Milestone 2:

Lighting Design Report

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University of Maryland: Prince Frederick Hall

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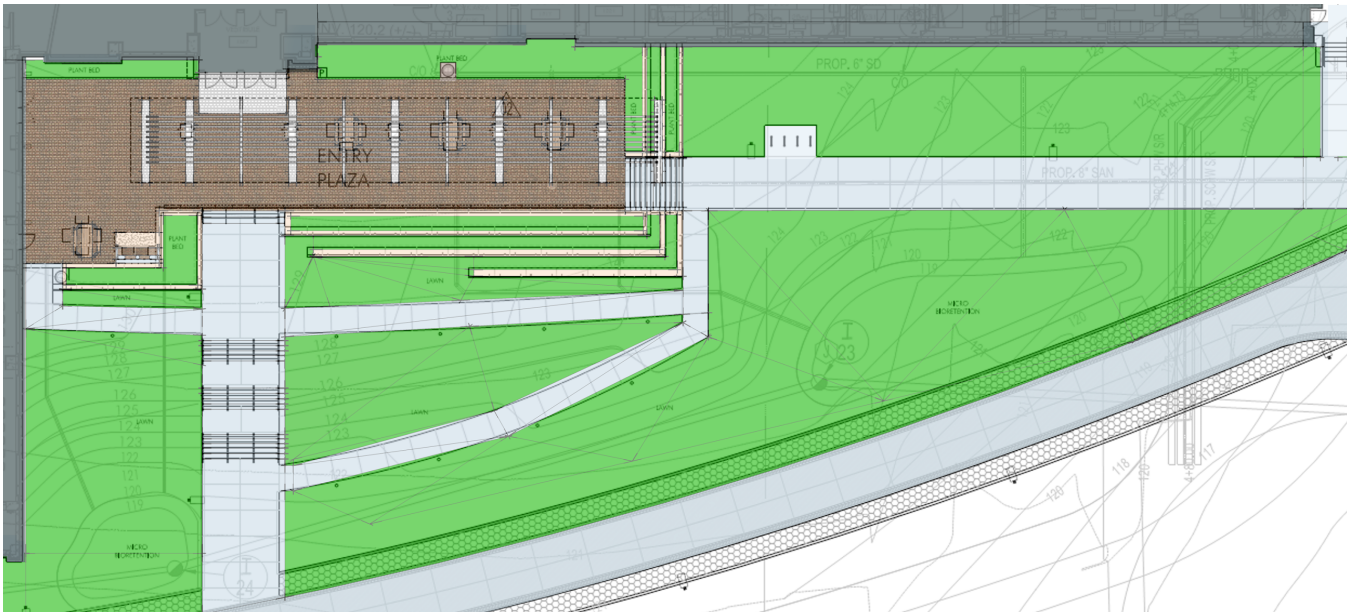
Introduction

This building's composition represents a gradient of public to private spaces. But the one binding factor across this variation is that the primary function of every space is to provide a good learning environment. This can be summarized into the singular concept of **DISCOVERY**. This concept is the driving force behind the lighting designs completed for this report. Through this concept, the lighting is able to express the building's function in multiple ways. In that occupants must literally be able to navigate through the building to discover new spaces, and discovery in sense that the lighting must provide an effective learning environment. Discovery is applied in a unique way to each of these four spaces: an outdoor entry plaza, the lobby, a seminar room, and a dormitory suite.

Entry Plaza

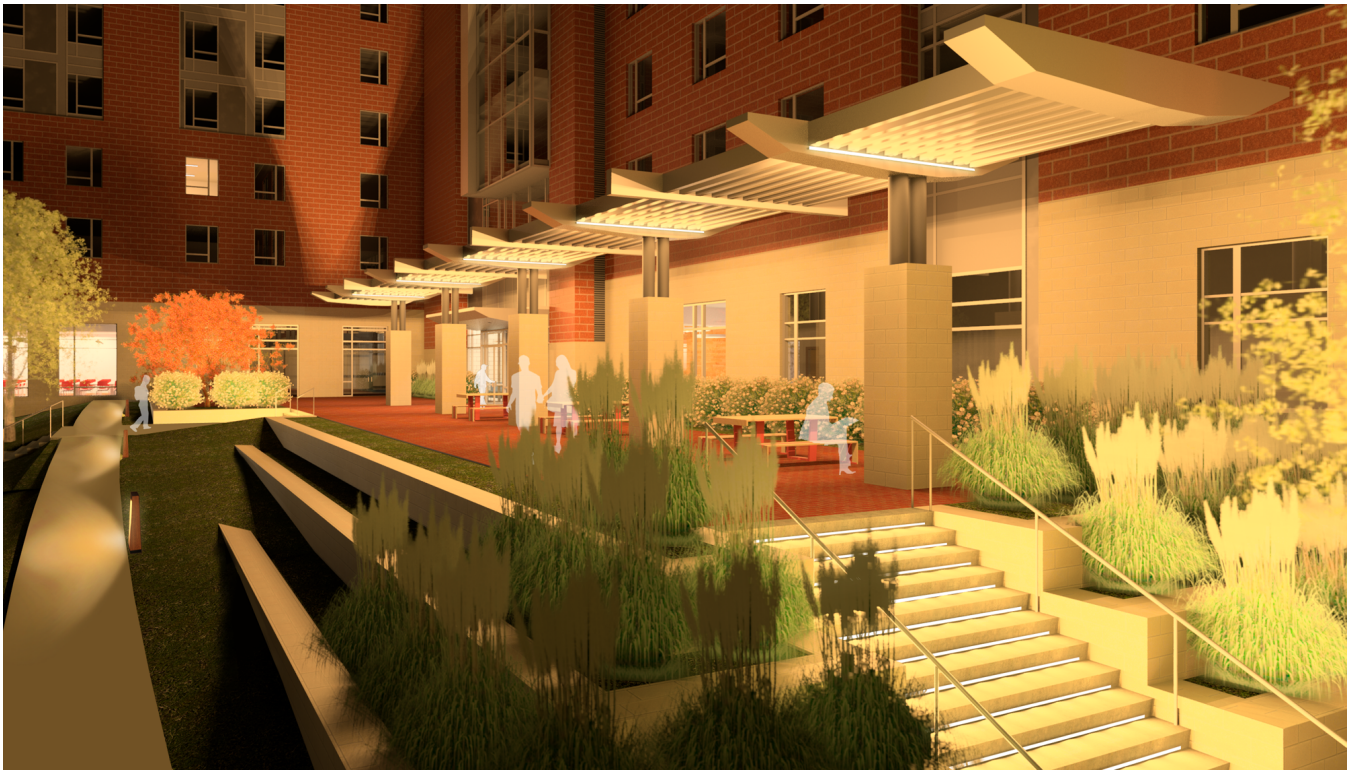
This is the most public of the four spaces. It is located on the south side of the building, and functions as both a circulation space and an outdoor social space with seating. Therefore, the lighting design for this space must apply the concept of discovery in two different layers. Safe levels of light must be provided for occupants transitioning through the plaza. This is in contrast to the casual atmospheric lighting that is well-suited to social areas. Both layers must work in concert to achieve the ultimate goal: for visitors discover the building.

