide comfort
- Not a concern at writing board because it is white gypsum which is highly reflective
- Minimize dark spots at tops of walls with fixtures close to wall

Modeling of Faces and Objects

- The teacher and glass writing board should be modeled so students will focus their attention onto them
- The ceiling drops down from 9'6" to 8'0" so recessed fixtures could be useful there to model the teacher and writing board
- Avoid concentrated downlighting because it causes harsh shadows

Points of Interests

- The back painted glass writing board should be the only point of interest so students will concentrate
- Accenting the glass writing board is also where the teacher will sit so lighting in this area will also model the professor's face

Reflected Glare

- Only potential is from the glass writing board from a luminaire too close to the wall it is on
    - This is important because it will be difficult for the students to see

Shadows

- Not important because no obstructions between ceiling and students' work plane

Source/Task/Eye Geometry

- Luminaires should aim directly down to floor to prevent glare in the distance when students are observing the writing board and teacher

Sparkle/Desirable Reflected Highlights

- Not important

System Control and Flexibility

- Should control for daylight
- Need a mode for when the projector is on

Illuminance (Horizontal)

- No criteria listed in IESNA handbook
- 30 fc will suffice considering the main occupants are young college students
- Daylight from the curtain wall will help the illuminance level

Illuminance (Vertical)

- Not important

ASHRAE 90.1 Requirements

- For Classroom/Lecture → 1.4 W/ft^2
- A classroom also requires an automatic light shutoff 30 minutes after people leave the space
    - An occupancy sensor of some sort will be required

3.) LIGHTING DESIGN CRITIQUE (Classroom 3-07)

Description

The fixture layout has been repeated before in some classrooms. The FT-6 linear fluorescent luminaires have a direct distribution. There are 8 rows of 5 luminaires butted up against each other. These luminaires are flush with the ceiling. They provide the general ambient illumination at a CCT of 3500 K for the students to read and write. This higher CCT works well with all the daylight entering through the south facing curtain wall.

In close proximity to the black board, the ceiling steps down in height. There are square downlights recessed in this lower section of the ceiling. The square downlights and the linear fixtures as well complement the rectangular architecture of the room. These downlights serve two purposes. The downlights are close to the north wall, so the glass board is wall washed slightly. It is beneficial that the luminaire is not angled or the reflected glare might make it difficult to see. Secondly the teacher is modeled. The warmer CCT at 3000K provide a contrast to the rest of the space, which draws the students' attention during class.

Light Loss Factors

Note : All calculations done in accordance with IESNA Handbook pp. 9-20 to 9-23. Assume all ballast factor are 1.0 unless otherwise noted. All initial and mean lumens were referenced from Osram Sylvania's Lamp and Ballast Catalog.

FT-6

- Category VI: Opaque unapertured top enclosure, translucent unapertured bottom enclosure
- Clean environment → B=0.58, A=0.078
- Assume cleaning cycle is 12 months (1 year)
- LDD = $e^{(-At^B)} = e^{[-(0.078)(1\ year)^{0.53}]}$
- LDD=0.902
- RCR ≈ 3, DD =10% → RSDD =0.98
- LLD = 4655 Mean lumens/4900 Initial Lumens = 0.95
- Total LLF = (0.902)(0.98)(0.95)(1.0 Ballast Factor) = 0.84

PB-3

- Category IV: Opaque unapertured top enclosure, translucent unapertured bottom enclosure
- Clean environment → B=0.72, A=0.07
- LDD=0.932
- RCR ≈ 3, DD ≈ 10% → RSDD =0.98
- LLD = 2064 Mean lumens/2400 Initial Lumens = 0.86
- Total LLF = (0.932)(0.98)(0.86)(1.0 Ballast Factor) = 0.785

AGI Calculations and Observations

Note: The total light loss factor was entered into the "BF" section in the "Define Luminaire" menu. The dimming level was entered into the "LLD" section in this menu. Furniture was omitted from the calculation for simplicity. The task plane was set at 3' for the calculation below.

The first calculation was performed with no dimming on any of the fixtures. The illuminance level was extremely excessive in this condition at approximately 100 fc. The linear fluorescent luminaires were dimmed to 40% to achieve an acceptable average illuminance of approximately 40 fc.

Classroom Design Conclusion

This is a general lighting design for a classroom. The luminance graph (Fig. C-2B) shows the uniform luminance on the floor which will translate to the task plane. This luminance graph also shows that the square downlight fixtures provide a contrast in luminances between other surfaces in the space. This reinforces the criteria stated earlier about how a contrast will draw attention to the writing board instead of elsewhere. Uniformity in lighting distribution is achieved despite the max/min value being high as seen in Figure C-1. This is in part due to the downlights concentrated in proximity to the glass board.

The visual clarity subjective impression is met partially. As stated earlier this lighting system is dimmed over 50 %. The can be bright with the luminaires installed as well as the full height curtain wall. There is some peripheral emphasis with the downlights at the north wall and the linear fluorescent fixtures close to the walls. However the walls are not highly reflective since they are composed of fabric.

Calculation Summary								
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min	CV
Horizontal Task Plane	Illuminance	Fc	39.28	53.1	11.6	3.39	4.58	N.A.

