



The Winsor School

Centers for Performing Arts and Wellness Academic Wing

103 Pilgrim Road, Boston, Massachusetts

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Lighting / Electrical

Advisor – Richard Mistrick

Technical Report 1

September 19th, 2014

Executive Summary

The Winsor School was chosen to be the focus of this technical report, assessing the existing conditions of the redesign of the new wing of the campus, the Center for Performing Arts and Wellness Academic Building.

As stated in the Building Statistics report, the Winsor School is a day school for young women in grades 5 – 12. The school's mission is to drive young women towards their aspirations and dream while also teaching them how to be independent and confident leaders.

This building features an abundance of fitness centers, performance spaces, rehearsal rooms, meditations rooms, gymnasiums and squash courts. The report below calls out these spaces in particular to specifically be the center of the redesign throughout the course of this year:

- + Dance Rehearsal Room
- + Theatre Assembly
- + Wellness Lobby & Corridor
- + Courtyard Plaza

Therefore, after the existing conditions are recorded and analyzed, design criteria was laid out for further analysis and conceptual design. Throughout the entire report, all spaces analyzed did achieve quality lighting and obtain the recommended illuminance levels. But there is room for improvement, especially in the lighting power density and fixture selection. While some Light Emitting Diode fixtures were utilized, there were instances of downlights and other fixtures that can be upgraded to more efficient sources than an MR16 or Compact Fluorescent. Also, some spaces seemed to depend on the daylighting to allow them to feel open or bright, like the Dance Rehearsal Room, while other spaces, like the theatre, concentrated and faded their light when it had the opportunity to become a focal piece and topic of conversation throughout the building. The hallway design is spacious and is the only space to utilize indirect lighting of a surface, yet its proximity to a southwest curtain wall could mean high glare and must be analyzed further. All the spaces have the ability to open the doors of performance and play to the women that walk these halls and give them a statement of which to be a part.

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Building Overview

BUILDING NAME

The Winsor School | Centers for Performing Arts and Wellness Academic Wing

LOCATION AND SITE

103 Pilgrim Road | Boston Massachusetts

BUILDING OCCUPANT NAME

The Winsor School

OCCUPANCY OR FUNCTION TYPE

Theater (A-1), Exercise Spaces (A-3), Offices (B)

The new wing is the performing arts and athletic wing connected to the academic portion of an all-girl preparatory school for young women in grades 5-12.

SIZE [TOTAL SQUARE FEET]

79,000 sf

NUMBER OF STORIES ABOVE GRADE | TOTAL LEVELS

Three Stories above grade | Five Total Levels

LIGHTING RELEVANT PROJECT TEAM

Architect: William Rawn Associates, Architects, Inc. | <http://www.rawnarch.com>

M / E / P / FP Engineer: Rist-Frost-Shumway Engineering, P.C. | <http://www.rfsengineering.com>

Landscape Architect: Landworks Studio Inc. | <http://www.landworks-studio.com>

Theatre Consultant: Theatre Projects Consultants | <http://www.theatreprojects.com>

Code Consultant: Sullivan Code Group | <http://www.rwsullivan.com/services/code-consulting>

Lighting Consultant: Horton Lees Brogden Lighting Design | <http://www.hlblighting.com>

Sustainability Consultant: The Green Engineer | <http://www.greenengineer.com/>

DATES OF CONSTRUCTION

May 2013 – September 2015

ACTUAL COST INFORMATION

Total Construction - \$71,000,000

Electrical / Lighting - \$7,200,000

PROJECT DELIVERY METHOD

Design - Bid - Build

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Proposed Areas of Study

LARGE WORK SPACE | DANCE REHERSAL ROOM

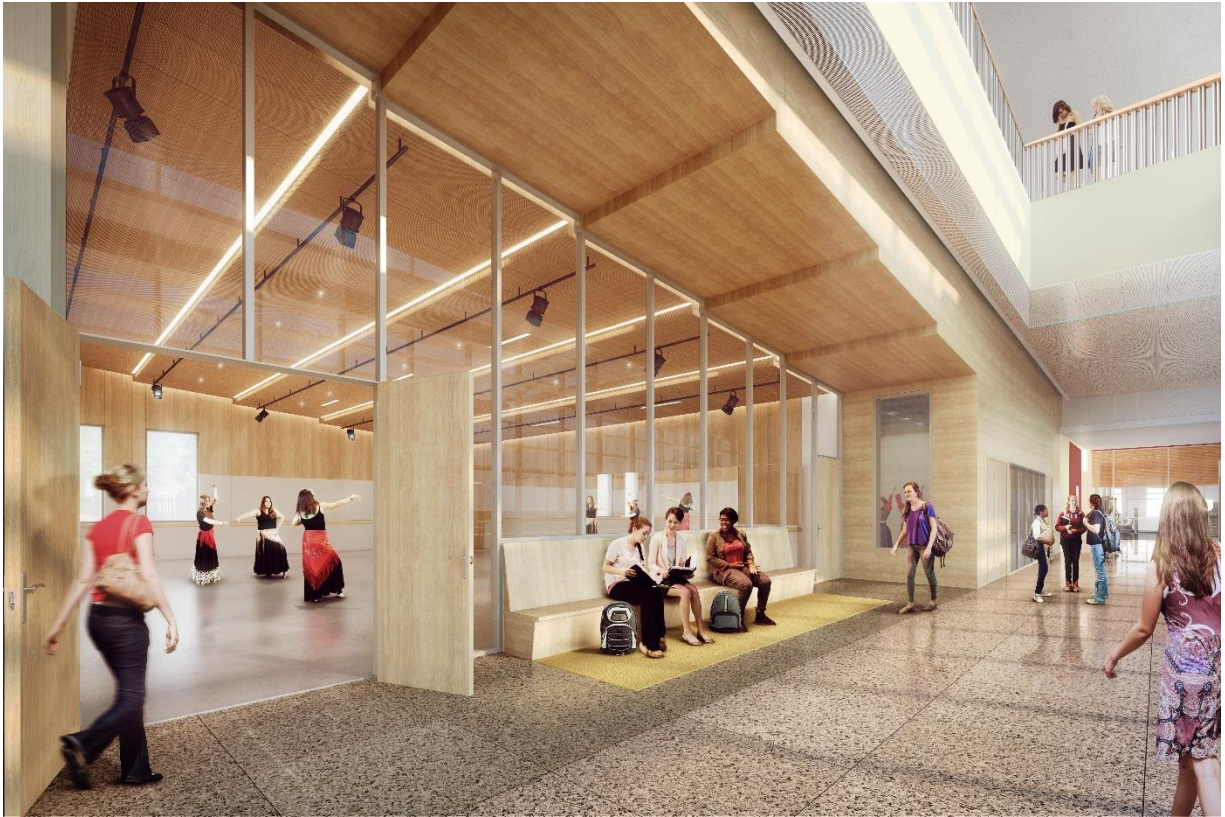


Figure 1 - Dance Rehearsal Rendering - Courtesy of William Rawn Assoc.

Existing Conditions

Summary & Dimensions

The dance rehearsal space is located on the first floor on the plan north side of the building and adjacent to the northeast façade. It is very important for many reasons, but first and foremost because it is one of the first things visitors will see when arriving through performing arts entrance and when traveling to the theatre spaces by route of the main stairs. The walls of the rehearsal space are mostly wood with one wall of glass and one wall of mirrors. The ceiling is a perforated metal ceiling. This space could be the future development of a possible acoustical breadth focused on how the redesign may change the acoustical properties of the space. This space will also be designed to attain certain psychological impressions which will be created during technical report three.

Square Footage: 1648 sf

Approximate width: 33 ft – 5 in

Approximate length: 50 ft

Height: 15 ft – 6 in to 12 ft – 6 in (stepping down 6in at a time)

Plans

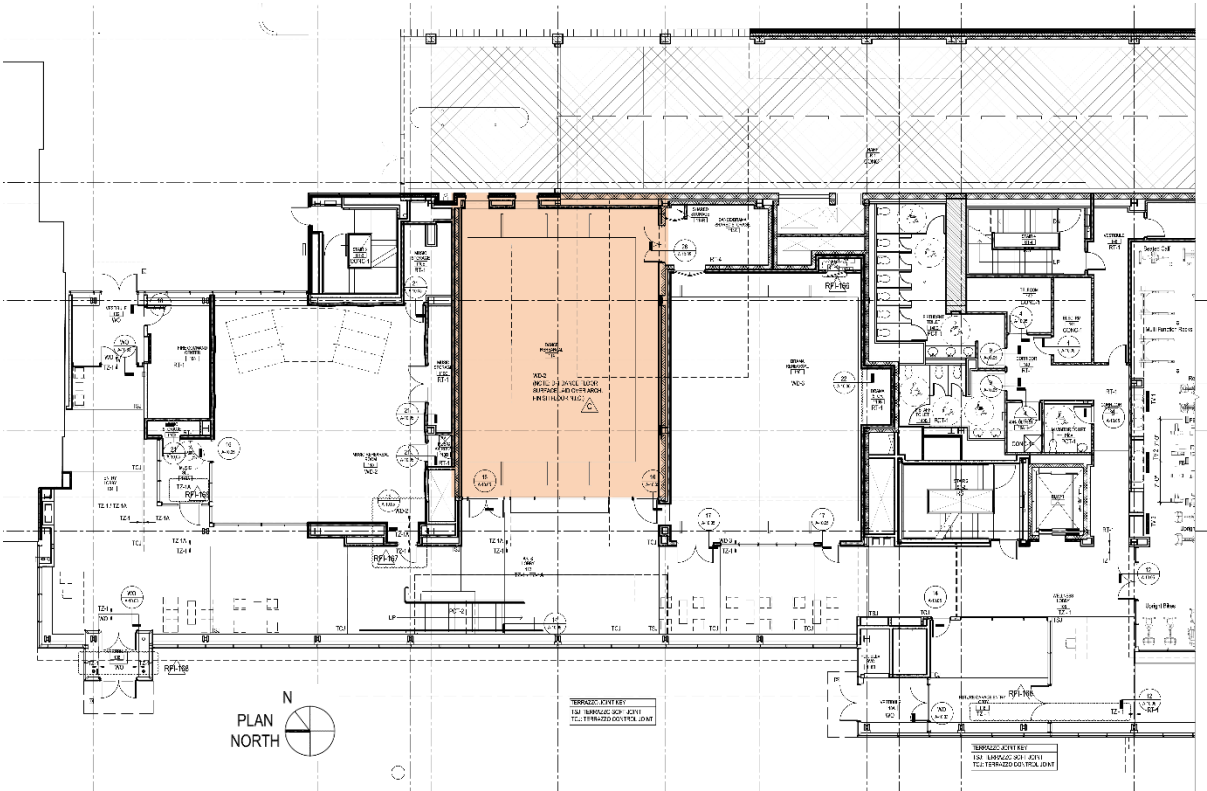


Figure 2 - First Floor "North" Plan – Dance Rehearsal Room

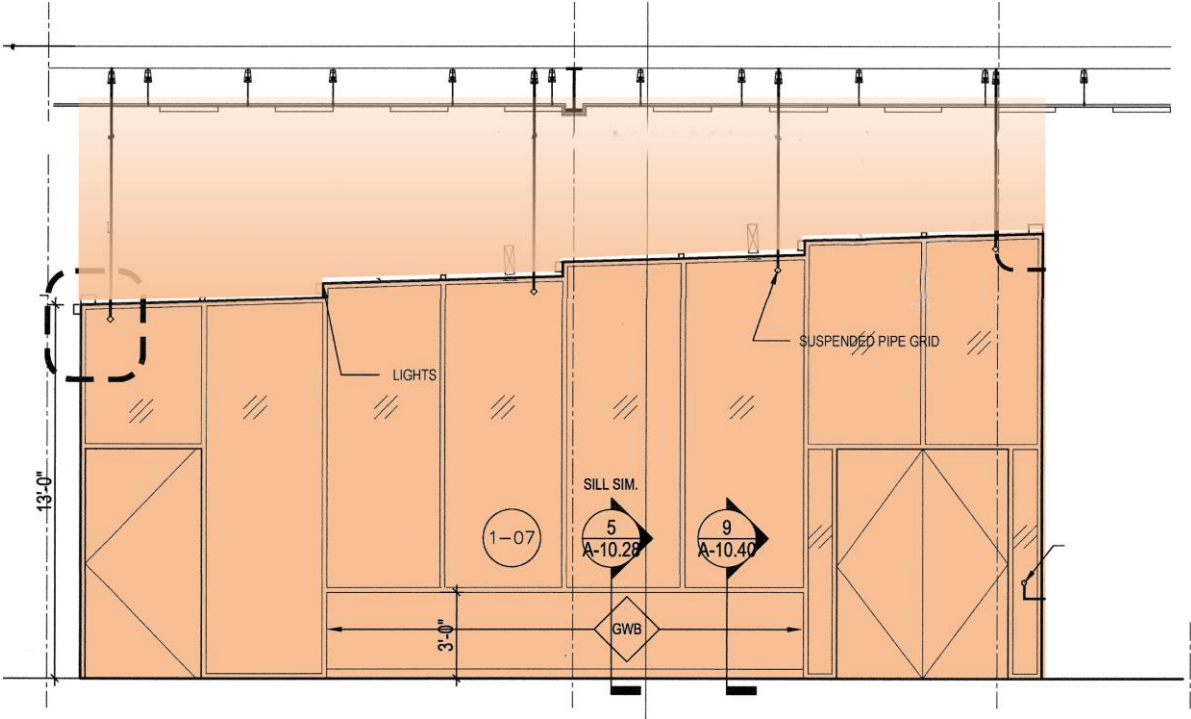


Figure 3- Dance Rehearsal Elevation

Tasks & Activities

Dance classes, practices, small performances, lectures

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Materials

The materials in the Dance Rehearsal room are designed to look like one entity folding over to create the rectangular room. Though there are many different types of materials, they are all created to look like a light tan color of anigre or maple wood. Even the metal perforated ceiling is designed to have a custom “Bacon” color alluding to the color of the wood walls. Also, in this space are mirrors and an entire wall of glass windows opening to the corridor and to lounge areas outside of the room. The details of the materials can be seen below in Table 1.