Spatial Environment

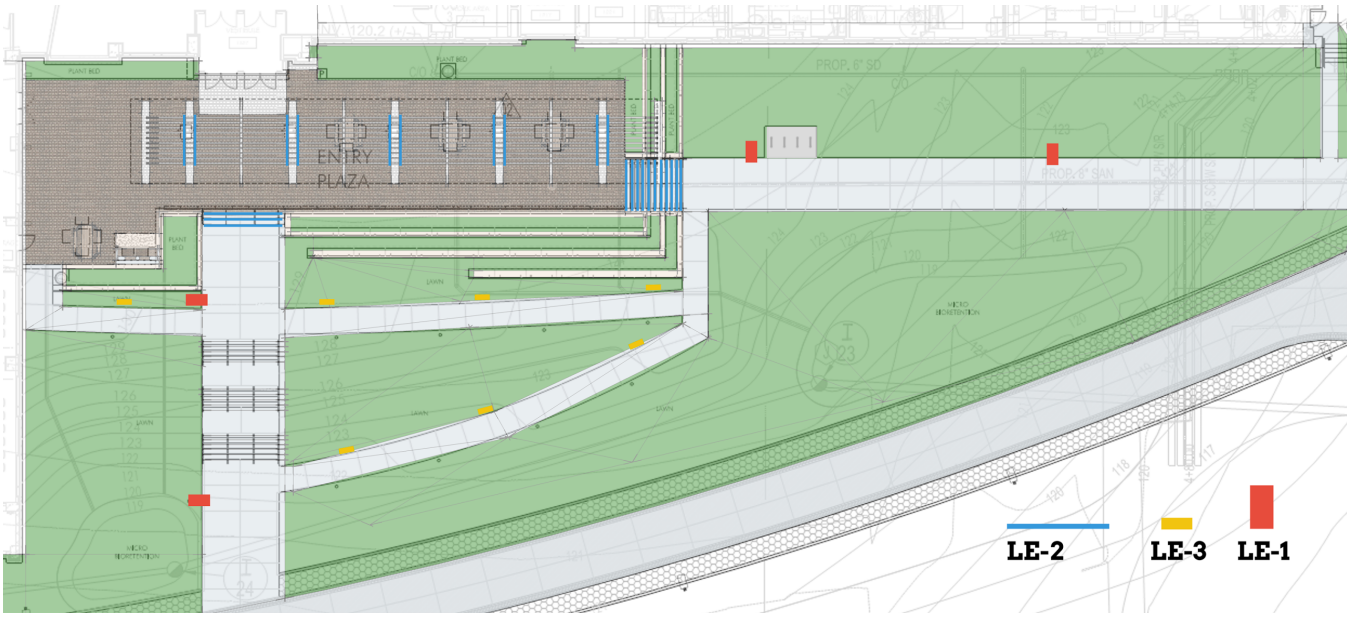


This brick patio serves as a transition space and as a social gathering space. A trellis provides shade and visual interest close to the building. This is also where the main seating area is located. Adjacent to the tables is a long path area to the front doors of the building.

Lighting Layout



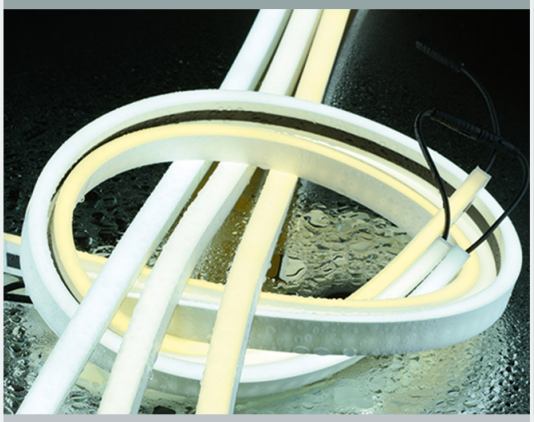
east side of entry plaza



entry plaza lighting plan

The pole fixtures, LE-1, are the university standard and are applied outside of the main plaza area to provide lighting from the building to the curb. Along the ramp that traverses this distance, bollards, LE-3, are used for extra illumination. There are two main steps up onto the plaza, and these feature integrated LED strips, LE-2. These bright stairs clearly indicate where the main entrance of the building is located. Finally, the same LED strips are also integrated into the trellis, for an indirect lighting effect at the seating areas.

Lighting Equipment*

LE-1: by LSI Industries	**LE-2:** by LED Linear	**LE-3:** by Cooper
		
Input: 138 watts	**Input:** 1.4 watts/ft	**Input:** 8 watts
Output: 1000 lumens	**Output:** 124 lumens/ft	**Output:** 57 lumens
Lamp: LED	**Lamp:** LED	**Lamp:** LED

LE-1: The University of Maryland's standard 15' pole fixture
LE-2: fully encapsulated IP67 protected flexible LED light, for outdoor applications
LE-3: exterior rated linear LED module in a 30" tall wood bollard

*see appendix for complete schedule of equipment and LLF calculations

Calculations and Metrics

LIGHTING LEVELS

	General Illumination			Paths to Curb			Seating Areas		
	Criteria	Existing	Thesis	Criteria	Existing	Thesis	Criteria	Existing	Thesis
E (horizontal)	30	30	50	4	11	30	50	31	81
E (vertical)	15						15	3	31
Avg:Min							4:1	1.8:1	2.5:1

