THESIS TECHNICAL REPORT 1 | PART B

UNIVERSITY OF MARYLAND – BALTIMORE
HEALTH SCIENCES FACILITY III

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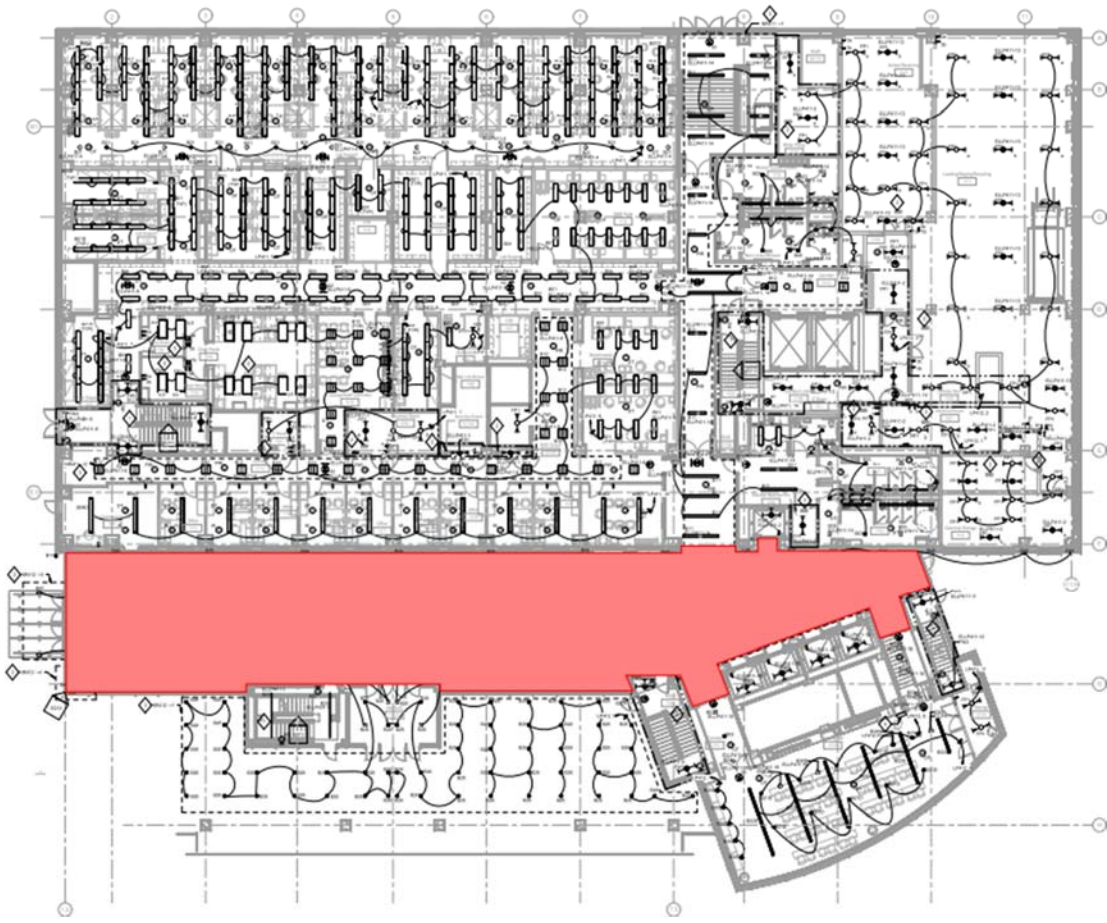
EXECUTIVE SUMMARY

The following technical report describes the existing lighting systems for the University of Maryland – Baltimore Health Sciences Facility III. Four selected spaces were evaluated including:

- CIRCULATION SPACE – MAIN ATRIUM AND ELEVATOR LOBBY
- LARGE WORK SPACE – NANOMEDICINE WORKSTATION
- SPECIAL PURPOSE SPACE – MEETING ROOM
- OUTDOOR SPACE – EXTERIOR PLAZA

These following spaces were analyzed and critiqued based on recommendations from the Illuminating Engineering Society. The lighting analysis also followed the lighting power density restrictions of the ASHRAE 90.1-2013 code. The evaluation of the spaces showed that majority of the specified criteria matched what was designed. However, without the inclusion of daylighting studies, there may be room for improvement when reevaluating the building's lighting design.

SECTION A | MAIN ATRIUM AND ELEVATOR LOBBY



EXISTING CONDITIONS | MAIN ATRIUM AND ELEVATOR LOBBY

- Room #1001 – Main Atrium (Lobby/Gathering Space)
- Room #1003 – Elevator Lobby
- Approximately 5337 sq. ft.
- Floor Finishes: Terrazzo Tile and Carpeting
- Atrium – 96’ (7 stories) height

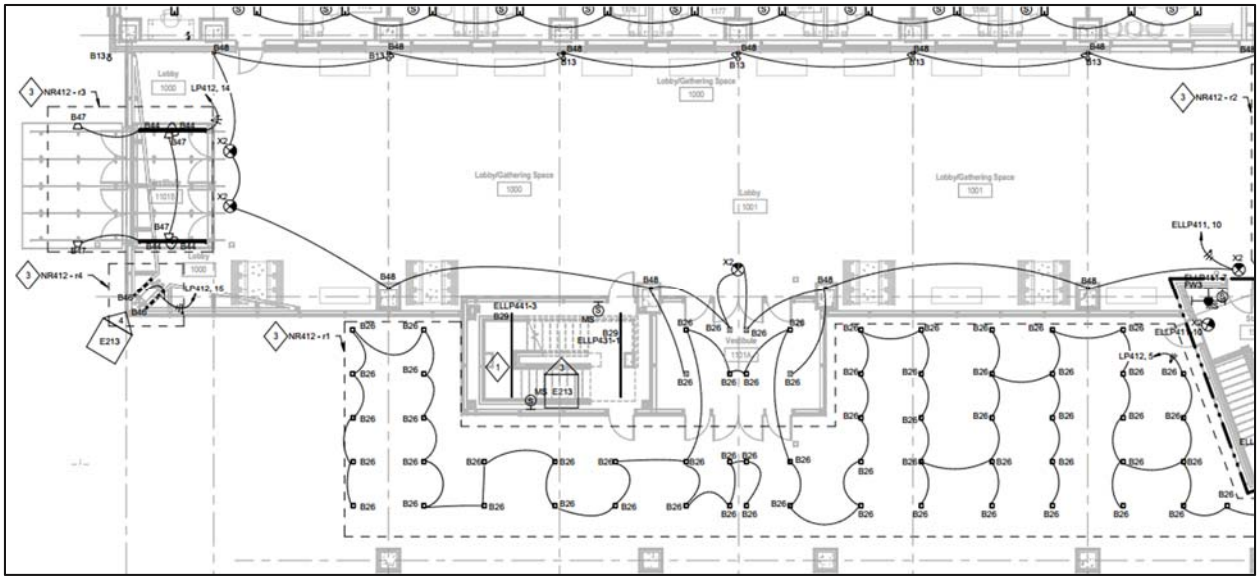


Figure 1: A drawing section showing the first floor of the main atrium space.

Above is a plan view of the main atrium space. This atrium is the connection between all the building towers and bridges the wet lab and dry lab together. This central space also features a 7 story curtain wall shown in the North West corner of figure 1. This curtain wall provides the majority of daylighting, however at nighttime hours the interior lighting must compensate. The atrium space can be entered via the overhang entrance connecting to the stairwell (south), or the canopied entrance closest to the vehicle drop-off/pickup circle (west).

The atrium features a series of wall mounted multi-head accent fixtures at the north wall. These are mounted just below the 2nd story and spread the light across the atrium floor from the north to south side. The remaining illuminance is provided by a set of surface mounted up light/down light fixtures. These are mounted to the columns of the south wall overhang.

The entry vestibule is lit by fluorescent surface mounted fixtures that are integrated into the canopy. At the south west corner of the lobby, the curtain walls meet with a large metal brace. Here, there are LED strip lights at the top surface of each brace, creating a glowing truss structure. The atrium ceiling features a series of coves at the perimeter of the atrium space.

The main atrium is the literal bridge between the wet and dry laboratories. In figure 2, the bulk of the first floor of the atrium can be seen. The bridge connections are at the 2nd, 3rd, 4th, and 5th floors of the building. These bridges have integrated lighting fixtures in the railings so that the entire walkway is illuminated.

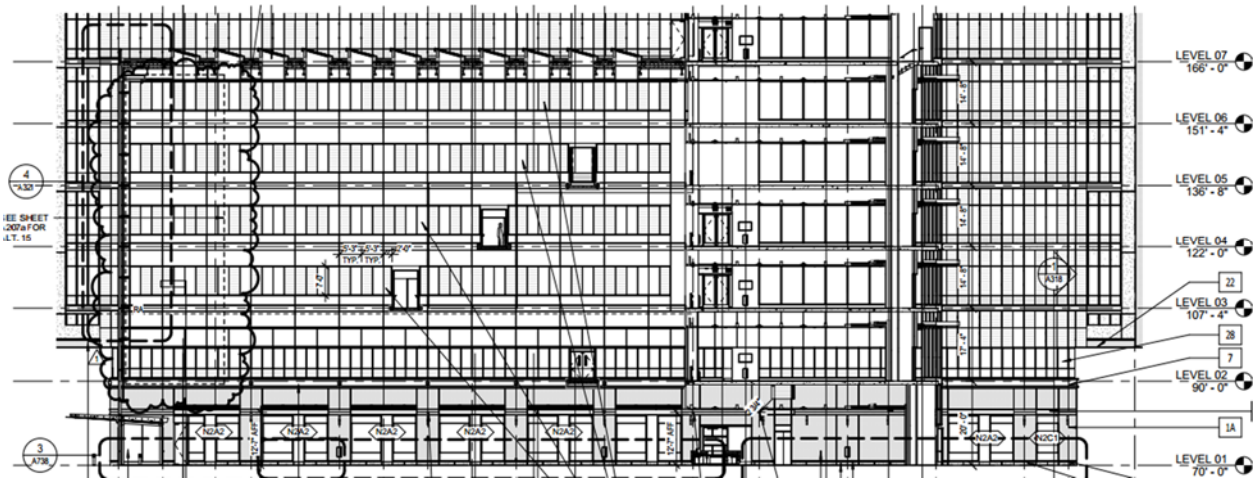


Figure 2: A building section of the atrium facing project south.

The atrium continues into the central elevator lobby. A central information and check-in desk is situated below the 2nd floor overhang which separates the lobby's ceiling height and the atrium's ceiling height. A total of 4 pedestrian elevators are available to the public, while a 5th staff elevator is located at the north wall of the elevator lobby. This lobby also connects to the meeting room space located on the first floor. The elevator lobby contains mostly recessed perimeter coves and an array of down lights.