Type	Description	Color	Reflectance	Manufacturer
Floor	Wood	Maple	0.5	T&G Wood Strip
	Dance Floor	Maple	0.5	Marley
Walls	Wood Louvre	Anigre	0.25	Bacon Veneer Company
	Wood Wall Panel	Anigre	0.4	-
	Acoustic Fabric Panel	-	0.3	-
	GWB	Off-white	0.7	USG Corporation
	Mirrors	-	1	-
	Glass	-	.78 transmittance	-
Ceiling	Perforated Metal Panel	Custom - Bacon	0.25	Ceilings Plus; Illusions

Table 1 – Interior Materials in the Dance Rehearsal

Existing Lighting

There are two types of lighting in the dance rehearsal space, for performances the theatrical consultant added in theatrical lighting that has the ability to provide flexibility for small performances and lectures. For the other layers of light, the lighting designers created a functional layer and aesthetic layer. The functional incorporating mostly downlights than can be seen below in Figure 4. Furthermore, as you can see in the elevation of the space (Figure 3) at every step down of the ceiling there is a slot fixture recessed into the vertical portion of the ceilings creating a visual emphasis of the architectural ceiling. The bright surfaces allow the room a spacious feeling, as do the glass wall. In this space, emergency lighting is provided by the F13 fixtures as documented by the (E) on the plans below.

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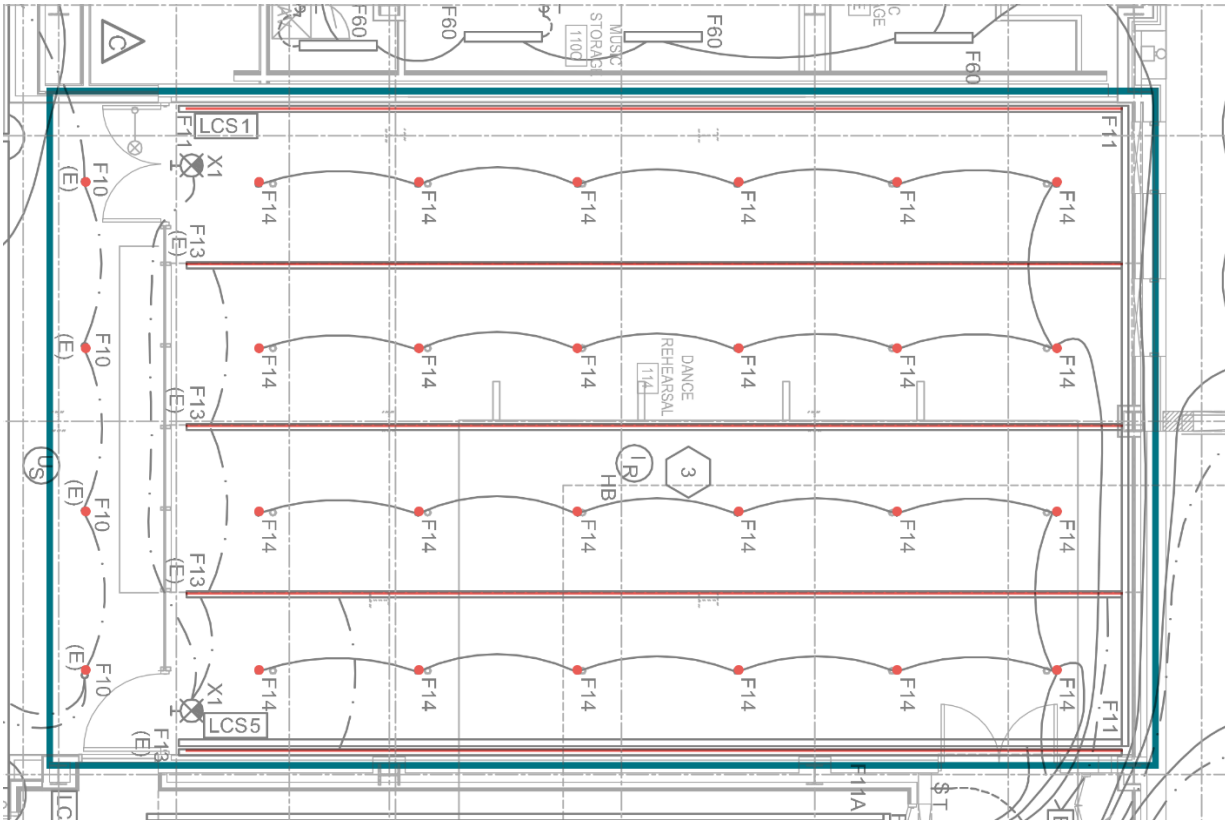


Figure 4 - Existing Lighting Design in the Dance Rehearsal space

Type	Manufacturer / Catalog #	Description	Mounting	Lamp	Ballast	Voltage
F11	Philips Color Kinetics "eW Fuse" #30x60-3000K	Surface mounted LED Wallwasher	Surface Ceiling Mounted	(1) 12.5 W/LF 600 lm/LF 3000 K LEDs	DMX Enabled Integral electronic LED driver	120
F13	Selux "M100 Recessed Linear LED" #L1R1U-1L35-30-LW	Recessed 4" aperture LED downlight with extruded aluminum housing	Ceiling Recessed	(1) 8.75 W/LF 627 lm/LF 3000K	Integral electronic dimming driver (1-100% Lutron 3-Wire)	120
F14	Lucifer Lighting "DL&ZP"	Recessed 1.75" MR16 adjustable accent light, soft focus lens and black baffle, 45° lockable rotation	Ceiling Recessed	(1) 50 watt MR16/IR/WFL60	Integral toroidal dimming transformer	120

Table 2- Fixture Schedule for the Dance Rehearsal Room

Existing Controls

In this space there will be two types of controls, there will be a Dimmer Rack which will accept (2) DMX systems and an Ethernet control signal. This system will be 3 phase, 4 wire and allow input line voltage as well as DMX input. A 3-pole circuit breaker will trigger emergency lighting if there is a power failure. The control systems should filter down to a user interface of push buttons or touchscreen. The House/Work Lights should be controlled by dim/non-dim buttons in various locations and a console panel with scene settings (5 Presets TBD, Show, Work, Reh, Night, Manual, Record and Off) while the performance lights will be powered by a 500 channel lighting console. For the work lights, LED

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fixtures will be controlled by the DMX system and every fixture must be able to dim smoothly to 0.1%. It is recommended to use Electrical Theatre Controls, Inc. as the manufacturer.

Design Criteria & Considerations

Design Criteria can be many things when taking into a lighting design. It can mean both functionality within a space of quantitative means, or more aesthetic appeal to nature of qualitative desires. Not only can they influence the occupants but they can help them in the space as well. Either way, guidelines for most of these can be found in the Illuminating Engineering Society Lighting Handbook, tenth edition or ASHRAE 90.1. Below is a summary of some main quantitative and qualitative points listed in order of importance for the space in question.

Lighting Power Density

ASHRAE 90.1 2010 requires lighting power densities, determined to be watts/square foot for all spaces in the building, this can be done by building type or by the space by space method. It is very important to meet this criteria as it required by state codes in Massachusetts to allow this building to be opened for use. Below is the breakdown of this space's lighting power density.

Space	Space Description	Allowance (W/sf)
Dance Rehearsal Room	Classroom/Lecture/Training	1.24

Illuminance Requirements

The values, provided in lux, are important in every space because they allow for the tasks of the room to be completed, or rather they help the functionality of the room. In some cases, they are also provided for safety concerns. The values for this space are broken down and listed in the table below with both horizontal and vertical illuminance levels as in most cases, the vertical is needed for facial recognition and to open the space rather than wash the floor with light. The illuminance levels were chosen based on stage levels for a dance rehearsal/performance. Vertical illuminance is much more important in this setting because of the emotion that must be portrayed.

Space	Task	E _h (lux)	E _v (lux)
Dance Rehearsal Room	Educational Stage - Dance	300	500

Controls

Controls in this space are listed in the existing conditions. In that section, preset scenes were discussed so flexibility and controllability of this space is desired and must be considered in the design.

Glare

Glare can come from two different sources, the sun and the fixtures. Both of these are a concern in this space. While some dancing is slow and rhythmic, others are fast paced and aerobic. Therefore, any glare that may distract or deter a dancer is unwanted. The existing lights in the ceiling are both adjacent to the ceiling and perpendicular. The perpendicular sources may be of concern if they are in the field of view of the dancers. They do face away from the mirror and therefore may not become a problem in this case. The other concern is the sun, this room is along a curtain wall corridor that faces southwest, it is not far out there to believe that low profile angle sun in the winter can cause direct light to come further into the room, this will possibly need to be something evaluated later on in the redesign.

Sustainability

In this project, LEED v3 was used to obtain LEED Silver rating, in regards to lighting/electrical systems and daylighting, several points were claimed. Daylighting and views of 90% were claimed as well as controllability of light systems,

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though this is where the sustainability in this segment stops. Below are the credits of LEED v4 standards for the Dance Rehearsal room to be designed to:

Optimize Energy Performance – [ASHRAE 50% Advanced Energy Design]

The goal is to reduce lighting power density with daylighting and interior finishes.

Interior Lighting – [Lighting Control and/or Lighting Quality]

Occupant control for full, midlevel and off settings of light

25% or less overhead lighting

CRI of 80 or higher

75% of connected load, light sources must have rated life of 24,000 hrs or more

Daylight – [Spatial Daylight Autonomy, Illuminance Calculations]

SDA of at least 55, 75, or 90% of floor area with 50% of 300 footcandles

Illuminance levels between 300 lux and 3000 lux for occupied hours

*** Note: It has been discussed that this method is difficult to achieve

Uniformity

Guidelines for this criteria are laid out in the IES Handbook mentioned above. The goal of the uniformity recommendations is to limit visual distraction and allow the best functionality of the task. In some spaces, a high uniformity is needed to wash the field with light – this is usually done when the task has a higher level of difficulty. If the task is an easier one, and the space can have a higher level of drama, then uniformity can be scaled back.

Space	$E_{h-avg} : E_{h-min}$
Dance Rehearsal Room	1.5:1

Psychological Impression

Because of the different scene settings requested, psychological impressions could play a role in this space, but because it is used mainly for rehearsal, functionality is a much bigger aspect than impressions. The settings can be derived from a transition between relaxation to functional.

Circulation

Movement around the space is not critical here.

Evaluation

The lighting in the Dance Rehearsal Room seems to be a lot for a little. Because of linear runs there was a total of 43 4' LED linear fixtures, then another 28 downlights. The calculated lighting power density is 2.141 w/sf which is much higher than allowed, though it is not clear what the designer may have used as decorative fixtures. That being said, the illuminance came out to be just under the recommended illuminance, as can be seen in the table below. In the architectural rendering, there appears to be an abundance of light on the walls, while in the AGI32 renderings below, that it not the case. It can be said that during the daytime there will be a large amount of natural light and that may even overpower the light fixtures. But it is not out of the realm of possibility to use this space during the evenings for clubs or rehearsals and therefore a higher emphasis on the perimeter may be desired since the materials are light but also textured and absorptive.