POWER USE

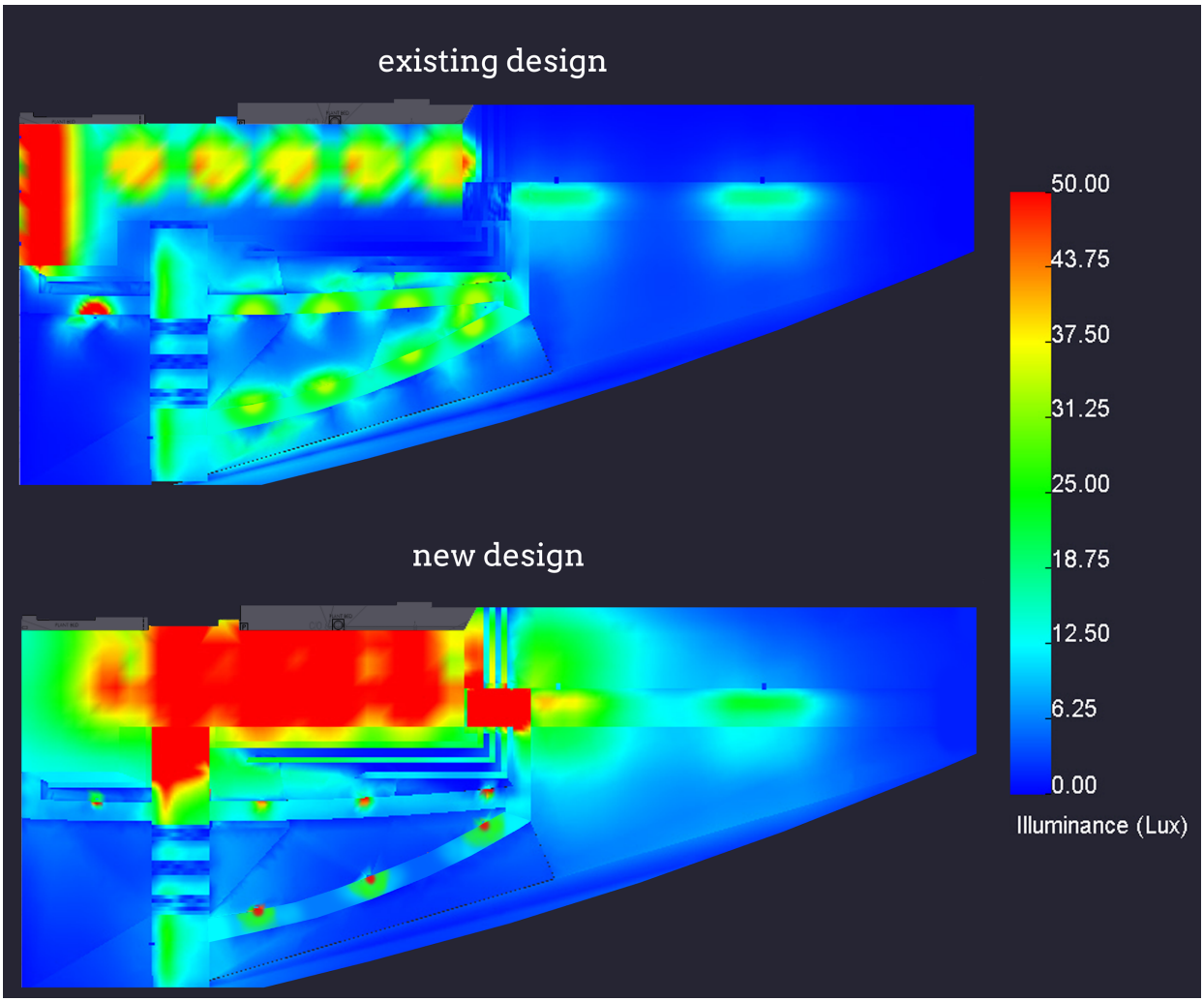
Existing LPD	Area (SF)	Total Watts	LPD	Target LPD	% Difference
0.09	12,300	987	0.08	0.09	10.80%

Criteria Evaluation

This is an important opportunity to provide a welcoming entrance to Prince Frederick Hall. Part of this involves maintaining safe light levels throughout the circulation areas of the plaza, as per IES Recommendations. But there are also seating areas on the plaza that need to be addressed with higher light levels and more indirect lighting for a comfortable atmosphere.

QUANTITATIVE

To determine energy savings of this new lighting design, the total watts used was compared to the watts used in the existing design. The new design is more effective at meeting IES recommendations for light levels and also uses 10% less energy than the existing design. In this new design, the grazing light applied to the underside of the trellis bounces indirect light down onto the seating area for a brighter and more evenly illuminated space. This is shown in the following diagram, where the scale is set to 50 lux, the IES recommendation for an outdoor seating area. Areas shown in red are bright enough to meet this recommendation.



QUALITATIVE

The above pseudo-color diagram shows a comparison of these two lighting schemes. In the new design, lighting is focused where it is needed most: on the main entrance and seating areas. This means that a clear delineation is made between the main entrance on the plaza and the tertiary entrances, located on the far west of the plaza.

SUSTAINABILITY

This design features sustainability in two different ways. One is that it uses less energy to provide a lighting design that better meets IES recommendations. The second green aspect of this design is that it accomplishes its goals without using any upward-facing fixtures; thus helping to maintain dark skies over The University of Maryland's campus.

Lobby

As the main entrance, there is tremendous opportunity for the lighting in this space to set the mood of the building. Furthermore, due to the atypical shape of the lobby, there is a real need for the lighting to help visitors navigate to their intended destination. The lobby contains access points to the building's main functions, ranging from public to private. By applying different lighting techniques to these areas, visual differentiation will invite occupants to discover the space around them.

Spatial Environment

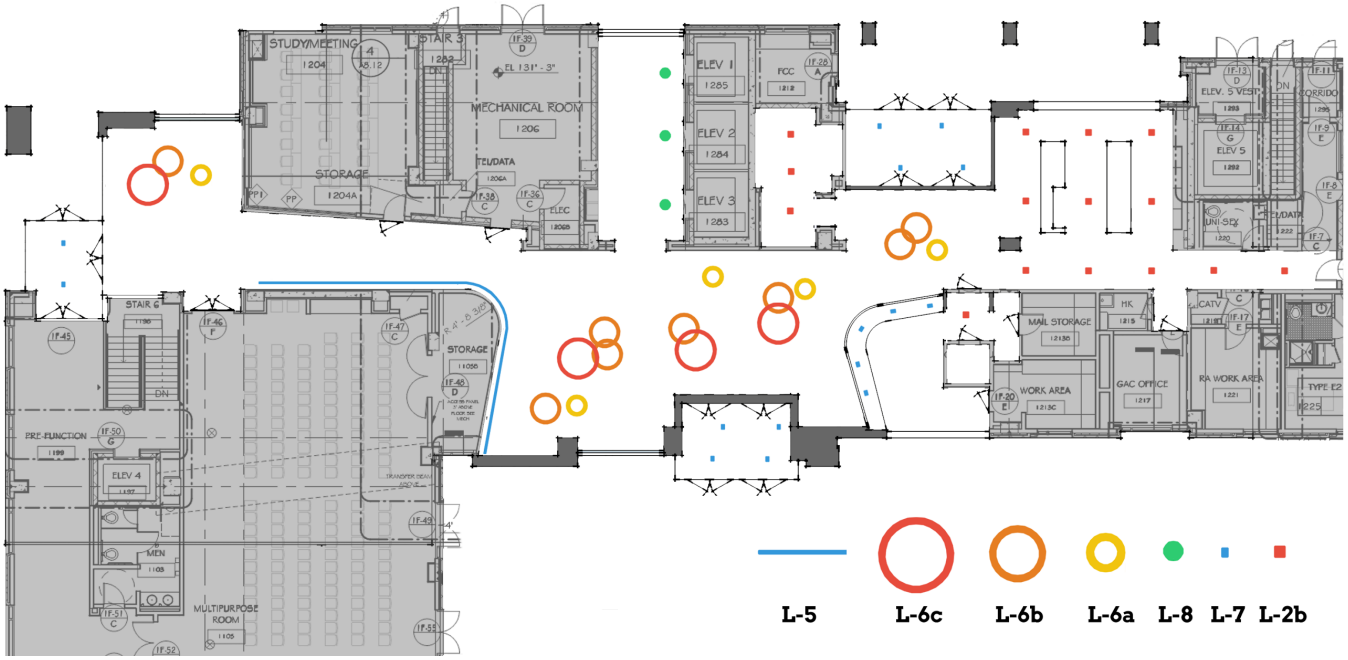
The lobby provides access to all of the main functions of the building. Three vestibules provide access from the exterior. The lobby serves as the main circulation to the academic spaces on the west side of the first floor, dormitory spaces on the upper floors, and other services throughout the building. Located within the lobby is a front desk, elevator lobby for building residents, seating areas, and mailboxes.