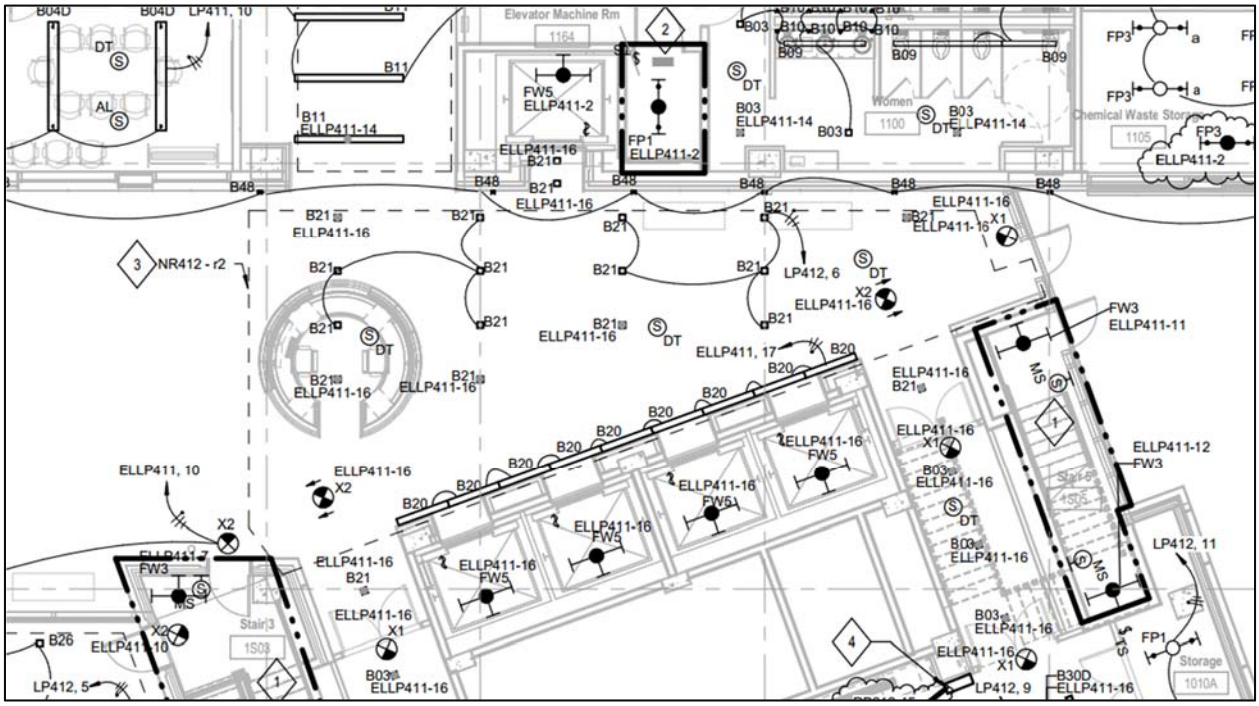


Figure 3: A drawing section of the first floor elevator lobby.

Luminaire Type	Luminaire Description, Specification & Location, etc.	Luminaire Manufacturer & Catalog Number	Lamp Type	Lamp Qty.	Lamp Wattage (Ea.)	Total Wattage	Voltage
B13	WALL MOUNTED ADJUSTABLE ACCENT MULTI-HEADED (QUANTITY 4 IN 2X2 PATTERN) LED ACCENT DOWNLIGHT LUMINAIRE. LAMPING: WARM WHITE LED COLOR TEMPERATURE: 3000K COLOR RENDERING INDEX: 80 OR ABOVE COLOR CONSISTENCY: 2-STEP MACADAM'S ELLIPSE MAXIMUM WATTAGE: 18 PER HEAD LED LIFE: L70 AT 50,000 HOURS ADJUSTABILITY: FULLY ADJUSTABLE BEAM SPREAD DISTRIBUTION: LOWER TWO 25° UPPER TWO 10° SIZE: APPROX. 16" SQUARE MOUNTING: INSTALL PER MANUFACTURER'S INSTRUCTIONS MOUNTING: SEE ARCHITECTURAL DETAIL FINISH: CUSTOM TBD GLARE CONTROL: SNOOT MOUNTING HEIGHT: PER ARCH. ELEVATION POWER SUPPLY: INTEGRAL POWER SUPPLY: DIGITALLY ADDRESSABLE, FULL RANGE DIMMING POWER SUPPLY: DIMMING REQUIRED, COMPATIBLE WITH DIMMING AND DAYLIGHT HARVESTING CONTROLS AS APPLICABLE CONTROL: DAYLIGHT HARVESTING INTEGRATION CONTROL: DIMMING, ENSURE COMPATIBILITY WITH DIMMING SYSTEM LOCATION: ATRIUM	RSA LIGHTING: COMBOLIGHT WALL SURFACE MOUNT 4-HEADED CSWI-N+M30MED-22-E-VOLT-FINISH OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: SISTEMALUX	LED	-	-	72	277
B16	CONTINUOUS LED LIGHTING INTEGRATED WITHIN HANDRAIL OF BRIDGES. LAMPING: WARM WHITE LED COLOR TEMPERATURE: 3000K COLOR RENDERING INDEX: 80 OR ABOVE MAXIMUM WATTAGE: 3 PER FOOT DELIVERED LUMENS: 219 PER FOOT LED LIFE: L70 AT 50,000 HOURS BEAM SPREAD DISTRIBUTION: ASYMMETRIC CROSS SECTION SIZE: PER HANDRAIL DETAILS MOUNTING: INSTALL PER MANUFACTURER'S INSTRUCTIONS MOUNTING: SEE ARCHITECTURAL DETAIL FINISH: MATCH HANDRAIL SPECIFICATIONS LENS: SOLITE, DIFFUSE POWER SUPPLY: FULL RANGE DIMMING AS STANDARD POWER SUPPLY: REMOTE LOCATION TBD CONTROL: PROGRAMMABLE RELAY LOCATION: ALL BRIDGES ACROSS ATRIUM (BOTH SIDES OF BRIDGE)	O LIGHTING: LUXRAIL 06-XXX-X-X-X-ASYM-3K-X' OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: COLE	LED	-	-	3 WLF	277
B20	X'-0" LENGTH (PER LIGHTING PLANS) RECESSED PERIMETER COVE LINEAR FLUORESCENT GRAZE DOWNLIGHT LUMINAIRE. LAMPING (IN CS): (1) 3'-0"/4'-0" 21/28 WATT T5HE LINEAR. FLUOR. BEAM SPREAD DISTRIBUTION: DOWNLIGHT GRAZE APERTURE SIZE: 6" WIDTH MOUNTING: INSTALL PER MANUFACTURER'S INSTRUCTIONS MOUNTING: CONTRACTOR TO COORDINATE LUMINAIRE MOUNTING OPTIONS AND CEILING COMPATIBILITY MOUNTING: SEE ARCHITECTURAL DETAIL BALLAST: PROGRAMMED RAPID START CONTROL: PROGRAM. RELAY LOCATION: ELEVATOR LOBBY	FOCAL POINT: MINI-GRAZER FMG-NS-1T5-1C-VOLT-S OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: LINEAR NEORAY PRUDENTIAL	LF02: F21T5 LF03: F28T5	(1) IN CS	21 28	8 WLF	277
B21	RECESSED SQUARE APERTURE (4.5") LED DOWNLIGHT LUMINAIRE. LAMPING: WHITE LED COLOR TEMPERATURE: 3500K COLOR RENDERING INDEX: 80 OR ABOVE LED LIFE: L70 AT 50,000 HOURS ADJUSTABILITY: NONE BEAM SPREAD DISTRIBUTION: 50° APERTURE SIZE: 4.5"X4.5" REGRESS DEPTH: 1" MOUNTING: CONTRACTOR TO COORDINATE LUMINAIRE MOUNTING OPTIONS AND CEILING COMPATIBILITY MOUNTING (ACT/METAL/WOOD): OVERLAP FLANGE TRIM REQUIRED MOUNTING (GYP.): TRIMLESS, MUD-TO-APERTURE REQUIRED MOUNTING (ARMSTRONG TECH-ZONE): TECH-ZONE COMPATIBLE REQUIRED REFLECTOR: CLEAR MATTE ALZAK BEVEL WITH PAINTED FLANGE FLANGE FINISH: WHITE FOR WHITE CEILINGS, METAL FOR WOOD OR GRAY LENS: SOLITE, DIFFUSE POWER SUPPLY: FULL RANGE DIMMING IS STANDARD POWER SUPPLY: INTEGRAL TO LUMINAIRE CONTROL: VARIES LOCATION: GENERAL: MAXIMUM WATTAGE: 24	USA ILLUMINATION: BEVELED 2.0 TRIM: 3110 TRIMLESS: 3311 OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: ERCO FOCAL POINT IRIS KURT VERSEN TECH	LED	-	-	24	277

	DELIVERED LUMENS: 1,675 LOCATION: LABS, HIGH CEILINGS						
B38	X'-0" LENGTH (PER LIGHTING PLANS) COVE CONCEALED CONTINUOUS ASYMMETRIC DISTRIBUTION LED UPLIGHT LUMINAIRE WITH INTEGRAL POWER SUPPLY FOR INDIRECT COVE LIGHTING EFFECT. LAMPING: WARM WHITE LED COLOR TEMPERATURE: 3000K COLOR RENDERING INDEX: 80 OR ABOVE COLOR CONSISTENCY: 2-STEP MACADAM'S ELLIPSE MAXIMUM WATTAGE: 7 PER FOOT DELIVERED LUMENS: 380 PER FOOT LED LIFE: L70 AT 50,000 HOURS BEAM SPREAD DISTRIBUTION: ASYMMETRIC UPLIGHT CROSS SECTION SIZE: 2.625"X5.75" MOUNTING: INSTALL PER MANUFACTURER'S INSTRUCTIONS MOUNTING: SEE ARCHITECTURAL DETAIL POWER SUPPLY: FULL RANGE DIMMING AS STANDARD POWER SUPPLY: INTEGRAL TO LUMINAIRE POWER SUPPLY: COMPATIBLE WITH DIMMING CONTROLS AS APPLICABLE CONTROL: DAYLIGHT HARVESTING INTEGRATION CONTROL: DIMMING, ENSURE COMPATIBILITY WITH DIMMING SYSTEM LOCATION: ATRIUM CEILING COVE CONTINUOUS ALONG WEST AND SOUTH SIDE OF ATRIUM	ELLIPTIPAR: FRAQTIR S305 OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: AMETRIX WINONA	LED	-	-	7 WLF	277
B44	X'-0" LENGTH (PER LIGHTING PLANS) CONTINUOUS SURFACE MOUNTED (TO STEEL BEAM SIDE) FLUORESCENT GLOW LUMINAIRE WITH SQUARE PROFILE AND THREE SIDES GLOWING VIA DIFFUSE GLASS LENS. LAMPING (IN CS): (1) 4'-0" 28 WATT T5HE LINEAR FLUOR. CROSS SECTION SIZE: 3.5"X3.5" MOUNTING: INSTALL PER MANUFACTURER'S INSTRUCTIONS MOUNTING: CONTRACTOR TO COORDINATE LUMINAIRE MOUNTING OPTIONS AND CEILING COMPATIBILITY MOUNTING: SEE ARCHITECTURAL DETAIL MOUNTING: FACTORY DRAWINGS REQUIRED FOR PROJECT SPECIFIC MOUNTING CONDITION FINISH: STAINLESS TRIM LENS: DIFFUSE, SELECTION TBD BALLAST: ELECTRONIC PROGRAMMED START BALLAST: COMPATIBLE WITH DIMMING CONTROLS AS APPLICABLE CONTROL: DAYLIGHT HARVESTING INTEGRATION LOCATION: ATRIUM WEST VESTIBULE	SELUX: NEO OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: SISTEMALUX VODE	LF03: F28T5	(1) IN CS	28	8 WLF	277
B46	REMOVED	-	-	-	-	-	-
B47	39" HIGH LED STANCHION MOUNTED LED LUMINAIRE. LAMPING: WARM WHITE LED COLOR TEMPERATURE: 3000K COLOR RENDERING INDEX: 80 OR ABOVE COLOR CONSISTENCY: 2-STEP MACADAM'S ELLIPSE MAXIMUM WATTAGE: 13 DELIVERED LUMENS: LED LIFE: L70 AT 50,000 HOURS BEAM SPREAD DISTRIBUTION: FLOOR WASH SIZE: 39"H MOUNTING: INSTALL PER MANUFACTURER'S INSTRUCTIONS MOUNTING: SEE ARCHITECTURAL DETAIL FINISH: CUSTOM TBD GLARE CONTROL: FULL CUTOFF POWER SUPPLY: FULL RANGE DIMMING AS STANDARD POWER SUPPLY: INTEGRAL TO LUMINAIRE CONTROL: PROG. RELAY AND EMERGENCY EGRESS LOCATION: ATRIUM WEST VESTIBULE	BEGA: 8659LED OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: ERCO IGUZZINI	LED	-	-	13	277
B48	SURFACE WALL MOUNTED CYLINDER LED UPLIGHT/DOWNLIGHT LUMINAIRE. LAMPING: WARM WHITE LED COLOR TEMPERATURE: 3000K MAXIMUM WATTAGE: 18 DELIVERED LUMENS: 1710 LED LIFE: L70 AT 50,000 HOURS BEAM SPREAD DISTRIBUTION: UPLIGHT AND DOWNLIGHT SIZE: 7"WX6"HX5"W	ERCO: 85103.023 OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: BEGA FC IGUZZINI	LED	-	-	18	277