Space	Task	E_h (lux)
Dance Rehearsal Room	Educational Stage - Dance	239

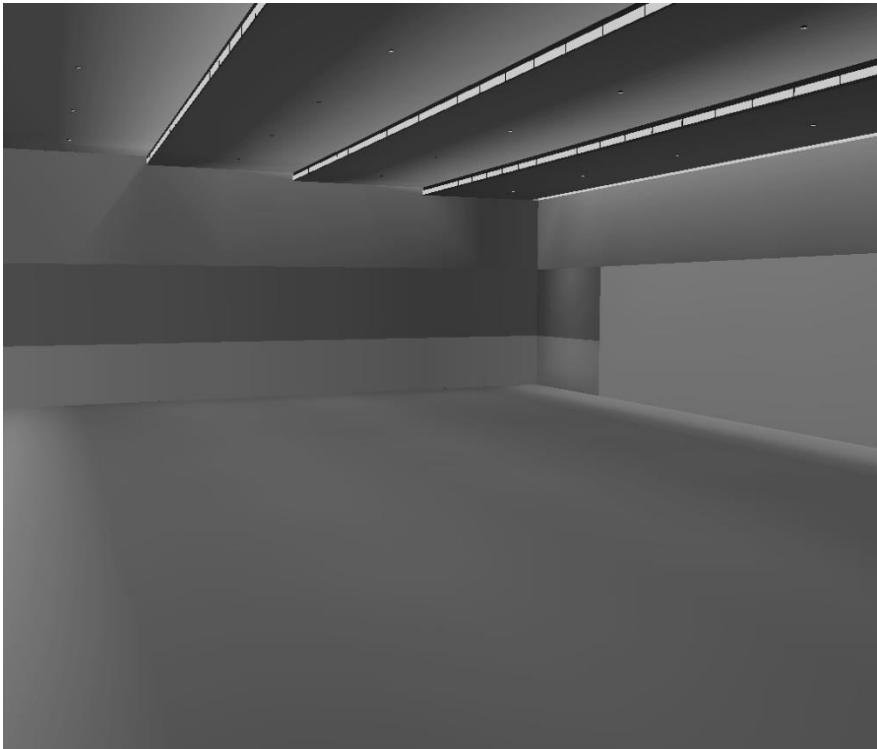


Figure 5 - AGI32 grayscale rendering of the Dance Rehearsal Space

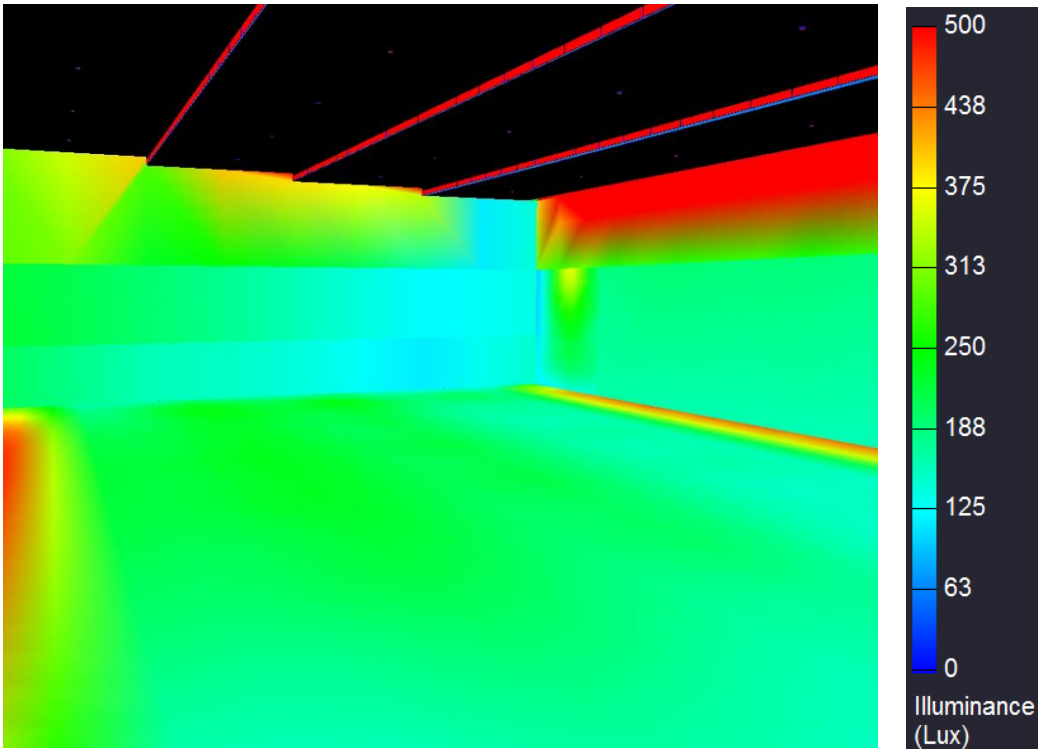


Figure 6 - Pseudocolor Rendering from AGI32 of the Dance Rehearsal space

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SPECIAL PURPOSE SPACE | THEATRE & ASSEMBLY



Figure 7 - Theatre Rendering - Courtesy of William Rawn Assoc.

Existing Conditions

Summary & Dimensions

The theatre is located on the third floor of the building and it is contained in the plan east or northeast part of the building. It is a triple height 510-seat space that includes a mezzanine and a sloping floor towards the stage. To arrive at this location, occupants must travel through the north entrance facing the dance rehearsal room and travel up an open staircase, or travel from the existing academic building by way of the “link” bridge. The challenge of this space will be the controllability of the lighting fixtures as well as not preventing the functionality of the theatre lighting designed by the theatre consultants. **Because of the space’s importance and it’s flexibility, this space was chosen to have three different schematic design concepts for the third technical report.**