Lighting Layout

lobby seating area

from right: elevator lobby, front desk, lobby south entrance

west lobby entrance



lobby lighting plan

Lighting Equipment*

L-6: by Eureka	**L-5:** by LED Linear	**L-7:** by iGuzzini	**L-8:** by Eureka	**L-2b:** by Lightolier
				
Input: 40/64/87 watts	**Input:** 1.4 watts/ft	**Input:** 4.2 watts	**Input:** 40 watts	**Input:** 19.8 watts
Output: 3880/6200/8530 lumens	**Output:** 124 lumens/ft	**Output:** 300 lumens	**Output:** 1800 lumens	**Output:** 1000 lumens
Lamp: LED	**Lamp:** LED	**Lamp:** LED	**Lamp:** 2 - 18W CFL	**Lamp:** LED

L-6: three different sizes of these large, circular pendants are used for general illumination
L-5: LED tape in the wall slot provides indirect, grazing light
L-7: this small LED is used in the vestibules and at the front desk
L-8: pendants located in the elevator lobby
L-2b: downlights with higher output, located around residential mailboxes and back hallway

*see appendix for complete schedule of equipment and LLF calculations

Calculations and Metrics

LIGHTING LEVELS

	General Illumination			Reception Desk			Vestibules		
	Criteria	Existing	Thesis	Criteria	Existing	Thesis	Criteria	Existing	Thesis
E (horizontal)	100	251	251	150	293	205	50	142	79
E (vertical)	30	121	177				30	98	41
Avg:Min	4:1	6:1	2.2:1	4:1	1.7:1	1.6:1	2:1	3.3:1	1.9:1

	Elevator Lobby			Reading/Work Area		
	Criteria	Existing	Thesis	Criteria	Existing	Thesis
E (horizontal)	50	173	60	150	237	244
E (vertical)				50	72	105
Avg:Min	2:1	2.2:1	3:1			

POWER USE

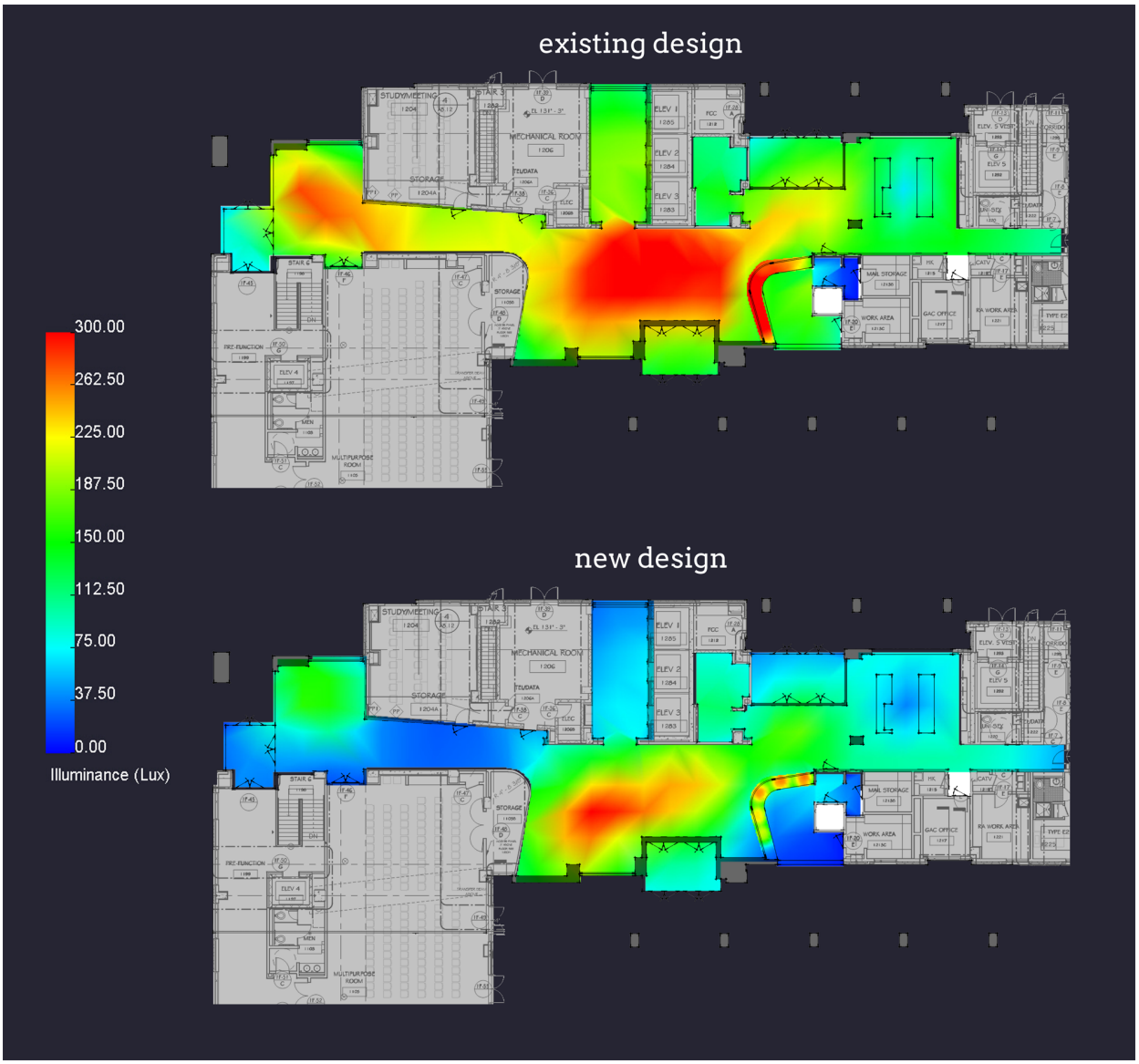
Existing LPD	Area (SF)	Total Watts	LPD	Target LPD	% Difference
0.70	5,152	1,427	0.28	0.90	69.22%

Criteria Evaluation

With so many different spaces served by the lobby, the most important criteria is good wayfinding. Prince Frederick Hall features many strictly functional spaces throughout it, such as classrooms and dormitory rooms. This makes the lobby the perfect moment to take time to celebrate the architecture of the building. Juxtaposition is key to create the visual diversity necessary for wayfinding and for artistic expression. In this case, it is the juxtaposition of public and private spaces. The final criteria for the lobby is to provide a welcoming entrance for the building.

QUANTITATIVE

This lighting design provides adequate light levels in all spaces, as per IES recommendations where the primary occupants are less than 25 years old. Light levels are higher at the most important areas of the space: the main entrance, the front desk, and the seating areas. This design also uses less power than the existing design and the ASHRAE allowance for a space of this type.



QUALITATIVE

Light levels are optimized to reflect the gradient of public to private spaces. The brightest areas are also the most public areas: the main entrance, and the front desk. Circular pendants throughout the space provides visual interest at the ceiling plane. The direct/indirect light from these fixtures means that both the ceiling and the floor is illuminated.

In more private areas, different lighting techniques are used to create juxtaposition to public areas. For example, in the elevator lobby direct pendants are used to create a more private atmosphere. In this space the ceiling is darker than in the main lobby, and the overall light levels are lower.