	MOUNTING: SEE ELEVATION FOR MOUNTING HEIGHT FINISH: CUSTOM TBD GLARE CONTROL: CUTOFF DOWNLIGHT CONTROL REQUIRED UL LISTING: WET LISTED IP RATING: IP65 POWER SUPPLY: INTEGRAL TO LUMINAIRE CONTROL: PROGRAMMABLE RELAY LOCATION: ATRIUM WALL MOUNTED						

Table 26.4 Nighttime Outdoor Lighting Zone Definitions

IES Lighting Handbook, 10th Edition

Zone	Outdoor Lighting Situation	Definition
LZ3	Moderately High Ambient Lighting	Areas of human activity where the vision of human residents and users is adapted to moderately high light levels. Lighting is generally desired for safety, security, and/or convenience and it is often uniform or continuous. After curfew, lighting may be extinguished or reduced as activity levels decline.

It is important to note the nighttime outdoor lighting zone criteria as this will determine the lighting levels needed to for the canopied entry into the atrium. In addition, the vestibule connecting the exterior canopied entry and the atrium should be considered for high pedestrian activity, as this is a research facility on a college campus. The bulk of the atrium is considered general circulation and connects to the building's central elevator lobby. Recommended Illuminance targets for both elevator lobbies (during daytime and nighttime hours), and reception lobbies have been included in the lighting criteria.

The reception desk at the junction of the atrium space and the elevator lobby must have adequate lighting to ensure a productive reception workplace, in addition to providing enough light for patron facial recognition.

Table 22.2 Common Applications Illuminance Recommendations

IES Lighting Handbook, 10th Edition

Applications and Tasks	Recommended Maintained Illuminance Targets (lux)		
Canopied Entries/Exits: High Activity	Horizontal (E_h) Targets	Vertical (E_v) Targets	Avg:Min
LZ3	30	15	2:1 (4:1)
(curfew)	20	10	2:1 (4:1)

Curbs typified by periods of high pedestrian and vehicular traffic; E_h @grade; E_v @ 5' AFG

Circulation, Elevator Lobbies	Horizontal (E_h) Targets	Vertical (E_v) Targets	Avg:Min
Day	100	30	4:1
Night	50	20	4:1
Distant from Entries	100	30	4:1

E_h @floor; E_v @ 5' AFF. Close proximity to exterior.
Lighting should be designed to assist with adaptation when passing to/from exterior.

Reception Lobbies	Horizontal (E_h) Targets	Vertical (E_v) Targets	Avg:Min
Desk Top	150	50	4:1

E_h @3'6" AFF; E_v @ 5'AFF

Vestibules: High Activity	Horizontal (E_h) Targets	Vertical (E_v) Targets	Avg:Min
Day	150	75	2:1
Night	100	50	2:1

E_h @floor; E_v @ 5' AFF. Entry/Exit vestibules typified by periods of high pedestrian traffic.

Table 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method

ANSI/ASHRAE/IES Standard 90.1-2013

Common Space Types	LPD (W/ft^2)
Atrium >40 ft. in height	0.40 + 0.20/ft. total height
Elevator Lobby	0.64
General Lobby Space	0.90

Table 9.4.2-2 Individual Lighting Power Allowances for Building Exteriors

ANSI/ASHRAE/IES Standard 90.1-2013

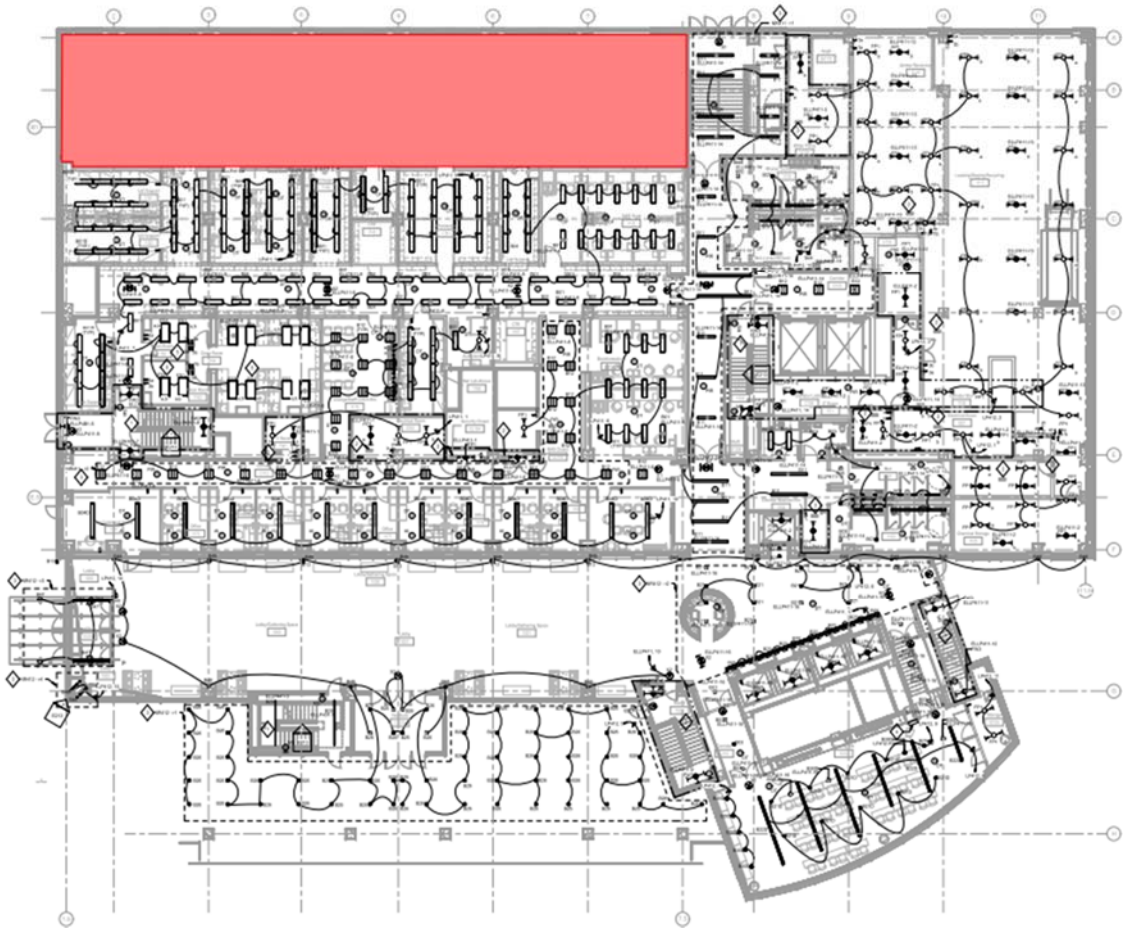
Building Entrances, Exits, and Loading Docks (Zone 3)	LPD (W/ft^2)
Main Entries	30 W/lin ft of door width
Other Doors	20 W/lin ft of door width
Entry Canopies	0.4

LIGHTING EVALUATION | MAIN ATRIUM AND ELEVATOR LOBBY

I plan to implement John Flynn's psychological counterpart system of Spaciousness vs. Closure within the atrium space. Because of its size, the students and staff members will experience a sense of an open/ public space, where you can see every person within the atrium at any point in time. The use of varied color temperatures within the space will cause the view to associate certain sections of the atrium with that particular color temperature. That way, the south wall of the atrium space can incorporate a warmer color temperature, creating a more personal, calmer atmosphere for lounging/ reading. On the contrary, the entryways and bridges could incorporate cooler color temperatures to increase the visual environment.

It is important to note from the lighting criteria that each of the entry ways to the lobby and atrium must be well lit to provide adequate illumination for safe passenger travel. The existing lighting maintains an acceptable target illuminance while also providing enough light in the atrium space to transition from one side to the other. The goal of a new lighting design is to incorporate new fixtures or layouts to potentially decrease the LPD for the main atrium.

SECTION B | NANOMEDICINE WORKSTATION



EXISTING CONDITIONS | NANOMEDICINE WORKSTATION

- Rooms #1130, #1140 – Nanomedicine PDoc/GS/Tech Wkst
- Approximately 4026 sq. ft.
- Floor Finishes: Terrazzo Epoxy Resin and Vinyl Composition Tile

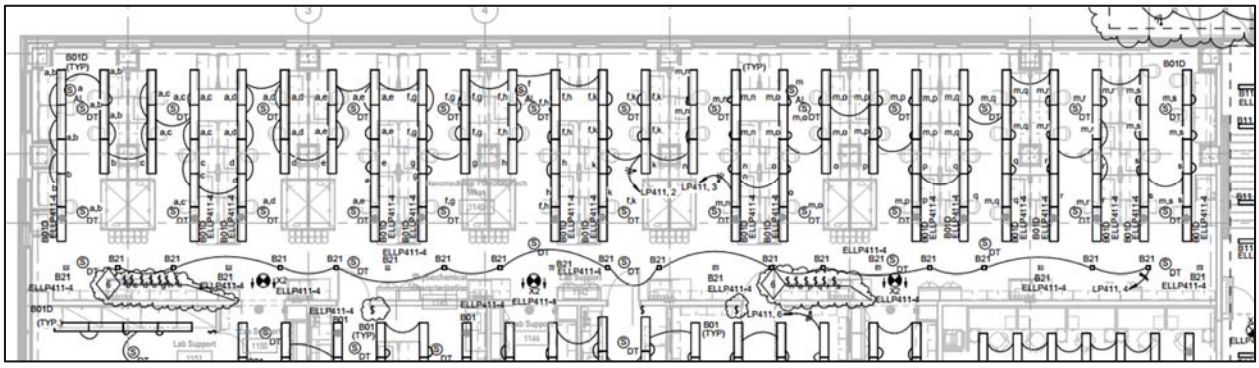


Figure 4: A drawing section of the first floor showing the nanomedicine workstation space.