Square Footage: Orchestra - 2982 sf; Mezzanine – 2028 sf; Stage -2058 sf

Orchestra Approximate Length: 48 ft

Orchestra Approximate Width: 66 ft

Height: Entrance to Ceiling – 36ft; Mezzanine at 14ft AFF; Catwalk at 26ft AFF

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Plans

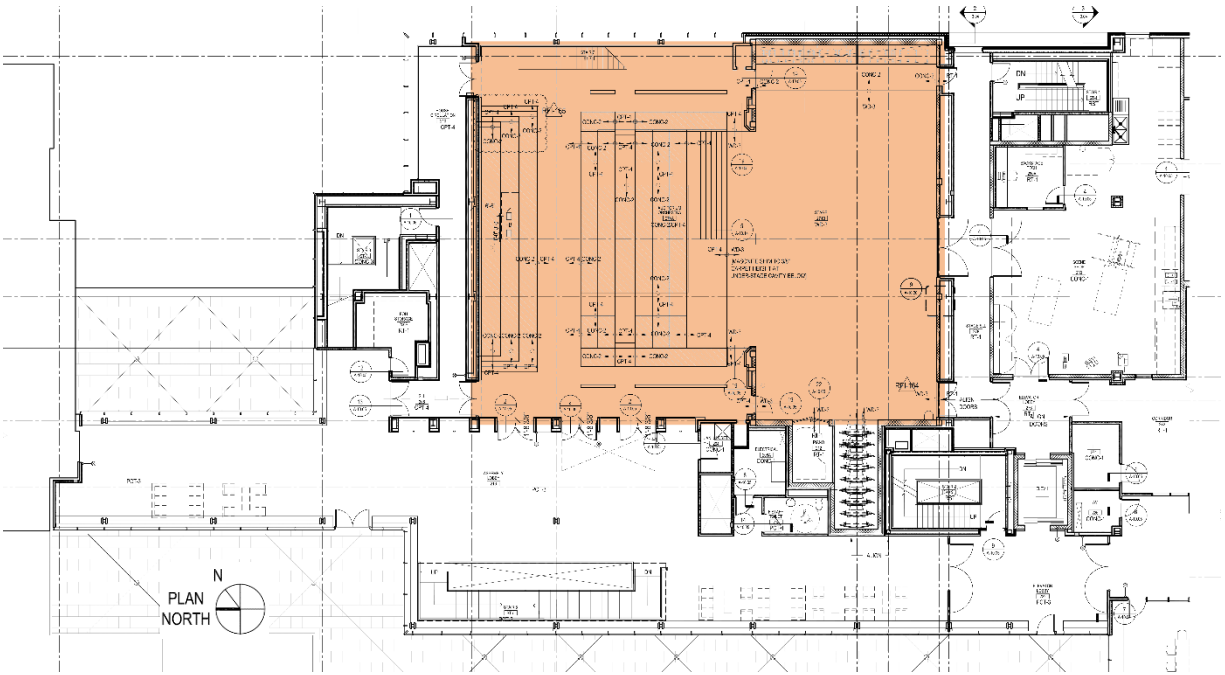


Figure 8 - Third Floor "North" Plan – 3 story Theatre

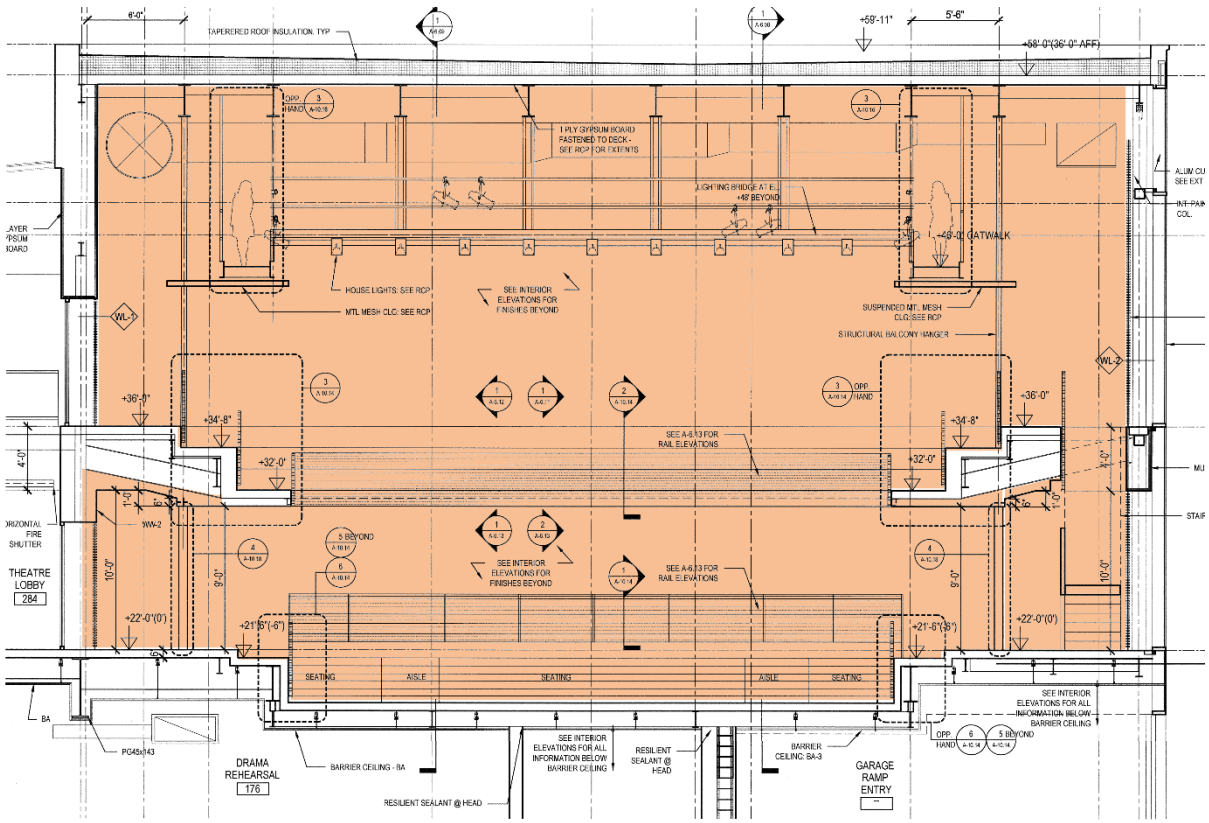


Figure 9 - Theatre Assembly Elevation

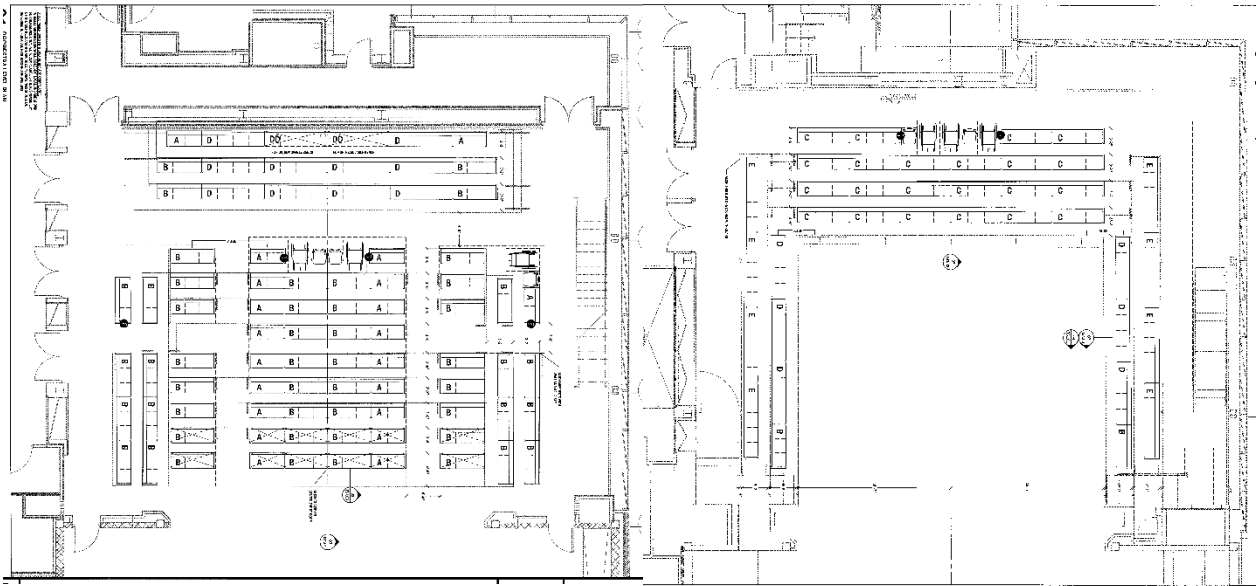
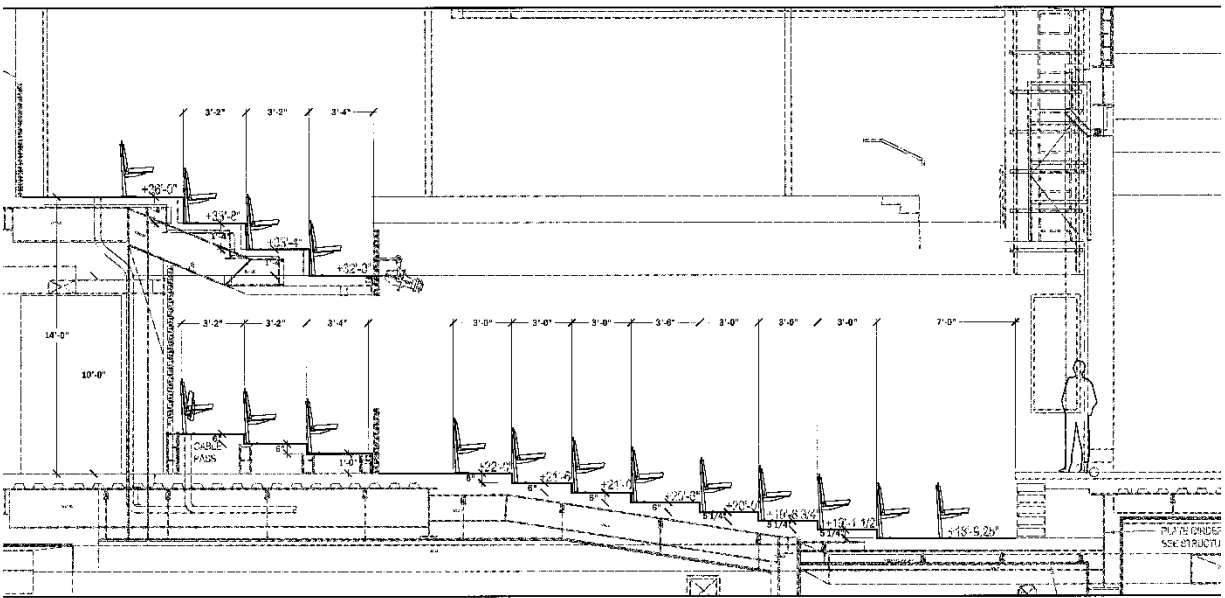


Figure 10 - Seating Arrangement for Theatre Assembly (right) and Mezzanine (left)



LINE SECTION

Figure 11 - Elevation of the Theatre Seating

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Tasks & Activities

Performances, assemblies, lectures, testing

Materials

The materials in this space are similar to the dance rehearsal room in the fact that the wood walls are designed to the color of a light tan wood. Though the largest difference is the floor and ceiling are designed to be very dark. Where there isn't dark stained concrete, the carpet is a very dark grey. Likewise the ceiling is made of a black mesh, except near the stage where plywood acoustical curved panels help radiate sound into the orchestra.

Type	Description	Color	Reflectance	Manufacturer
Floor	Stained Concrete	-	0.5	Vexcon Star Seal
	Carpet	Havana	0.1	Bentley Prince Street
	Plywood (Stage)	Painted Gloss	0.55	-
	Painted Steel (Catwalk)	Black	0.1	-
Walls	Wood Louvre	Anigre	0.25	-
	Wood Wall Panel	Anigre	0.4	Bacon Veneer Company
	CMU Blocks (Stage)	-	0.5	-
Ceiling	Metal Mesh	Bronze	0.2	Armstrong MetalWorks
	Acoustical Reflectors	-	0.3	-

Table 3 – Interior materials of the Theatre and Stage

Existing Lighting

The lighting in this space is very complicated as it has to serve many different functions in the theatre. Below are the plans for the Orchestra seating and Mezzanine lighting plans. To see enlarged versions of these, or the lighting plans for the catwalk or stage, please see Appendix A. The fixtures now are all made to provide general lighting without calling any attention to themselves. They are painted with a black finish to allow them to fade into the black mesh ceiling of the catwalks. The fixture selection is higher end for the orchestra, then for behind and above the stage and orchestra the lighting becomes extremely functional and less aesthetic. In this space, the emergency lighting is provided by mainly the F25 fixtures over the orchestra area, yet also by the F14A fixtures located near the emergency exits. They are denoted on the plan below with the symbol (E).

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Type	Manufacturer / Catalog #	Description	Mounting	Lamp	Ballast	Voltage
F14A	Lucifer Lighting "DL8ZP"	Recessed 1.75" MR16 adjustable accent light, soft focus lens and black baffle, 45 degree lockable rotation	Ceiling Recessed	(1) 50 watt MR16/IR/WFL60	Remote Q-Tran toroidal dimming transformer	120
F21	Lumenpulse "Lumenfacade Interior" #LOGi HO-Voltage-Length-30K-30x60-UMAS BK DMX 1Fx	Surface mounted linear LED wallwasher with extruded aluminum housing, black powder coat finish, clear acrylic lens, radial louver	Recessed into Cove	(1) 15.25 W/LF 543 lm/LF 3000K LEDs	Integral electronic dimming LED driver, DMX controlled	120
F21A	Lumenpulse "Lumenfacade Interior" #LOGi HO-Voltage-Length-30K-30x60-UMAS BK DMX 1Fx	Stem mounted linear LED wallwasher with extruded aluminum housing, black powder coat finish, clear acrylic lens, radial louver	Recessed into Cove	(1) 15.25 W/LF 543 lm/LF 3000K LEDs	Integral electronic dimming LED driver, DMX controlled	120
F23	MP Lighting "L02" #L02-2-W30S-W-C/F-LB-0"	Recessed 2-1/4" LED step light cast in place concrete housing, frosted inner lens, black anodized louve, clear front lens, 120 degree beam	Recessed Step	(1) 2.5 W, 53 lm, 3000K LED	Remote dimming LED driver	120
F24	Lighting Services Inc "238 Series" #238-3G-WL-B	C-Clamp mounted 6" diameter halogen adjustable accent light with aluminum housing, black finish and removable cross baffle	Track	(1) GE 83 PAR/HIR+/FL25	Line Voltage Dimming	120
F25B	Kurt Versen "8" Diameter #L308-SC-MOD (Black Finish)	Surface mounted 8" cylinder aluminum housing with black baked enamel, softglow clear reflector	Surface	(1) Sylvania 50PAR30HIR/FL25	Line Voltage Dimming	120
F25C	Kurt Versen "8" Diameter #L308-SC-MOD (Black Finish)	Suspended Cable mounted 8" cylinder aluminum housing with black baked enamel, softglow clear reflector and aircraft cable suspension	Pendant	(1) Sylvania 50PAR30HIR/FL25	Line Voltage Dimming	120
F34	Kurt Versen "5-7/8" Conoid Aperture" #C7310-SC	Recessed 6" aperture halogen adjustable accent light with Aluminum housing, black painted finish, softglow clear Alzak reflector	Recessed	(1) GE 83 PAR/HIR+/FL25	Line Voltage Dimming	120
F45	Edge Lighting " Soft Strip" #SS2P-12V-WW	Surface mounted LED tape light with a wide flexible copper strip cuttable in 1'-0" increments and remote dimming	Surface	(1) 2.3W/lf 182 lm/ft 3000K LED	Remote dimming LED driver	120
F49	D'ac Lighting "D8012" #D8012-1F42-120-MB-RG	Surface mounted compact fluorescent jelly jar with cast aluminum grill and clear glass enclosure, matte black finish	Surface	(1) Sylvania CF42DT/E/IN/830/ECO	Integral electronic ballast	120
F50A	Lithonia Lighting "Z Strip" #Z-2-28T5-MVOLT-GEB10PS-WGZ46	Surface or chain mounted 4' linear fluorescent strip light with wire guard, white finish	Surface	(2) Sylvania FP28/830/ECO	Integral Electronic Programmed Start Ballast	120
F56	Cole Lighting "158 Series" #F158-BLK-EB	Recessed compact fluorescent step light with black faceplate	Recessed	(1) Sylvania CF9DS/835/ECO	Integral Electronic Ballast	120

Table 4 - Lighting Fixture Schedule for the Theatre, Stage and Catwalk

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Existing Controls

The controls in this space are very similar to the Dance Rehearsal Room. The main difference is the larger control panel for the performance lighting. And there is no ability to establish scenes by a console desk. Otherwise, like the Dance space, there will be a Dimmer Rack which will accept (2) DMX systems and an Ethernet control signal. This system will be 3 phase, 4 wire and allow input line voltage as well as DMX input. A 3-pole circuit breaker will trigger emergency lighting if there is a power failure. The control systems should filter down to a user interface of push buttons or touchscreen. The House/Work Lights should be controlled by dim/non-dim buttons in various locations while the performance lights will be powered by a 3000 channel lighting console. For the work lights, LED fixtures will be controlled by the DMX system and every fixture must be able to dim smoothly to 0.1%. It is recommended to use Electrical Theatre Controls, Inc. as the manufacturer.

Design Criteria & Considerations

Design Criteria can be many things when taking into a lighting design. It can mean both functionality within a space of quantitative means, or more aesthetic appeal to nature of qualitative desires. Not only can they influence the occupants but they can help them in the space as well. Either way, guidelines for most of these can be found in the Illuminating Engineering Society Lighting Handbook, tenth edition or ASHRAE 90.1. Below is a summary of some main quantitative and qualitative points listed in order of importance for the space in question.

Lighting Power Density

ASHRAE 90.1 2010 requires lighting power densities, determined to be watts/square foot for all spaces in the building, this can be done by building type or by the space by space method. It is very important to meet this criteria as it required by state codes in Massachusetts to allow this building to be opened for use. Below is the breakdown of this space's lighting power density. For this space in particular, the catwalk was one in which assumptions had to be made. Since it is mostly unused except for performances and maintenance, a LPD for active storage was chosen to be the most accurate portrayal.

Space	Space Description	Allowance (W/sf)
Theatre Seating	Audience/Seating Area Performing Arts Theatre	2.43
Catwalk	Active Storage	0.63

Controls

The existing controls in this space are listed above in the existing conditions. The complexity of controls in this space is very high in terms performance lighting. The architectural is much simpler. But, this space requires every fixture to be turned off in back of house, or in view of people, must be able to be dimmed down to 0.1%. Therefore, special consideration must be focused on selecting fixtures that can provide this.

Illuminance Requirements

The values, provided in lux, are important in every space because they allow for the tasks of the room to be completed, or rather they help the functionality of the room. In some cases, they are also provided for safety concerns. The values for this space are broken down and listed in the table below with both horizontal and vertical illuminance levels as in most cases, the vertical is needed for facial recognition and to open the space rather than wash the floor with light. It is important to note that it was requested to allow for light levels for testing and thus, paper only testing light levels were shown below. Also, since the lights over the stage will be purely functional, the light levels chosen were for a set up/tear down of set pieces in which the back of house lights will be on.

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Space	Task	E _h (lux)	E _v (lux)
Theatre Seating	Performance House During Show	2	10
Theatre Seating	Performance House Pre/Post Show	75	50
Theatre Seating	Testing - Paper Only	400	150
Stage	Set up / Tear Down	400	200
Catwalk	Back of House Transitional Independent Passageway	50	30

Psychological Impression

The impressions gathered in this space are much more important than in the others. The other spaces are mainly transitional or full of movement and task. In the theatre an occupant may sit in the orchestra for longer periods of time for a lecture or waiting for the show to begin. It is important to allow a relaxed atmosphere playing upon the use of darkness to add drama while not limiting functionality and safety. The large three story space should not be lit to feel more spacious but rather enclosed to allow the stage to be the centerfold. This can be done by centering the light, as described by John Flynn.

