Technical Report 1 | Part 2

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Lighting + Electrical Option
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Lighting calculation 3dsMax files can be found at Y:\Conley_John

Executive Summary

In the following technical report, the existing lighting for four selected spaces within the recently built, Engineering Center, building on Oakland University's campus in Rochester, Michigan. The four spaces are as follows:

Large Work Space | Project Labs

Special Purpose Space | Lecture Hall

Transition Space | South Lobby + Atrium

Outdoor Space | Covered Walkway + Stair

The lighting design of these spaces are analyzed according to their adherence to Illuminating Engineering Society recommendations, lighting power density restrictions from ASHRAE 90.1, and the overall aesthetic and practicality of the lighting in the space. It was determined that in most of the spaces, the design was able to meet the IES recommendations while keeping the power consumption low enough to adhere to the ASHRAE LPD restrictions. Qualitatively however, all of the spaces analyzed had seriously considered the programming of the spaces and provided aesthetically pleasing designs that limited glare, allowed for daylighting integration, and added to the overall quality of the very geometric architecture that is Oakland University's Engineering Center.

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1.0 Large Work Space | Project Labs

1.1 Existing Conditions

Figure 1 | a simple section of the project labs

The large open-plan project labs on the first floor function as a large multipurpose space for fabrication and testing of a variety of engineering-related work and will be a very important space for a hands on learning experience. According to the plans, the labs will be for Senior Projects, Mechatronics and SAE (Society of Automotive Engineers). The space is 5,704 square feet in area and has a double-height exposed ceiling at about 30 feet in height. The materiality in this space is very raw and unfinished; the floor is a basic polished concrete floor and the walls are painted CMU blocks. The furniture is very movable and consists of simple tables, office chairs and partitions in order to facilitate a very versatile space.

The current lighting scheme is very simple and consists of an almost-equally spaced array of 1.5′ by 4′ industrial high-bay fluorescent fixtures. The purpose in this lighting scheme is more quantitative in nature than qualitative or aesthetic which, is very appropriate in this very work-oriented space. There are 8 occupancy sensors, shown in Figure 3 as small circles with a DT written in them, mounted at 26′ in order to accurately cover the entire area with

sightlines. The sensors work with sets of the luminaires in order to try to keep the least number of luminaires on possible.

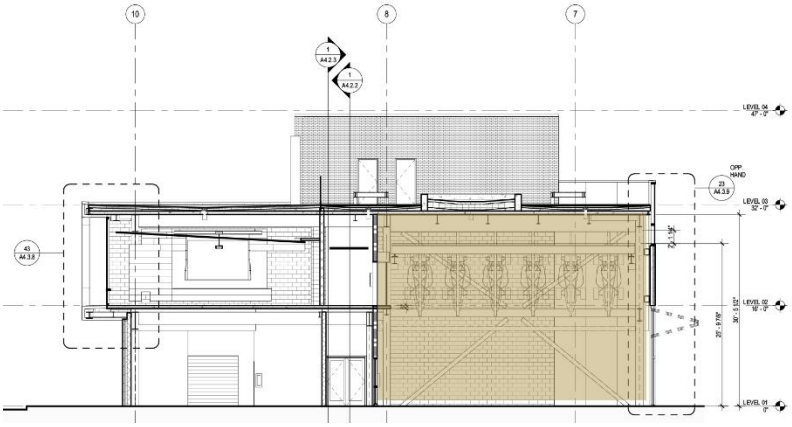

Figure 2 | Section of project labs (North is Right)

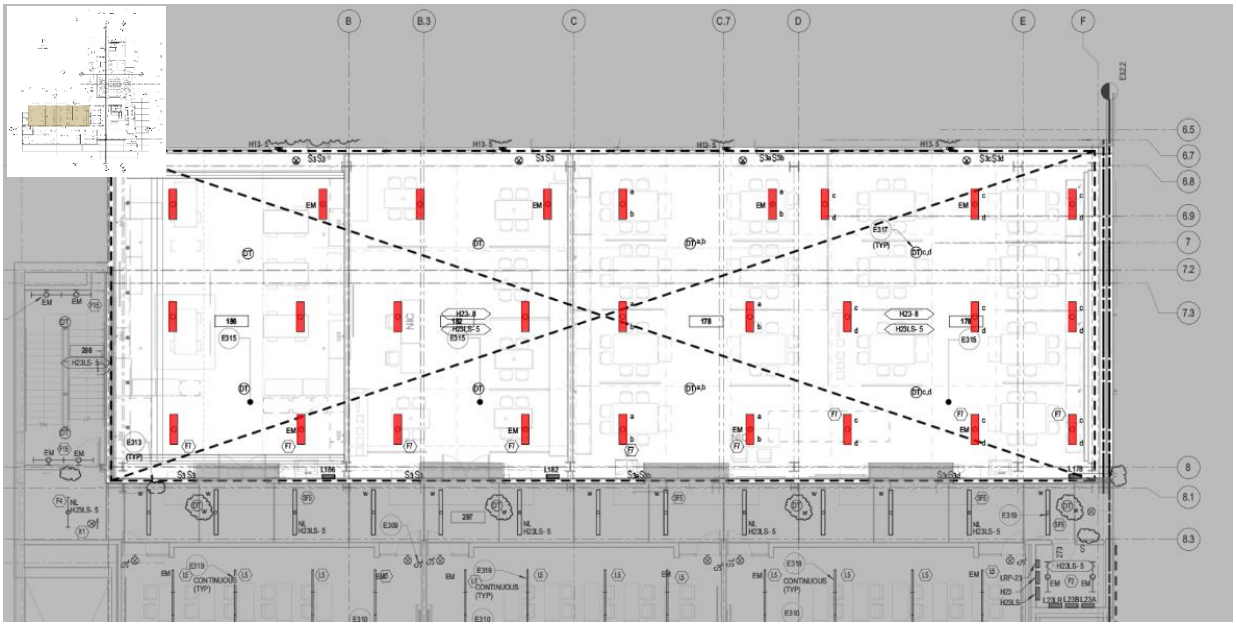

Figure 3 | plan highlighting the project lab existing lighting (colors match fixture schedule)

Type	Load	Voltage	Mounting	Lamp	Description	Manufacturer	Model
F7	364W	277 V	SUSPENDED	6-F54T5HO, PS; 4100K CCT	18" WIDE BY 4' LONG AIRCRAFT CABLE SUSPENDED HIGH BAY FIXTURE; ALL STEEL CONSTRUCTION WITH SPECULAR ALUMINUM REFLECTOR THAT PROVIDES 10% UPLIGHT, HIGH-GLOSS, WHITE POLYESTER POWDER COAT FINISH	LITHONIA	IBZ

Table 1 | project labs fixture schedule

1.2 Project Labs Lighting Design Criteria

The main tasks to be performed in this space are classroom shop work, reading and writing, and automobile work. There will be a multitude of activities taking place in this space and thus should have a high enough illuminance to accommodate all activity or else have designated spaces within the larger space. Since the space does not seem to have any sense of separating the spaces in any permanent sense, it would be best if the lighting design accommodated any possible activity. The IES recommended horizontal illuminance for shop classrooms seems to be the max that would be considered a viable solution to this space. The minimum amount of activity would probably reading or writing which we see is recommended to be 300 lux. If the existing design is in-between these two values, then it can be assumed to be adequate.

According to ASHRAE 90.1 the allowable LPDs for these three rooms are 1.40 W/ft^2 for the Senior Project lab and 0.7 W/ft^2 for both the Mechatronics lab and SAE lab.

Task	E_h (lux)	E_v (lux)	Avg:Min
Classrooms | Shops	1000	500	1.5:1 (Table 12.6)
Reading + Writing	300	75	1.5:1 (Table 12.6)

Table 2 | IES recommendations for tasks in project labs

1.3 Project Labs Lighting Evaluation

After a simplified 3dsMax calculation of the F7 industrial luminaires in the project lab space it was found that the average illuminance is actually more in the 200 to 300 lux range than the 300 to 1000 lux range. For this to make any sense, it can be assumed that the lighting designers were designing for a different task than was found or there is a technical problem with one or more parts of the model. This dissimilarity is not, however, very troubling as there are more opinions when it comes to lighting than correct answers.

The LLF for the fluorescent fixture used was 0.85 in the 3dsMax Design 2015 calculations.