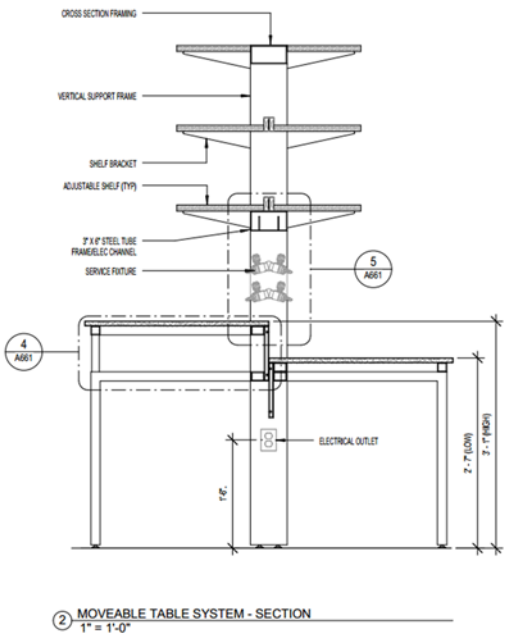


Figure 5: A section view of the workspace shelving and table system.

The nanomedicine workstation room is one of a number of research and development labs within the building. It is expected to be a laboratory where a myriad of chemicals and compounds are synthesized, while also serving as presentation and educational space. The lab is predominantly filled with casework, sinks, benches, and shelving units. The shelving units are attached to the partition of the benches, above the table workspace. These units can be seen in section detail in figure 5. These shelving units can reduce the amount of light hitting the surface of the desk, depending on the placement of the overhead fixture. There are also ten fume hoods within the lab, small ventilation devices that limits human exposure to hazardous materials or fumes. The hoods can be seen in detail in figure 6.

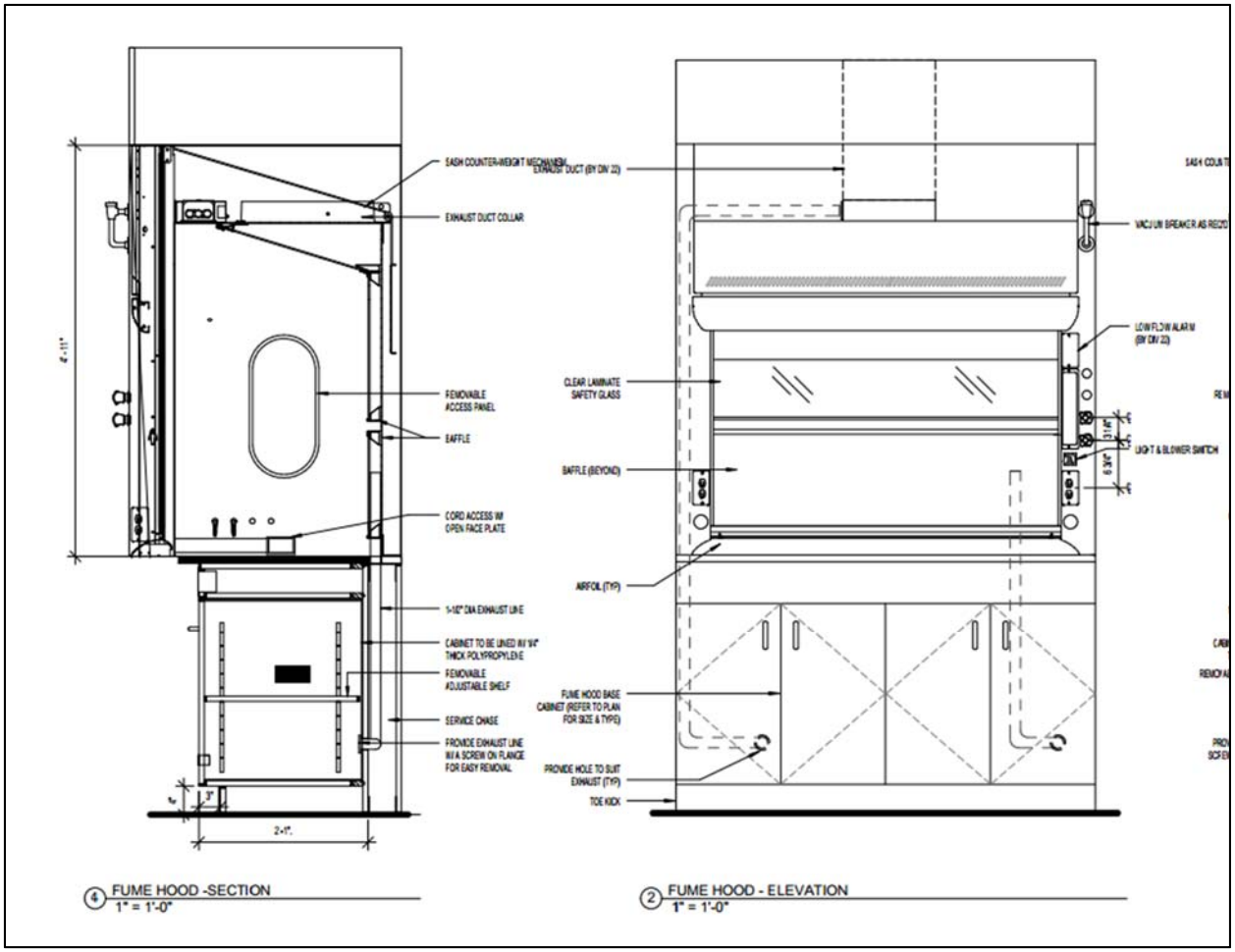


Figure 7: A section view of one of the ten workstation fume hoods.

The workstation is a general layout of recessed volumetric luminaires. These linear fluorescent fixtures provide the majority of light for the bench and shelving space. The transition space in the room is illuminated by a string of recessed down lights.

Luminaire Type	Luminaire Description, Specification & Location, etc.	Luminaire Manufacturer & Catalog Number	Lamp Type	Lamp Qty.	Lamp Wattage (Ea.)	Total Wattage	Voltage
B01D	RECESSED 1'X4' VOLUMETRIC DISTRIBUTION LUMINAIRE WITH RIBBED ACRYLIC LENS AND RIBBED UPPER REFLECTOR. LAMPING: (1) 28 WATT T5HE LINEAR FLUOR. REFLECTOR: LINEAR FACETED HIGHLY REFLECTIVE SILVER LENS: RIBBED FROSTED ACRYLIC REFRACTOR MOUNTING: CONTRACTOR TO COORDINATE LUMINAIRE MOUNTING OPTIONS AND CEILING COMPATIBILITY BALLAST: DAYLIGHT HARVESTING VIA DIGITALLY ADDRESSABLE DIMMING TO 10% OUTPUT BALLAST: COMPATIBLE WITH DIMMING CONTROLS AS APPLICABLE CONTROL: DAYLIGHT HARVESTING INTEGRATION, FULL RANGE DIMMING LOCATION: WET LAB MODULE DAYLIGHT HARVESTING, OTHER	LITHONIA: RT5	LF03: F28T5	1	28	39	277
B21	RECESSED SQUARE APERTURE (4.5") LED DOWNLIGHT LUMINAIRE. LAMPING: WHITE LED COLOR TEMPERATURE: 3500K COLOR RENDERING INDEX: 80 OR ABOVE LED LIFE: L70 AT 50,000 HOURS ADJUSTABILITY: NONE BEAM SPREAD DISTRIBUTION: 50° APERTURE SIZE: 4.5"X4.5" REGRESS DEPTH: 1" MOUNTING: CONTRACTOR TO COORDINATE LUMINAIRE MOUNTING OPTIONS AND CEILING COMPATIBILITY MOUNTING (ACT/METAL/WOOD): OVERLAP FLANGE TRIM REQUIRED MOUNTING (GYP.): TRIMLESS, MUD-TO-APERTURE REQUIRED MOUNTING (ARMSTRONG TECH-ZONE): TECH-ZONE COMPATIBLE REQUIRED REFLECTOR: CLEAR MATTE ALZAK BEVEL WITH PAINTED FLANGE FLANGE FINISH: WHITE FOR WHITE CEILINGS, METAL FOR WOOD OR GRAY LENS: SOLITE, DIFFUSE POWER SUPPLY: FULL RANGE DIMMING IS STANDARD POWER SUPPLY: INTEGRAL TO LUMINAIRE CONTROL: VARIES LOCATION: GENERAL: MAXIMUM WATTAGE: 24 DELIVERED LUMENS: 1,675 LOCATION: LABS, HIGH CEILINGS	USA ILLUMINATION: BEVELED 2.0 TRIM: 3110 TRIMLESS: 3311	LED	-	-	24	277

Table 24.2 Educational Facilities Illuminance Recommendations

IES Lighting Handbook, 10th Edition

Applications and Tasks	Recommended Maintained Illuminance Targets (lux)		
Classrooms: Science Labs	Horizontal (E_h) Targets	Vertical (E_v) Targets	Avg:Min
Bench	500	300	1.5:1

E_h @3'; E_v @ 4'6" AFF. Ave:Min based on Table 12.6 Default Illuminance Ratio Recommendations.

Classrooms: Science Labs	Horizontal (E_h) Targets	Vertical (E_v) Targets	Avg:Min
Demonstration Area	1000	500	3:1

E_h @3' AFF; E_v @ 4'6" AFF

The majority of the workstation space is casework, lab tables, and shelving. Since it is part of an educational facility, the illuminance recommendations for science labs are appropriate. The lighting criteria is such that all of the workstation benches, desks, and demonstration areas have adequate lighting for the staff and students should be able to see what they are doing. The safety of certain projects may be determined by reading and understanding what chemical compounds they are using. Thus, the target illuminance at the desk height must match the criteria.