Maintenance

Since this space is three stories in height, accessibility to repair, re-lamp and adjust fixtures is critical to allow this space to be highly functioning long after design.

Circulation

It is critical to guide people to the exits and to move people during a shows production but does not play a major role in the consideration of lighting within the space. For way-finding, it is desired to follow the architecture and lead the eye towards the stage.

Sustainability

In this project, LEED v3 was used to obtain LEED Silver rating, in regards to lighting/electrical systems and daylighting, several points were claimed. Daylighting and views of 90% were claimed as well as controllability of light systems, though this is where the sustainability in this segment stops. Below are the credits of LEED v4 standards for the Theatre to be designed to:

Optimize Energy Performance – [ASHRAE 50% Advanced Energy Design]

The goal is to reduce lighting power density with daylighting and interior finishes.

Interior Lighting – [Lighting Control and/or Lighting Quality]

Occupant control for full, midlevel and off settings of light

25% or less overhead lighting

CRI of 80 or higher

75% of connected load, light sources must have rated life of 24,000 hrs or more

Glare

Glare can come from two different sources, the sun and the fixtures. Since there is no exterior lighting in this space, only the sources are of a concern in this space. Sources though will be dimmed during production and theatrical uses of the space, so it only in the testing scenario that glare may be address. For the existing design, the fixtures are so high up that this is not seen as an issue.

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Uniformity

Guidelines for this criteria are laid out in the IES Handbook mentioned above. The goal of the uniformity recommendations is to limit visual distraction and allow the best functionality of the task. In some spaces, a high uniformity is needed to wash the field with light – this is usually done when the task has a higher level of difficulty. If the task is an easier one, and the space can have a higher level of drama, then uniformity can be scaled back.

Space	$E_{h-avg}:E_{h-min}$
Theatre Seating	3:1
Theatre Seating	3:1
Theatre Seating	2:1
Stage	2:1
Catwalk	2:1

Evaluation

The lighting in the theatre is meant to fade into the background. The mounting heights are even other structures or recessed to high the majority of them. The light is supposed to come from nowhere and the focus is on the stage. As stated above all the fixtures not recessed are painted black to blend with the surroundings. All the lighting is direct which encloses the theatre and concentrates the light on the occupants and the seating. This space could benefit from a little drama or visual interest. Though the focus will be on the stage, the occupants will be in the theatre for longer periods of time without needing to look at the stage and therefore, visual interest could be of benefit. Furthermore, this space is one of the highlights of the new wing of The Winsor School. This is where a lot of the benefactors will come to enjoy the plays the young ladies put on through-out the year. A wow-factor could heighten the excitement. The calculated illuminance values can be see below and they closely resemble the recommended levels. The levels for paper testing were met and the fixtures are all set to dim so the other theatre levels will be met. The stage is a little low, but that was under the assumption that people will be taking down set pieces on the stage, which may not be the case. Also below are renderings and a pseudo-color of the theatre. As for lighting power density, the calculated LPD is 3.36 watts/sf which is very much over the calculated allowance, though this does not take into account the decorative wall washers in fixture F21 which is very abundant in the space. Even without theses though, this would not pass the current strictest code.

Space	Task	E_h (lux)
Theatre Seating	Performance House During Show	-
Theatre Seating	Performance House Pre/Post Show	-
Theatre Seating	Testing - Paper Only	397
Stage	Set up / Tear Down	253
Catwalk	Back of House Transitional Independent Passageway	-

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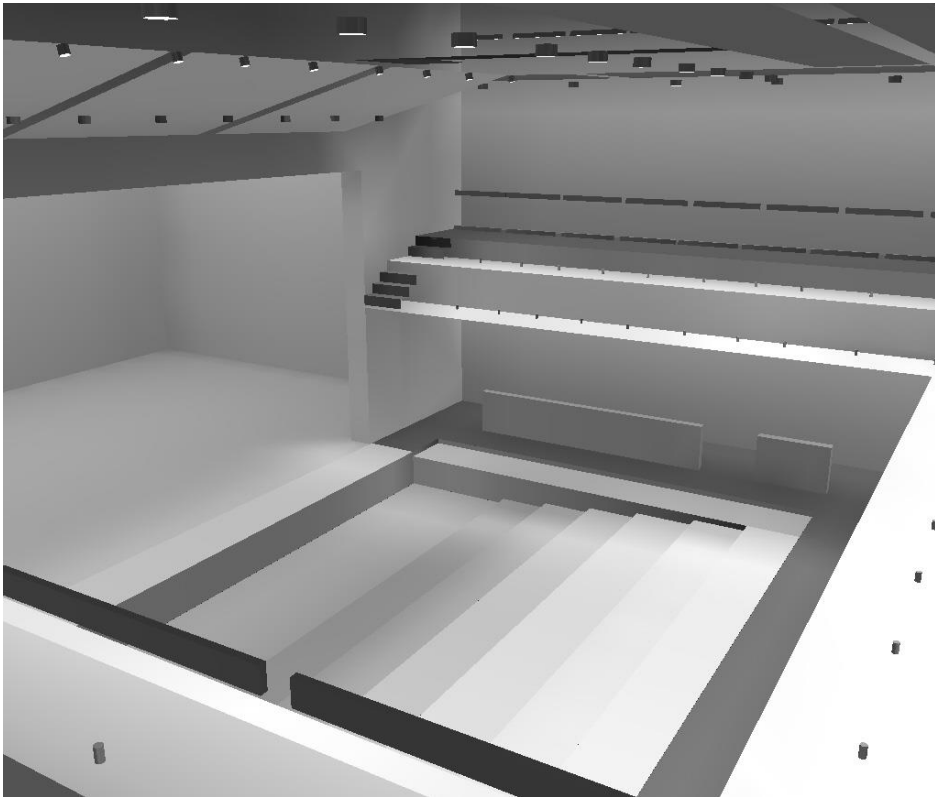


Figure 13 - Grayscale Rendering of the Three Story Theatre

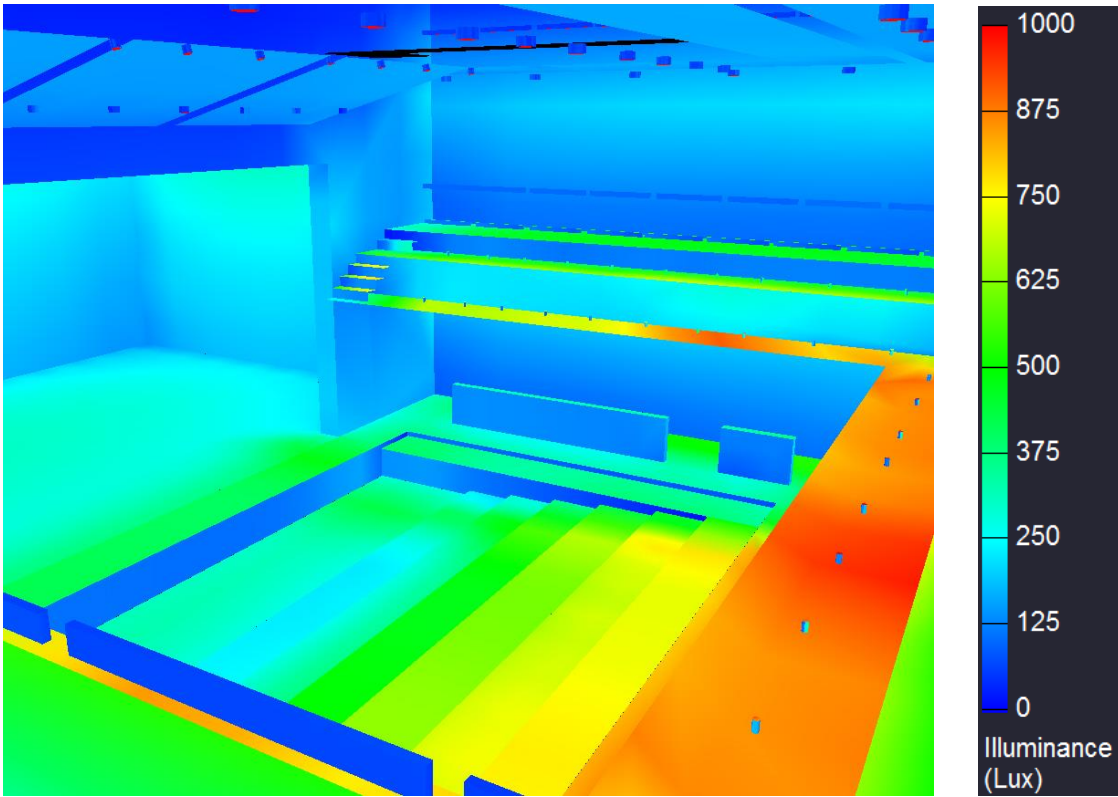


Figure 14 - A psuedo color rendering complete with scale of the Theatre

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CIRCULATION SPACE | SOUTH ENTRANCE – WELLNESS LOBBY & CORRIDOR



Figure 15 - Wellness Lobby Rendering - Courtesy of William Rawn Assoc.

Existing Conditions

Summary & Dimensions

The Wellness Lobby and Corridor is located on the first floor in the plan west or southwest area of the building. It is a double high space with one wall of floor to ceiling glass curtain wall. This lobby has their own separate entrance from the performance portion of the building but can be entered from a hallway adjoining the two areas. This space was chosen for the large amount of daylighting and possibly direct light that will enter in from the southwest sun and travel into the corridor and into the fitness area, which also has floor to ceiling glass. The Fitness area is shown on the plan below with a fading color, as it will only be analyzed from a daylighting aspect.

Square Footage: 1624 sf

Length: 86 ft

Width: 13ft – 6 in

Height: 17 ft – 0 in

Plans

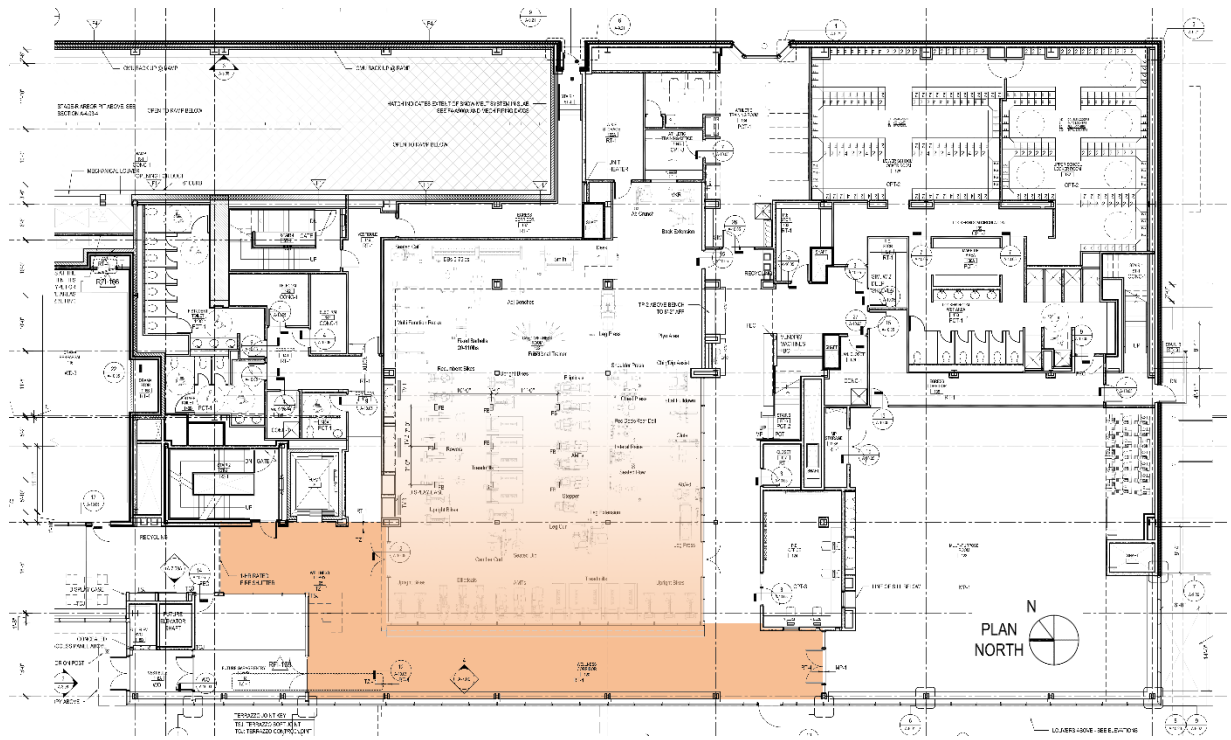


Figure 16 - First Floor South Plan - Wellness Lobby and Possible Fitness Area

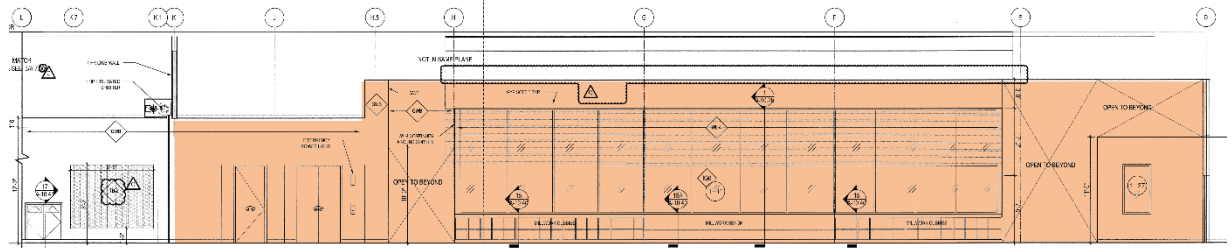


Figure 17 - Wellness Lobby Elevation

Tasks & Activities

Circulation, Lounge Areas, Study/Breakout Areas

Materials

The materials in this space are on the higher end as this is a more public space. The flooring is a light terrazzo that blends into a slightly less specular recycled rubber athletic material. The interior glass removes the visual barrier between the fitness area and the corridor and allows a site line for an occupant, above this line there are wooden louvers to limit the sunlight coming from the corridor. The exterior wall of the corridor faces the southwest sun and therefore incorporates three different types of glazing to limit sun exposure.