A document provided by SmithGroupJJR showed that the resulting LPDs of these three spaces were 0.11 W/ft^2 above allowed for the Senior Project lab, 0.84 W/ft^2 above for the Mechatronics lab and 0.77 W/ft^2 above for the SAE lab. Here, however, could be a cause for concern if the goal is to use the space-by-space method of ASHRAE as all three LPDs are over the allowed. If the building method is used, the same document mentioned before, states that the total designed load is much less than the allowed load by ASHRAE 90.1.

The design of this space is very simple in nature as well as industrial in aesthetic. This is an appropriate take on the project labs due to program and rough look that this building is trying to achieve in other areas as well. Since this space has a clerestory and lower windows to the North there should not be any glare issues, but harnessing the daylight to put it to good use would be a great study. For the re-design, a different look at the programming of the space and the level of complexity of the lighting scheme and daylight usage will also be given some thought.

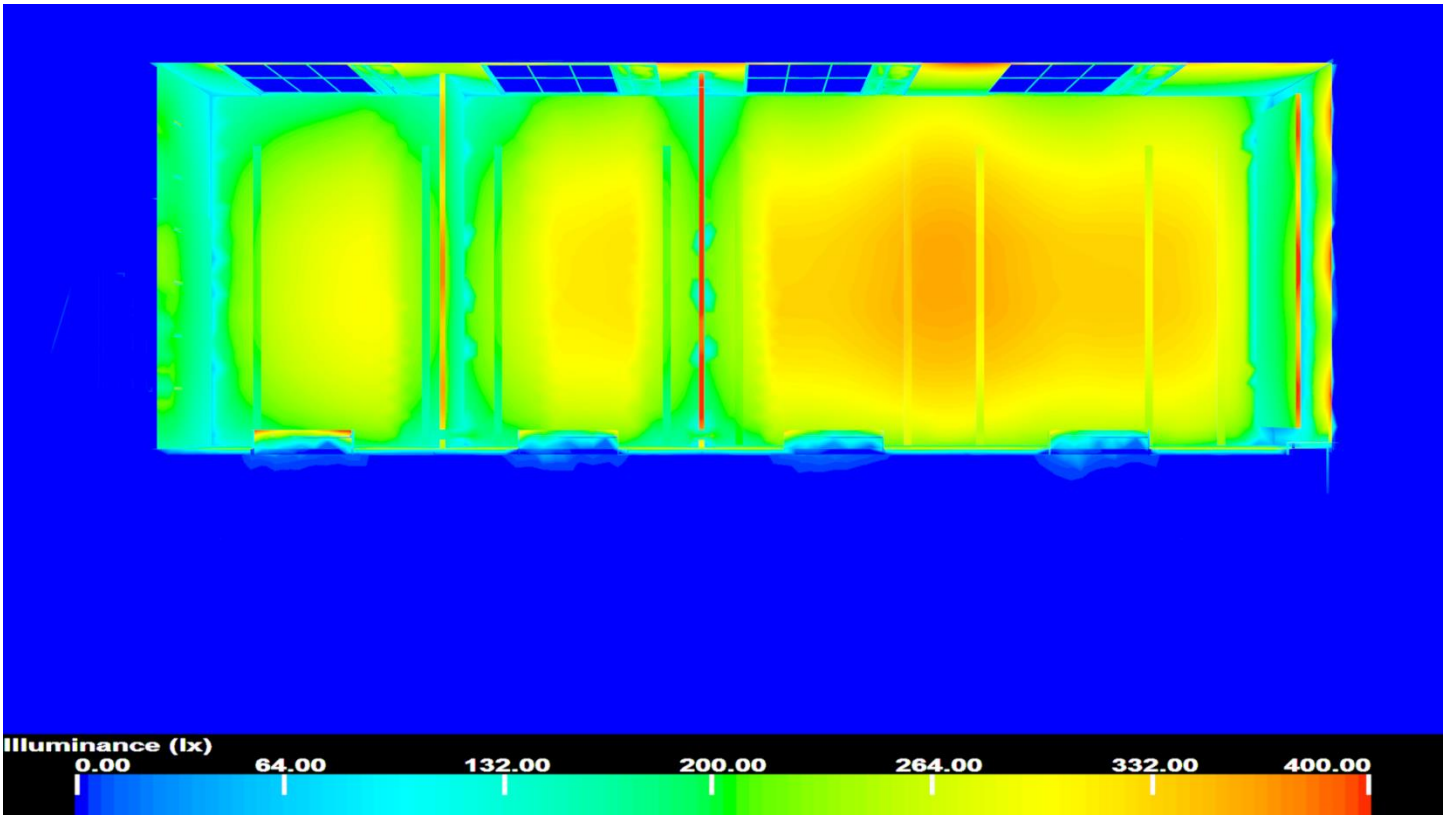

Figure 4 | pseudo render of the lighting effects in the project labs

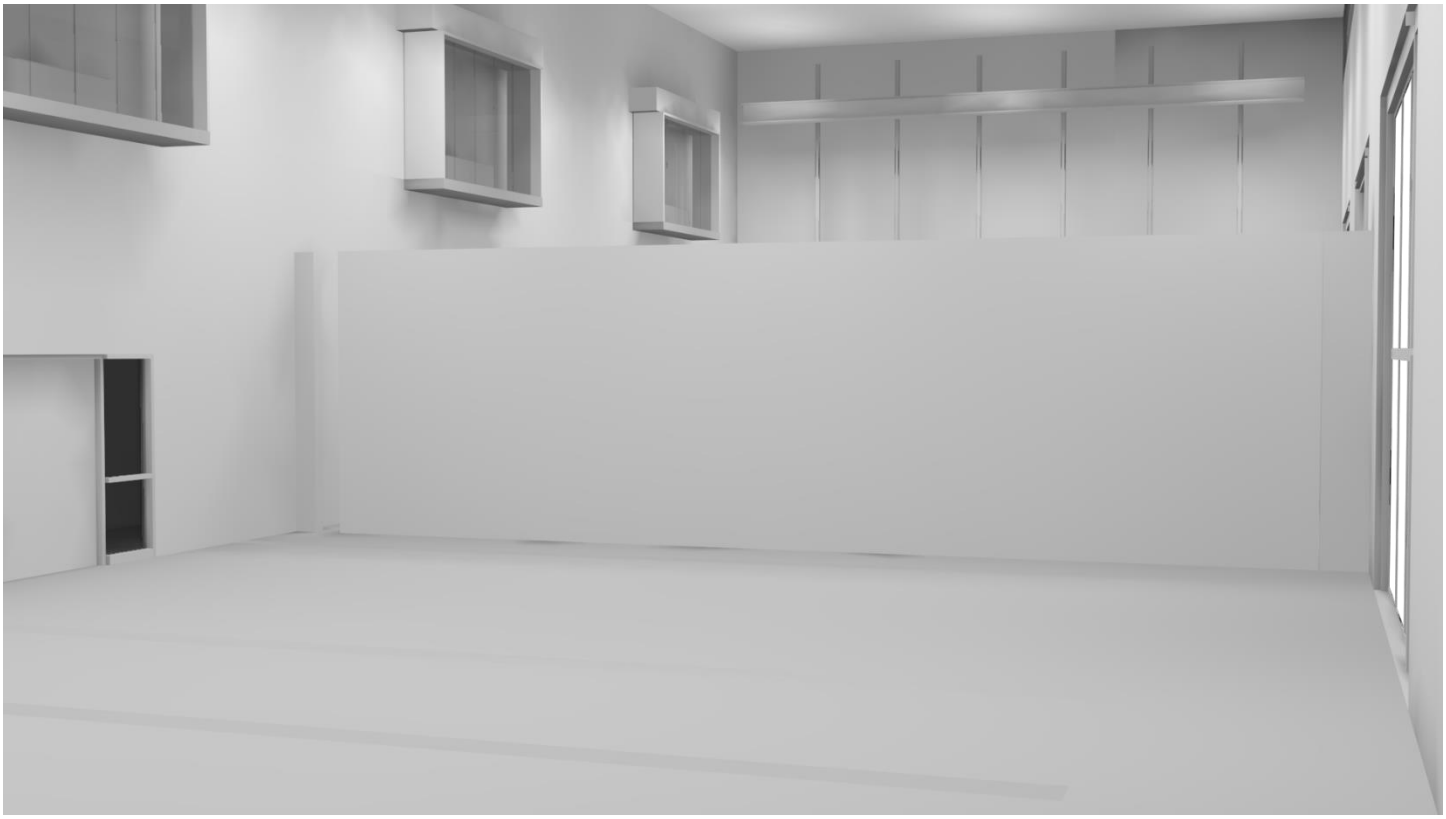

Figure 5 | Simplified render of the project labs with the existing lighting layout