Table 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method

ANSI/ASHRAE/IES Standard 90.1-2013

Common Space Types	LPD (W/ft^2)
Workshop	1.59

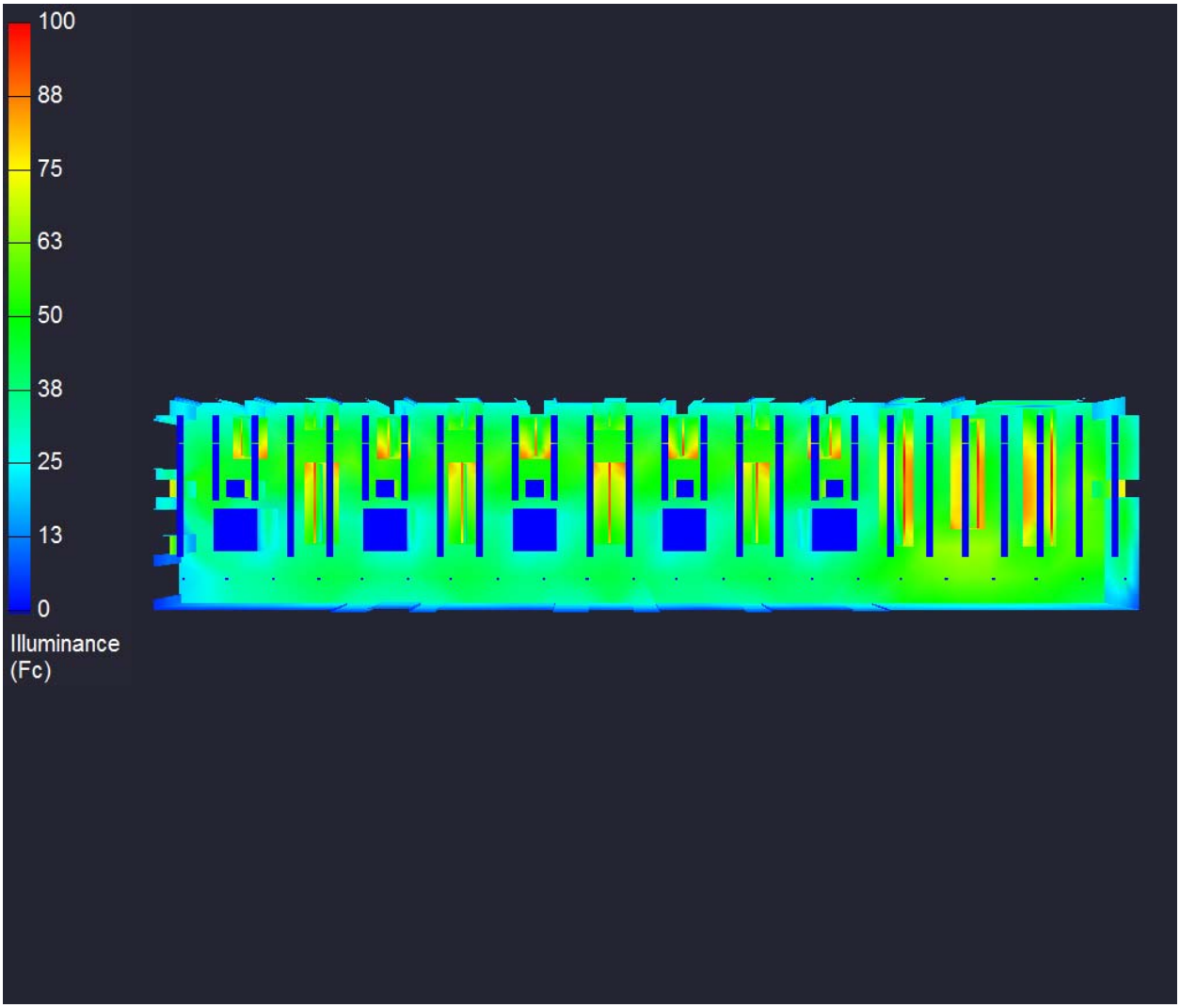
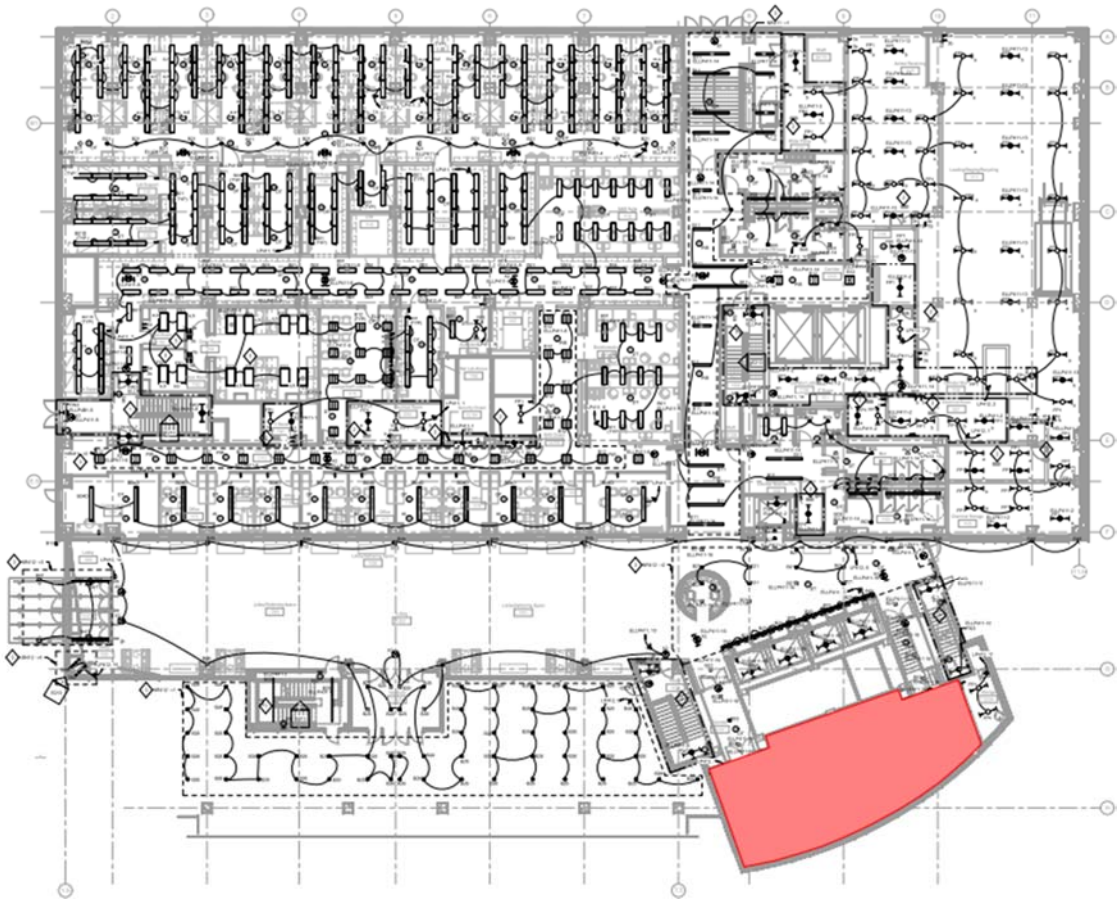


Figure 7: A pseudo rendering of the nanomedicine workstation space. Calculated in AGI32-15.2.

Lighting Criterion	Recommended Value	Achieved Value	Code Compliant
LPD Area Summary	< 1.59 W/ft^2	0.973 W/ft^2	Yes
Average Target Illuminance	≥ 500 lux	600 lux	Yes

A detailed performance analysis of the nanomedicine workstation space showed that the existing lighting met the criteria that had been previously specified. This met both the IES Lighting Handbook and ANSI/ASHRAE/IES 90.1-2013 standards. The average illuminance at 2' 6" AFF was 60.72 fc (roughly 600 lux). The LPD area summary was well below the maximum allowance of 1.59 W/ft^2. Although I specified a demonstration area target of 1000 lux, my evaluation showed that this is an unnecessary specification. To maintain a higher illuminance would require a higher wattage lighting fixture, which would most likely result in an overpowered LPD. The 600 lux average should provide enough light for students and researchers to work comfortably.

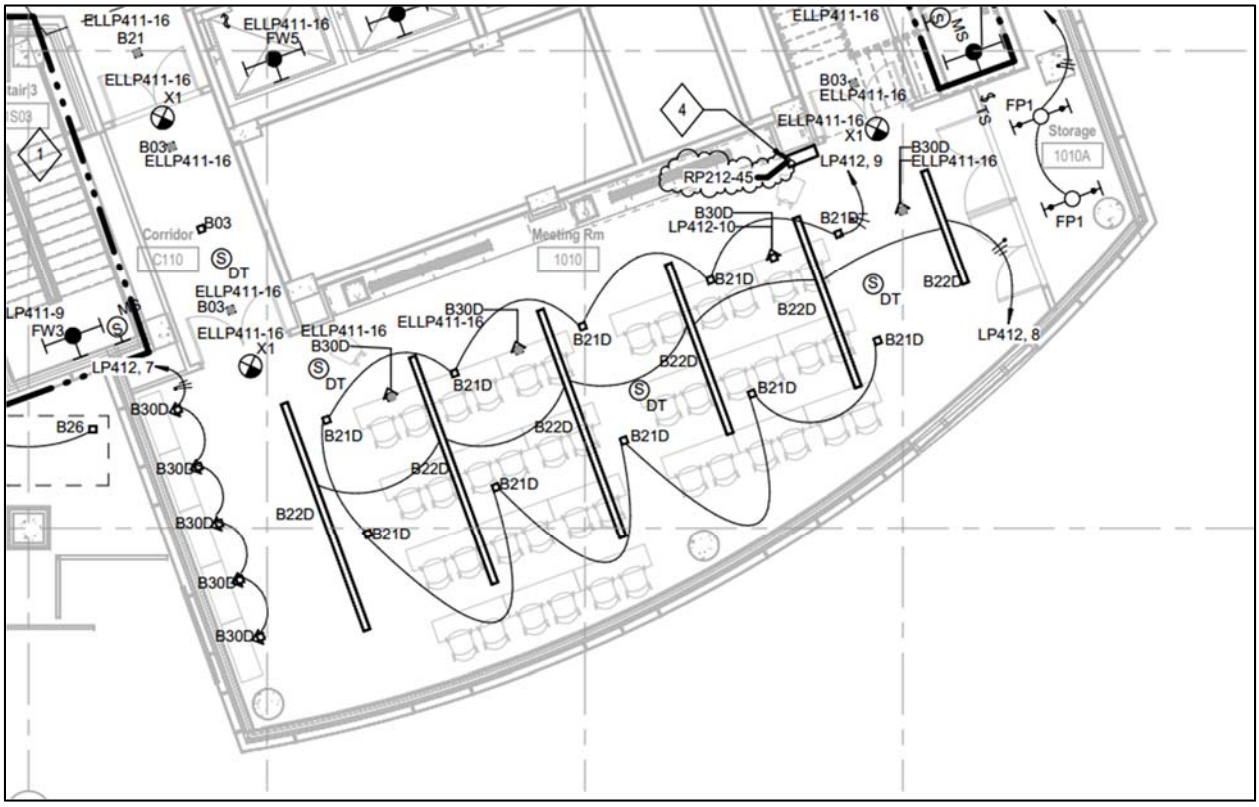
SECTION C | MEETING ROOM



EXISTING CONDITIONS | MEETING ROOM

- Room #1010 – Meeting Room
- Approximately 1421 sq. ft.
- Floor Finishes: Carpeting

The meeting room is a moderately sized conference room space. Here office staff and building patrons can meet for video conferencing, audiovisual presentations, and lectures. The majority of seating is assumed to be temporary, and can be moved as needed to fit the conferencing event. The north wall of the meeting room features two presentation boards mounted between the structural columns. The surrounding exterior is large pane glass windows showing wonderful views of the exterior space and landscaping.



Fixtures for the meeting room space include square aperture recessed down lights and linear recessed linear down lights. This is commonly seen, however, the design also includes some wall washers on the west wall, which add depth to what may be a dull conference room. The wall washers also take the place of the video screens on the north wall when they are rolled up and not being used for a presentation.