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Type	Description	Color	Reflectance	Manufacturer
Floor	Terazzo Floor	-	0.6	Key Resin Company
	Recycled Rubber	Match Terazzo	0.45	Mats Inc.
Walls	GWB	off white	0.7	USG Corporation
	Wood Louvers	Anigre	0.25	-
	Glass	-	.78 transmittance	-
Ceiling	Metal Panels	Gray	0.77	Ceilings Plus

Table 5 – Interior Finishes of the Wellness Corridor and Lobby

Glazing Type	Description	Color	Transmittance	Manufacturer	U-Value	
					Summer	Winter
XG6	1-1/8" Clear Insulating	Clear	64%	PPG ; Solarban 70xl	0.26	0.28
XG5	1" Clear Insulating 100% ceramic frit pattern	White Frit Glass	14%	PPG ; Solarban 60	0.27	0.29
XG7	1-1/8" Clear Insulating 40% Ceramic frit pattern	Warm Grey Frit Glass	40%	PPG ; Solarban 70xl	0.26	0.28

Table 6 - Exterior glazing types along the Wellness Corridor

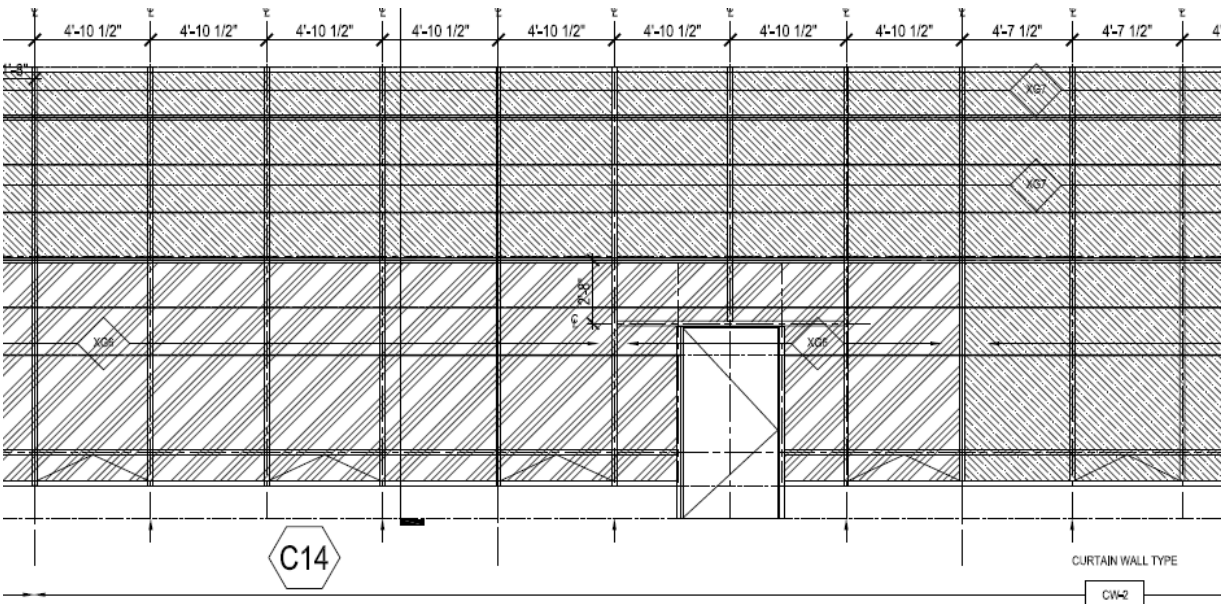


Figure 18 – Elevation of the different exterior glazing types, from left to right is XG6, XG5, XG7

Existing Lighting

The lighting in the lobby and corridor is designed to look high end and aesthically pleasing, while also being function and flexible. Adjustable accent lights are joined together in one fixture creating a sleek look emphasized by the gimbal ring adjustability of each lamp. There is also a layer of light that is uplighting the metal perforated ceiling to allow it to reflect and absorb light. There is no emergency lighting in this corridor but it will probably receive spill emergency lighting from the fitness center located along the glass interior wall of the corridor.

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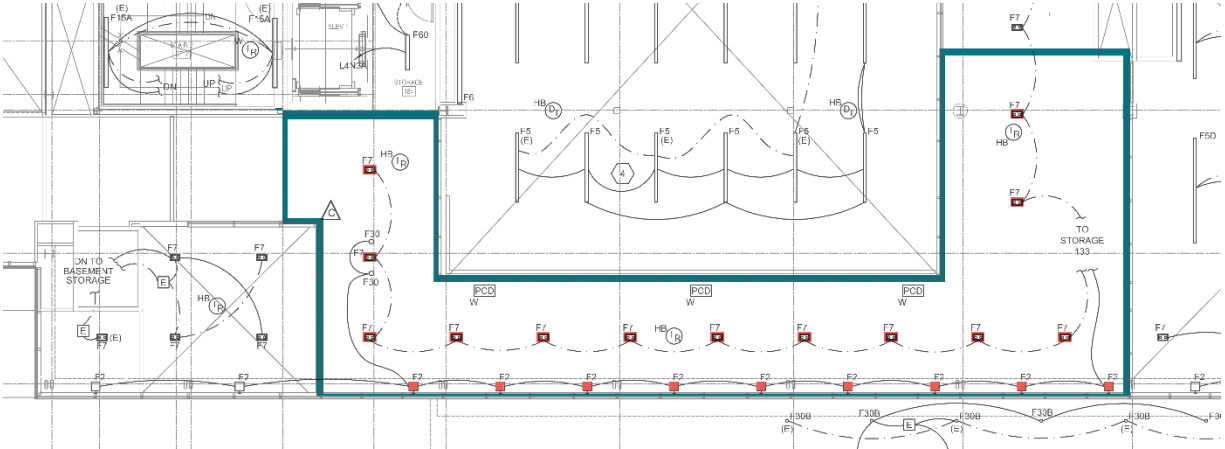


Figure 19 - Lighting plan for the Wellness Lobby and Corridor

Type	Manufacturer / Catalog #	Description	Mounting	Lamp	Ballast	Voltage
F2	Elliptipar #M-102-070G-E-99- Voltage-V0-0	Surface mounted ceramic metal halide uplight sconce with an aluminum extrusion, 180 degree tilt	Wall	CMH T6 Sylvania MC70T6	Remote Magnetic Ballast	120
F7	3G Lighting "Madison" #3G-RC2LED-36W-30K- 40D-Dim	Recessed 5"x12.5" aperture LED multiple head adjustable accent light with cold rolled steel housing, aluminum gimbals and a 45° tilt	Recessed	(2) 36W 2000 lm 3000K LEDs	Integral Dimming Input Watts: 72	120

Table 7 - Fixture Schedule for the Wellness Corridor and Lobby

Existing Controls

The Corridor and Lobby will be controlled mainly by occupancy sensors and this corridor in particular will be controlled by daylight sensors as well. The high bay occupancy sensor in this hallway uses infrared technology. These sensors will reduce the light output or turn the fixtures off after a certain owner-determined time delay. They can be seen on the plan below label HB_{IR}. Also designated by the owner, a time clock shall switch off all luminaires at a designated time and have a manual override. The Daylight sensors in the space are a wireless open-loop system with an integral IR receiver and provides a linear response from 0 to 10,000 footcandles and are documented by wPCD on the plan below.

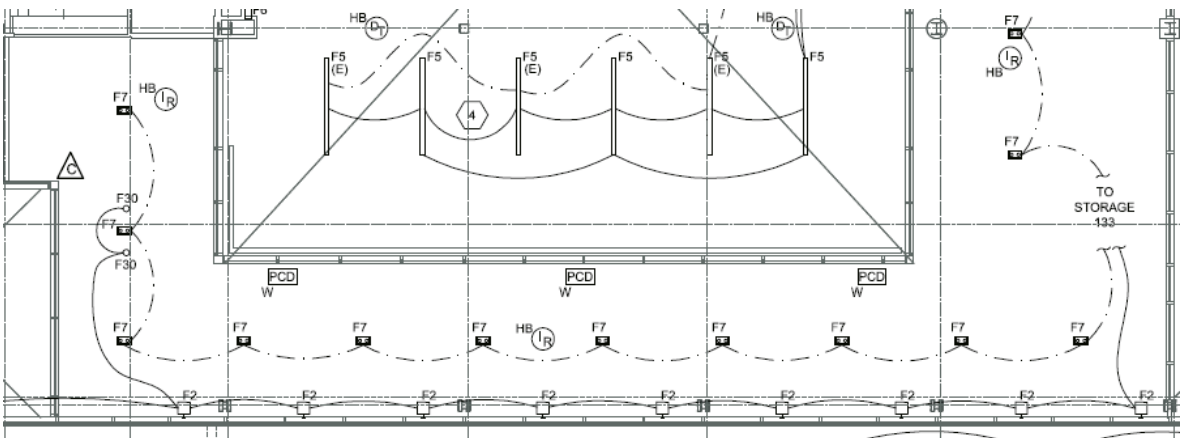


Figure 20 - Wellness Corridor Electrical Plan with Sensors

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Design Criteria & Considerations

Design Criteria can be many things when taking into a lighting design. It can mean both functionality within a space of quantitative means, or more aesthetic appeal to nature of qualitative desires. Not only can they influence the occupants but they can help them in the space as well. Either way, guidelines for most of these can be found in the Illuminating Engineering Society Lighting Handbook, tenth edition or ASHRAE 90.1. Below is a summary of some main quantitative and qualitative points listed in order of importance for the space in question.

Lighting Power Density

ASHRAE 90.1 2010 requires lighting power densities, determined to be watts/square foot for all spaces in the building, this can be done by building type or by the space by space method. It is very important to meet this criteria as it required by state codes in Massachusetts to allow this building to be opened for use. Below is the breakdown of this space's lighting power density.

Space	Space Description	Allowance (W/sf)
Wellness Lobby	Lobby Typical Building	0.9
Wellness Corridor	Corridor/Transistion	0.66

Illuminance Requirements

The values, provided in lux, are important in every space because they allow for the tasks of the room to be completed, or rather they help the functionality of the room. In some cases, they are also provided for safety concerns. The values for this space are broken down and listed in the table below with both horizontal and vertical illuminance levels as in most cases, the vertical is needed for facial recognition and to open the space rather than wash the floor with light.

Space	Task	E _h (lux)		E _v (lux)	
		Day	Night	Day	Night
Wellness Lobby	Educational Transistional Lobby	100	50	50	20
Wellness Corridor	Educational Transistional Lobby	100	50	50	20

Circulation

As this is a transitional space, circulation is desired to direct occupants from the lobby and down the hall to entrances to rooms along the way, as well as fitness centers down and around the bend of the hallway, just out of site.

Sustainability

In this project, LEED v3 was used to obtain LEED Silver rating, in regards to lighting/electrical systems and daylighting, several points were claimed. Daylighting and views of 90% were claimed as well as controllability of light systems, though this is where the sustainability in this segment stops. Below are the credits of LEED v4 standards for the Wellness Corridor to be designed to:

Optimize Energy Performance – [ASHRAE 50% Advanced Energy Design]

The goal is to reduce lighting power density with daylighting and interior finishes.