FIG. C-1A
CALCULATION SUMMARY OF CLASSROOM

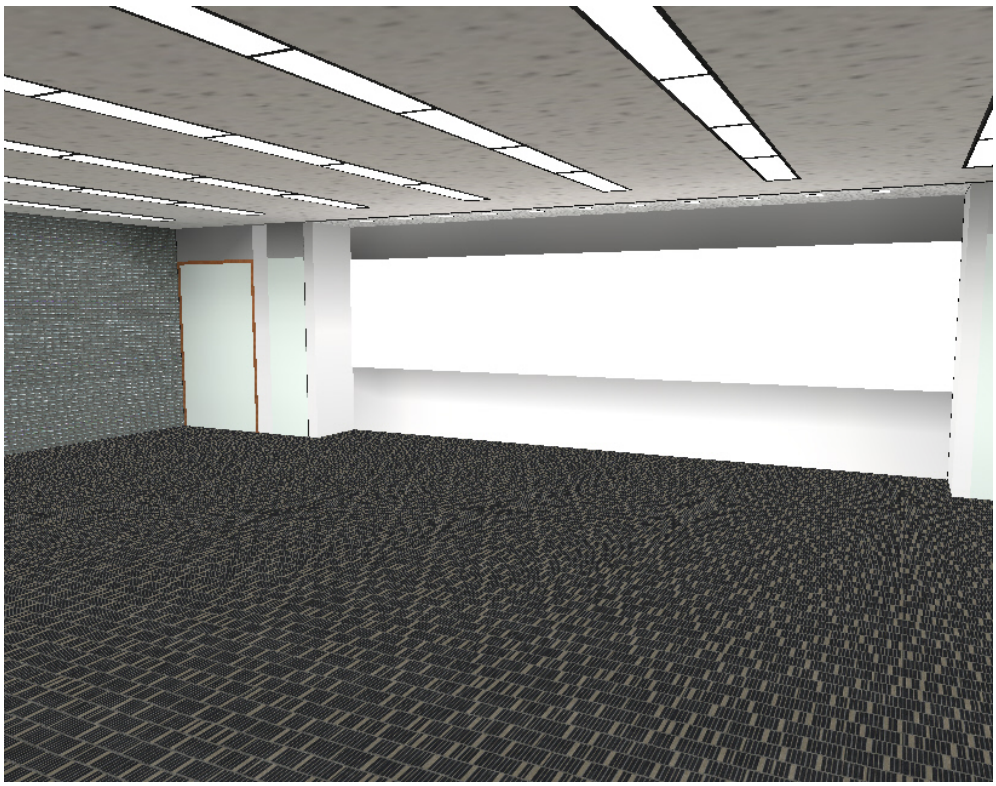


FIG. C-2A
PERSPECTIVE RENDERING OF NORTH WALL

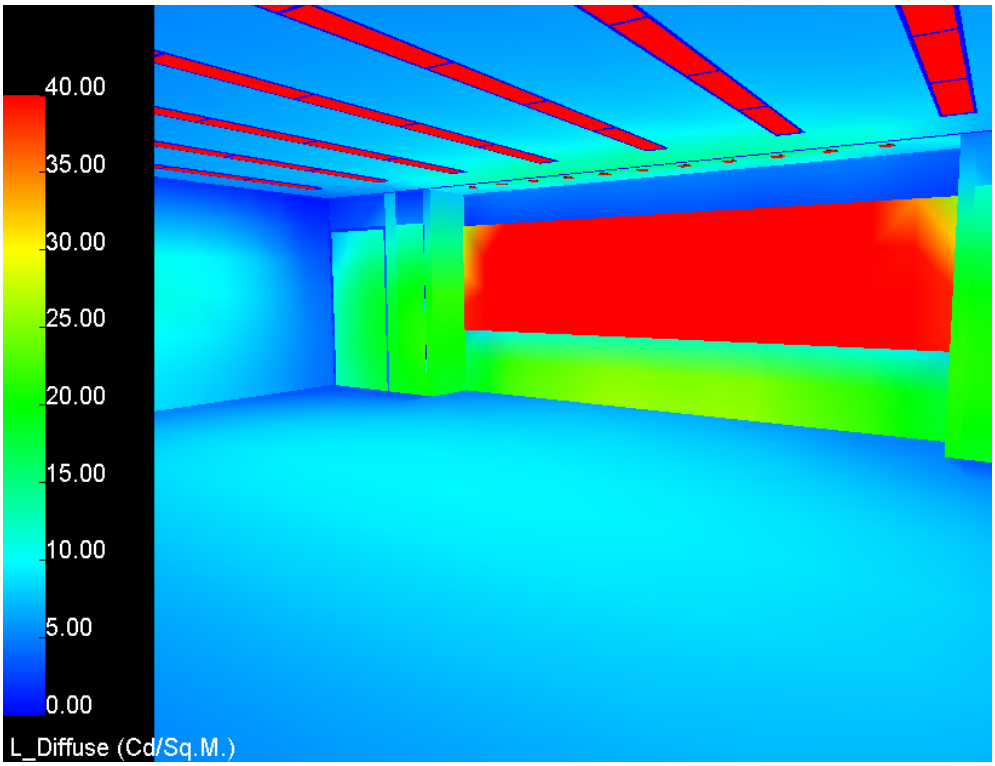


FIG. C-2B
LUMINANCE PSEUDO COLOR OF NORTH WALL

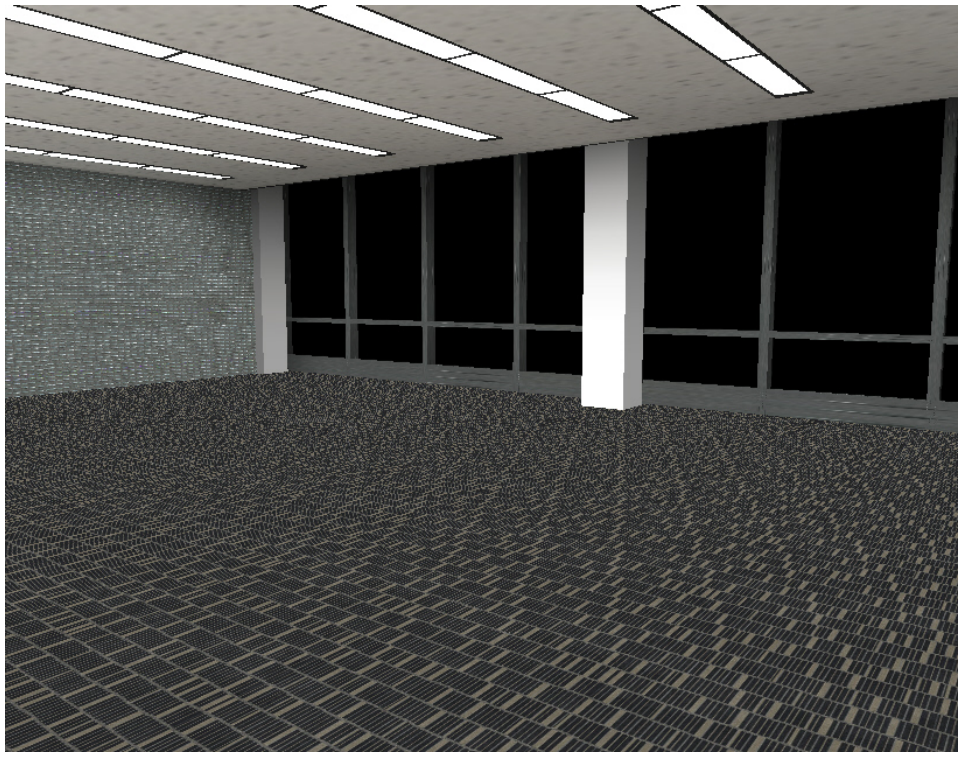


FIG. C-3A
PERSPECTIVE RENDERING OF SOUTH CURTAIN WALL

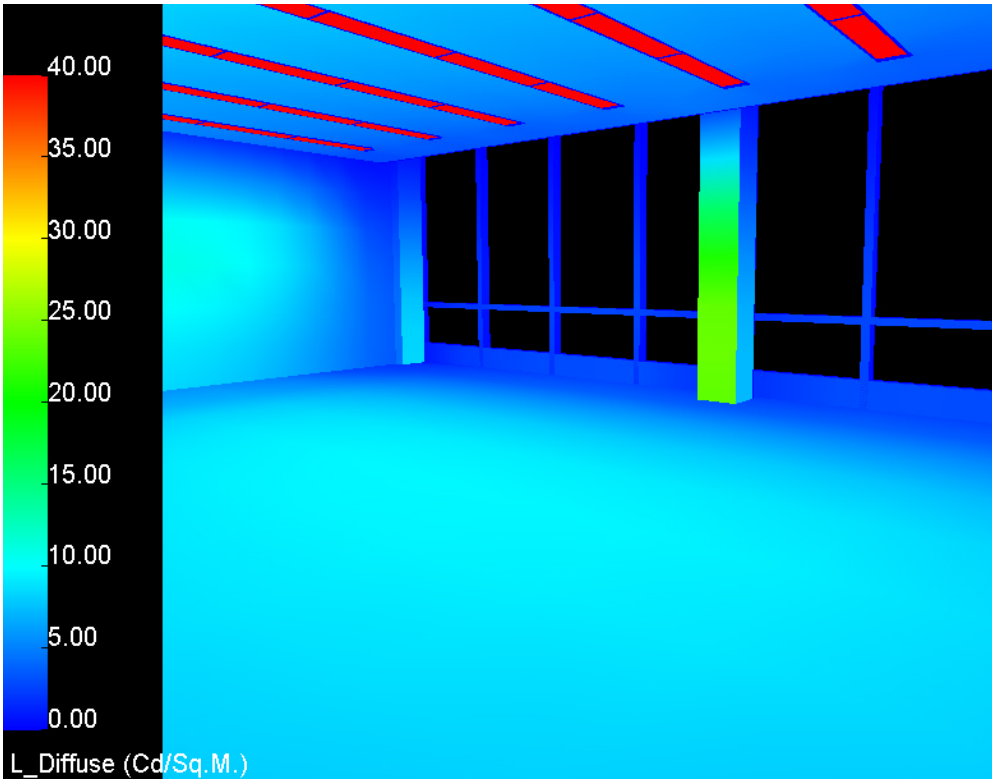
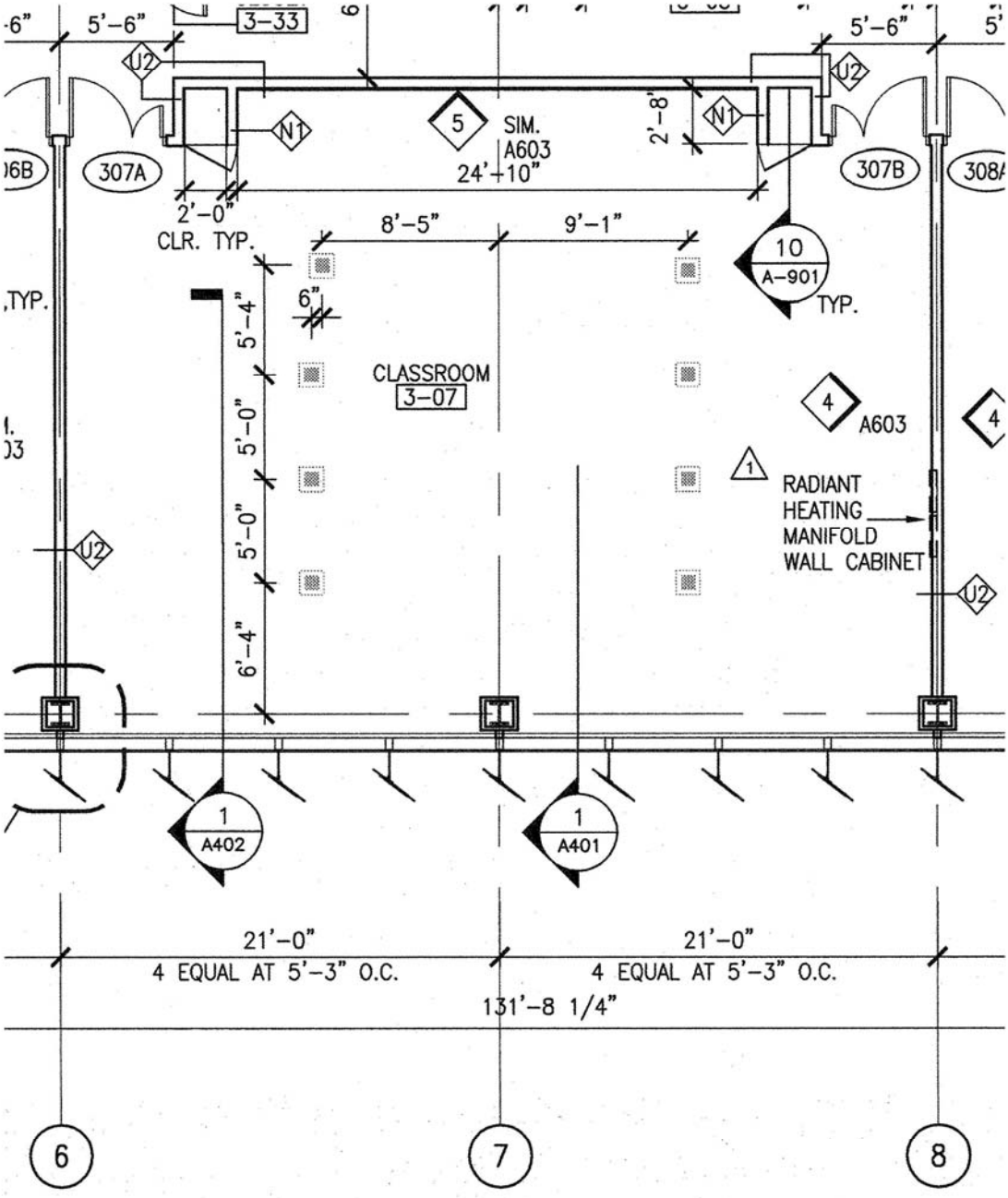
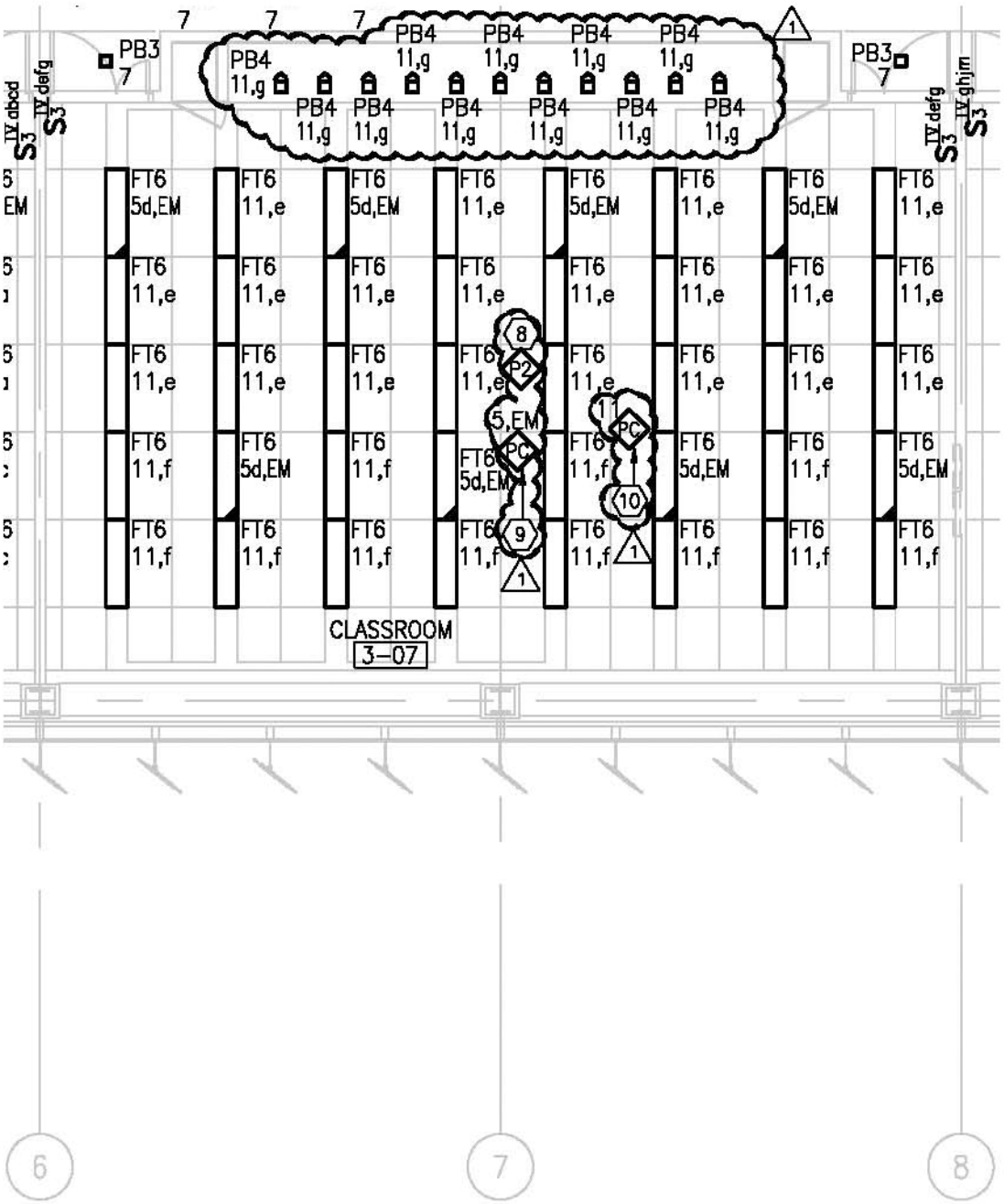


FIG. C-3B
PERSPECTIVE RENDERING OF SOUTH CURTAIN WALL

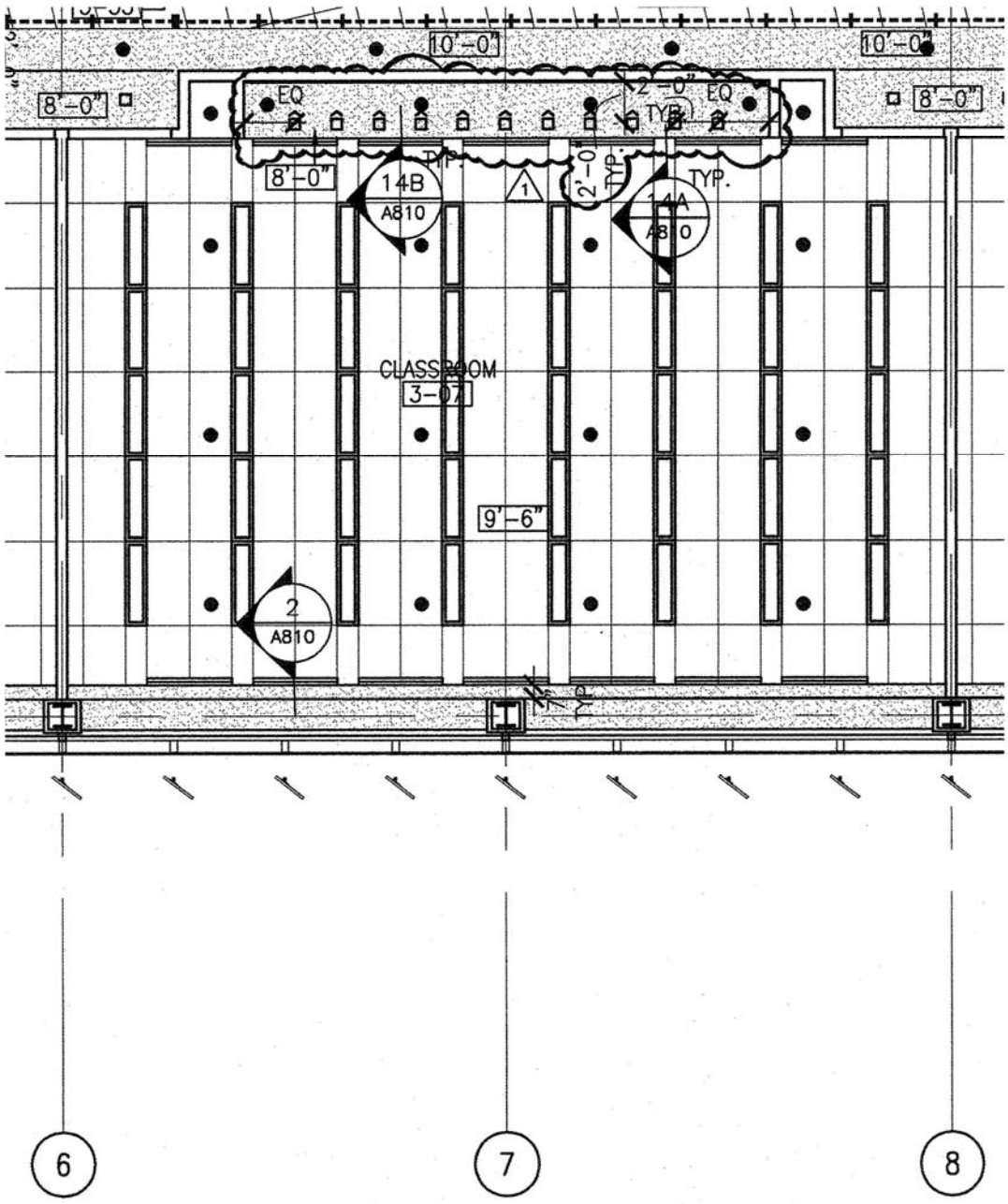
<u>Classroom Plan</u> (N.T.S.)
"Drawing A-103"



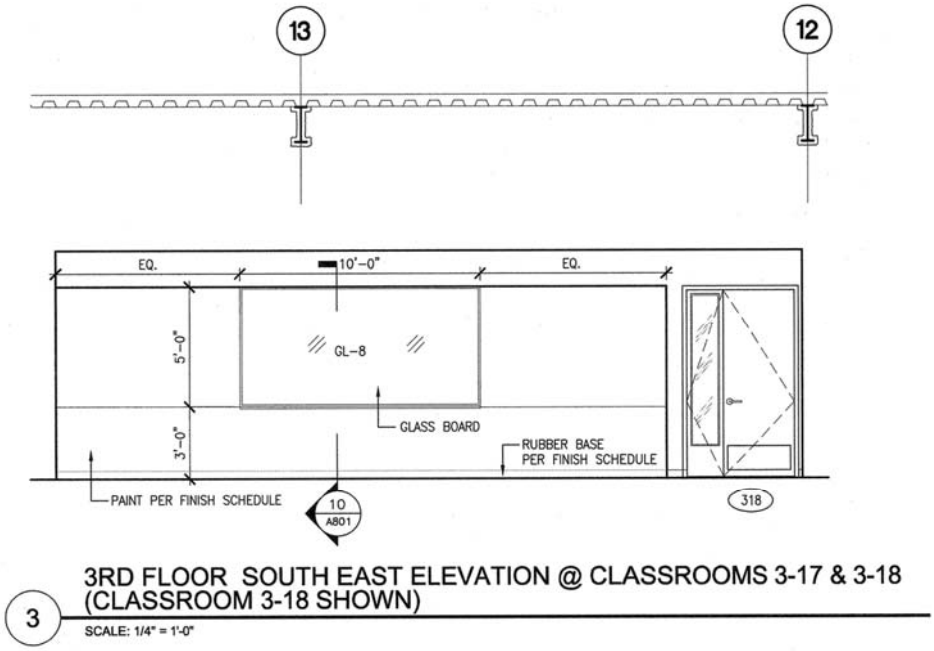
Classroom Lighting Plan
"Drawings E-103"



Classroom Reflected Ceiling Plan (N.T.S.)
"Drawing A-703"