SUSTAINABILITY

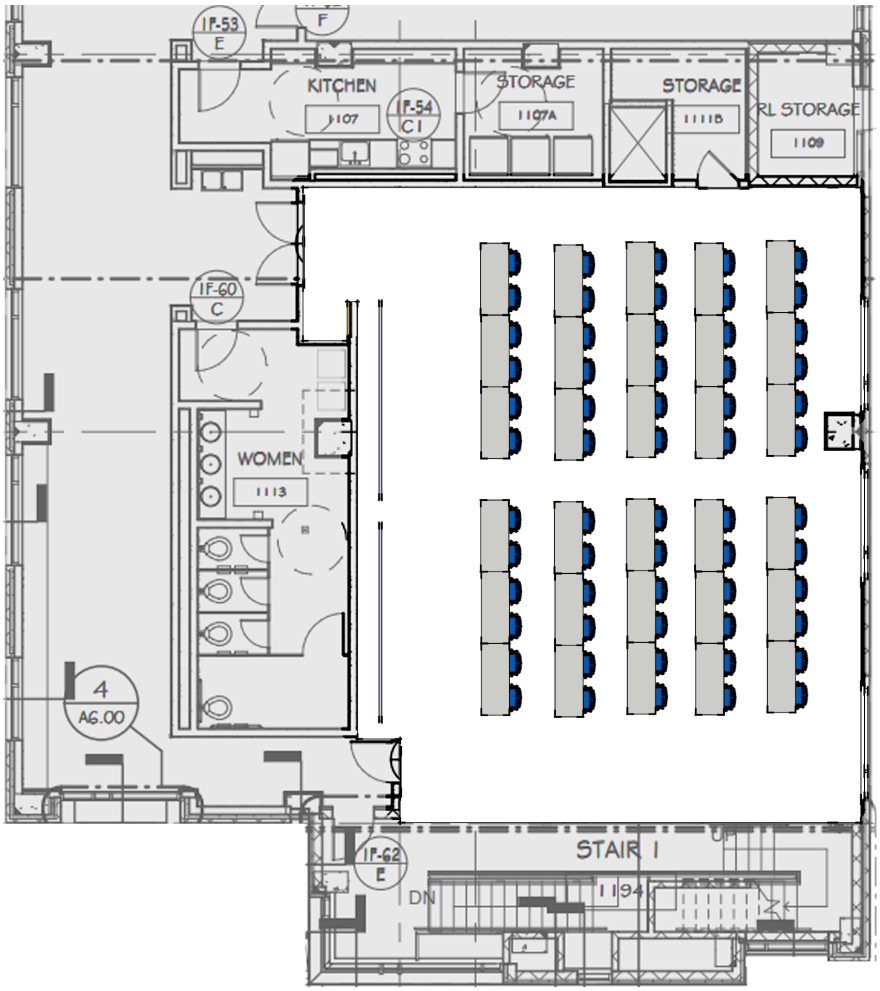
By sticking to the IES recommendations for light levels in each area of this space, a great reduction in energy use was achieved. It is important to remember that, since there are many daylight openings throughout the space, during the day most of these luminaires will not be needed. Therefore the criteria focused on night time illuminance values for all spaces adjacent to large windows. This allowed for the use of lower output fixtures, and ultimately a low LPD.

Luminaire selection was also important to reducing the LPD. In the existing design, the lobby is lit almost entirely with compact fluorescent downlights. These types of luminaires are inefficient at getting light onto the plane below them. By selecting more efficient fixtures, the LPD is easily decreased without sacrificing light levels.

Seminar Room

The design for this space utilizes several different types of lighting to provide flexibility. The main goal of the lighting for this classroom is to provide a good learning environment. In this case, by providing a space free from distraction, discovery is made accessible to students through their education.

Spatial Environment

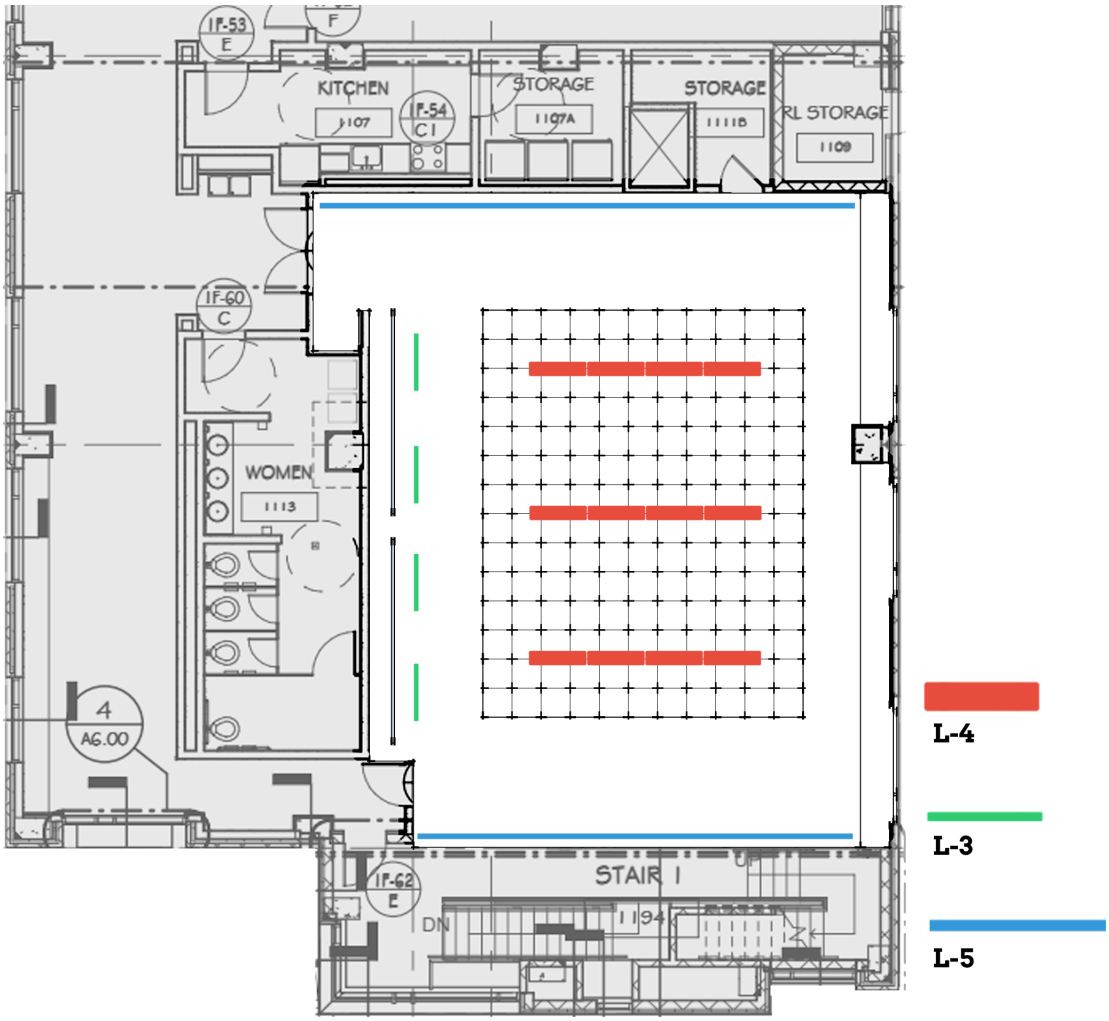


This is one of several academic spaces located throughout the first and ground floor of the building. This room is on the first floor, and is capable of seating around 60 students. Desks in this room face away from three, east-facing windows that offer a view of the entry plaza and the south facade of the building. The room features whiteboards on the front three walls and two motorized projection screens.