2.0 Special Purpose Space | Lecture Hall

2.1 Lecture Hall Existing Conditions

Figure 6 | lecture hall rendering

The main lecture hall on the first level of the building is the largest space for lectures in the School of Engineering and Computer Science and is about 4,808 square feet and seats 200 people. This space needs to have a strong academic feel as well as a sense of collaboration and excitement for learning; if this space feels too bland then it will become just another lecture hall. This space is going to be the one that I use to create three schematic design concepts for as it is an interesting shape and has a very important functionality within the

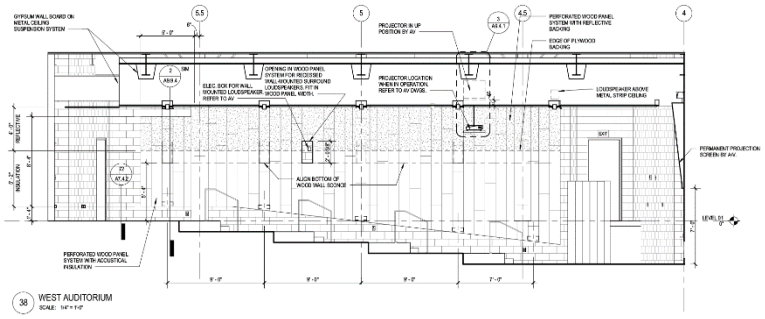

Figure 7 | lecture hall section looking west

program of the building and can have a big impact on the student body. This space is also the most complex in terms of the number of luminaires present, which lends itself to multiple scenes or zones and can have a great amount of flexibility.

To the right, in Figure 8, is a detailed section of the sconce lights which are along the perimeter walls of the lecture hall. Other lighting in the space includes: rows of linear and round downlight LED luminaires for the general lighting, under-cabinet lighting on the edges of the fixed desks along the aisles, step lights around the perimeter, and wall washing LEDs for the white boards.

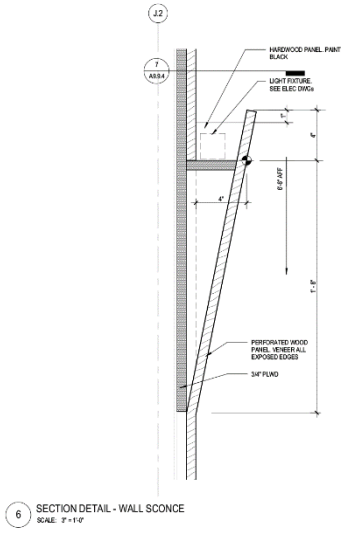

Figure 8 | wall sconce architectural feature detail

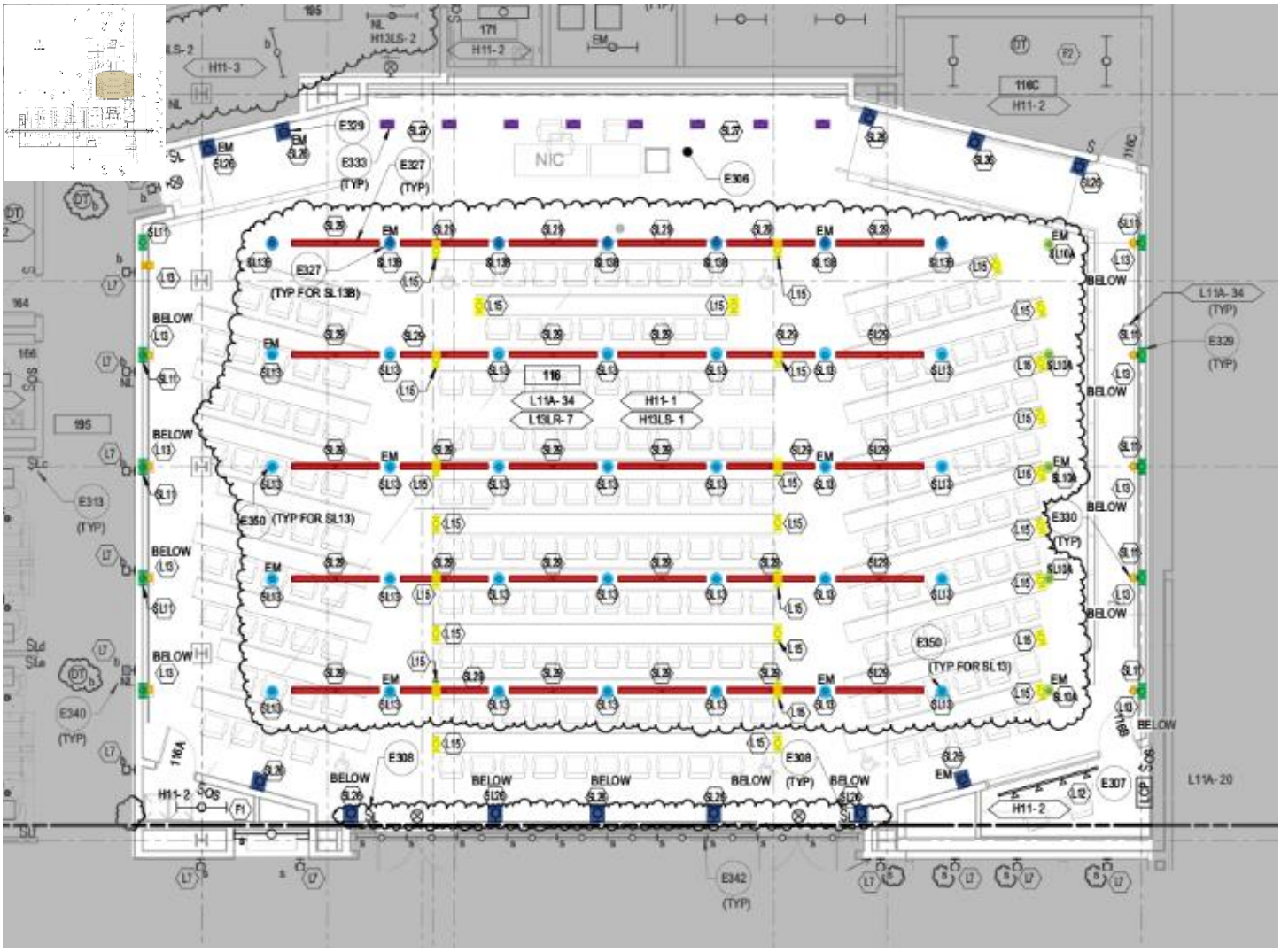

Figure 9 | plan highlighting the lecture hall existing lighting (colors match fixture schedule)

Type	Load	Voltage	Mounting	Lamp	Description	Manufacturer	Model
L13	4.5W	277 V	RECESSED	REPLACEABLE LED MODULE; 810LM; 4000K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	2-1/2" X 6" LED STEP LIGHT WITH DIE CAST ALUMINUM LOUVERED FACE PLATE, DIE CAST AND EXTRUDED ALUMINUM HOUSING, TEMPERED AND ETCHED GLASS, INTEGRAL LED DRIVER, IP64 OUTDOOR RATING, CONTINUOUS GASKETING, STAINLESS STEEL SCREWS.	BEGA	2195LED-K4
L15	5W	120 V	UNDER SURFACE MOUNTED	LED; 285 LM/FT; 3000K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY.	12" LONG LINEAR COVE; 45 DEGREE ANGLE ALUMINUM MOUNTING CHANNEL WITH WIRING COMPARTMENT; FLAT FROSTED LENS; IP LISTED	MP LIGHTING	L102A