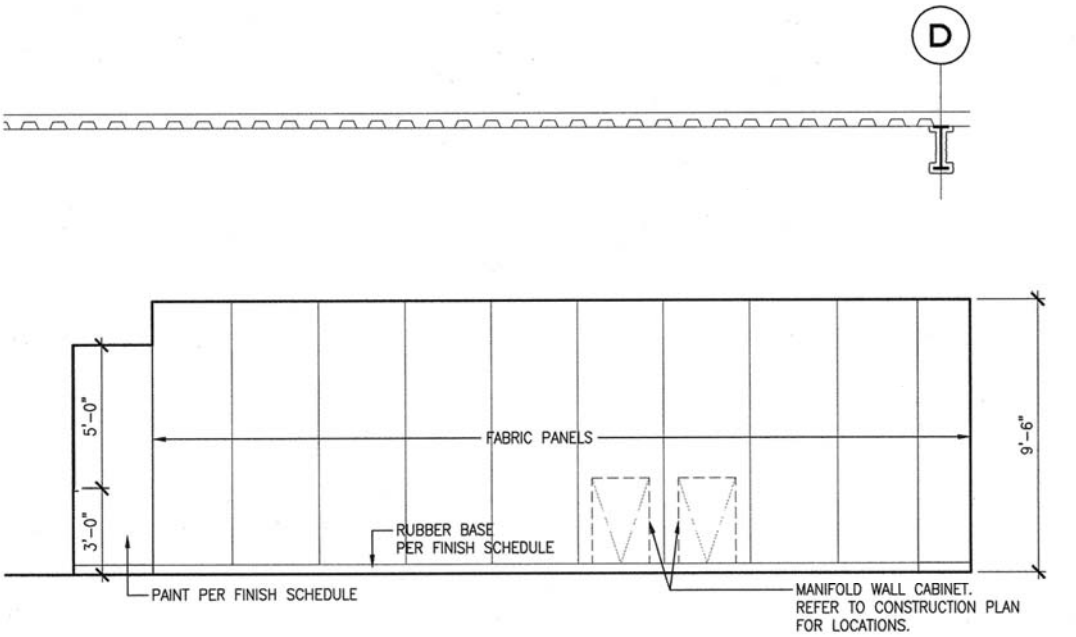


Classroom Southeast Elevation (N.T.S.)
"Drawing A-603"



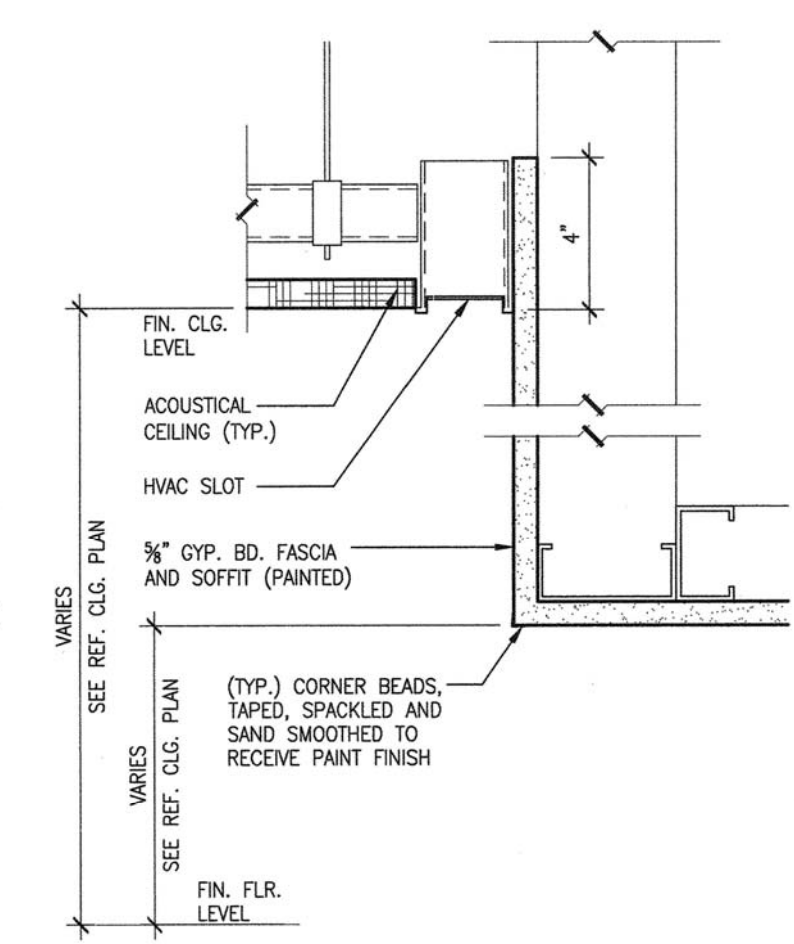
3RD FLOOR SOUTH EAST ELEVATION @ CLASSROOMS 3-17 & 3-18
(CLASSROOM 3-18 SHOWN)
3 SCALE: 1/4" = 1'-0"

Classroom East Elevation (N.T.S.)
"Drawing A-603"

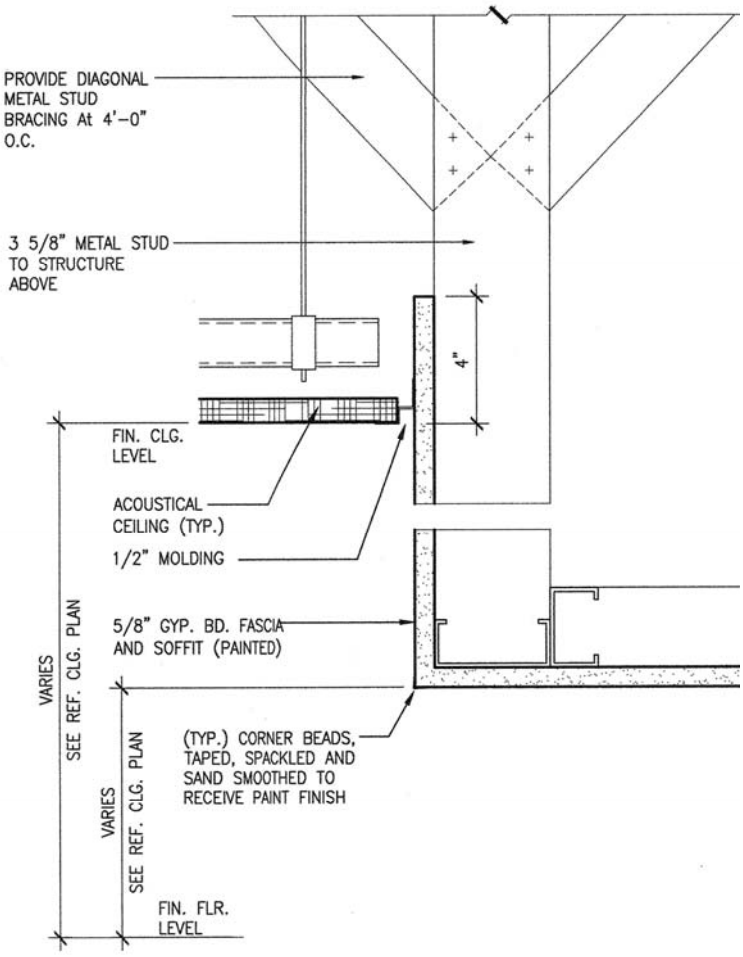


3RD FLOOR EAST ELEVATION @ CLASSROOMS 3-06, 3-07 & 3-08
(CLASSROOM 3-08 SHOWN)
4 SCALE: 1/4" = 1'-0"

<u>Ceiling Details</u> (N.T.S.)
"Drawing A-810"



14B TYPICAL CEILING DETAIL
SCALE: 3" = 1'-0"



14A TYPICAL CEILING DETAIL
SCALE: 3" = 1'-0"

Lower Lobby

1.) EXISTING SPACE AND LIGHTING CONDITIONS

Description of Space

This lobby will be the highlight of all the spaces in this building. It is a double height lobby with a 19' ceiling height. The walls in the plan north and plan south direction are partially double height curtain wall. The ceramic tile curved wall is along the plan east wall. There is a curving staircase to the second floor with glass railing and stainless steel handle. There are 8 cylindrical aluminum columns in the interior of the space. Occupants will be able to see part of the second floor exhibition space and the second floor elevator lobby with openings guarded by glass railings

Tasks

There are multiple tasks in this lower lobby building. The first task is simple lounging. Students will be there talking and possibly reading in there. There may be a welcome desk for information as well. There is no furniture in the schematics because the university is arranging the furniture and making the selections. Kean University will also hold parties and galas at times so different scenes will be needed. There will also be circulation to the elevator lobby and staircase for the occupants to get to their respected spaces in the building.

Luminaire, Lamps, Ballast

The luminaire used the most in the Lower Lobby is FQ-5. This is the model Multi-Lyte MMC manufactured by Lightolier®. Its catalog number is #MMC-2-4-E-D-*-TC8. It is a 4' X 8" luminous pendant mounted luminaire with a direct light distribution. The rails of the Equation ^{TM} are natural anodized metal. The reflector and housing are made of 20 gauge steel finished in a matte satin white powder coat. There is also a prismatic acrylic lens.

This Multi-Lyte MMC is suspended 2'6" from a trapeze in the ceiling cavity. It is suspended to the finished ceiling height.

This luminaire contains (2) 54 W T5 high output fluorescent lamp. The CCT of the lamp is **3500K**. It is equipped with a dimming ballast with less than 10% total harmonic distortion and a ballast factor of 0.87. The dimming capabilities are as low as 15% for 120V only, which it is.

Another luminaire used in this space is PT-1. This is the model Lytespan® Track Lighting 8338 Sof-Tech® Ring PAR38 manufactured by Lightolier®. Its catalog number is #8338-WH-TC8. It is a 5" track head. It has a microprism glass lens and the lower cone is die formed, satin glow, pre-finished aluminum. The housing is made of black painted heavy duty steel. FQ-6. The lamp sits in the ring slightly to cut off the light distribution slightly. It is mounted to a track system FQ-6. This is Multi-Lyte Channel MC manufactured by Lightolier®.

Luminaire PT-1 contains (1) 90 W PAR 38 lamp. The CCT of the lamp is 2950K. There is also a micro cove fixture FQ-4 in the circular cove in front of the core. This is the model Windirect™ Micro Cove Fluorescent manufactured by Winona Lighting. Its catalog number is #P1-MC-148T5-277-MCVU-RA-DM. It is a 4' nominal linear fluorescent cove fixture with an asymmetric light distribution. It has an extruded aluminum specular reflector and stainless steel hardware.

This luminaire contains (**1 or 2**) 28 W T5 fluorescent lamp. The CCT of the lamp is **3500K**. It is equipped with a dimming ballast. The dimming capabilities are as low as 10%.

At the southeast corner of the lower lobby in the café area, FQ-2 fixtures are hung from the ceiling. This is the model Enigma 825 manufactured by Louis Poulsen Lighting. Its model number is #ENIG825-1/70W/CMH/T-6 G12-120/277V. It is a pendant mounted luminaire designed to illuminate spaces with high ceilings. It has a protective glass shield and injection molded matte white, opal acrylic shades which make it a glare free fixture with diffuse light. It has a spun aluminum reflector and white powder coat finish.

Inside this fixture is (1) 70W ceramic metal halide lamp. It has a cool CCT of 4200K. There is only a normal ballast for this fixture.

FQ-4 fixtures are placed in the curved cove at the elevator core wall. This is the model Micro Cove Fluorescent manufactured by Windirect™. Its model number is #P1-MC-148T5/HO-277. It is an 8" wide linear fluorescent micro cove fixture with an asymmetric distribution. It has an anodized extruded aluminum specular reflector and stainless steel hardware.

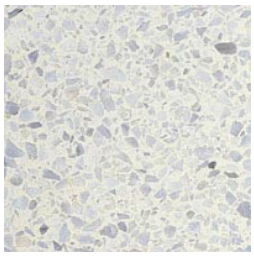
The luminaire contains (1) T5 high output lamp with a CCT of 3500 K. It contains an integral ballast.

Glass Curtain Wall

There is double height curtain wall in this space. The glass is only the type GL-1. GL-1 is a low emissivity glass with a clear glass substrate. It has a nominal visible light transmittance of 70%, so the reflectance is 30%. The mullions have an aluminum sliver metallic finish with an assumed reflectance of 75% taken from pg. 1-22 of the IESNA Handbook.

Floor

The floor is made of TZ-1 Terazzo tile. The size of the tile is 11-13/16" X 11-13/16". TZ-1 is a custom selection with no picture, so for future renderings assume it is TZ-2 with its picture shown below.



TERAZZO TILE

Ceiling

The ceiling is 2'x8' fiberglass plank with slots running the entire width of the building for the light in the ceiling to shine through. There are also slots along the perimeter of the lobby. Assume its reflectance value is 0.8.

FIBERGLASS PLANK CEILING

There are 2' wide openings between each row of ceiling tiles running north and south the length of the lobby. There are fluorescent luminaires (FQ-5) pendant mounted in these openings to the finish ceiling height of the lobby. There is a cove along the circular elevator core wall made of painted white gypsum.

Walls

Most of the walls in the lobby are made of the double height curtain wall described previously. Some of the east walls are white painted gypsum wallboard. The elevator lobby walls are made of a plastic laminate panel PLAM-1 with silver leaf finish.

PLASTIC LAMINATE PANELS

The elevator circular core walls consist of a ceramic tile pattern of the following colors:

CT-1: Vanniglia

CT-1A: Cacao

CERAMIC TILE PATTERN COLORS

CT-1B: Lavangna 

CT-1C: Paprika 

CT-1D: Oceano 

CERAMIC TILE PATTERN COLORS

Stairs and Railings

The monumental staircase curves going up to the 2nd floor. The stairs made of stainless steel and railings made of clear glass GL-6. The railings for the exhibition space on the second floor are made of this material as well. The 2nd floor elevator lobby railings visible in the lobby are made of double side mirror back acid etched glass GL-9. The stairs are made of terrazzo tile TZ-1 stated above in the floor section.