Lighting Layout

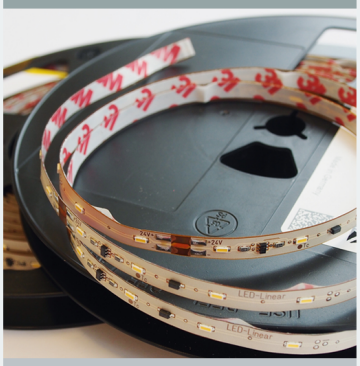
from front of seminar room

from back of seminar room



seminar room lighting plan

Lighting Equipment*

L-4: by Focal Point	**L-3:** by Arch Lighting Works	**L-5:** by LED Linear
		
Input: 98 watts	**Input:** 32 watts	**Input:** 1.4 watts/ft
Output: 3373 lumens	**Output:** 2610 lumens	**Output:** 124 lumens/ft
Lamp: LED	**Lamp:** 1 - 28W T5	**Lamp:** LED

L-4: general illumination is provided by direct/indirect pendants
L-3: semi-recessed fixtures at the front of the room illuminate the whiteboard
L-5: LED tape is recessed into wall slots for peripheral lighting

*see appendix for complete schedule of equipment and LLF calculations

Calculations and Metrics

LIGHTING LEVELS

	General Illumination, non-AV			General Illumination, AV			Whiteboard		
	Criteria	Existing	Thesis	Criteria	Existing	Thesis	Criteria	Existing	Thesis
E (horizontal)	250	503	344	15	145	24			
E (vertical)	75	353	304	15	57	14	300	258	295
Avg:Min				3:1	4.34:1	3:1	3:1	1.44:1	2.11:1

POWER USE

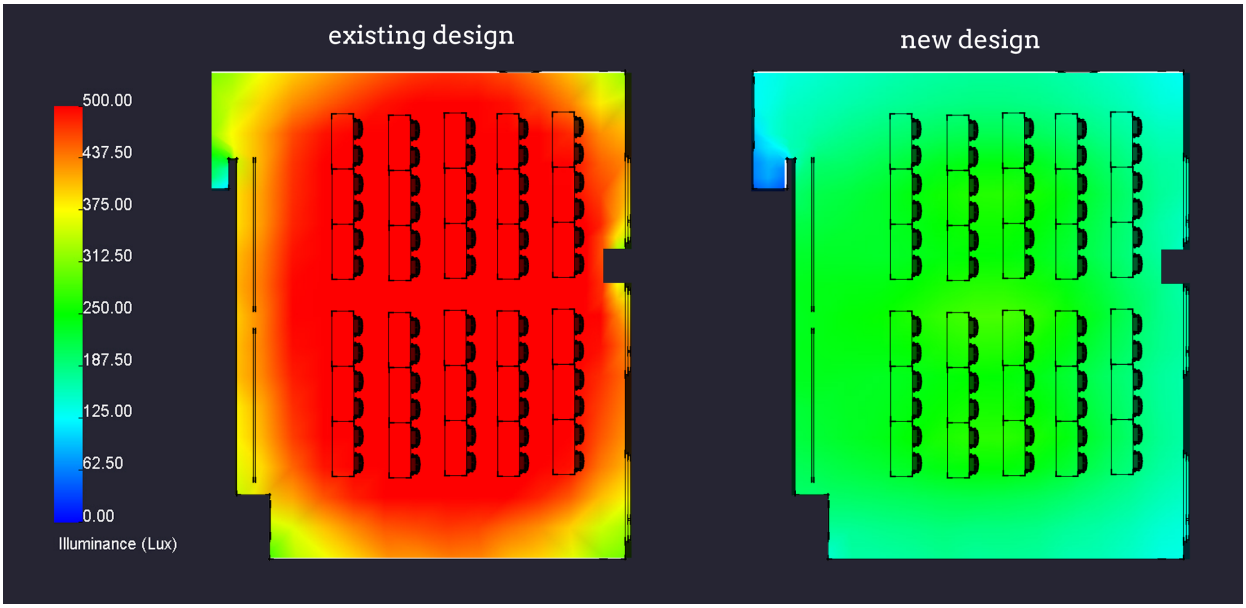
Existing LPD	Area (SF)	Total Watts	LPD	Target LPD	% Difference
0.74	1,750	1,350	0.77	1.24	37.78%

Criteria Evaluation

First and foremost, this space needs to be functional. Criteria are therefore based on recommendations given by the IES Handbook. In this case, illuminance values have been selected for spaces where the primary user is under 25 years old. In order to increase the feeling of brightness in the space, some type of peripheral lighting should be applied to the walls. Lastly, since this is a multi-use classroom, flexibility must be provided in the lighting scheme and controls of the room.

QUANTITATIVE

compare light levels and power use to existing design



QUALITATIVE

One of the major criteria set for this space was peripheral lighting. This was accomplished with the use of wall slots to evenly graze the sides of the room. By lighting the walls, the room is given an extra feeling of brightness. This effect is added to by the direct/indirect pendants used in the main part of the room. The final result of this lighting scheme is one that promotes a productive learning environment.