Luminaire Type	Luminaire Description, Specification & Location, etc.	Luminaire Manufacturer & Catalog Number	Lamp Type	Lamp Qty.	Lamp Wattage (Ea.)	Total Wattage	Voltage
B21D	RECESSED SQUARE APERTURE (4.5") LED DOWNLIGHT LUMINAIRE. LAMPING: WHITE LED COLOR TEMPERATURE: 3500K COLOR RENDERING INDEX: 80 OR ABOVE WATTAGE: 24 DELIVERED LUMENS: 1,675 LOCATION: LABS, HIGH CEILINGS LED LIFE: L70 AT 50,000 HOURS ADJUSTABILITY: NONE BEAM SPREAD DISTRIBUTION: 50° APERTURE SIZE: 4.5"X4.5" REGRESS DEPTH: 1" MOUNTING: CONTRACTOR TO COORDINATE LUMINAIRE MOUNTING OPTIONS AND CEILING COMPATIBILITY MOUNTING (ACT/METAL/WOOD): OVERLAP FLANGE TRIM REQUIRED	USA ILLUMINATION: BEVELED 2.0 TRIM: 3110 TRIMLESS: 3311 OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: ERCO FOCAL POINT IRIS KURT VERSEN TECH	LED	-	-	24	277

	MOUNTING (GYP.): TRIMLESS, MUD-TO-APERTURE REQUIRED MOUNTING (ARMSTRONG TECH-ZONE): TECH-ZONE COMPATIBLE REQUIRED REFLECTOR: CLEAR MATTE ALZAK BEVEL WITH PAINTED FLANGE FLANGE FINISH: WHITE FOR WHITE CEILINGS, METAL FOR WOOD OR GRAY LENS: SOLITE, DIFFUSE POWER SUPPLY: FULL RANGE DIMMING IS STANDARD POWER SUPPLY: COMPATIBLE WITH DIMMING CONTROLS AS APPLICABLE CONTROL: DIMMING, ENSURE COMPATIBILITY WITH DIMMING SYSTEM LOCATION: L1 CONFERENCE						
B22D	X'-0" LENGTH (PER LIGHTING PLANS) CONTINUOUS RECESSED REGRESSED LENS FLUORESCENT LUMINAIRE WITH STAGGERED LAMPING AND NO BREAKS ACROSS GRID LINES FOR A CONTINUOUS GLOW. LAMPING (IN CS): (1) 3'-0"/4'-0" 39/54 WATT T5HO LIN. FLUOR. APERTURE SIZE: 6" WIDTH REGRESS DEPTH: 1" MOUNTING: CONTRACTOR TO COORDINATE LUMINAIRE MOUNTING OPTIONS AND CEILING COMPATIBILITY MOUNTING (ARMSTRONG TECH-ZONE): TECH-ZONE COMPATIBLE LOCATION: L1 CONFERENCE LENS: DIFFUSE BALLAST: PROGRAMMED RAPID START BALLAST: DIMMING, DIGITALLY ADDRESSABLE, ENSURE COMPATIBILITY WITH DIMMING SYSTEM CONTROL: PROGRAMMABLE SCENE CONTROLLER LOCATION: CONFERENCE NOTE: MANUFACTURER SHALL PROVIDE NO DARK SPOTS OR EXCESSIVE BRIGHT SPOTS DUE TO STAGGERED LAMPING CONDITION.	FOCAL POINT: AVENUE 6/SEEM 6 REGRESSED FAV6-SR-1T5-1C-VOLT-D-XX-WH OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: LINEAR MARK ARCHITECTURAL PRUDENTIAL	LF08: F39T5HO LF09: F54T5HO	(1) IN CS	39 54	15 W/LF	277
B30D	RECESSED SQUARE APERTURE (4.5") LED WALLWASH LUMINAIRE. LAMPING: WHITE LED COLOR TEMPERATURE: 3500K COLOR RENDERING INDEX: 80 OR ABOVE MAXIMUM WATTAGE: 24 DELIVERED LUMENS: 1,150 LED LIFE: L70 AT 50,000 HOURS ADJUSTABILITY: NONE BEAM SPREAD DISTRIBUTION: WALLWASH APERTURE SIZE: 4.5"X4.5" REGRESS DEPTH: 1" MOUNTING: CONTRACTOR TO COORDINATE LUMINAIRE MOUNTING OPTIONS AND CEILING COMPATIBILITY MOUNTING (GRID): OVERLAP FLANGE TRIM REQUIRED MOUNTING (GYP.): TRIMLESS, MUD-TO-APERTURE REQUIRED MOUNTING (ARMSTRONG TECH-ZONE): TECH-ZONE COMPATIBLE REQUIRED REFLECTOR: CLEAR MATTE ALZAK BEVEL WITH PAINTED FLANGE FLANGE FINISH: WHITE FOR WHITE CEILINGS, METAL FOR WOOD LENS: SOLITE, DIFFUSE POWER SUPPLY: FULL RANGE DIMMING IS STANDARD POWER SUPPLY: INTEGRAL POWER SUPPLY: COMPATIBLE WITH DIMMING CONTROLS CONTROL: PROGRAMMABLE SCENE CONTROLLER LOCATION: L1 CONFERENCE	USA ILLUMINATION: BEVELED 2.0 3151 OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: ERCO FOCAL POINT IRIS KURT VERSEN TECH	LED	-	-	24	277

Table 22.2 Common Applications Illuminance Recommendations

IES Lighting Handbook, 10th Edition

Applications and Tasks	Recommended Maintained Illuminance Targets (lux)		
Conferencing: Meeting	Horizontal (E_h) Targets	Vertical (E_v) Targets	Avg:Min
Discourse	300	100	1.5:1

E_h @2'6"; E_v @ 4'AFF maintained for presentation surfaces (vertical poster boards, presentation boards, task surfaces). Ave:Min based on Table 12.6 Default Illuminance Ratio Recommendations.

Conferencing: Presentation	Horizontal (E_h) Targets	Vertical (E_v) Targets	Avg:Min
AV	30	30	-

E_h @2'6"; E_v @4' AFF.

The meeting room should maintain a 300lux average so that presenters and listeners alike can see each other, be able to recognize the space, and be able to read and write within the space. Because of the addition of the audio visual equipment at the north wall, the horizontal and vertical targets must also be considered. The general LPD for a conference room is listed below.

Table 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method

ANSI/ASHRAE/IES Standard 90.1-2013

Common Space Types	LPD (W/ft^2)
Conference/Meeting/Multipurpose	1.23

LIGHTING EVALUATION | MEETING ROOM

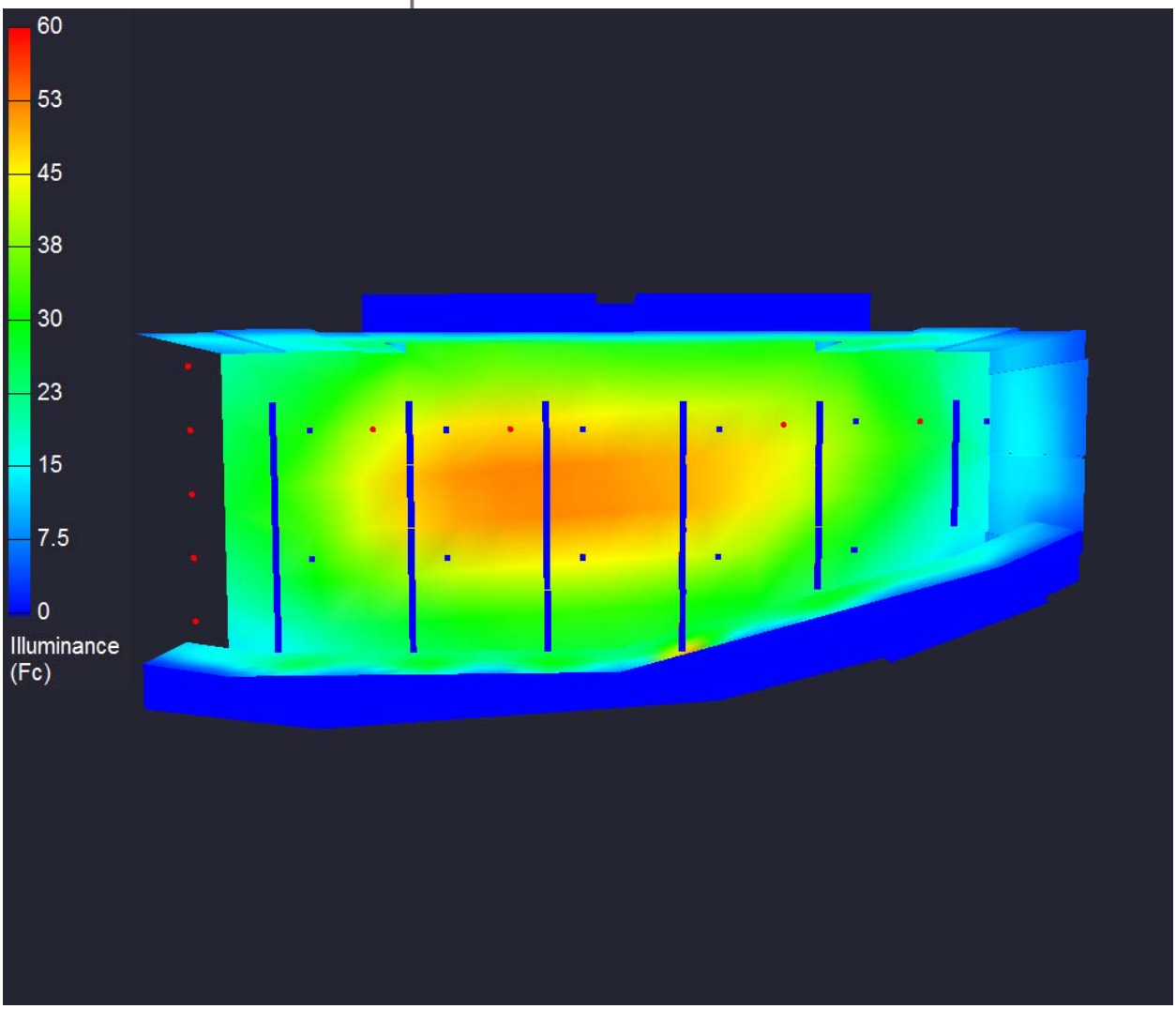
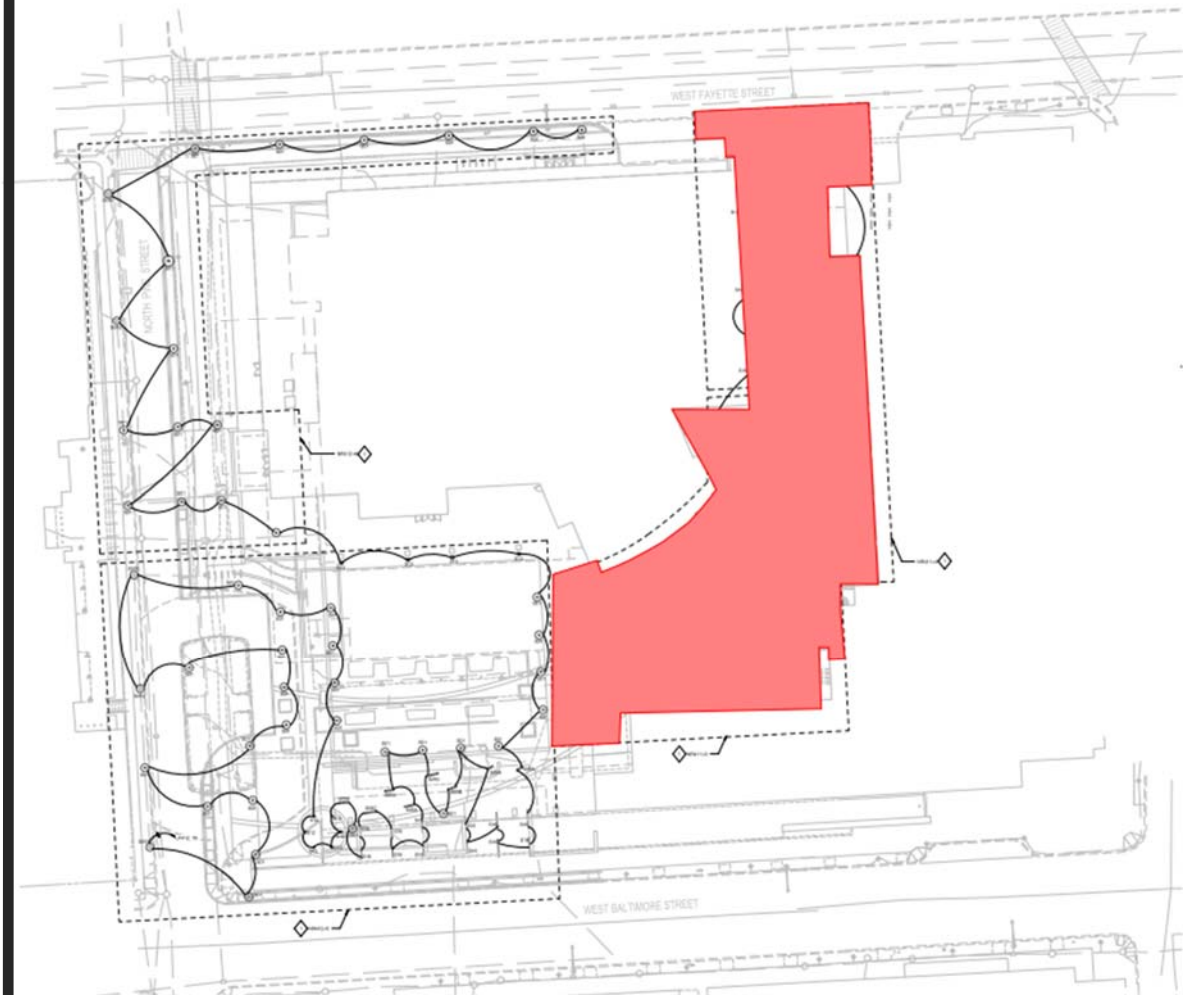