2.) LIGHTING DESIGN CRITERIA (Lower Lobby)

Appearance of Space

- This lobby will be the highlight of all the spaces in this building
- The luminaires should be some sort of white finish to blend in with the ceiling
- Should have a feeling of spaciousness and grandeur
- Also should have a modern feel with white ceiling and tiles and glass railings

Color Appearance (Color Contrast)

- There needs to be 2 different CCT lamps for this space for different functions
- During the daytime it is a general lobby, so a cooler CCT will complement the daylight from the curtain wall glazing
- There will be events such as galas held at night, so a cooler CCT will not suffice for the event mood
- These events need a warmer CCT
- There is contrast between the ceramic tile wall and the rest of the space

Daylight Integration and Control

- This is a very important criteria seeing how the client desires a LEED certified building
- There are solar shades on the south façade (south wall of the lobby) for the summer so the daylight levels will be variable
- Photo sensors could be installed to detect daylight levels seeing how this project will be certified LEED Gold

Direct Glare

- Will be a problem in winter with low sun angles and double height south facing curtain wall
- Not a problem with luminaires because ceiling height is so high at 19’

Flicker and Strobe

- Not a problem with mostly indoor fluorescent lighting

Light Distribution on Surfaces

- Uniformity is not required in the lobby with all the daylight
- There will be lounging and light reading in the lobby but other than that, during the day it will mostly be a circulation space
- Non-uniformity during events such as galas at night

Light Distribution on Task Plane

- This is not an important because there no set tasks in this space

Luminances of Room Surfaces

- Might be a concern with darker fabric walls, because not as much diffuse light will provide comfort
- Not a concern at writing board because it is white gypsum which is highly reflective
- Minimize dark spots at tops of walls with fixtures close to wall

Modeling of Faces and Objects

- Need speakers modeled during gala events
- Ceramic tile wall on circular core needs to stand out
    - Very beautiful Italian tile, so the lighting should bring out its exquisiteness

Points of Interests

- Speaker podium during events
- Café area and millwork
- Elevator lobby needs lighting that makes it stands out and to draw visitors for circulation
- Monumental staircase

Reflected Glare

- Could get some reflected glare near with luminaires at curtain wall
- Not significant issue considering the large ceiling height

Shadows

- Will be some shadows from the aluminum columns but uniformity is not required in a lobby

Source/Task/Eye Geometry

- Ceiling height makes this problem not significant

Sparkle/Desirable Reflected Highlights

- The ceramic tile wall should be highlighted as well as the stairs
- The elevator lobby and the café should be highlighted as well for circulation

System Control and Flexibility

- 2 modes for daytime and night functions
- 2 different lighting systems required with different CCT's and dimming capabilities

Illuminance (Horizontal)

- It is somewhat like an office lobby so use criteria C (10 fc)

Illuminance (Vertical)

- The lobby requirement for an office is very minimal so disregard this criteria

ASHRAE 90.1 Requirements

- For Classroom/Lecture → 1.3 W/ft^2

3.) LIGHTING DESIGN CRITIQUE (Lower Lobby)

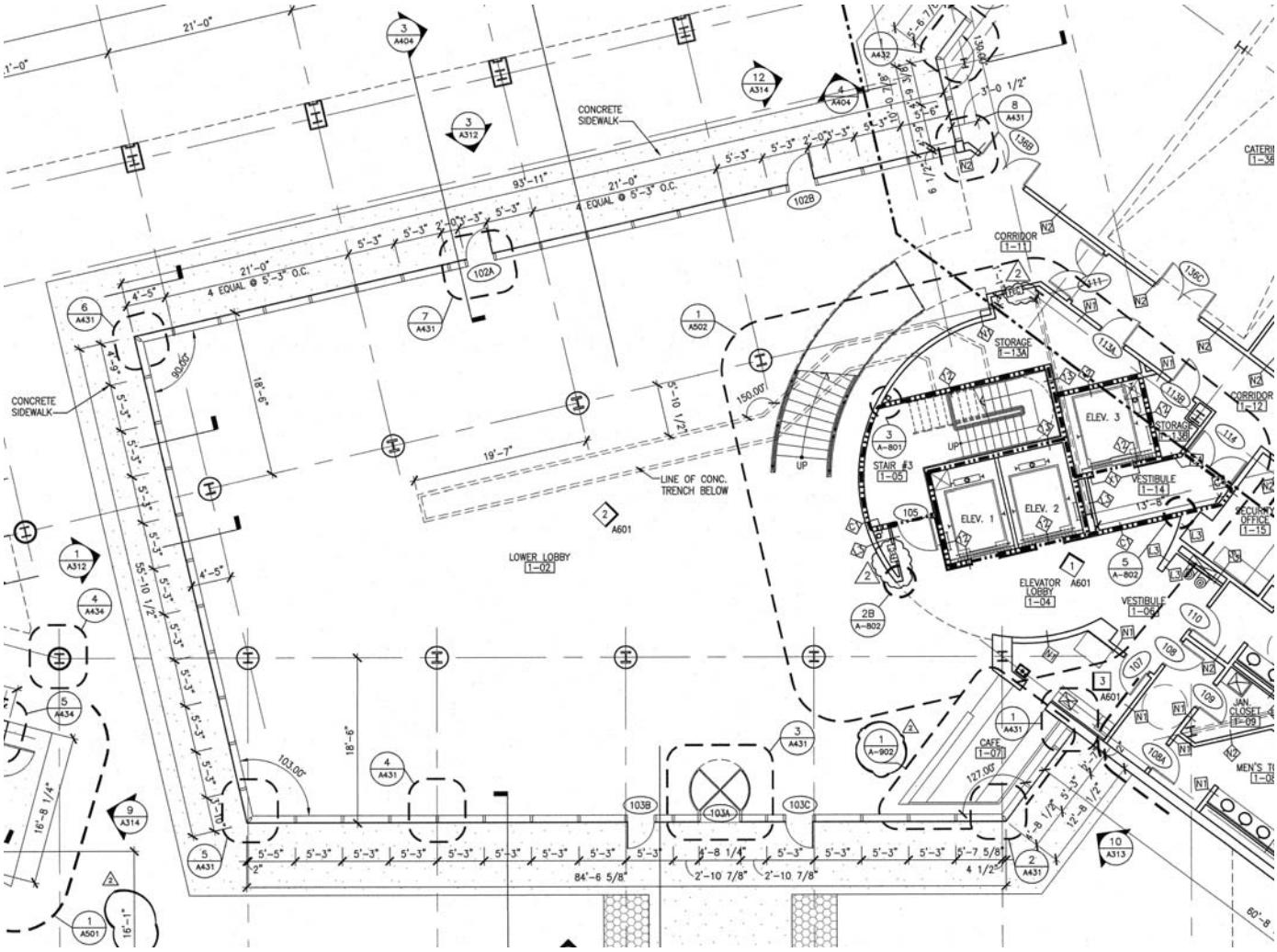
Description/Critique

This fixture layout is very similar to the classroom. There are ceiling rows of ceiling tiles with gaps between each row for the FQ-5 fixtures butted up against each other. The only difference is that the ceiling 2'x8' fiberglass planks and it is a double height ceiling. These fixtures are hung from the ceiling. The track with the halogen lamp fixtures runs along these slots as well. There is a halogen lamp between every fluorescent one.

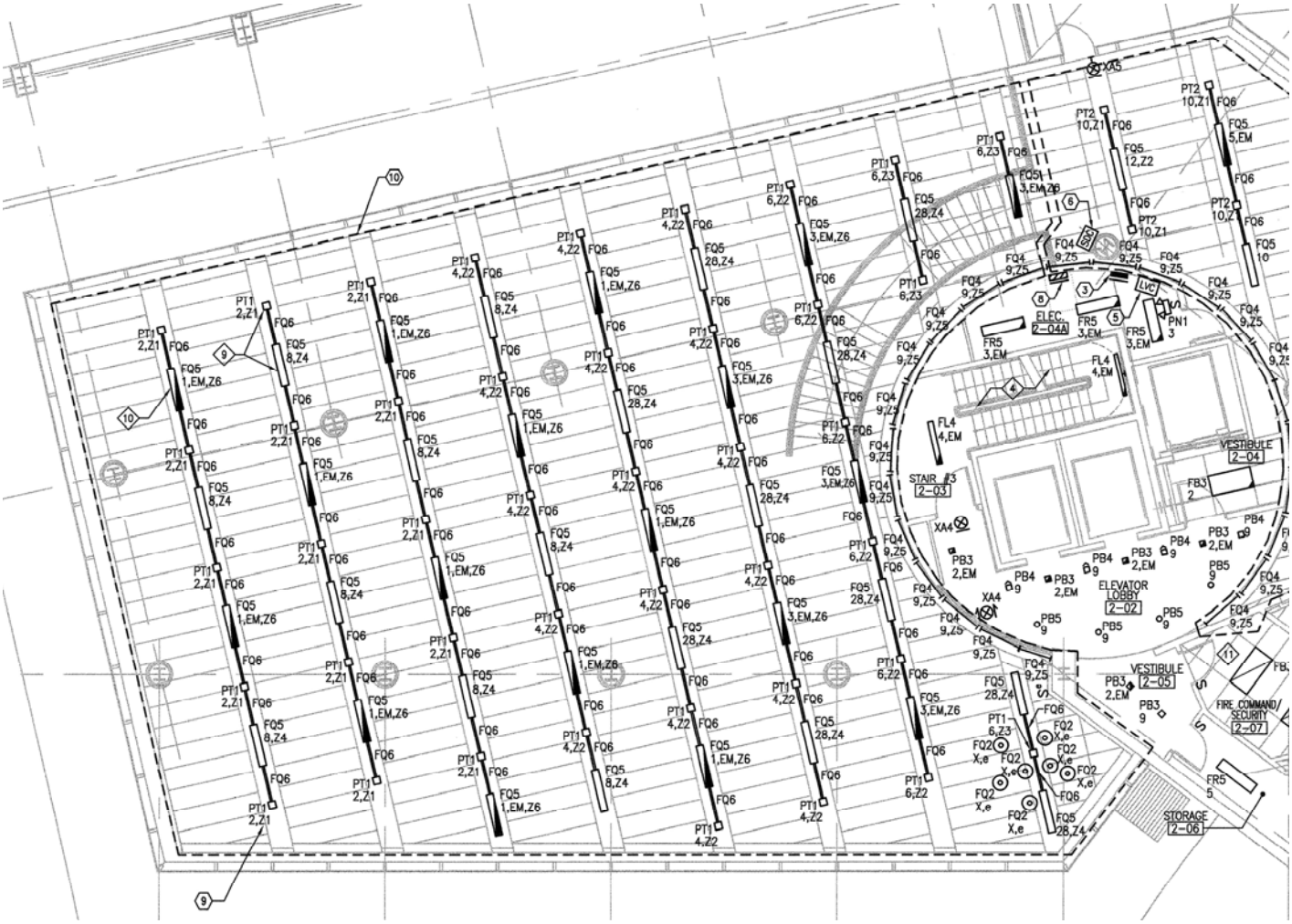
The café has very elegant fixtures suspended from the ceiling. This helps it stand out for circulation and as a point of interest. Also the cove lighting highlights the ceramic tile wall another important criteria. The ceiling height is tall enough that the direct fixtures make a good choice. The linear fluorescent fixture has 3500K lamps and the downlights for events have 3000K lamps which enforces the criteria as well.

Overall this design is very well done. The architectural pattern of the white ceiling planks should not be broken up with a suspended fixture. The luminaires are hidden within the ceiling and people only see the light and not the fixture, which is always desired. Illuminance values and uniformity are not important criteria in a lobby. For the amount of fixtures in this space, it can meet the 10 fc criteria with ease.

<u>Lower Lobby Plan</u> (N.T.S.)
"Drawing A-101"

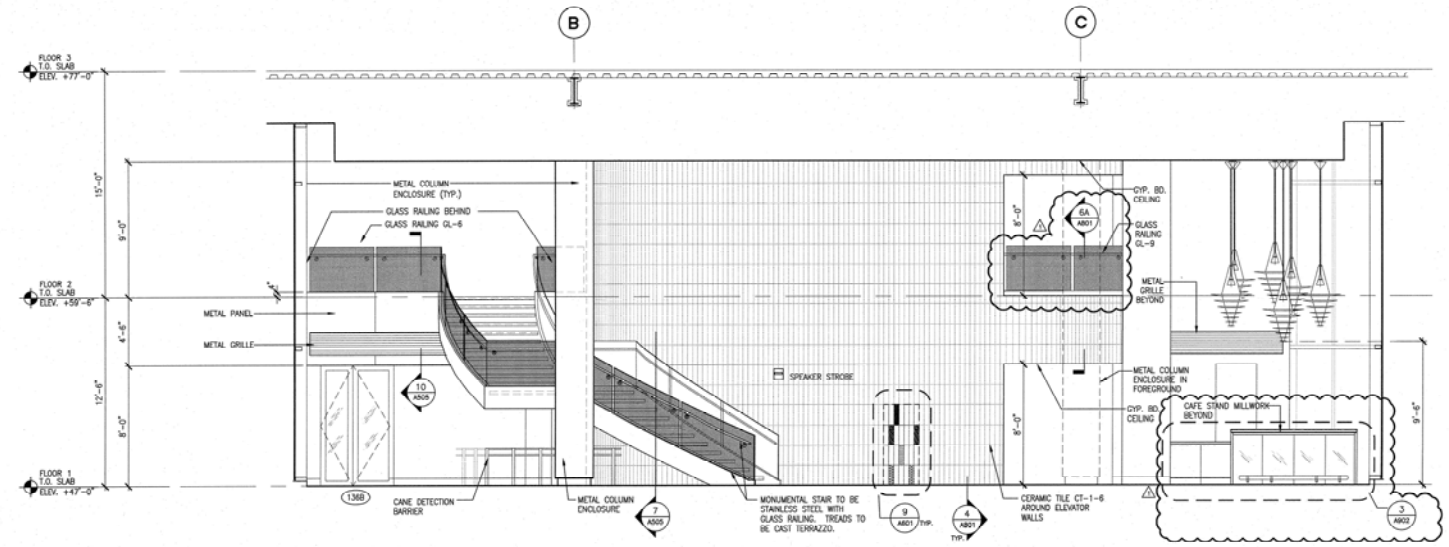


<u>Lower Lobby Lighting Plan</u> (N.T.S.)
"Drawing E-102"