Interior Lighting – [Lighting Control and/or Lighting Quality]

Occupant control for full, midlevel and off settings of light

25% or less overhead lighting

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CRI of 80 or higher

75% of connected load, light sources must have rated life of 24,000 hrs or more

Daylight – [Spatial Daylight Autonomy, Illuminance Calculations]

SDA of at least 55, 75, or 90% of floor area with 50% of 300 footcandles

Illuminance levels between 300 lux and 3000 lux for occupied hours

*** Note: It has been discussed that this method is difficult to achieve

Glare

Glare can come from two different sources, the sun and the fixtures. The main concern in this space is solar glare. As it is a circulation space and public area, direct light may not be of great concern, but the corridor could be used for lounging during free periods. This space is a curtain wall corridor that faces southwest, it is not far out there to believe that low profile angle sun in the winter can cause direct light to come further into the room. While there is fritting applied to the glass, it may not be enough. This will possibly need to be something evaluated later on in the redesign.

Controls

Controls are not extremely important in this space except for daylighting and occupancy sensors which have been discussed in detail in the existing conditions section. The same will be desired to be done in the redesign of the space.

Uniformity

Guidelines for this criteria are laid out in the IES Handbook mentioned above. The goal of the uniformity recommendations is to limit visual distraction and allow the best functionality of the task. In some spaces, a high uniformity is needed to wash the field with light – this is usually done when the task has a higher level of difficulty. If the task is an easier one, and the space can have a higher level of drama, then uniformity can be scaled back.

Space	$E_{h-avg} : E_{h-min}$
Wellness Lobby	3:1

Psychological Impression

As this space is meant to be occupied temporary, a psychological impression isn't as important. That being said the space should still feel spacious and public, even if temporary. According to John Flynn, this means the space should emphasize the peripheral surfaces with relatively higher uniformity and brighter light levels.

Evaluation

The lighting in this space is highly central and concentrated. The only fixtures providing direct illuminance are the 3G gimbal fixtures. They can be altered to spread light out more evenly through a space, they still are centered in the corridor. Though it is appreciated that this space is the first one using indirect sources and allowing for a more public and spacious feeling with the highlighting of the metal ceiling. Though not much light will make it from the perforated metal ceiling back down to the workplane, the recommended levels are low enough that it may not be a problem. The biggest concern with this area is the southwest sun that comes in the length of the corridor through the curtain wall. Though there is fritted glass, it is still yet to be determined whether this is an effect method overall.

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OUTDOOR SPACE | COURTYARD PLAZA



Figure 21 - Exterior Rendering - Courtesy of William Rawn Assoc.

Existing Conditions

Summary & Dimensions

The Courtyard Plaza is in the plan Northeast section of the building and is directly actual east of the building. It is fairly open and leads to entrances of both the wellness area and performance areas of the new wing. It is also directly next to two sporting fields that are planned to be washed with light.

Square Footage: Pavement - 2572 sf; Grounds- 4300 sf

Soffit / Canopy Height: 11 ft

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Plans

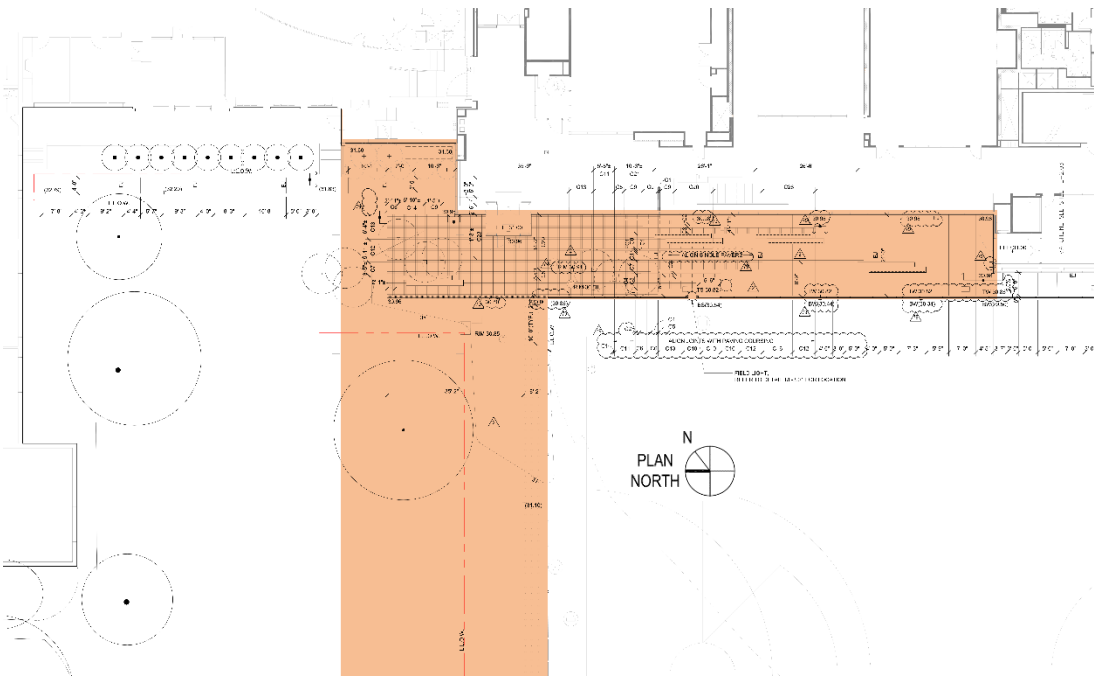


Figure 22 - First Floor North Plan - Courtyard Plaza and Entrance

Tasks & Activities

Lounge Areas, Way finding

Materials

The materials on the ground are mostly concrete pavers, some are precast while others are units to create a pattern of the larger units morphing into the darker, smaller units. The Canopies above the entrances are metal as a juxtaposition to the overhang created by the balcony above, which is a light wood. This is all along the glass curtain wall of the wellness area.

Type	Description	Color	Reflectance	Manufacturer
Ground	Concrete Pavers	Many (Greys)	0.3	Hanover Architectural Products
	Bituminous Concrete	-	-	-
	Grass / Groundcover	-	0.3	The Earth
Ceiling	Metal Canopy	Aluminum	0.65	-
	Wood Canopy/Balcony	Douglas Fir	0.6	-

Table 8 – Exterior Materials in the Courtyard Plaza

Existing Lighting

The lighting in this outdoor space is very minimal. The main illumination is coming from the downlights under the canopies. There is a higher concentration at the entrances, to help an occupant visually find the entryway. Other layers include under-bench lighting along the path and curb lighting where the grass meets the pavement. Spill light will also be a factor since it can be assumed that because this area is adjacent to a curtain wall leading indoors. Also, shown on the plan below are a few of the fixtures that lend themselves to lighting the sports field, while not directly in the scope, they may wash out the courtyard plaza and therefore should be taken into account.

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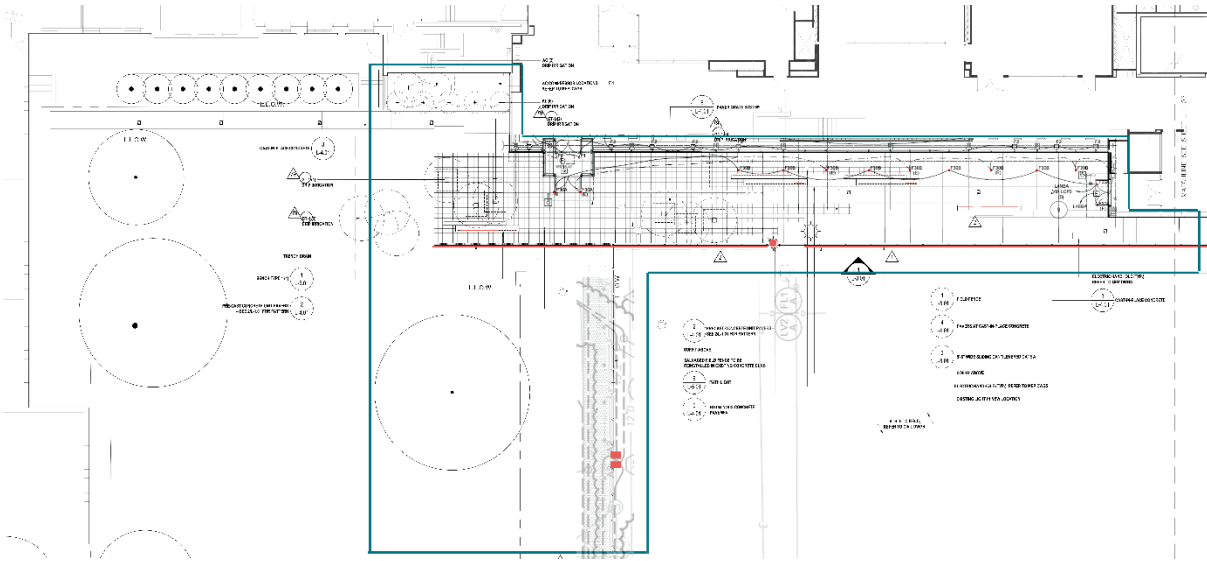


Figure 23 - Exterior Courtyard Plaza lighting plan

Type	Manufacturer / Catalog #	Description	Mounting	Lamp	Ballast	Voltage
F30A	Spectrum Lighting "Infinium LED" #SGA4LED-20W-31K-WD	Recessed 4" aperature LED adjustable downlight with 38° optics, corrosion resistant steel housing, wet location listed	Recessed	(1) 20W 980 lm 3100 K LED	Integral electronic LED driver	120
F30B	Spectrum Lighting "Infinium LED" #SGA4LED-20W-31K-MD	Recessed 4" aperature LED adjustable downlight with 22° optics, corrosion resistant steel housing, wet location listed	Recessed	(1) 20W 980 lm 3100 K LED	Integral electronic LED driver	120
A2	RAB lighting #FXLED150SF	LED Flood Light	Pole	(1) 150W 5000K LED	Integral electronic LED driver	277
D1	iO Lighting #0,10,E,3KM0,45,100,1	LED Strip Light with 1.5" diameter extruded aluminum housing, wet location listed	Surface	(1) 3.96 W/LF	Remote electronic LED driver	120
P1	Musco Lighting "SportsCluster Green"	70 ft pole with 5 fixtures mounted at 70' above grade	Pole	(1)1500W Metal Halide 134000 lms 37.54 KW	Line Voltage	277

Table 9 - Lighting fixture schedule for the Courtyard Plaza and Sports field

Existing Controls

Site Lighting will be controlled by an astronomic time clock with a manual override for daytime re-lamping.

Design Criteria & Considerations Design Criteria can be many things when taking into a lighting design. It can mean both functionality within a space of quantitative means, or more aesthetic appeal to nature of qualitative desires. Not only can they influence the occupants but they can help them in the space as well. Either way, guidelines for most of these can be found in the Illuminating Engineering Society Lighting Handbook, tenth edition or ASHRAE 90.1. Below is a summary of some main quantitative and qualitative points listed in order of importance for the space in question.

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Design Criteria & Considerations

Lighting Power Density

ASHRAE 90.1 2010 requires lighting power densities, determined to be watts/square foot for all spaces in the building, this can be done by building type or by the space by space method. It is very important to meet this criteria as it required by state codes in Massachusetts to allow this building to be opened for use. Below is the breakdown of this space's lighting power density.

Space	Space Description	Allowance (W/sf)
Courtyard Plaza	Entry Canopies (Zone 3)	0.4
Courtyard Plaza	Walkway 10ft or wider (Zone 3)	0.16

Illuminance Requirements

The values, provided in lux, are important in every space because they allow for the tasks of the room to be completed, or rather they help the functionality of the room. In some cases, they are also provided for safety concerns. The values for this space are broken down and listed in the table below with both horizontal and vertical illuminance levels as in most cases, the vertical is needed for facial recognition and to open the space rather than wash the floor with light.

Space	Task	E_h (lux)	E_v (lux)
Courtyard Plaza	Canopied Entry (LZ3 - Medium Activity)	15	8

Circulation

This area incorporates a main entrance to the wellness wing and therefore must be able to direct an occupant to the entrance area with relative ease. This will be difficult to do, but not impossible, since the area will already be fairly bright from the interior spaces.

Uniformity

Guidelines for this criteria are laid out in the IES Handbook mentioned above. The goal of the uniformity recommendations is to limit visual distraction and allow the best functionality of the task. In some spaces, a high uniformity is needed to wash the field with light – this is usually done when the task has a higher level of difficulty. If the task is an easier one, and the space can have a higher level of drama, then uniformity can be scaled back.

Space	$E_{h-avg}:E_{h-min}$
Courtyard Plaza	2:1

Sustainability

There was no sustainability methods planned here in lighting/electrical systems.