SL10A	21W	277 V	RECESSED	REPLACEABLE LED MODULE; 1000 LM; 4100K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	4" DIAMETER RECESSED MOUNT DOWNLIGHT FIXTURE WITH MEDIUM DISTRIBUTION, REPLACEABLE LED MODULE, SEMI-SPECULAR FINISH WITH DIMMING CONTROL.	GOTHAM	4" EVO
SL11	6 W/FT	120 V	SURFACE MOUNTED	REPLACEABLE LED MODULE; 272 LM/FT; 2700K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	1.4" DIAMETER X 6" LENGTH LINEAR COVE LUMINAIRE WITH 110 DEGREE LIGHT DISTRIBUTION, ±90 DEGREE ADJUSTABILITY, END-TO-END CONNECTORS, INTEGRAL DRIVER, WHITE FINISH, AND 0-10V DIMMING	PHILIPS COLOR KINETICS	eW COVE QLX POWER-CORE
SL13	18W	120 V	CANOPY	REPLACEABLE LED MODULE; 1120 LM; 4000K; 80 CRI; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	5 5/16" TRACK LED FIXTURE WITH 60 DEGREE DISTRIBUTION, BLACK ALUMINUM HOUSING, DIMMABLE DRIVER, INTEGRAL DRIVER, CANOPY MOUNT TO SUSPENDED JBOX.	INTENSE	MB LED
SL13B	40W	120 V	SUSPENDED	REPLACEABLE LED MODULE; 1120 LM; 4000K; 80 CRI; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	SAME AS SL13 - EXCEPT 24 DEGREE NARROW FLOOD DISTRIBUTION	INTENSE	MB LED
SL26	2.2W	120 V	RECESSED	REPLACEABLE LED MODULE; 2.2 W, 4000K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	8 1/2" X 7 1/2" SHEILDED LED RECESSED STEP LIGHT, SILVER FINISH	BEGA	2095 LED - K4
SL27	20W	120 V	TRACK	REPLACEABLE LED MODULE; 20W; 1106LM; 4000K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	WALL WASH LED TRACK FITTING FIXTURE WITH HORIZONTAL/VERTICAL PIVOT, DIE CAST EXTRUDED ALUMINUM HEAT SINK; MOLDED POLYCARBONATE DRIVER HOUSING; COLORLESS BOROSILATE GLASS COVER LENS AND BLACK FINISH. 1 FT. SINGLE CIRCUIT PENDANT MOUNTED TRACK PER FIXTURE WITH BLACK FINISH TO MATCH TRACK FIXTURE.	LIGHTOLIER	LYTESPAN ALCYON LED SERIES
SL29	9W/FT	277 V	PENDANT	LED; 4000K; 2640 LM	4" X 7' CONTINOUS LENSED LINEAR PENDANT WITH DIMMING DRIVER, BLACK FINISH, SEAMLESS SATIN LENS, EXTRUDED ALUMINUM HOUSING.	FINELITE	HP-4 DIRECT

Table 3 | lecture hall fixture schedule

2.2 Lighting Design Criteria

Lecture hall, room 116, is the building's largest lecture space. There are whiteboards and projector screens at the front of the room, 3 projectors, slightly tiered rows of fixed desk surfaces, and access ramps on the far sides of the room. This room's main tasks will consequently be, reading and writing for students at the desks, whiteboard use with a presenter, AV presentations with notes, and general circulations. The lighting is going to be mostly focused on the first two of these since they have precedence and importance due to the higher illuminances and which should be done with direct lighting over the seating areas and wall washing the whiteboard for the vertical illuminance. Below, table 4 lists the illuminance criteria for the tasks discussed above based on the IES recommendations in the Lighting Handbook, 10th edition.

Task	E_h (lux)	E_v (lux)	Avg:Min
Reading + Writing	300	75	1.5:1 (Table 12.6)
Whiteboard w/ Presenter	---	300	3:1
AV + Notes	50	15	2:1
Circulation | AV	2	10	5:1
Circulation | All other	10	30	10:1

Table 4 | IES recommendations for lecture hall tasks

As a classroom, AHRAE 90.1 requires that the space have local control of the lighting, bi-level lighting control with possibly a dimming control or multiple scenes, and also have automatic daylight responsive controls for top lighting which will have to be ignored since this space is not adjacent to any daylighting opportunities. The lighting power density allowance for a lecture hall is 1.24 W/ft^2.

2.3 Lighting Evaluation

SmithGroupJJR found a sophisticated and interesting solution for the lighting of this lecture hall space with aesthetic appeal as well as a fair amount of practicality. This layout that was designed, if all turned on at the same time which may not be the case in operation, provides an average of around 300 lux on the desk work plane and somewhere in the vicinity of 300 lux on the whiteboard as well as much lower illuminances at the perimeter of the space for circulation purposes which all seem to be in accordance with the IES recommendations.

The first aspect that stands out when analyzing this space is the hot spots in the middle of the room due to the downlights over the desks and how at the perimeter the illuminance really falls off and is probably not enough light for some people to read and write according to IES recommendations. Another aspect is that the step lights are not very noticeable when all of the other lights are turned on and are most likely used in situations when the downlights are turned off to allow for safe circulation. The sconces on the side walls really add a nice touch to the aesthetic quality of the room and since they are uplighting and the steplights are lighting the ground the ramps have a very comfortable and non-glaring condition.

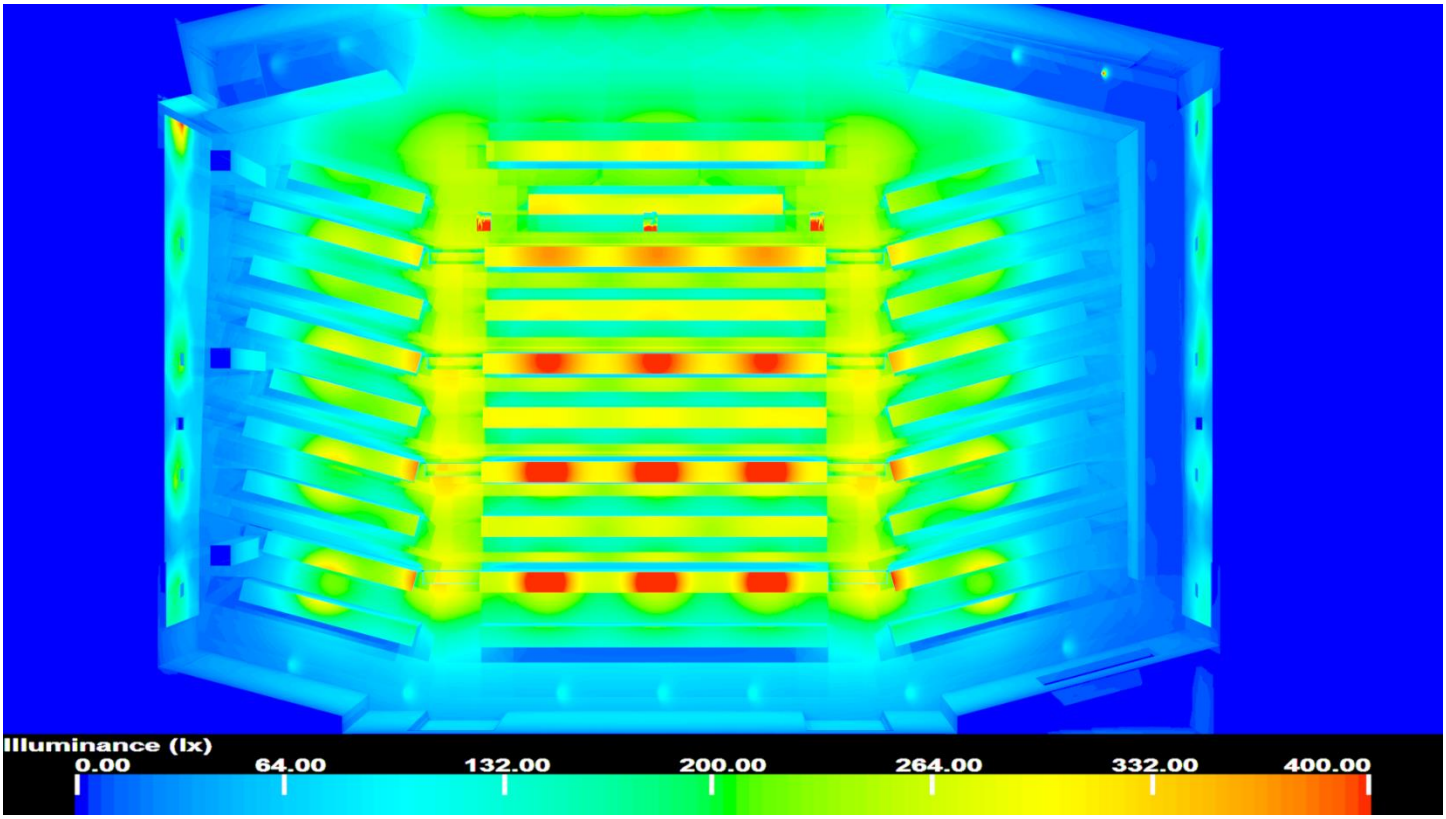

Figure 10 | pseudo color render of the lecture hall with existing lighting

The calculation was done in 3dsMax Design 2015 and for the purpose of this evaluation of the current lighting scheme, used light loss factors of 0.7 for all of the LED fixtures and used fairly basic material.