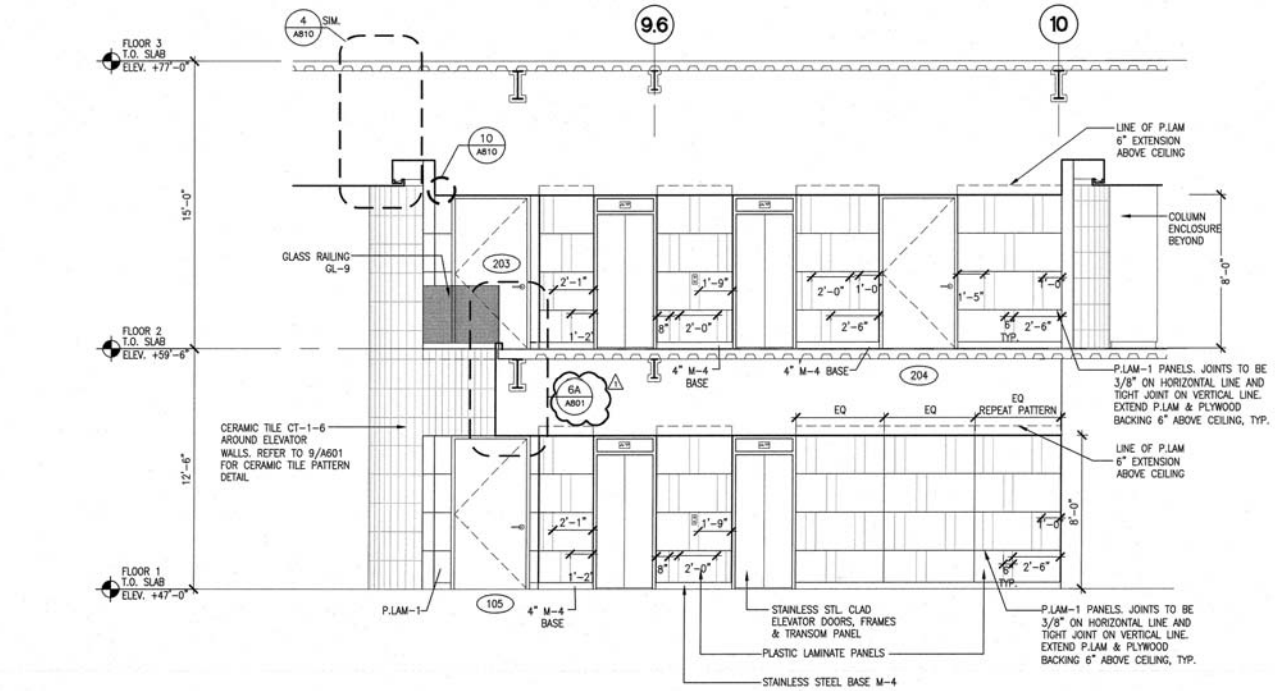
<u>Lower Lobby Reflected Ceiling Plan</u> (N.T.S.)
"Drawing A-702"

Lower Lobby 1ST AND 2ND FLOOR ELEVATION (N.T.S.)
"Drawing A-601"



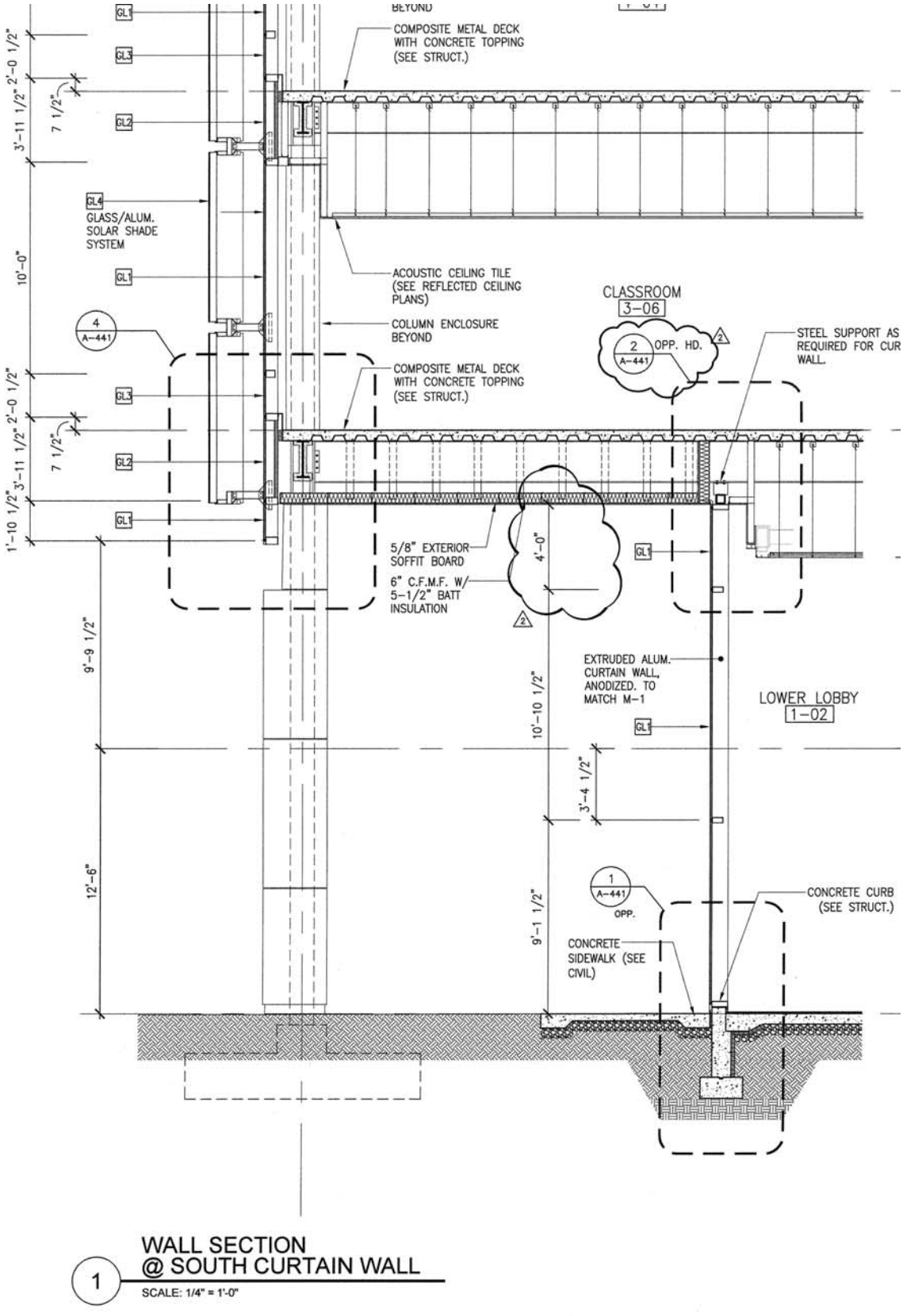
2 1ST AND 2ND FLOOR LOWER LOBBY ELEVATIONS
SCALE: 1/4" = 1'-0"

Lower Lobby 1ST And 2ND Floor Elevator Lobby Elevation (N.T.S.)
"Drawing A-601"



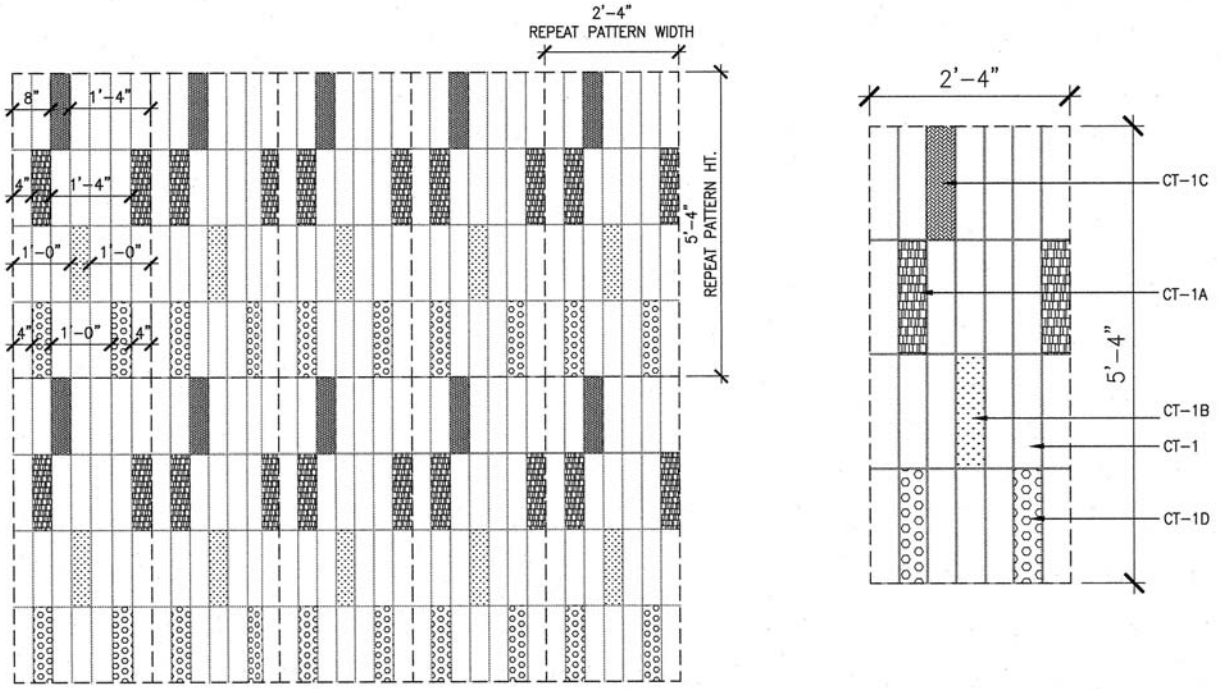
1 1ST AND SECOND FLOOR ELEVATOR LOBBY NORTH ELEVATIONS
SCALE: 1/4" = 1'-0"

<u>Lower Lobby Section South Curtain Wall</u> (N.T.S.)
"Drawing A-402 Detail #1"



1 WALL SECTION @ SOUTH CURTAIN WALL
SCALE: 1/4" = 1'-0"

<u>Lower Lobby Ceramic Tile Pattern</u> (N.T.S.)
"Drawing A-402 Detail #1"



9 CERAMC TILE PATTERN @ ELEVATOR CORE & PROJECTION ROOM
SCALE: 1/4" = 1'-0"
(PROVIDE LAYOUT DRAWING INDICATING PATTERN)

Auditorium

1.) EXISTING SPACE AND LIGHTING CONDITIONS

Description

This lecture hall has approximately 280 students with fold out desks. The ceiling has multiple slopes with heights ranging from 8', 10', 11.5', 12', and 12.5'. It has a jagged shape when viewed in section. There are three sections of seats with two aisles. There is a stage area where most likely a teacher will have a desk onto which he or she will place his belongings. The walls are made of acoustic material for sound absorption to prevent echoes. The walls have a jagged shape in plan for acoustic reflections. The floors are made of carpet with a rubber base underneath. There is also a projector room which will house the projector and controls for presentations.

Tasks

There are multiple tasks in this auditorium building. First and foremost there are many desks. There will be approximately 280 students reading and writing in this classroom during lectures. This is an important task to consider for lighting design criteria. The projection screen is another important task for the students. There must not be a lot of glare. The professor also has to read his own lecture notes on his podium/desk and talk to the class on a microphone system.

Luminaire, Lamps, Ballast

One luminaire used in the auditorium is PB-8. This is the model Recessed Fluorescent Square Horizontal Lamp Downlight manufactured by Kramer Lighting ™. Its catalog number is # KL-8-SQ-2-57PLT-2SL-FF-277-DM-MC. It is an 8" aperture square recessed downlight with a direct light distribution. It has a microprism glass lens and the lower cone is die formed, satin glow, pre-finished aluminum. The housing is made of black painted heavy duty steel.

Luminaire PB-8 contains (2) 42 W triple tube compact fluorescent lamps. The CCT of the lamp is not listed in the schedule, but the wall washers of the same manufacturer are at 3000K, so assume this is the CCT for PB-8. It is equipped with a Power Line dimming ballast.

Another luminaire used in this space is PB-2. This is the model Recessed Fluorescent Square Horizontal Lamp Lensed Wall Wash manufactured by Kramer Lighting ™. Its catalog number is # KL-8-SQ-2-42PLT-LWW-FF-277-DM-MC. It is an 8" aperture square recessed downlight with a direct light distribution. It has a prismatic glass lens and the lower cone is die formed, satin glow, pre-finished aluminum. The housing is made of black painted heavy duty steel.

Luminaire PB-2 contains (2) 42 W triple twin tube fluorescent lamp. The CCT of the lamp is 3000K. It is equipped with a Power Line dimming ballast.

There is a track lighting system close to the stage with track head PT-3. This is the model ProSpec ™ Track Lighting Cylinder PAR38 manufactured by Lightolier®. Its catalog number is #26038WH. The track head has a matte white finish. It has (1) 250W PAR38 lamp. It has an aluminum cross blade baffle. The track system has dimming capabilities as well.

For the stage lighting, PB-9 is the luminaire selected. This is the model Recessed Incandescent PAR Adjustable Downlight manufactured by Kramer Lighting ™. Its catalog number is # KL6-75PAR30-ADJ-CFF-MC. It is a 6" aperture adjustable accent luminaire with a direct light distribution. It has a specular clear finish and aluminum cone. The housing is made of black painted heavy duty steel.

Luminaire PB-9 contains (1) 75 W PAR30 incandescent lamp. The CCT of the lamp is not listed in the schedule, but the wall washers of the same manufacturer are at 3000K, so assume this is the CCT for PB-9.

FQ-4 fixtures are placed in the curved cove at the projection room wall. This is the model Micro Cove Fluorescent manufactured by Windirect™. Its model number is #P1-MC-148T5/HO-277. It is an 8" wide linear fluorescent micro cove fixture with an asymmetric distribution. It has an anodized extruded aluminum specular reflector and stainless steel hardware.

The luminaire contains (1) T5 high output lamp with a CCT of 3500 K. It contains integral ballast.

The projection room and hall behind the stage have luminaires of the type PB-3. This is the model Recessed Fluorescent Square Horizontal Lamp Downlight manufactured by Kramer Lighting ™. Its catalog number is # KL-6-SQ-2-32PLT-2SL-FF-277-DM-MC. It is a 6" aperture square recessed downlight with a direct light distribution. It has a microprism glass lens and the lower cone is die formed, satin glow, pre-finished aluminum. The housing is made of black painted heavy duty steel.

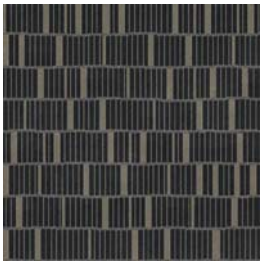
Luminaire PB-8 contains (1) 32 W triple tube compact fluorescent lamp. The CCT of the lamp is not listed in the schedule, but the wall washers of the same manufacturer are at 3000K, so assume this is the CCT for PB-8. It is equipped with a Power Line dimming ballast.

FT-4 is a strip light in a cove between ceiling height transitions. This is the model Linear T5 Fluorescent manufactured by Bartco Lighting. The housing is 20 gauge steel with a reflective powder white finish.

The lamps were not specified but assume it is (2) 28W fluorescent T5 lamps and a dimming ballast.