Figure 8: A pseudo rendering of the Meeting/Conference Room space. Calculated in AGI32-15.2.

Lighting Criterion	Recommended Value	Achieved Value	Code Compliant
LPD Area Summary	< 1.23 W/ft^2	0.821 W/ft^2	Yes
Average Target Illuminance	≥ 300 lux	400 lux	Yes

A detailed performance analysis of the meeting room space showed that the existing lighting met the criteria I had specified earlier. This met both the IES Lighting Handbook and ANSI/ASHRAE/IES 90.1-2013 standards. The average illuminance at 2' 6" AFF was 37.65 fc (roughly 400 lux). The LPD area summary was well below the maximum allowance of 1.23 W/ft^2. The vertical target illuminance to replace the AV equipment was also met.

SECTION D | EXTERIOR PLAZA



EXISTING CONDITIONS | EXTERIOR PLAZA

- Lighting Site Plan
- Approximately 32704 sq. ft.

The Health Sciences Facility site is within one block of the Schools of Pharmacy and Medicine, and adjacent to the School of Dentistry building. The exterior space is mostly paved walkways. There is a large courtyard space near the south entrance which connects to a pathway that functions as a pedestrian channel through the HSF3 site and the School of Dentistry building. This pathway's slope declines walking from north to south, thus there are a series of stairs and ramps between the paved paths. There are also many raised planters for landscaping which can be seen in the grayscale rendering below. This heavily trafficked space will need to provide an adequate amount of illumination for pedestrians to travel safely through the campus either during the day, or at night.

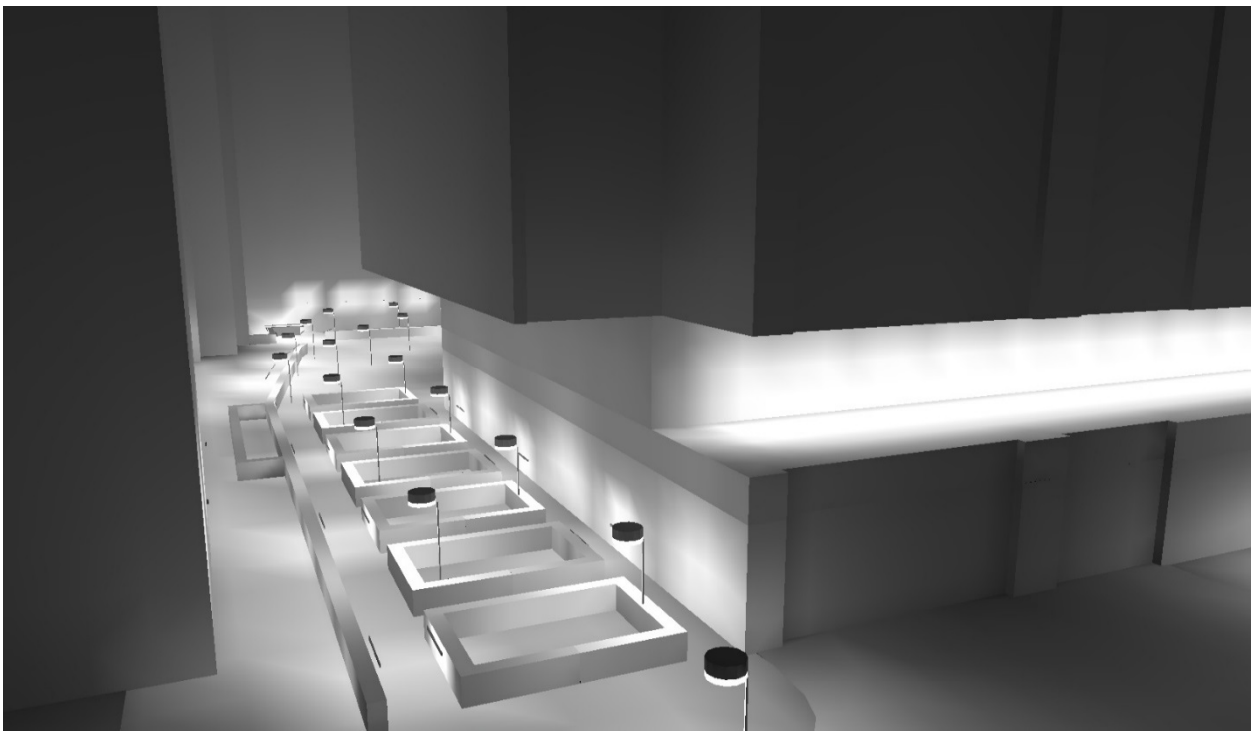


Figure 9: Rendering of the outdoor pathway separating the HSF3 Building (right) and The School of Dentistry (left) looking south.

The post mounted fixtures provide the majority of the exterior pathway lighting. These LED fixtures are mounted at a height of 10', and are scattered along the pathway to maintain a rough area of illumination for the raised planters and sidewalk. A series of above grade wall up lights that provide a linear grazing at the base of the elevator tower. These can be seen in figure 10. The remaining fixtures are surface or wall mounted to the School of Dentistry building or integrated into the handrails of the ramps and stairwells.

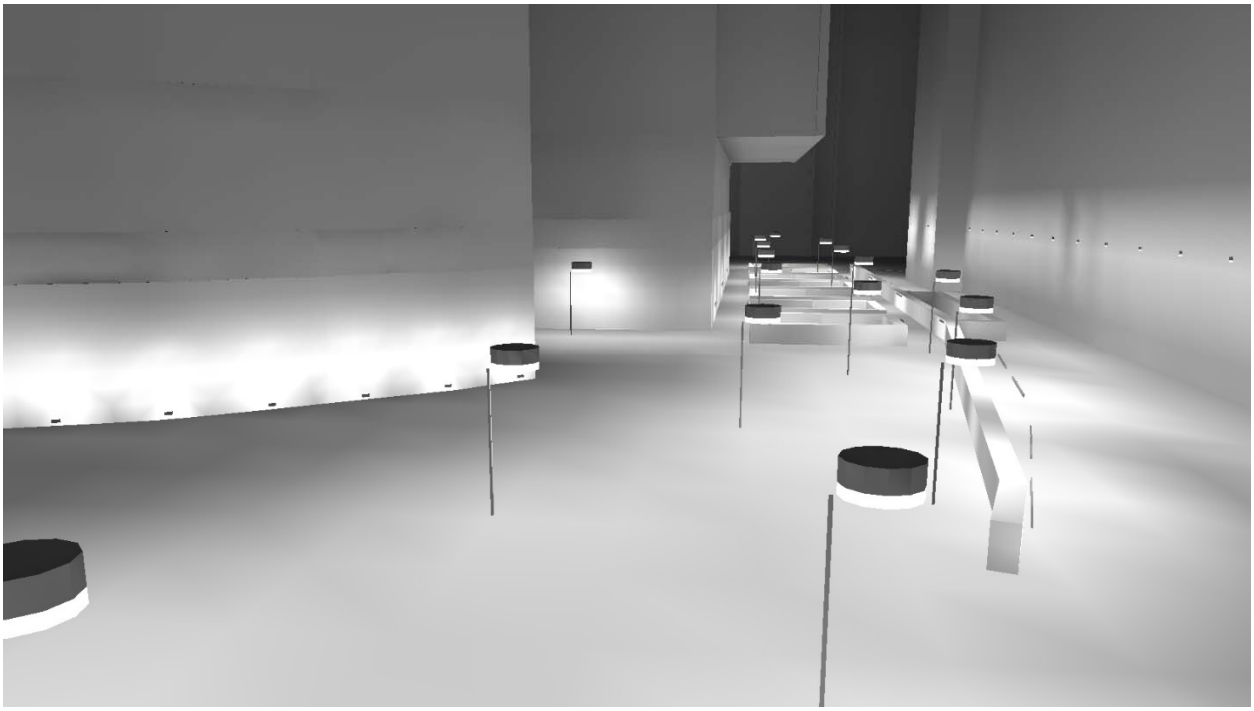


Figure 10: Grayscale rendered view looking north along the pathway.