In the lighting power density excel document provided by SmithGroupJJR the LPD of this space turned out to be well under the allowed at -0.92 W/ft^2. The space used only 0.55 W/ft^2 out of the 1.24 W/ft^2 and is a very successful design from the qualitative and quantitative criteria considered.

Figure 11 | rendering from the back of the lecture hall with existing lighting

3.0 Transition Space | South Lobby + Atrium Café

3.1 Existing Conditions

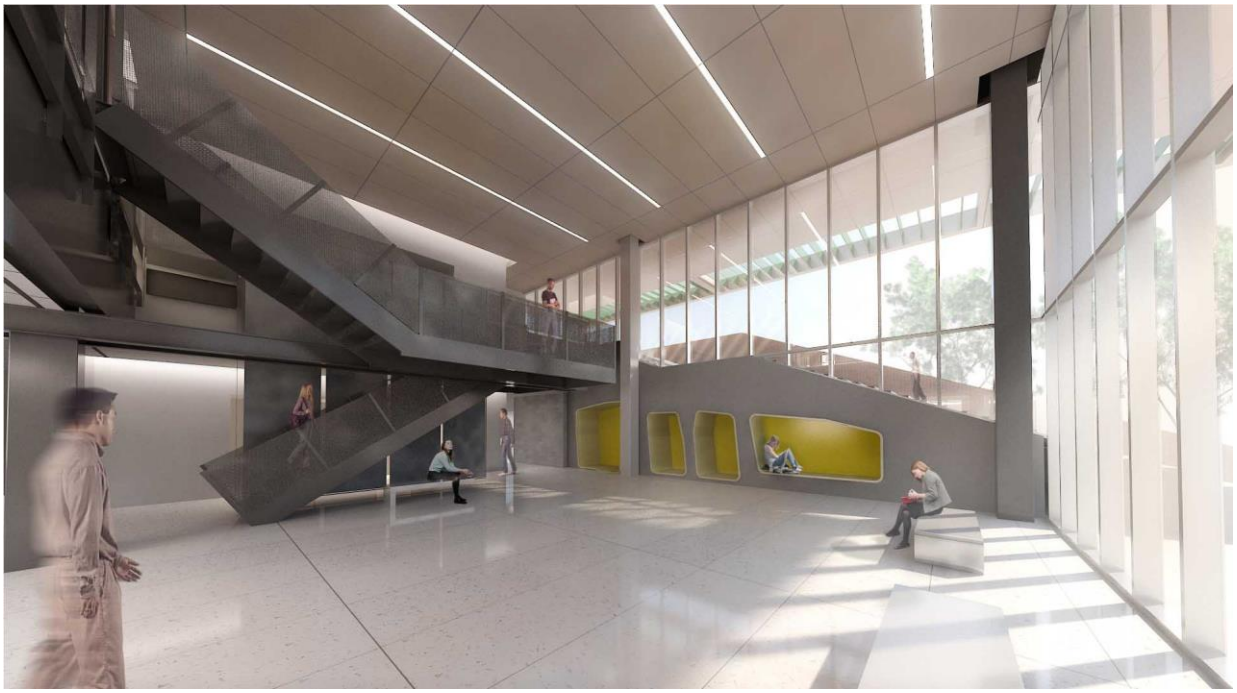

Figure 12 | rendering of south lobby and stair to atrium

Figure 13 | rendering of cafe and atrium

This is a combined transition space consisting of the South Lobby which is a double height entrance area from the first level to the second level and then the café on the second level and the open atrium from the second level up to the fifth level. This transition space will be heavily trafficked by students and faculty alike as it surrounds all of the main transitional paths between the south entrance and the labs, classrooms and offices on the other levels. This space will be a space of transition but also a place of rest and informal study for the building's occupants and surely a very important public space. For this space I would like to implicate the psychological impressions of relaxation and tension (John Flynn's studies) and play off of the programmatic flux within this large space of transition.

Figure 14 | section rendering of atrium and cafe seating

Within this grouping of spaces there are a lot of materiality changes from exposed steel and concrete to full walls of transparent curtain walls in the atrium to wood veneer study nooks and terrazzo floors in the south lobby. With the psychological impressions in mind as well as the materiality, there seems to be a direct comparison there which can be utilized when redesigning.

The existing lighting scheme is fairly simple though consisting of many different fixtures. When you enter the south lobby, there are downlights in the vestibule, accent lights on the wall to your left, linear task lights integrated into the study nooks, and linear LED fixtures sweeping across the ceiling two stories above. When you travel up the main stair, you notice the linear mullion lighting along the exterior wall and the linear lights along the railing surrounding the lobby. On the second floor, the café has a simple fluorescent troffer lighting scheme, and the lower ceiling has an array of round downlights as well as linear LED fixtures running down the two corridors, perpendicularly, that branch out from the stair.

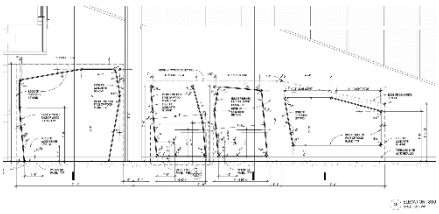

Figure 15 | section showing the student study spaces in the south lobby

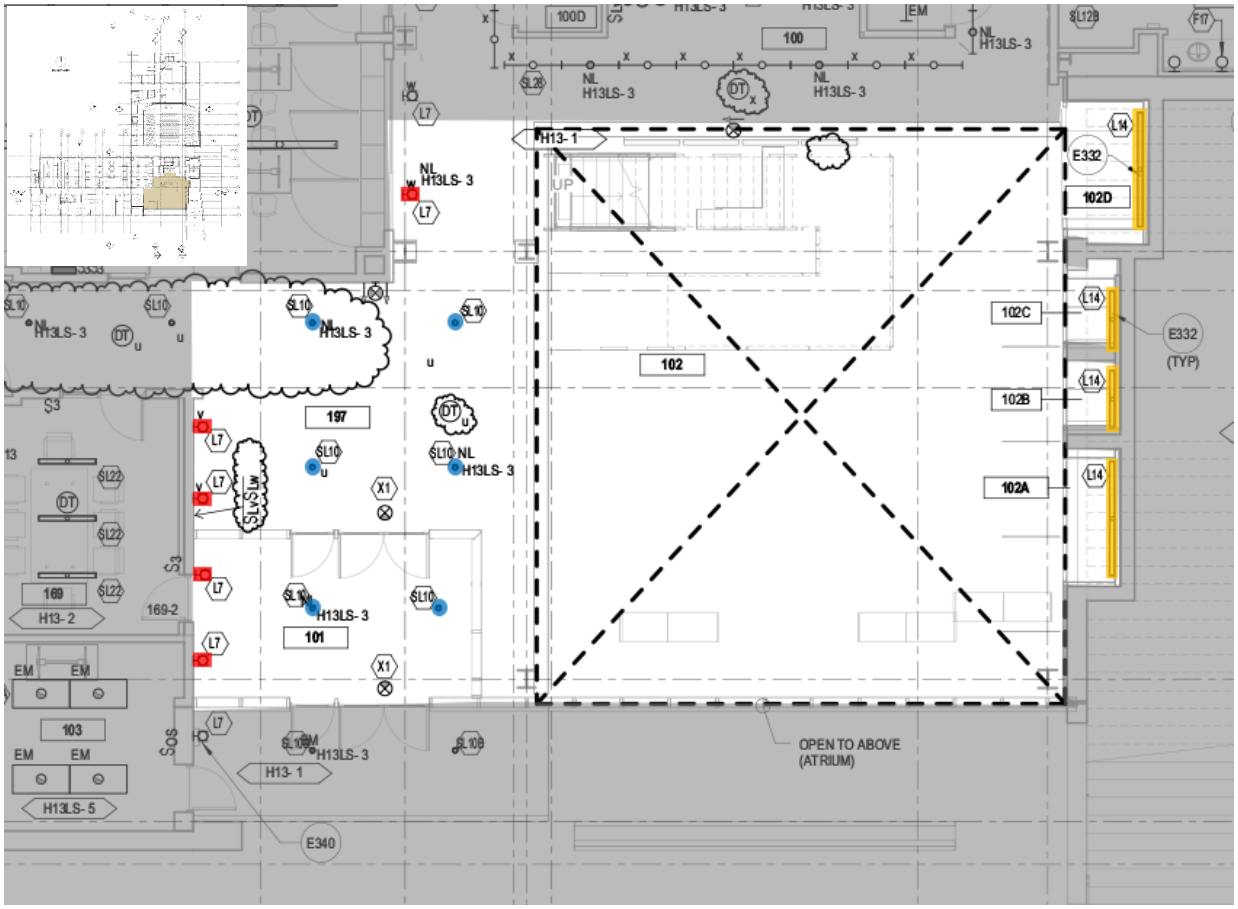

Figure 16 | plan highlighting the south lobby (level 1) existing lighting (colors match fixture schedule)