Floor

The stage floor is composed of wood flooring WS-1. It is maple custom grade strip flooring. The rest of the auditorium flooring is covered in carpet CPT-1. The floor is covered with 3'x3' carpet tiles in the color 708 stone. It is tufted and textured loop pile carpet made of nylon.



3' x 3' CARPET TILES

Ceiling

The ceiling is mostly 2'x6' glass fiber reinforced gypsum panel. These panels have perforations for acoustical purposes. The ceiling has multiple slopes with heights ranging from 8', 10', 11.5', 12', and 12.5'. It has a jagged shape when viewed in section.

Walls

Most of the walls in the auditorium are finished with painted white gypsum board. There are 4 different types of TEXAA acoustic panel for sound absorption. A large amount of this material is used in the rear of the room to control the sound reverberation time from the speaker system.

ACOUSTIC PANEL

The curved projection room wall has the exact same ceramic tile pattern as mentioned in the "Walls" section of the Lower Lobby on page 31 of this report.

2.) LIGHTING DESIGN CRITERIA (Auditorium)

Appearance of Space

- This is a large lecture hall so it should have a feeling of spaciousness
- The luminaires should be some sort of white finish to blend in with a lot of the gypsum wall board ceiling
- Where there is exposed ceiling, the luminaires finish should be darker to blend in because the ceiling plenum is obviously not illuminated

Color Appearance (Color Contrast)

- There needs to be 2 different CCT lamps for this space for different functions
- There is a general lecture mode where 3500 K CCT will be used
- For a presentation on the projector screen, the CCT should be warm (3000 K)
- There is contrast between the TEXXA acoustical covering and the gypsum wall board
- There is also contrast between the metal fascia and

Daylight Integration and Control

- There are no windows in this lecture hall

Direct Glare

- There is a concern at the projector screen for the students visibility
- There should not be a lot of spill light near the projector which will cause too high of a vertical illuminance hindering the students' ability to see

Flicker and Strobe

- Not a problem with mostly indoor fluorescent lighting

Light Distribution on Surfaces

- Uniformity is desired for reading and writing which will be the main tasks
- Uniform vertical illuminance on the projector as well
- Walls do not have to be uniform

Light Distribution on Task Plane

- This should be uniform for reading and writing

Luminances of Room Surfaces

- The projector screen should have a lower illuminance compared to the other walls so the images are clear

Modeling of Faces and Objects

- Professor needs to be modeled at his desk for presentations
- Curved projector room wall with ceramic tile should be washed

Points of Interests

- Projector screen during presentations
- Teacher and is desk are points of interest when not in presentation mode
- Curved ceramic tile wall is an interesting sight when students exit the auditorium

Reflected Glare

- Could get some reflected glare near with luminaires at curtain wall
- Not significant issue considering the large ceiling height

Shadows

- No problems with shadows

Source/Task/Eye Geometry

- Luminaires should not have steep vertical angles
    - This will cause the screen to be illuminated to high
    - Has the potential for glare with the students

Sparkle/Desirable Reflected Highlights

- The ceramic tile wall should be highlighted

System Control and Flexibility

- One mode for general lecture
- Another mode for presentations on the large projector screen

Illuminance (Horizontal)

- IESNA recommends category C for an assembly auditorium (10 fc)
    - This will work for presentation mode
- For general lecture and note taking with young students who have good eyesight, 30 fc should suffice

Illuminance (Vertical)

- IESNA recommends category A for vertical illuminance (5 fc)
- This is a good value for the walls and the spill light from fixtures even if they are direct will achieve this criteria
- On the projector there should be less than 5 fc for visibility reasons

ASHRAE 90.1 Requirements

- For Classroom/Lecture → 1.4 W/ft^2
- A classroom also requires an automatic light shutoff 30 minutes after people leave the space
    - An occupancy sensor of some sort will be required

3.) LIGHTING DESIGN CRITIQUE (Auditorium)

Description

The auditorium lighting design has system flexibility incorporated. The main lighting is from square downlights throughout the space. These downlights have dimming capabilities for different scenes. There are four rows of five downlights in a gypsum board ceiling.

The architecture of the ceiling is staggered leaving coves for luminaires. The FT-4 linear strip fixture works well in this cove. This washes an otherwise dark ceiling due to the fact that there are recessed downlights and no indirect luminaires.

The track fixtures are for the stage area. The stage could have science presentations that the professor will perform. The track heads are adjustable to illuminate the stage floor. There are recessed downlights that wash the walls of the stage as well.

There are also fixtures tucked into the circular cove wall of the projection room. The recessed downlights in the back corner of the auditorium provide wall washing.

Light Loss Factors

Note : All calculations done in accordance with IESNA Handbook pp. 9-20 to 9-23. Assume all ballast factor are 1.0 unless otherwise noted. All initial and mean lumens were referenced from Osram Sylvania's Lamp and Ballast Catalog.

FT-4

- Category V: Translucent unapertured top enclosure, opaque unapertured bottom enclosure
- Clean environment → B=0.53, A=0.128
- Assume cleaning cycle is 12 months (1 year)
- LDD = $e^{(-At^B)} = e^{[-(0.078)(1\ year)^{0.53}]}$
- LDD=0.88
- RCR
  - Room is not rectangular (approximately 61' x 53')
  - Area = 3233 SF
  - Ceilings of different height all have approximately the same area so average them after averaging the sloped ceiling heights
  - Average ceiling height ≈ 10.5 ft
- RCR ≈ 2, DD ≈ 10% → RSDD =0.90
- LLD = 4655 Mean lumens/4900 Initial Lumens = 0.95
- Total LLF = (0.88)(0.9)(0.95)(1.0 Ballast Factor) = 0.75

PB-2

- Category IV: Opaque unapertured top enclosure, translucent unapertured bottom enclosure
- Clean environment → B=0.72, A=0.07
- LDD=0.932
- RCR ≈ 2, DD ≈ 10% → RSDD =0.98
- LLD = 2670 Mean lumens/3200 Initial Lumens = 0.834
- Total LLF = (0.932)(0.98)(0.834)(1.0 Ballast Factor) = 0.76

PB-3

- Category IV: Opaque unapertured top enclosure, translucent unapertured bottom enclosure
- Clean environment → B=0.72, A=0.07
- LDD=0.932
- RCR ≈ 2, DD ≈ 10% → RSDD =0.98
- LLD = 2064 Mean lumens/2400 Initial Lumens = 0.86
- Total LLF = (0.932)(0.98)(0.86)(1.0 Ballast Factor) = 0.785

PB-9

- Category IV: Opaque unapertured top enclosure, translucent unapertured bottom enclosure
- Clean environment → B=0.72, A=0.07
- LDD=0.932
- RCR ≈ 2, DD ≈ 10% → RSDD =0.98
- LLD = 1000 Mean lumens/1100 Initial Lumens = 0.91
- Total LLF = (0.932)(0.98)(0.91)(1.0 Ballast Factor) = 0.83

PT-3

- Category IV: Opaque unapertured top enclosure, louvers bottom enclosure
- Clean environment → B=0.72, A=0.07
- LDD=0.932
- RCR ≈ 2, DD ≈ 10% → RSDD =0.98
- LLD = 4200 Mean lumens/5000 Initial Lumens = 0.84
- Total LLF = (0.932)(0.98)(0.84)(1.0 Ballast Factor) = 0.77

PB-8

- Category IV: Opaque unapertured top enclosure, translucent unapertured bottom enclosure
- Clean environment → B=0.72, A=0.07
- LDD=0.932
- RCR ≈ 2, DD ≈ 10% → RSDD =0.98
- LLD = 2670 Mean lumens/3200 Initial Lumens = 0.834
- Total LLF = (0.932)(0.98)(0.834)(1.0 Ballast Factor) = 0.76

AGI Calculations and Observations

Note: The total light loss factor was entered into the "BF" section in the "Define Luminaire" menu. There was no dimming on this calculation. Furniture was omitted from the calculation for simplicity. The task plane was set at 3' for the calculation below. There was no IES file for fixture FT-4, so FQ-4 was substituted in place of it because it is a cove fixture.

The calculation was performed with no dimming on any of the fixtures. The illuminance level has no chance of being low in the middle of the auditorium. The side sets of seats had potential for lighting problems and the rear vestibule near the projection room. The average illuminance was well over the 30 fc criteria at both of these spaces. However, the dimming capabilities of the square recessed fixture enable the occupants to lower the illuminance when necessary. A calculation was only performed for the left seating area and the back vestibule.

Classroom Design Conclusion

This is a very flexible lighting design for this space. The light distribution on the floor is very uniform as the criteria requires for reading and writing. Direct luminaires were the best choice because an indirect fixture would have an irregular light distribution with a sloped and jagged ceiling. The tall ceiling eliminates the problem of harsh shadows with downlighting.

The jagged and sloped ceiling stands out the most out of all the architectural features. The ceiling was highlighted with a linear fluorescent strip fixture. A cove fixture with an asymmetric light distribution could perform better by placing more light on the ceiling. The curved ceramic tile wall is another point of interest was highlighted. The cove fixture was implemented to wash this feature.

For different science presentations the track lighting is a great feature. It helps wash the walls along with the recessed fixture to make the stage uniformly lit as possible, which is an important criterion. The walls are uniformly washed as seen in Fig. A-2B.

The auditorium walls were a major criteria missed. They are washed in proximity by the PB-8 downlight, but this is not sufficient. A wall wash fixture could have been used to supplement the downlight for this part. Overall the design is good for this auditorium.

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Right Seats_Right Seats_1	Illuminance	Fc	46.32	83.1	26.1	1.77	3.18
Carpet_1_Back Vestibule	Illuminance	Fc	31.27	81.4	4.8	6.51	16.96