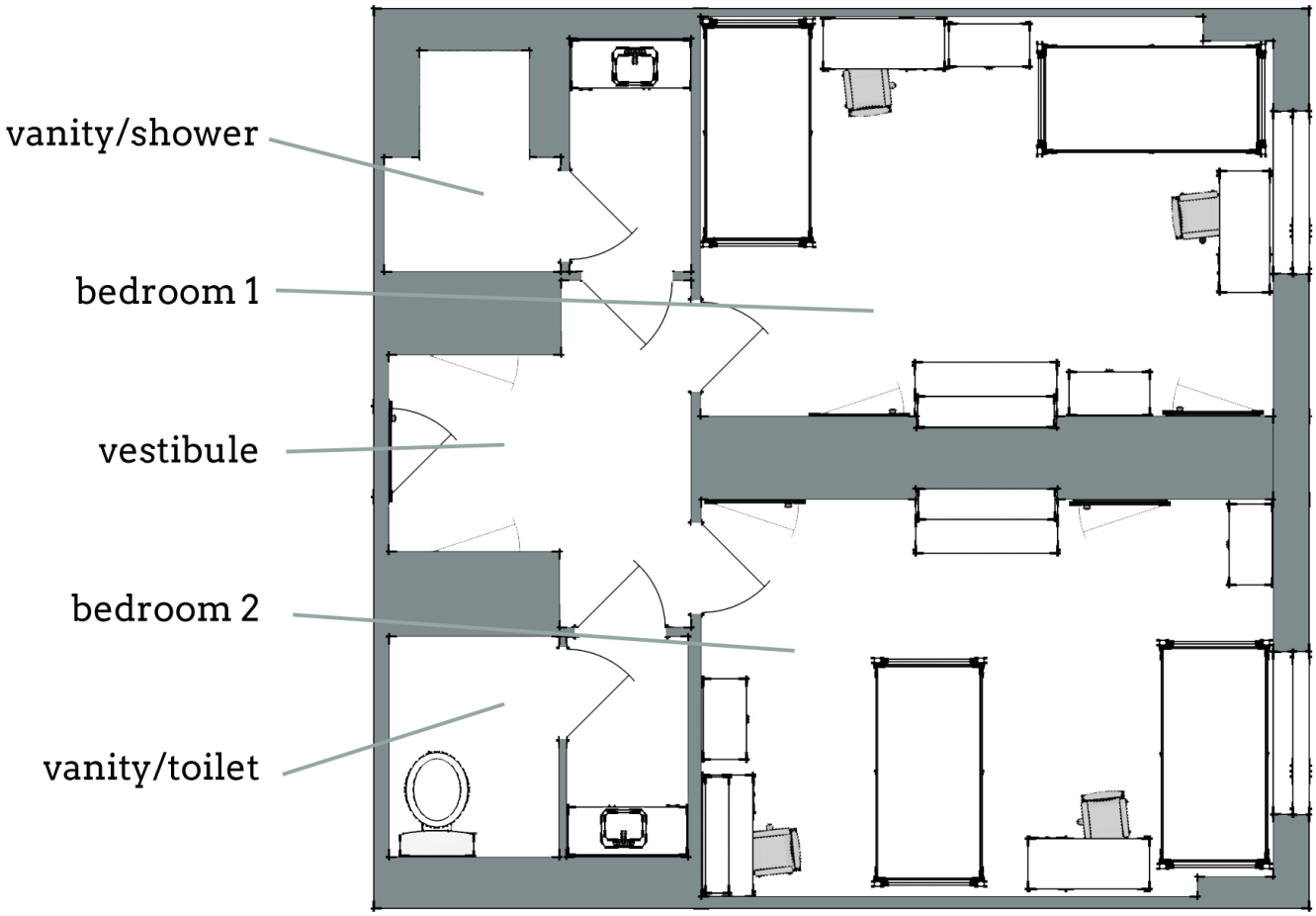
SUSTAINABILITY

This scheme allows for different lighting combinations, so only the necessary lights need to be turned on. The pendants above the desks have independant down and uplight components, for added flexibility. Finally, this lighting design is 37% below the ASHRAE allowance.

Dormitory Suite

The concept is applied to this space in the sense of social discovery; this isn't, after all, a totally private space. A shared dorm room, isn't going to express itself the same way that a bedroom or hotel room would. In the life of busy college students, a dorm room is more like to a social office space. It needs to have sturdy, function work light. A bright ceiling will help reduce the heaviness of the concrete surfaces. A focal point can create a more casual atmosphere for social life. Ideally, all of these elements need to be applied in layers to reduce the institutional feel of this otherwise utilitarian space.

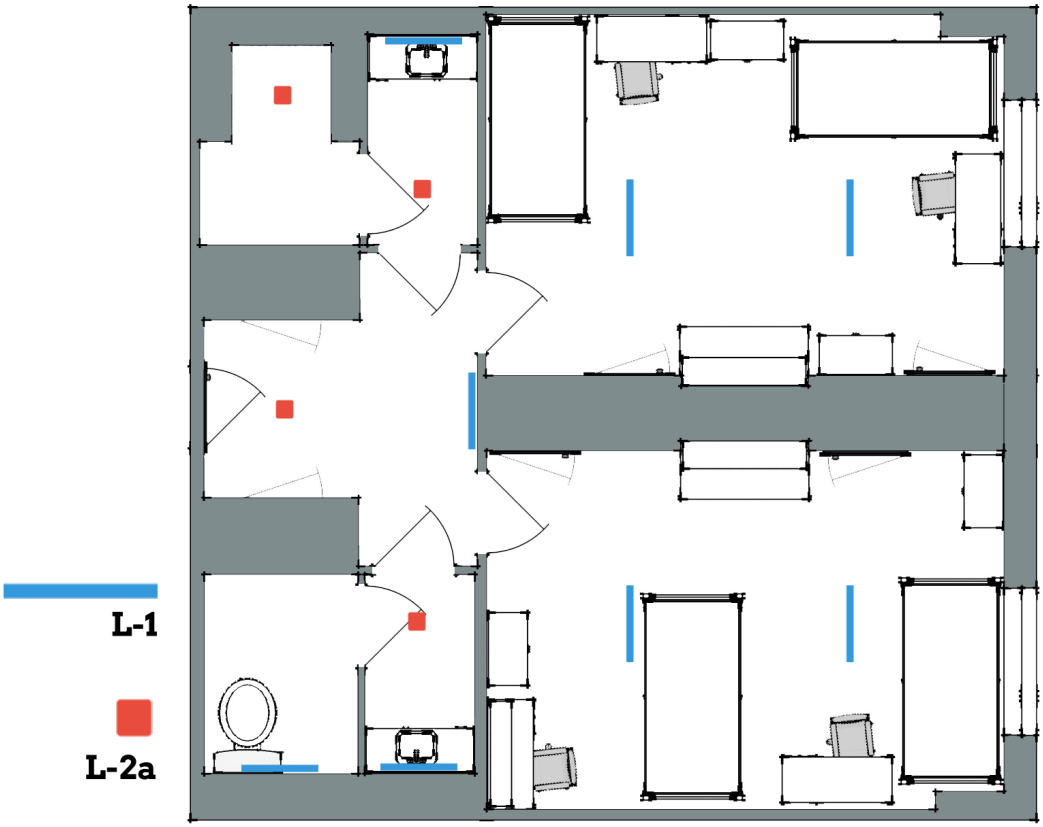
Spatial Environment



This is a typical suite, located throughout the 2nd - 7th floors. It is one of several different typical dorm rooms, but represents the living quarters for a little more than one-third of the total students living in the building. Each suite has two bedrooms to accommodate a total of four students per suite. Residents enter into a vestibule area that serves both bedrooms, two bath areas, and two storage closets. One bath area contains a vanity and shower, the other has a vanity and toilet.

Lighting Layout

dormitory suite bedroom from entrance



dormitory suite lighting plan

Lighting Equipment*

L-1: by Architectural Lighting Works	**L-2a:** by Lightolier
	
Input: 15.8 watts	**Input:** 8.7 watts
Output: 1222 lumens	**Output:** 500 lumens
Lamp: LED	**Lamp:** LED

L-1: this fixture is used in varied applications around the dormitory suite for general lighting
L-2a: accent and direct lighting is provided by a recessed LED downlight

*see appendix for complete schedule of equipment and LLF calculations

Calculations and Metrics

LIGHTING LEVELS

	General Illumination			Desk Areas			Bath Areas		
	Criteria	Existing	Thesis	Criteria	Existing	Thesis	Criteria	Existing	Thesis
E (horizontal)	25	626	290	250	590	268	50	1066	550
E (vertical)									
Avg:Min	3:1	1.2:1	1.3:1				2:1	1.4:1	1.3:1

	Vanities			Foyer		
	Criteria	Existing	Thesis	Criteria	Existing	Thesis
E (horizontal)	150	960	627	50	732	423
E (vertical)	200	1022	628			
Avg:Min	2:1	1.1:1	1.1:1	3:1	1.2:1	1.3:1