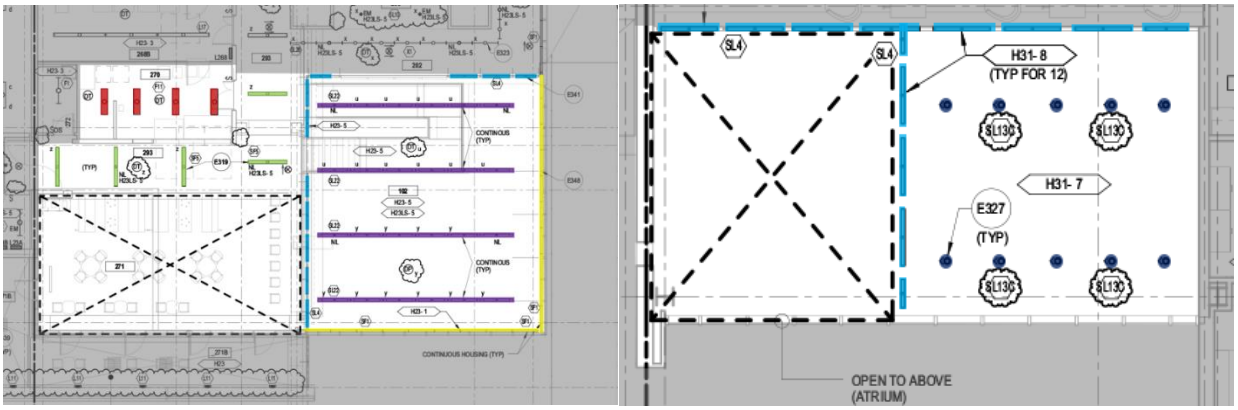

Figure 17 | RCPs highlighting the atrium/lobby (levels 2 and 3 respectively) existing lighting (colors match fixture schedule)

Type	Load	Voltage	Mounting	Lamp	Description	Manufacturer	Model
F11	33W LED,	277 V	RECESSED	4000 LM; 4000K CCT	1' X 4' RECESSED DIRECT/INDIRECT FIXTURE WITH DIE-FORMED STEEL HOUSING, WHITE POST PAINTED POWDER COAT FINISH WITH ACRYLIC DIFFUSER. CONTINUOUS ROW CONFIGURATION WHERE SHOWN IN PLAN. PROVIDE DRYWALL KIT ACCESSORY WHERE MOUNTING CONDITION APPLIES. PROVIDE LINE SIDE FUSE. STEP DIMMING TO 50% OUTPUT.	CREE	CR14 HE (4000LMS)
L7	14W	277 V	WALL MOUNTED	1800LM; 4000K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	COMPACT LED ACCENT FIXTURE WITH 40 DEGREE FLOOD BEAM DISTRIBUTION; STANDARD YOKE MOUNT, BLACK FINISH.	LUMENPULSE	LUMENBEAM SMALL
L14	6W/FT	277 V	WALL SURFACE	LED; 1270 LM; 3500K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	LED RECESSED PERIMETER SLOT WITH FROSTED LENS, 3" ARCHITECTURAL SLOT, EXTRUDED ALUMINUM HOUSING, CEILING MOUNT TO REST ABOVE FINISH CEILING, SLIDING SLEEVE TO COMPLETE CONTINUOUS RUNS. LENGTH AS INDICATED. PROVIDE MANUFACTURER'S SHOP DRAWING PRIOR TO FINAL APPROVAL.	FOCAL POINT	TRACE
SF1	7.5W/FT	277 V	MULLION	1-32T8S; 4100K CCT	3-1/2" X 3-1/2" FLUORESCENT MULLION-MOUNTED UP LIGHT WITH SYMMETRICAL LIGHT DISTRIBUTION, DUST COVER, 3/8" MULLION MOUNTING BLOCK; CONTINUOUS RUN; HOUSING TO MATCH MULLION FINISH.	A-LIGHT	ACCOLADE4
SF5	36W	277 V	RECESSED	1- F32T8; 4100K	6" X 4'-0" LINEAR FLUORESCENT FIXTURE WITH FLUSH SATIN DIFFUSE LENS, WHITE FINISH; DIE-FORMED ONE PIECE STEEL HOUSING; LUMINAIRE TO REMAIN AT CEILING FACE	FOCAL POINT	AVENUE 6
SH4	75W	277 V	WALL SURFACE	(1) 45W LED; 4000K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	WALL MOUNTED LED FIXTURE WITH DIE CAST ALUMINUM HOUSING; WHITE FINISH, -30 DEGREE TO 90 DEGREE VERTICAL TILT ADJUSTABILITY	BEGA	6854 LED
SL4	9W/FT	277 V	SURFACE	LED; 600 LM/FT; 4000K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	2-3/8" X 3-1/3" LINEAR LED FIXTURE WITH SEAMLESS SATINE LENS, EXTRUDED ALUMINUM HOUSING, FLANGED ALUMINUM EXTRUSION AND ENDCAPS, REPLACEABLE LED BOARD AND DRIVER, DIRECT SURFACE MOUNTING TYPE, SILVER FINISH, DIMMING DRIVER. LENGTH SHOWN IN PLAN.	SELUX	M60LED
SL10	21W	277 V	RECESSED	REPLACEABLE LED MODULE; 1000 LM; 4100K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	4" DIAMETER RECESSED MOUNT DOWNLIGHT FIXTURE WITH MEDIUM DISTRIBUTION, REPLACEABLE LED MODULE, SEMI-SPECULAR FINISH.	GOTHAM	4" EVO USAI "BEVELED" OR APPROVED SUBMITTED EQUAL
L14	28W	277 V	SUSPENDED	LED; 1800 LUMENS;	5 5/16" TRACK LED FIXTURE WITH 60 DEGREE DISTRIBUTION, BLACK ALUMINUM HOUSING,	INTENSE	MB LED

			CANOPY	4000K CCT; 82 CRI	DIMMABLE DRIVER, INTEGRAL DRIVER, CANOPY MOUNT TO SUSPENDED JBOX, 1800 LUMENS, SPOT DISTRIBUTION, AND NON-DIMMING INTENSE MB LED		
SL22	9W/FT	277 V	RECESSED	LED; 2640 LM; 4000K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	LED RECESSED CONTINUOUS 4" APERTURE DOWNLIGHT WITH SEAMLESS SATINE LENS, EXTRUDED ALUMINUM HOUSING, HOUSING WITHOUT EXTRUDED FLANGE, ALUMINUM EXTRUSION AND ENDCAPS, WHITE FINISH, AND DIMMING DRIVER PER MANUFACTURER'S RECOMMENDATION. CONTINUOUS LENGTH AS INDICATED IN PLAN. REPLACEABLE LED BOARD/MODULE AND DRIVER.	FINELITE	HP-4

Table 5 | lobby + atrium fixture schedule

3.2 Lighting Design Criteria

This combined transition space also has a combined set of lighting design criteria based on the IES recommendations. The most important tasks to be performed in the south lobby are circulation during the day and night, pleasure reading in the study nooks, and traversing the highly active stair in the space. Once you are upstairs, the main tasks transition from mainly circulation based to more sedentary based with coffee shop seating which will also double as a study area, food preparation in the café, and the exchange of money and product at the café. These important illuminance recommendations are shown in Table 6 below.

Space	Task	E_h (lux)	E_v (lux)	Avg:Min
South Lobby	Lobbies | Circulation | Building Entries | Day	100	50	3:1
	Lobbies | Circulation | Building Entries | Night	50	20	3:1
	Lounges | Pleasure Reading	200	100	1.5:1 (Table 12.6)
	Stairs | High Activity	100	50	2:1
Café and Seating	Dining Areas | Coffee Shops	100	30	3:1
	Kitchens | Food Preparation	500	200	1.5:1 (Table 12.6)
	Cashiers	200	75	2:1

Table 6 | IES recommendations for the lobby + atrium tasks

The ASHRAE 90.1 2013 has a special rule for atrium spaces of 0.4 + 0.02 * (total height) for the lighting power density and in this case would equal, 1.23 W/ft^2 (0.4+0.02*61). And requires that the space have local control of the lighting, bi-level lighting control with possibly a dimming control or multiple scenes, and also have automatic daylight responsive controls for side lighting and top lighting.