FIG. A-1A
CALCULATION SUMMARY OF CLASSROOM

FIG. A-2A
PERSPECTIVE RENDERING OF STAGE

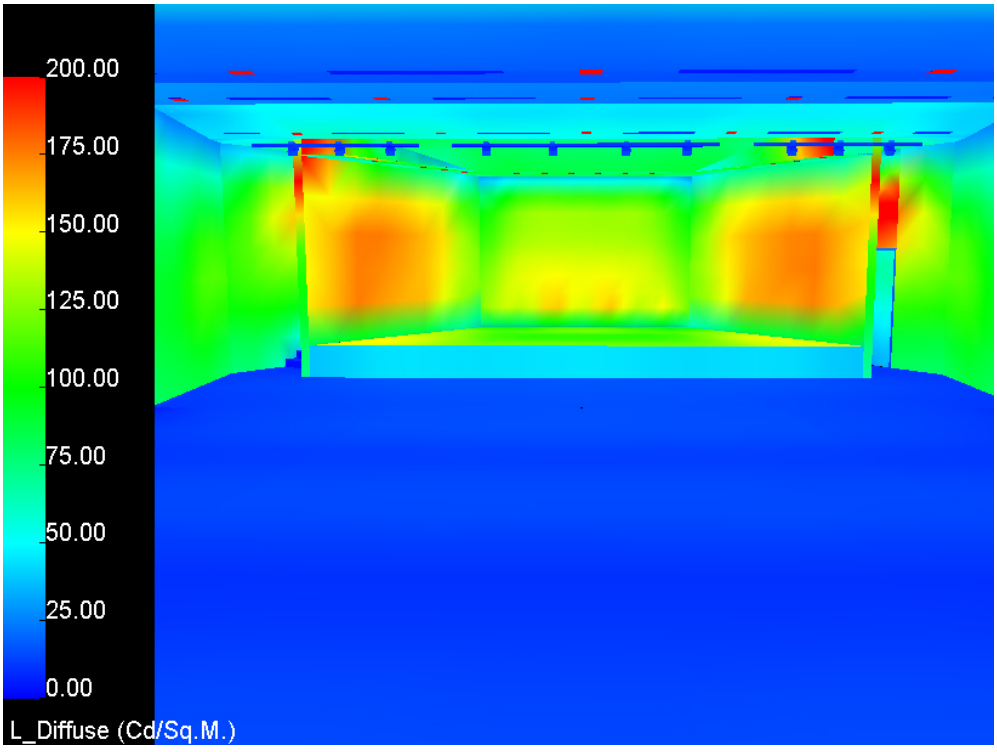


FIG. A-2B
LUMINANCE PSEUDO COLOR OF STAGE WALLS

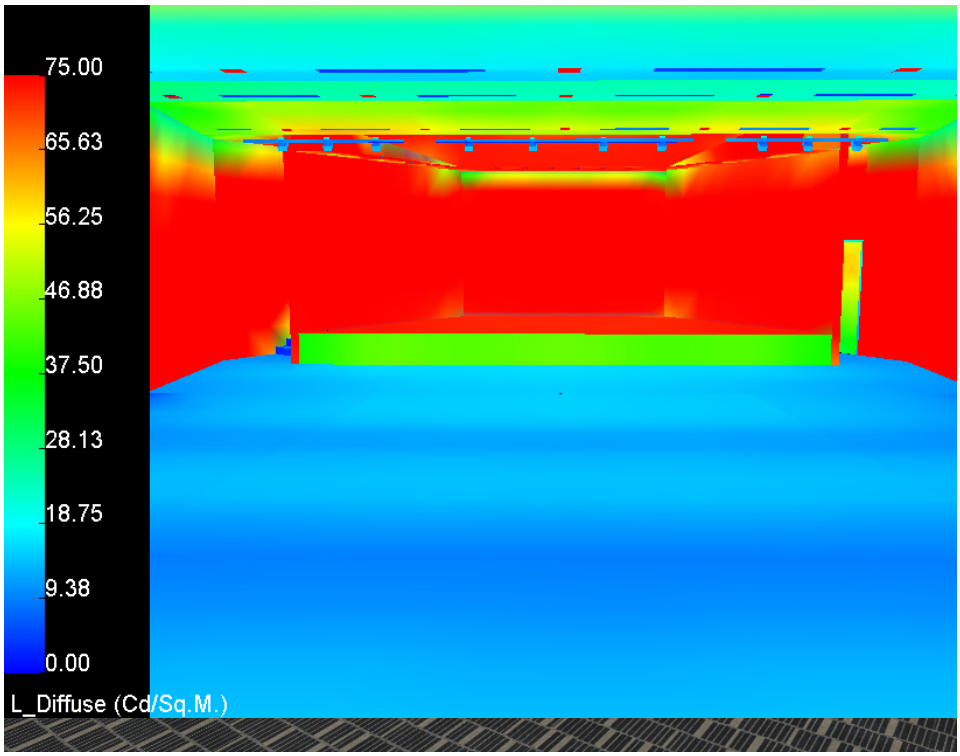
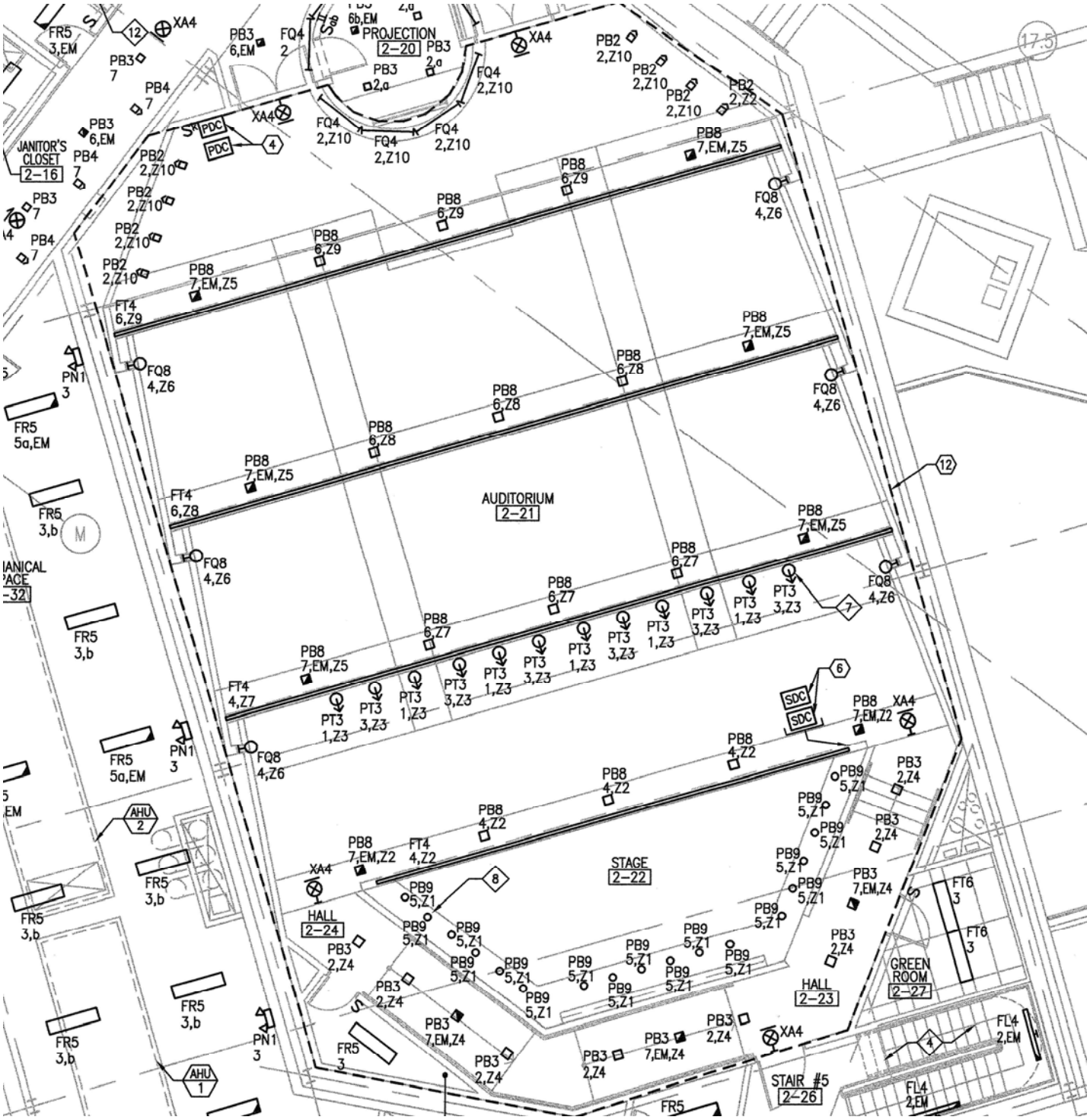


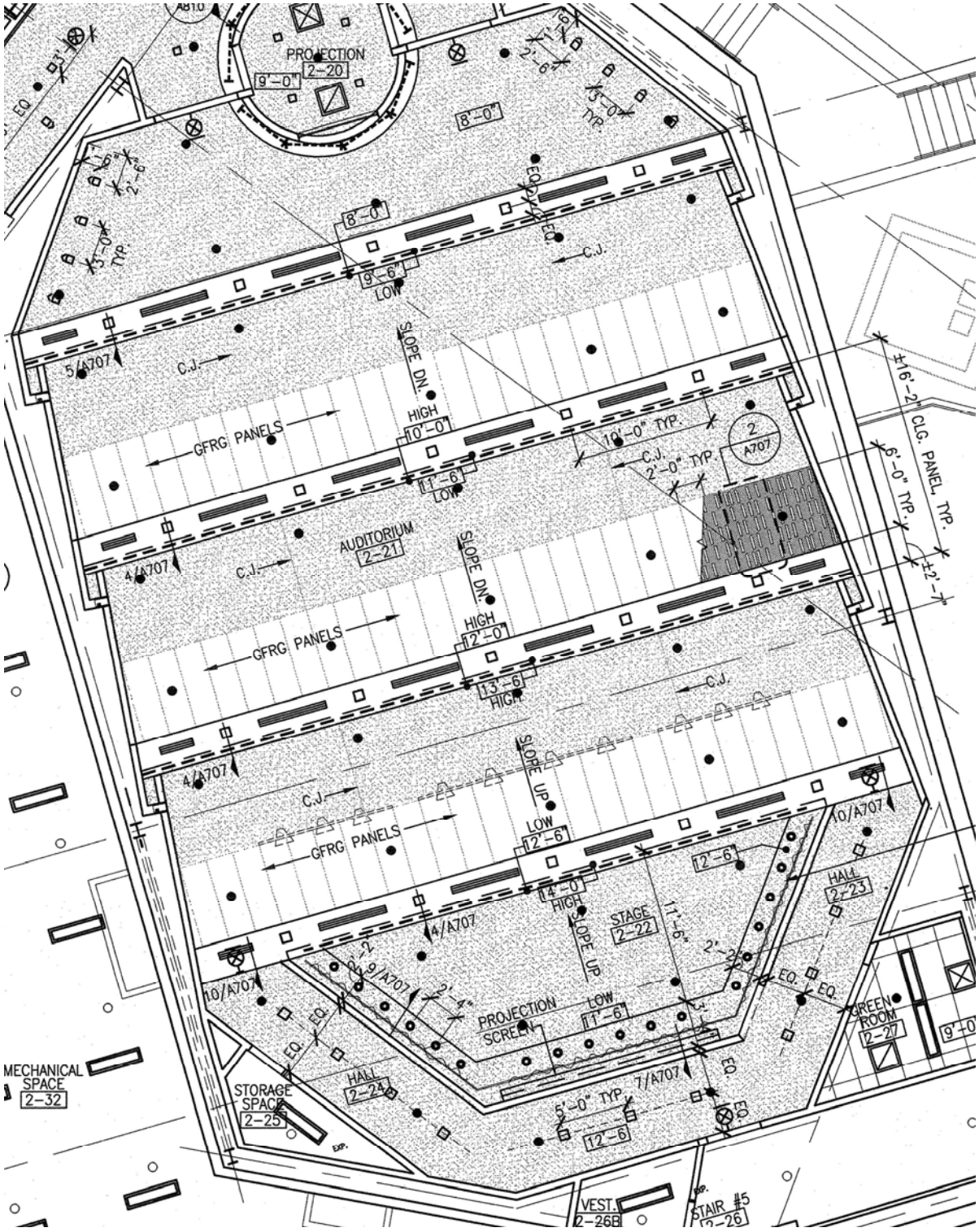
FIG. A-2C
LUMINANCE PSEUDO COLOR OF FLOOR

<u>Auditorium Enlarged Plan</u> (N.T.S.)
"Drawing A-201"

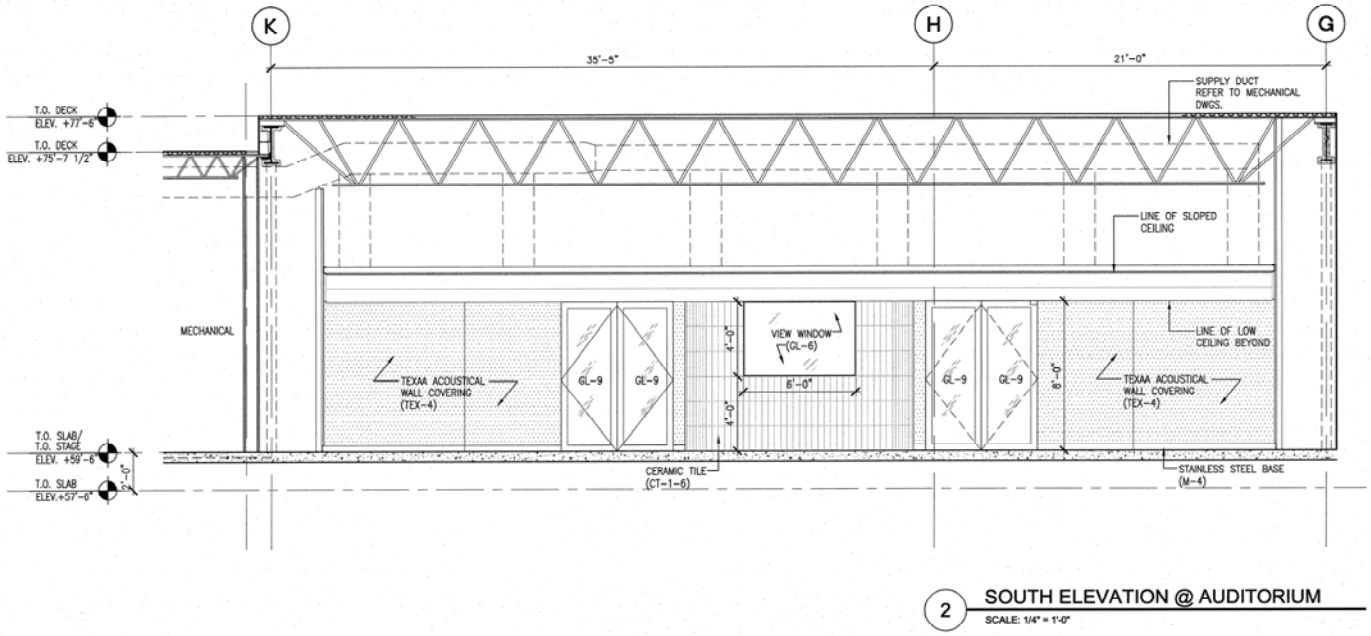
<u>Auditorium Lighting Plan</u> (N.T.S.)
"Drawing E-102"



Auditorium Reflected Ceiling Plan (N.T.S.)
"Drawing A-702"

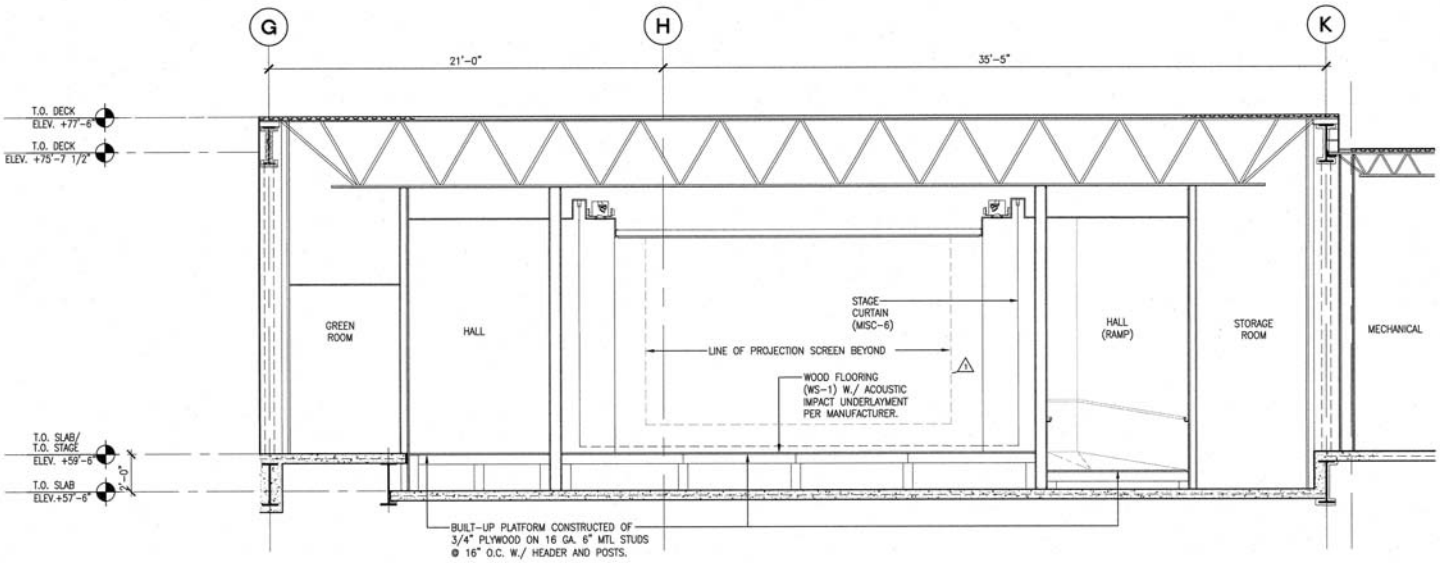


Auditorium South Elevation (N.T.S.)
"Drawing A-201"