Glare

Glare is not an issue in this exterior space as it expected to be low level lighting and very transitional.

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Psychological Impression

This outdoor space should feel relaxed and intimate, except at entry spaces which should feel public. Therefore, the entry canopies should be lit to a higher light level, while the bench and lounges areas should be low level lighting focused away from the occupant.

Controls

The only controls in this space will be an astronomical time clock which will trigger the lights functionality. This will be desired to be continued in the future.

Evaluation

The outdoor space is largely overshadowed by the all glass façade of the building. The under lit benches try for a relaxed feel but in reality are probably overwhelmed by spill light at night. This space opens up to a large courtyard that most people will cross to get to this building, this has the ability to become more dramatic or play with shadows to create a visual interest for special events. Though, that being said, it may have been kept calm in an interest to keep focus on the building. The downlights and spill light will provide ample light for recommended levels to be functional.

References

All professional renderings were provided courtesy of William Rawn Associates, Architects, Inc.

ASHRAE Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings. 2010th ed. ASHRAE, Print.

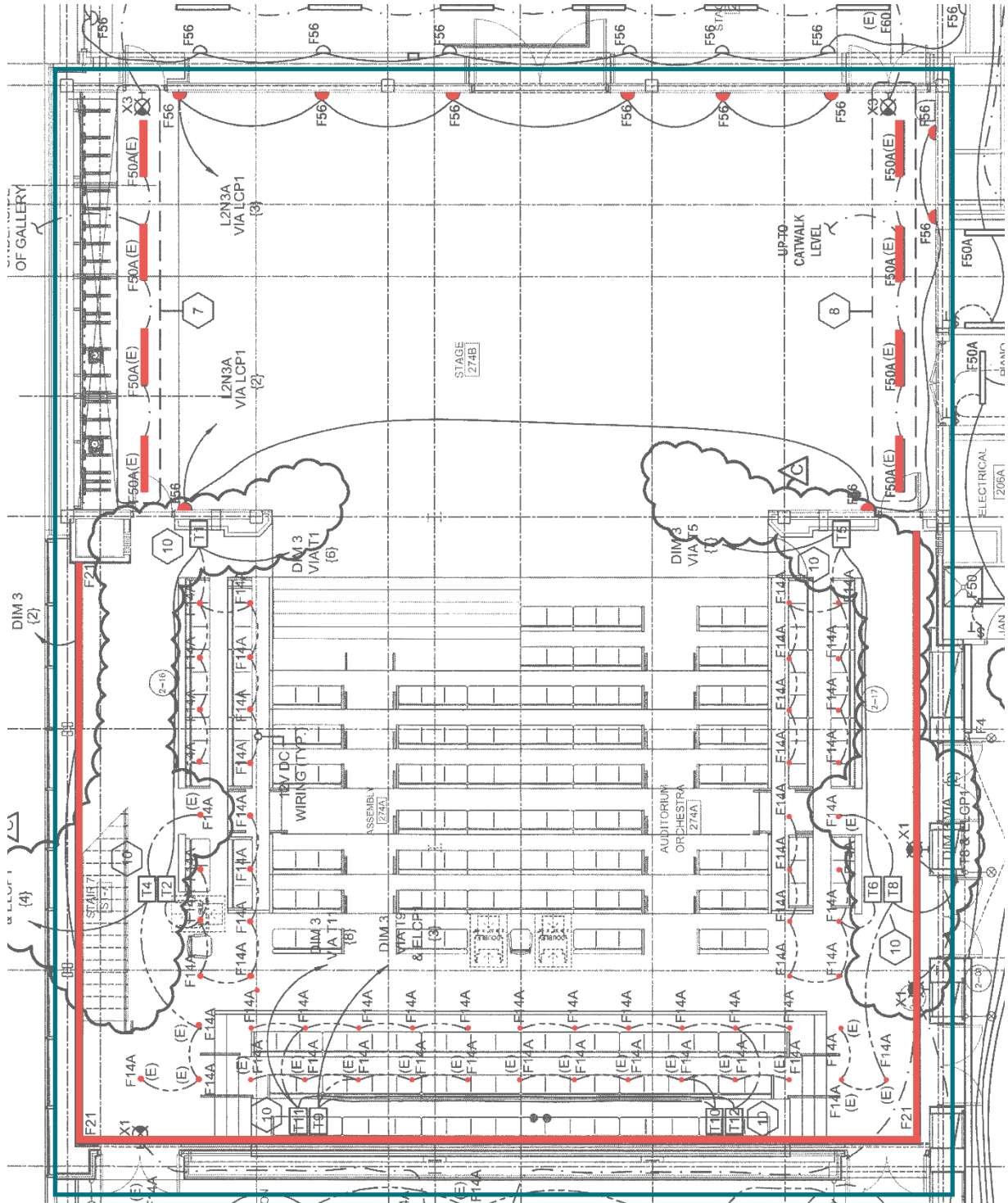
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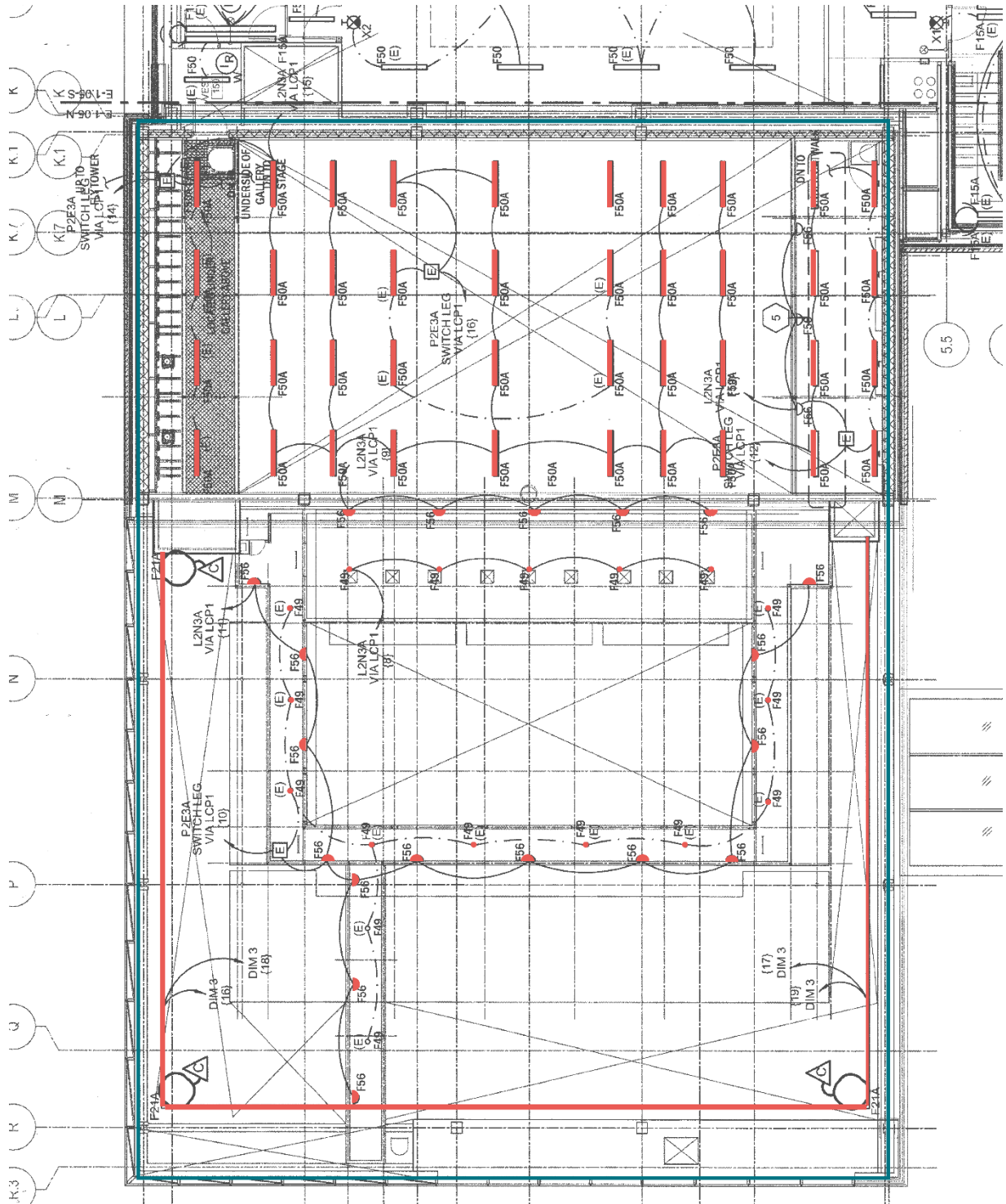
Appendix A : Theatre Drawings Enlarged

LOWER LEVEL THEATRE LIGHTING PLAN



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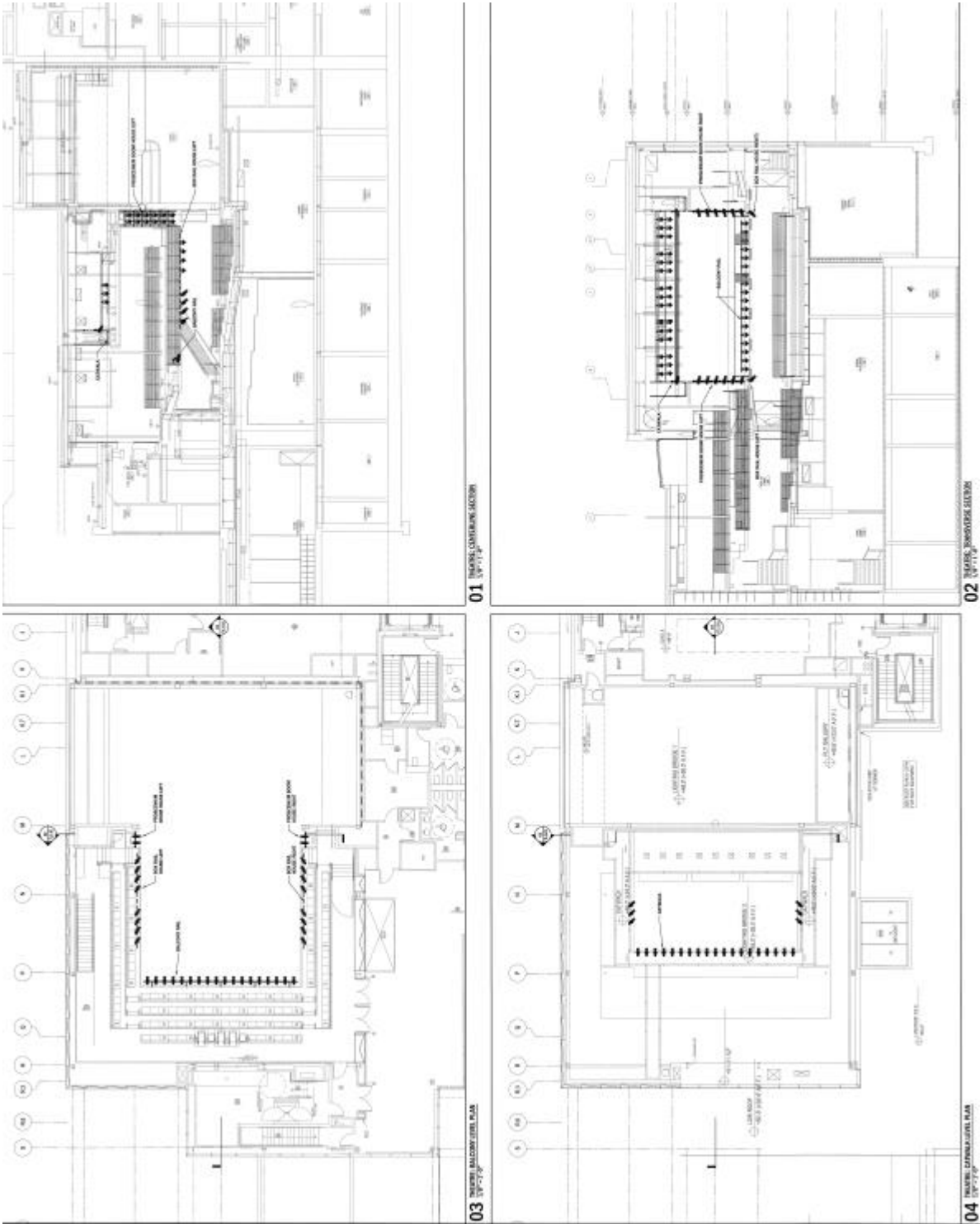
CATWALK & STAGE LEVEL THEATRE LIGHTING PLAN



TECH REPORT ONE

Appendix B : Theatre and Dance Rehearsal Performance Lighting

THEATRE PERFORMANCE LIGHTING



TECH REPORT ONE

DANCE REHEARSAL PERFORMANCE LIGHTING