3.3 Lighting Evaluation

The design for this space, by SmithGroupJJR, really focuses on the flow of people and lighting the perimeter giving a very visually stimulating design for proper way-finding through the space. This layout that was designed, is set up quite nicely to react to the external daylighting conditions and have zones for dimming or switching off during certain conditions; this is one aspect of this space that I plan to look into extensively.
By keeping much of the lighting at the perimeter, the probability of glare is much lower and having the linear downlights providing the general circulation illuminance, there should be a nice contrast on the floor between transient and sedentary spaces. There really isn't much in terms of general lighting in the café seating area and is something that I believe will change with my redesign.

The lighting power densities, found in the SmithGroupJJR excel document, are as follows: café seating is 0.63 W/ft^2 below allowed, café is 0.25 W/ft^2 below allowed and the south lobby is 0.29 W/ft^2 below allowed according to ASHRAE 90.1.

4.0 Outdoor Space | Covered Walkway + Stair

4.1 Existing Conditions

Figure 18 | rendering showing the overhang and stair

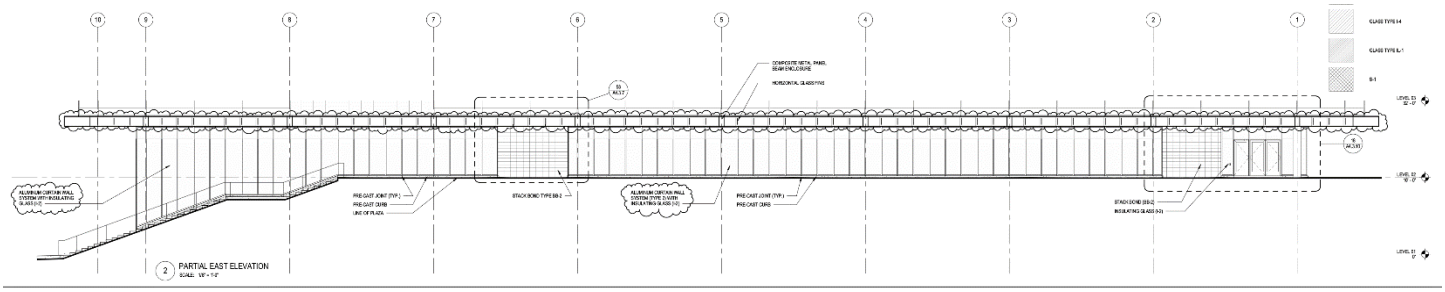

Figure 19 | east elevation showing outside stair and overhang

The main exterior staircase is going to be a heavily traversed transition from the parking lots to the south of the Engineering Center and the other academic buildings to the north. The goal for this exterior space will be to assure that pedestrians feel comfortable while walking through the area and to highlight the architecture of the

building and stair so as to compliment the design and make a positive statement on the campus fabric. This area may have possible daylighting components to study in terms of the overhang and louvered structure and the implications that it will have on the interior. The lighting, in this exterior area, consists of small down lights near the North and South entries into the building, step lights, recessed wall washers in the louvered overhang, and a sconce fixture near the Southern entrance.

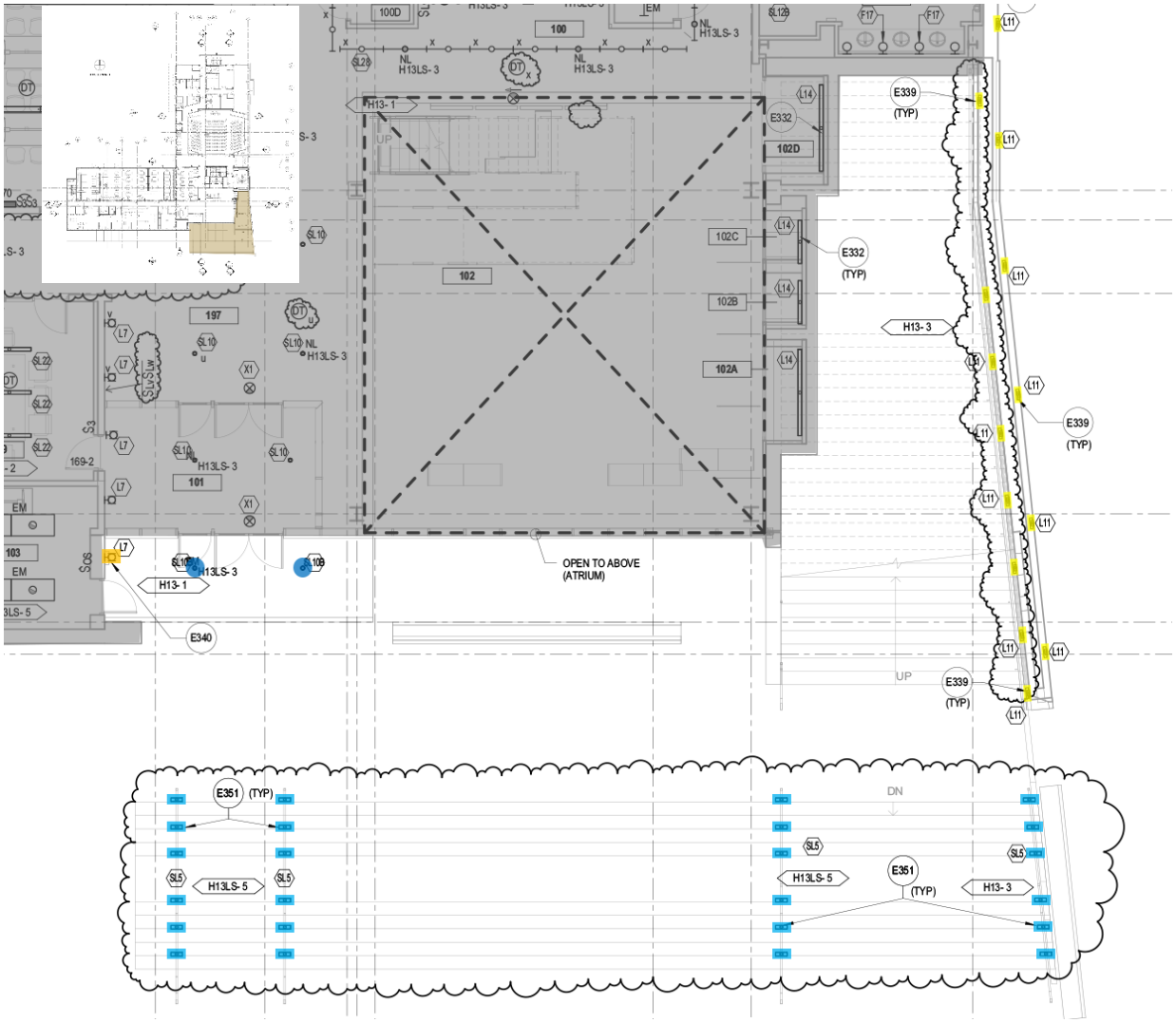

Figure 20 | plan showing the existing lighting for the outdoor stair (colors match fixture schedule)