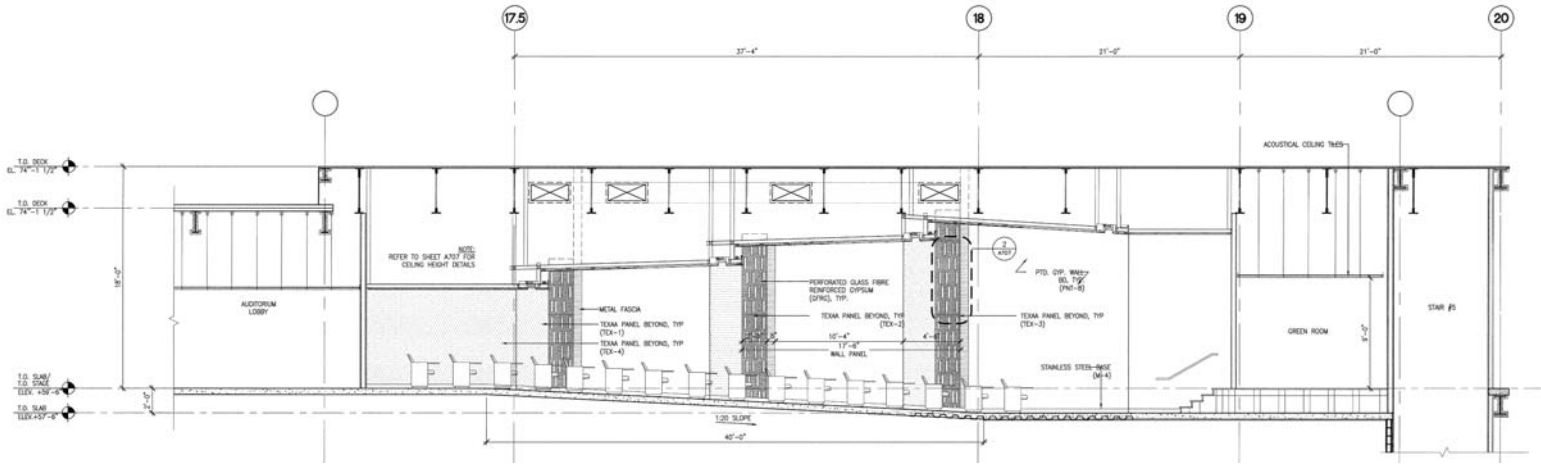
2 SOUTH ELEVATION @ AUDITORIUM
SCALE: 1/4" = 1'-0"

Classroom North Elevation (N.T.S.)
"Drawing A-201"

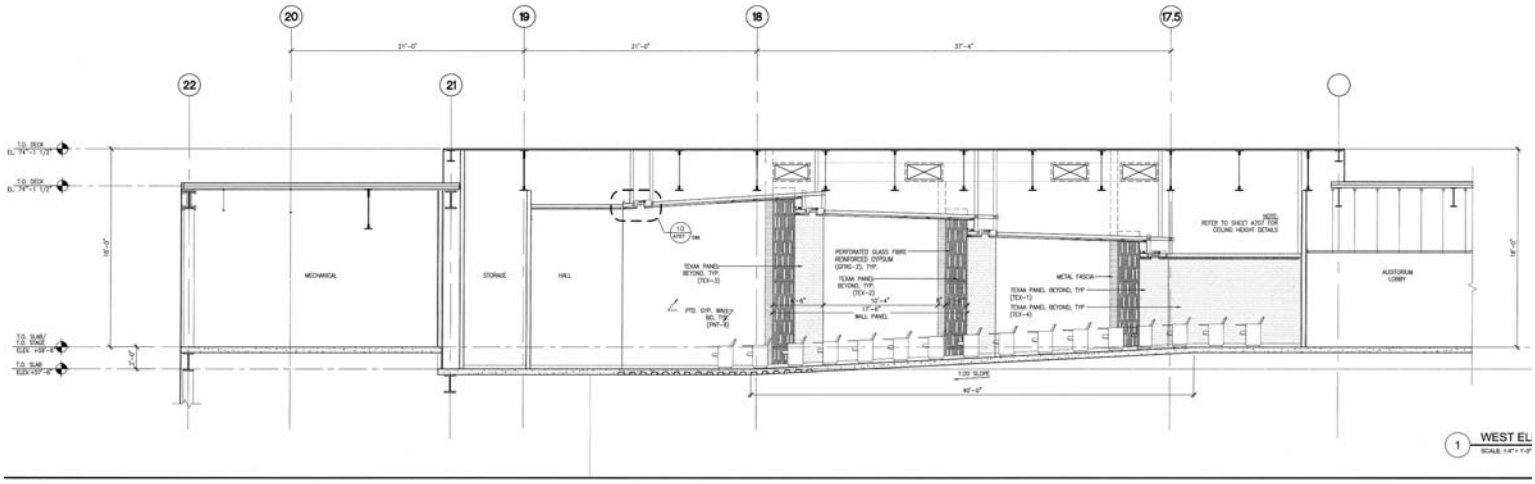


3 NORTH ELEVATION @ AUDITORIUM
SCALE: 1/4" = 1'-0"

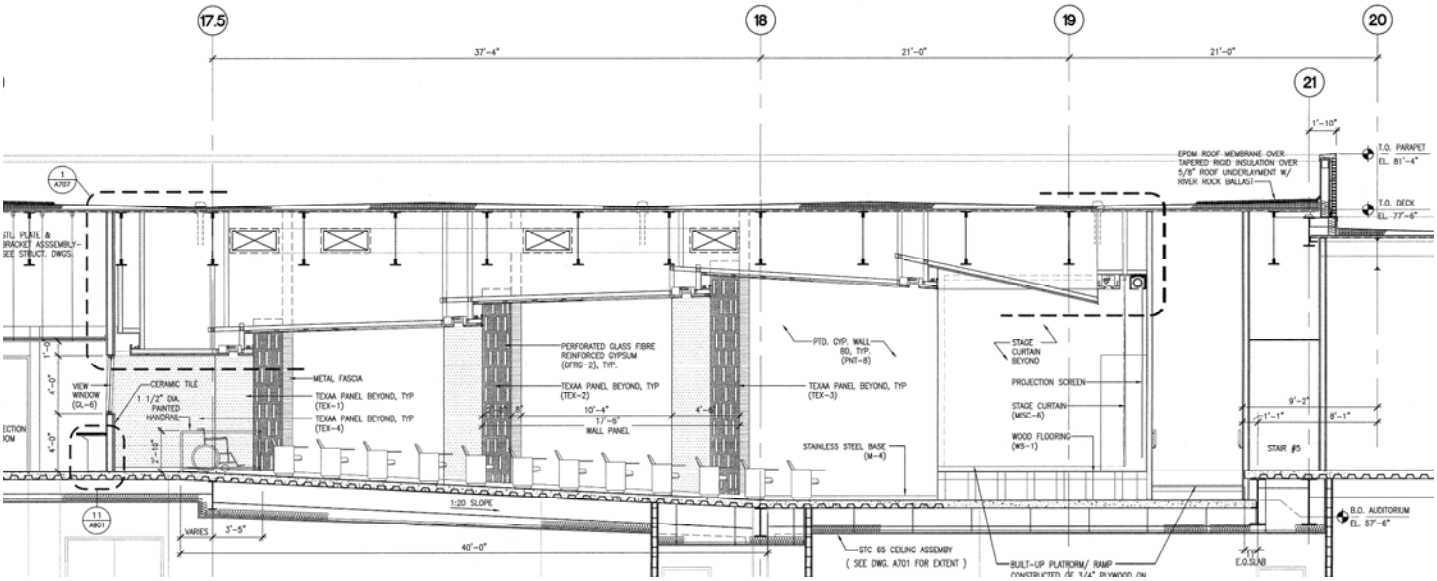
Auditorium East Elevation (N.T.S.)
"Drawing A-201A"



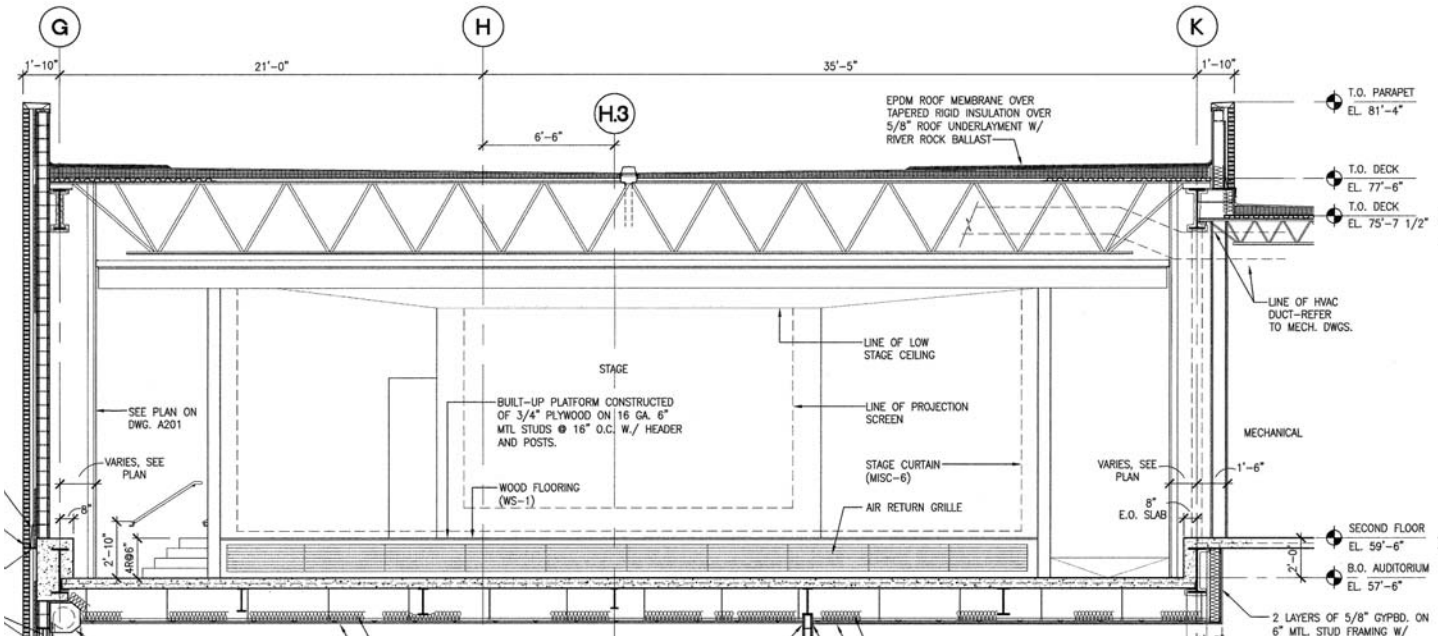
Auditorium West Elevation (N.T.S.)
"Drawing A-201A"



Auditorium East Section (N.T.S.)
"Drawing A-201B"



Auditorium North Section (N.T.S.)
"Drawing A-201B"



Outdoor Space South Lawn

1.) EXISTING SPACE AND LIGHTING CONDITIONS

Description

The outdoor space is outside of the main entrance on the south side of the building. There is a concrete sidewalk at the exit of the building. It splits similar to a shape of a wishbone in plan. The two paths converge and lead to the building. There is grasscrete along the edge of sidewalk, but not for the entire run. There are only a few trees inside the wishbone shape. There is also low vegetation along the brick wall adjacent to the auditorium. Otherwise the space is very open.

Tasks

There will not be many tasks for the outdoors. Eventually there will be benches of some sort at which people congregate. The space is generally for circulation in or out of the building. It is the main entrance to the elegant lobby, so it should stand out more than other paths.

Luminaire, Lamps, Ballast

The only luminaire used in this section of Kean University's campus is SA1. This is the model Pole Top-Indirect manufactured by BEGA. Its catalog number is #8101MH. It is a pole top indirect fixture with a specular floodlight optical system. The top indirect reflector can be rotated 30 degrees from the horizontal. It has a clear tempered glass shield and aluminum housing. SA1 is mounted on an aluminum pole.

Luminaire SA1 contains (1) 150 W T6 G12 metal halide lamp. The CCT of the lamp is 4200K. It is equipped with a magnetic ballast.

Materials

Most of this space is open grass and some concrete for sidewalks. Grasscrete is used along the edges of the path so car tires do not destroy the grass. Grasscrete is like a honeycomb of concrete with grass poking through. It provides a transition from grass to concrete as well.

2.) LIGHTING DESIGN CRITERIA (Outdoor Space)

Appearance of Space

- This is a wide open green space with very little trees
- At night the building will stand out having no other buildings in close proximity
    - Building will glow from inside with all the curtain wall

Color Appearance (Color Contrast)

- High Pressure Sodium lamps make spaces seem too gloomy and drown out all the potential for colors to show up at night
- CCT should be cool to simulate daylight at night
- The path will have contrast because the open grass does not have light poles installed there

Daylight Integration and Control

- There is no need for this because they lights will be only for night and on a time clock

Direct Glare

- Can be a nuisance to people walking towards the building
- Keep vertical aiming angle at 45 degrees or below

Flicker and Strobe

- Could be a problem in extreme cold which happens in winter in the Northeast
- Only a problem at startup however and lights turn on before it turns completely dark

Light Distribution on Surfaces

- Uniformity is desired
- Luminaires should be on one side of path instead of staggered

Luminances of Space Surfaces

- This is a residential/rural setting so the luminance cannot be too much larger relative to the background which is very dark
- Could possibly increase luminance closer to the building because the building is all curtain wall, so it will be a brighter background than the night sky

Modeling of Faces and Objects

- Not important

Points of Interests

- Glowing building in the distance
- Not many other points of interest cause it is an open field

Reflected Glare

- Not a problem with concrete pathways and grass

Shadows

- No problems with shadows because path is open

Source/Task/Eye Geometry

- Luminaires should not have steep vertical angles for glare reasons

Sparkle/Desirable Reflected Highlights

- None are really necessary
- Path is highlighted because it is the only thing lit outside

System Control and Flexibility

- Time clock for when night time occurs

Illuminance (Horizontal)

- Assume its outdoors, a garden, and a path away from the building
    - IESNA then recommends 1 fc for this pathway

Illuminance (Vertical)

- N/A

ASHRAE 90.1 Requirements

- Lamp in this fixture is 150W
    - For lamps greater than 100W, they must have efficacy of 60lumens/watt or better as required by ASHRAE
- Pathway outside is greater than 10 feet wide
    - ASHRAE requires 0.2 W/ft^2 for walkways of 10 feet or wider

3.) LIGHTING DESIGN CRITIQUE

Description/Critique

The fixtures on the pathway are not staggered just as the criteria required. The pathway is approximately 10,000 ft^2 in area. The IESNA requires approximately 1 fc, so calculating an approximate average illuminance as shown on pg. 9-30 of the IESNA Handbook with a CU value of 1 and an assumed total light loss factor of 0.75 gives the following value below:

$$\text{Illuminance} = \frac{(\#\text{ of Luminaires}) \times (\text{Lumens per Luminaires}) \times (CU) \times (LLF)}{\text{Area}}$$

$$\text{Illuminance} = \frac{(10\text{ Luminaires}) \times (12700\text{ Lumens/Luminaire}) \times (1) \times (0.75)}{(10{,}000\ ft^2)}$$

Illuminance = 9.5 fc

This value is well over the required criteria for outdoor pathways by initial inspection. The lamp lumens were taken from the Phillips online catalogue. This fixture could cause some urban sky glow if the reflector is rotated. However there is no note on the schematics describing the tilt of the reflector, so it should not be a problem. Also the lamp for the fixture meets the efficacy criteria easily. There is not much to the design of this outdoor space. The lights were not staggered which is important not to do.

Outdoor Site Plan (N.T.S.)
"Drawing A-000"