Luminaire Type	Luminaire Description, Specification & Location, etc.	Luminaire Manufacturer & Catalog Number	Lamp Type	Lamp Qty.	Lamp Wattage (Ea.)	Total Wattage	Voltage
S01	PEDESTRIAN SCALE LED POST-TOP LUMINAIRE ATOP 10'-0" TALL POLE. LAMPING: WHITE LED COLOR TEMPERATURE: 4000K MAXIMUM WATTAGE: 112 LED LIFE: L70 AT 50,000 HOURS BEAM SPREAD DISTRIBUTION: IES TYPE 5 LUMINAIRE SIZE: 26"H X 35"D MOUNTING: SEE LANDSCAPE DETAIL FINISH: PER UNIVERSITY STANDARD POLE HEIGHT: 10'-0" POLE AESTHETIC: STEPPED BASE AT 36" AFG (PER UNIVERSITY STANDARD) POWER SUPPLY: FULL RANGE DIMMING AS STANDARD UL LISTING: WET LISTED CONTROL: PROGRAM. RELAY (PHOTOCELL ON, PHOTOCELL OFF) LOCATION: TYPICAL AREA LIGHT	LOUIS POULSEN: ALBERTSLUND-MAX-LED PRE-ARRANGED OWNER PRICING EXISTS DUE TO UNIVERSITY STANDARD. OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: BEGA HESS AMERICA SE'LUX	LED	-	-	112	TBD
S04	ABOVE GRADE ASYMMETRIC DISTRIBUTION LED WALL UPLIGHT LUMINAIRE MOUNTED TO SMALL VERTICAL TENON WITH SIDE-MOUNT SLIPFITTER. LAMPING: WARM WHITE LED COLOR TEMPERATURE: 3000K COLOR RENDERING INDEX: 80 OR ABOVE COLOR CONSISTENCY: 2-STEP MACADAM'S ELLIPSE MAXIMUM WATTAGE: 18 DELIVERED LUMENS: 750 LED LIFE: L70 AT 50,000 HOURS ADJUSTABILITY: FULL ADJUSTABLE BEAM SPREAD DISTRIBUTION: ASYMMETRIC SIZE: 12"L X 6"H C 6"W MAX. MOUNTING: SEE LANDSCAPE DETAIL FINISH: STANDARD TBD GLARE CONTROL: VISOR LENS: SOLITE, DIFFUSE POWER SUPPLY: FULL RANGE DIMMING AS STANDARD POWER SUPPLY: INTEGRAL TO LUMINAIRE UL LISTING: WET LISTED IP RATING: IP66	ELLIPTIPAR: S170-0700-X-X-VOLT-V0-0-30 OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: AMETRIX WINONA	LED	-	-	18	277

	JUNCTION BOX: WATERPROOF, IP68, WATER-STOPPER CONTROL: PROGRAM. RELAY (PHOTOCELL ON, TIMER OFF) LOCATION: ELEVATOR CORE WALL UPLIGHT NOTE: CONTRACTOR TO SUPPLY 18" DIAMETER X 18" DEEP CONCRETE BASE DETAIL (TOP FLUSH WITH GRADE) WITH CENTERED VERTICAL TENON FOR LIGHT FIXTURE MOUNTING.						
S14	SURFACE MOUNTED (TO SIDE OF STRUCTURE OF EXISTING SCHOOL OF DENTISTRY TRELIS/CANOPY) LED DOWNLIGHT LUMINAIRE. LAMPING: WHITE LED COLOR TEMPERATURE: 4000K MAXIMUM WATTAGE: 12 DELIVERED LUMENS: 960 LED LIFE: L70 AT 50,000 HOURS BEAM SPREAD DISTRIBUTION: FLOOR WASHLIGHT SIZE: 7"WX6"HX5"W MOUNTING: SEE LANDSCAPE DETAIL FINISH: CUSTOM TBD GLARE CONTROL: CUTOFF DOWNLIGHT CONTROL REQUIRED UL LISTING: WET LISTED IP RATING: IP65 POWER SUPPLY: INTEGRAL TO LUMINAIRE CONTROL: PROGRAM. RELAY (PHOTOCELL ON, PHOTOCELL OFF) LOCATION: SCHOOL OF DENTISTRY TRELIS	ERCO: 85101.023(4000K=MOD.) OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: BEGA FC IGUZZINI	LED	-	-	12	277
S15	WALL SURFACE MOUNTED (TO BUILDING AT SOUTH SIDE OF UPPER J'S CAFÉ AT SCHOOL OF DENTISTRY) LED AREA DOWNLIGHT LUMINAIRE. LAMPING: WHITE LED COLOR TEMPERATURE: 4000K MAXIMUM WATTAGE: 35 DELIVERED LUMENS: 1,400 LED LIFE: L70 AT 50,000 HOURS SIZE: 10.6"D X 8.1"H MOUNTING HEIGHT: TBD MOUNTING: SEE LANDSCAPE DETAIL FINISH: PER UNIVERSITY STANDARD UL LISTING: WET LISTED POWER SUPPLY: FULL RANGE DIMMING AS STANDARD POWER SUPPLY: INTEGRAL TO LUMINAIRE CONTROL: PROGRAM. RELAY (PHOTOCELL ON, PHOTOCELL OFF) LOCATION: SCHOOL OF DENTISTRY UPPER J'S CAFÉ	LOUIS POULSEN: ALBERTSLUND-WALL-LED (MOD.) PRE-ARRANGED OWNER PRICING EXISTS DUE TO UNIVERSITY STANDARD. OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: BEGA HESS AMERICA SE'LUX	LED	-	-	ALLOW 35	277
S16	CONTINUOUS LED LIGHTING INTEGRATED WITHIN HANDRAIL OF STAIRS. LAMPING: WHITE LED COLOR TEMPERATURE: 4000K COLOR RENDERING INDEX: 80 OR ABOVE MAXIMUM WATTAGE: 3 PER FOOT DELIVERED LUMENS: 219 PER FOOT LED LIFE: L70 AT 50,000 HOURS BEAM SPREAD DISTRIBUTION: ASYMMETRIC FOR STAIR EDGE, 55° FOR STAIR CENTER LOCATIONS CROSS SECTION SIZE: PER HANDRAIL DETAILS MOUNTING: INSTALL PER MANUFACTURER'S INSTRUCTIONS MOUNTING: SEE LANDSCAPE DETAIL FINISH: MATCH HANDRAIL SPECIFICATIONS LENS: SOLITE, DIFFUSE UL LISTING: WET LISTED POWER SUPPLY: FULL RANGE DIMMING AS STANDARD POWER SUPPLY: REMOTE LOCATION TBD, IP68 ENCLOSURE REQUIRED CONTROL: PROGRAM. RELAY (PHOTOCELL ON, PHOTOCELL OFF) LOCATION: TYPICAL SITE STAIRS	IO LIGHTING: LUXRAIL 06-XXX-X-X-X-55/ASYM-4K-X' OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: COLE	LED	-	-	W/LF	277
S17	EXTERIOR WALL SURFACE MOUNTED FULL CUTOFF LED DOWNLIGHT LUMINAIRE. LAMPING: WHITE LED COLOR TEMPERATURE: 4000K COLOR RENDERING INDEX: 80 OR ABOVE MAXIMUM WATTAGE: 26 DELIVERED LUMENS: 1597 LED LIFE: L70 AT 50,000 HOURS BEAM SPREAD DISTRIBUTION: FULL CUTOFF WIDE THROW SIZE: 8"W X 8"H X 4"D MOUNTING HEIGHT: TBD MOUNTING: INSTALL PER MANUFACTURER'S INSTRUCTIONS FINISH: CUSTOM TBD UL LISTING: WET LISTED IP RATING: IP65 CONTROL: PROGRAM. RELAY (PHOTOCELL ON, PHOTOCELL OFF)	BEGA: 3242LED OR APPROVED AESTHETIC & PERFORMANCE EQUAL BY: ERCO IGUZZINI WE-EF	LED	-	-	32	-

Table 26.4 Nighttime Outdoor Lighting Zone Definitions

IES Lighting Handbook, 10th Edition

Zone	Outdoor Lighting Situation	Definition
LZ3	Moderately High Ambient Lighting	Areas of human activity where the vision of human residents and users is adapted to moderately high light levels. Lighting is generally desired for safety, security, and/or convenience and it is often uniform or continuous. After curfew, lighting may be extinguished or reduced as activity levels decline.

Since the building site is within one block of the Schools of Pharmacy, Medicine, and Dentistry. Therefore it is safe to assume that the site will be exposed to heavy pedestrian traffic throughout the day. Thus I accounted for high activity when setting my outdoor lighting criteria.

Table 34.2 Retail Illuminance Recommendations

IES Lighting Handbook, 10th Edition

Applications and Tasks	Recommended Maintained Illuminance Targets (lux)		
Plazas and Town Squares: High Activity	Horizontal (E_h) Targets	Vertical (E_v) Targets	Avg:Min
LZ3	6	2	5:1 (10:1)
(curfew)	4	2	5:1 (10:1)

E_h @pavement; E_v @ 5' AFG in at least the two primary directions of circulation. Coordinate lighting with security cameras.

Ramps, Stairs, and Steps: High Activity	Horizontal (E_h) Targets	Vertical (E_v) Targets	Avg:Min
LZ3	8	4	5:1 (10:1)
(curfew)	6	2	5:1 (10:1)

E_h @treads/landings; E_v @ 5' AFG in at least the two primary directions of circulation. Coordinate lighting with security cameras.
Lighting should address the area of the ramps, steps, and landings. Alternatively, draw attention to the elevation changes with contrast lighting.

The recommended horizontal illuminance at the pavement will be the target illuminance factor for the path of egress. It is important to note the limiting vertical illuminance factor as this will determine what lighting must be implemented to prevent lighting trespass and urban glow.

There is a portion of the paved space is either inclining north along the path. In addition, there are small stairs located at various positions and must be accounted for based on a separate standard.

Table 9.4.2-2 Individual Lighting Power Allowances for Building Exteriors

ANSI/ASHRAE/IES Standard 90.1-2013

Building Grounds (Zone 3)	LPD (W/ft^2)
Walkways less than 10ft wide	0.8
Plaza Areas	0.16
Stairways	1.00
Landscaping	0.05

The exterior lighting power density must remain within the allowances set in the above criteria. Some of the exterior pathways are greater than 10' wide, while others are less than that width. Thus, I will account for both when considering LPD. In addition, the stairways and landscaping allowances are considered due to the large amount of landscaping space and several small stairwells.

LIGHTING EVALUATION | EXTERIOR PLAZA

Based on the lighting criteria above, the main goal for lighting the outdoor space will be to provide a minimum of 1 fc along the pedestrian pathway. This should be easily achievable when considering the spacing and concentration of fixtures throughout the exterior. The safety of pedestrians, especially during nighttime curfew hours is paramount. The use of LED fixtures to maintain the lighting standard is appropriate as they are specified at high color temperature of 4000K and have a lasting lamp life of 50,000 hrs. This will hopefully reduce the need for lamp maintenance, also preventing additional building expenses.

LEED CONSIDERATIONS

The UMB HSF3 building will be considered for LEED Silver (50-59 points) based on the LEED-NC 2009 LEED Project Checklist for Laboratories. The checklist denotes a definitive 59 points, however there are an additional 17 points that are available to the project. If these points are met, the project would then be considered for a LEED Gold rating (60-79points) having then received a total of 76 points.

While the building will meet many of the requirements for optimized performance and energy efficiency, there will not be any lighting design innovations. Namely the following credits were considered but not met.

Credit 6.1 – Controllability of Systems: Lighting
Credit 8 – Light Pollution Reduction
Credit 8.1 – Daylight & Views: Daylight (75% = 1 point)
Credit 8.2 – Daylight & Views: Views (90% = 1 point)

The project will however meet requirements with task lighting and occupant control as per the responsibility of the AEI Engineers team. With the lack of these LEED credits on the project, it is reasonable to consider implementing a daylighting scheme for these spaces.

REFERENCES

ASHRAE Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings. 2013 ed. N.P.: ASHRAE, n.d. Print.

DiLaura, David, Kevin Houser, Richard Mistrick, and Gary Steffy. Illuminating Engineering Society The Lighting Handbook. 10th ed. N.p.: ISENA, n.d. N. pag. Print.

Images provided by Barton Malow and HOK.
Lighting fixture schedule provided by HOK.