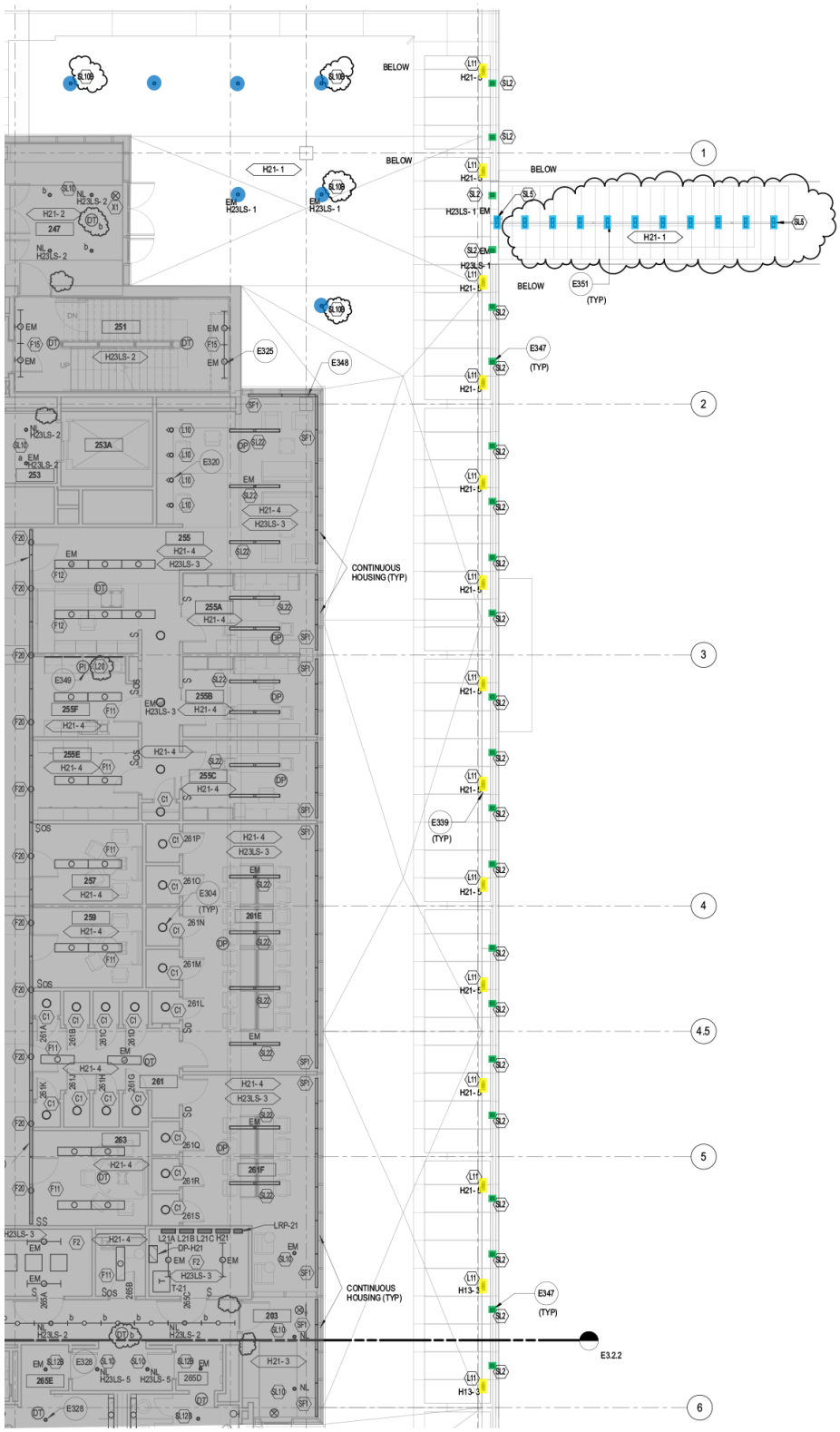

Figure 21 | plan showing the existing lighting for the overhang area (colors match fixture schedule)

Type	Load	Voltage	Mounting	Lamp	Description	Manufacturer	Model
L7	14W	277 V	WALL MOUNTED	1800LM; 4000K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	COMPACT LED ACCENT FIXTURE WITH 40 DEGREE FLOOD BEAM DISTRIBUTION; STANDARD YOKE MOUNT, BLACK FINISH.	LUMENPULSE	LUMENBEAM SMALL
L11	6W	277 V	RECESSED	REPLACEABLE LED MODULE; 450LM; 4000K; 3 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	2-3/4" X 6-5/8" LED STEP LIGHT WITH ONE PIECE DIE CAST ALUMINUM FACE PLATE, DIE CAST AND EXTRUDED ALUMINUM HOUSING, CLEAR TEMPERED GLASS, MACHINED FLUSH TO FACEPLATE, INTEGRAL LED DRIVER, IP65 OUTDOOR RATING, CONTINUOUS GASKETING, STAINLESS STEEL SCREWS, SILVER FINISH.	BEGA	2382LED-K4
SL1	20W	277 V	RECESSED	REPLACEABLE LED MODULE; 800LM; 3000K CCT; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	4 5/8" SQUARE RECESSED MEDIUM FLOOD WALL WASH FIXTURE WITH IP65 OUTDOOR RATING, REPLACEABLE LED MODULE, CONTINUOUS RUBBER GASKETING, TRIM TO MATCH PANEL.	KIRLIN	LRS SERIES
SL2	10W	277 V	RECESSED	REPLACEABLE LED MODULE; 150LM; 4000K CCT	13" LED RECESSED FIXTURE, IP65 WET RATING, LINE VOLTAGE POWER CONNECTION WITH INTEGRAL DRIVER; STAINLESS STEEL SCREWS AND COMPONENTS; SILVER POWDER COATED FINISH; TEMPERED GLASS DIFFUSER, CONTINUOUS GASKETING.	BEGA	2042LED K4
SL5	11W	277 V	WALL RECESSED	REPLACEABLE LED MODULE; 810LM; 4000K; 4 STEP MAX. MACADAM ELLIPSE COLOR CONSISTENCY	2-1/2" X 11-3/4" LED STEP LIGHT WITH DIE CAST ALUMINUM LOUVERED FACE PLATE, DIE CAST AND EXTRUDED ALUMINUM HOUSING, TEMPERED AND ETCHED GLASS, INTEGRAL LED DRIVER, IP64 OUTDOOR RATING, CONTINUOUS GASKETING, STAINLESS STEEL SCREWS.	BEGA	2197LED-K4
SL10B	20W	277 V	RECESSED	REPLACEABLE LED MODULE; 1250 LUMENS; 4100K CCT	4" DIAMETER RECESSED LED DOWNLIGHT WITH WET LOCATION LISTING, NARROW FLOOR (25 DEGREES) DISTRIBUTION, SELF-FLANGED CLEAR ALUMINUM REFLECTOR WITH GLASS LENS, AIRTIGHT OPTION	KIRLIN	LRR-04002

Table 7 | fixture schedule for the outdoor spaces

4.2 Lighting Design Criteria

Being on a fairly large university, the Engineering Center would most likely be categorized as a lighting zone 2, LZ2, for moderate ambient light according to the IES Lighting Handbook, 10th edition, chapter 26. The horizontal illuminances for pre and post-curfew are shown below in Table 8. Another aspect that should be considered when looking at an outdoor lighting situation is light trespass and urban glow. According to documentation from SmithGroupJJR, only about 3 % of the light is above 90 degrees which will help substantially with urban glow.

Task	E_h (lux)	E_v (lux)	Avg:Min
LZ2 Moderate Ambient Light			
Pre-curfew	3	---	---
Post-curfew	1	---	---

Table 8 | IES recommendations for the outdoor spaces

This stair and overhang section of the east side of the Engineering Center will become a very heavily trafficked area of campus with its positioning on campus. For this reason, the lighting should provide a sense of comfort as well as showcase the new engineering building for their campus and be something that the university can be proud of.

4.3 Lighting Evaluation

The criteria that was set out in the last section seem to all be met since the step lights will not provide too much illuminance to the stairs and the downlights near the entrances are necessary for the entry situation. The use of LEDs will have less of an effect on the power consumption of the building and the number of luminaires and layout seem to be enough to provide the illuminances needed for circulation as well as the aesthetic quality to make the space interesting. One thing to note is the use of primarily high CCT fixtures (~4000K) which will most likely have higher color rendering capabilities and provide a feeling of safety. The design of the lighting for this area should also tie into the surrounding landscape and campus lighting in some way if at all possible and will be considered in the redesign.

5.0 Additional Considerations

5.1 LEED Checklist

The latest spreadsheet filled out by SmithGroupJJr for LEED rating shows that they expect to receive 110 total points which puts them on par to be in the LEED Platinum (80+ points). In the table below, points that are related to lighting are outlined. There are only 4 points possible for lighting and they seem to be going for only 3 of these.

Section	Credit Number	Description	Points Earned
Sustainable Sites	Credit 8	Light Pollution Reduction	0
Indoor Environmental Quality	Credit 6.1	Controllability of Systems - Lighting	1
Indoor Environmental Quality	Credit 8.1	Daylight and Views - Daylight	1
Indoor Environmental Quality	Credit 8.2	Daylight and Views – Views	1

6.0 References

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

- All renderings and plans are courtesy of SmithGroupJJR, 3dsMax existing lighting renders and pseudo-color renders were done by John Conley