POWER USE

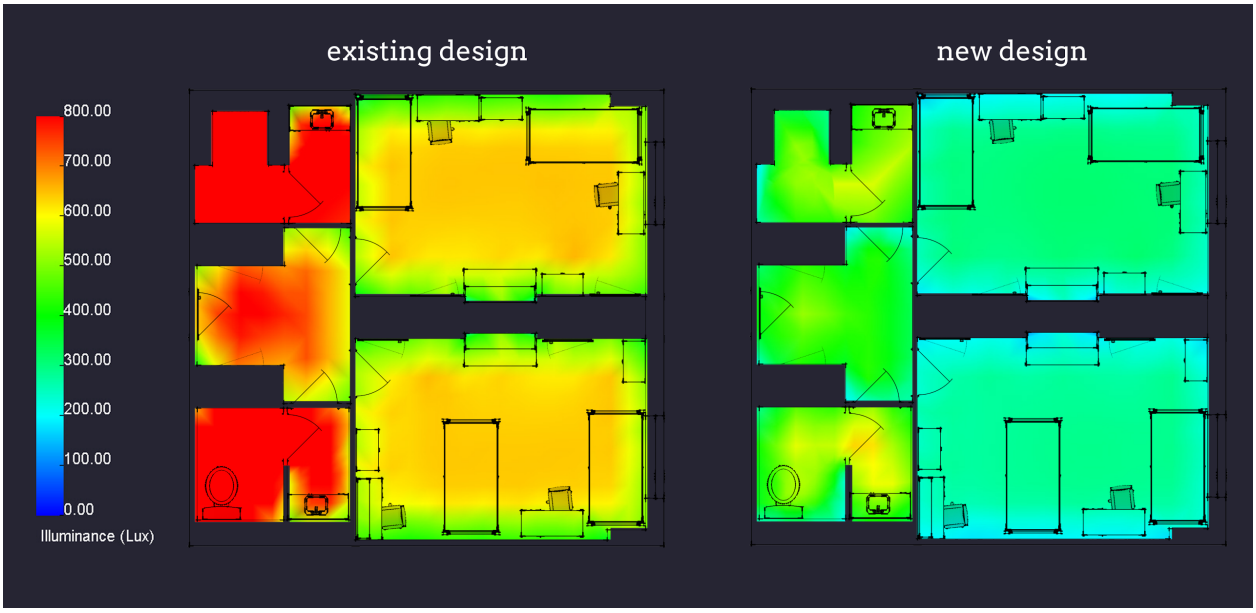
Existing LPD	Area (SF)	Total Watts	LPD	Target LPD	% Difference
0.45	777	161	0.21	0.38	45.40%

Criteria Evaluation

Comfort is the most important factor for a living space. And due to the high concentration of people living in this space, extra comfort can be provided in the form of controllability. This means not simply using a 2x2 troffer, like most every other dorm room, but instead using layers of light. On a more practical side, by staying 10% under the ASHRAE requirements for a space of this type, this design has the potential to create savinging throughout the building. Since there is 42 duplications of this suite in the building, even small savings per space will have a large effect.

QUANTITATIVE

The new design for the lighting in this space is focused on achieving power savings for the building. By first evaluating the needs of the space, as per IES recommendations, this could be done without sacrificing the comfort of adequate illuminance levels. IES recommendations revealed that the existing lighting for this space was over-designed to provide more light than was necessary. By reducing the size of fixtures throughout the space, savings are provided in form of reduced LPD. Originally, this was planned as 10% below ASHRAE 90.1 standard, but the final design achieved an LPD 45% below ASHRAE.



QUALITATIVE

The goal of qualitative criteria in this space were to reduce the institutional feel of the rooms. The key to this was applying layers of light, like a hotel room or restaurant. For several reasons, this final design has changed routes and not achieved this goal. One reason was due to the professionals' comments to the Tech 3 presentation at Lutron that it is unreasonable to use more than the bare minimum fixtures in a public university's dormitory. Another comment was that student are accustomed to providing their own desk lamps, and that a university would not want to install and maintain atmospheric lighting.

For this design, the fixtures selected for the rooms are different from the existing design in that they have 3-sided lenses. This will allow for a certain amount of light to illuminate the ceiling around them, lightening the otherwise dark and heavy concrete ceiling. The real quality of this final design, however, comes in the form of adequate and uniform lighting.

SUSTAINABILITY

For this space, sustainability comes in the form of longevity. By using all LED fixtures, this will save the university the maintenance associated with linear fluorescents. The LED modules are less likely to need replacing, and are sturdy enough to handle the wear and tear of operating in a dorm setting.

Appendix

Luminaire Schedule

	Type Mark	Description	Manufacturer	Lamp	Quantity	Input Watts
Lobby	L-5	LED tape	LED Linear	LED (1.4 W/LF)	30	1.4
	L-2b	4" Square Downlight; high output	Lightolier	LED	15	19.8
	L-6a	36" cyliner pendant	Eureka	LED	5	40
	L-6b	54" cyliner pendant	Eureka	LED	8	64
	L-6c	72" cyliner pendant	Eureka	LED	4	87
	L-7	2 cell downlight	iGuzzini	LED	15	4.2
	L-8	Decorative pendant	Eureka	2 - 18W CFL	3	37
Seminar Room	L-3	Semi-recessed linear wall washer	Architectural Lighting Works	1 - 28W T5	4	30
	L-4	Linear pendant 4' direct/indirect	Focal Point	LED	12	98
	L-5	LED tape	LED Linear	LED (1.4 W/LF)	33	1.4
Dormitory Suite	L-1	Surface mounted linear with wrapped lens	Architectural Lighting Works	LED (7 W/LF)	8	15.8
	L-2a	4" Square Downlight; low output	Lightolier	LED	4	8.7
Entry Plaza	LE-1	Exterior 15' UMD Standard LED Pole	LSI Industries	LED	4	138
	LE-2	LED tape; IP67 rated	LED Linear	LED	268	1.4
	LE-3	Bollard	Cooper	LED	7	8.6

Light Loss Factors

		LLF calculation						
	Type Mark	Initial Lumens	Mean Lumens	BF	LDD	LLD	Total	Input Watts
Lobby	L-5	124.1	n/a	n/a	0.90	0.90	**0.81**	1.4
	L-2b	1000	n/a	n/a	0.90	0.90	**0.81**	19.8
	L-6a	3880	n/a	n/a	0.90	0.90	**0.81**	40
	L-6b	6200	n/a	n/a	0.90	0.90	**0.81**	64
	L-6c	8530	n/a	n/a	0.90	0.90	**0.81**	87
	L-7	300	n/a	n/a	0.90	0.90	**0.81**	4.2
	L-8	2500	2250	0.9	0.90	0.90	**0.73**	37
Seminar Room	L-3	2900	2750	0.95	0.90	0.95	**0.81**	30
	L-4	3373	n/a	n/a	0.90	0.90	**0.81**	98
	L-5	124.1	n/a	n/a	0.90	0.90	**0.81**	1.4
Dormitory Suite	L-1	1222	n/a	n/a	0.90	0.90	**0.81**	15.8
	L-2a	500	n/a	n/a	0.92	0.90	**0.83**	8.7
Entry Plaza	LE-1	1000	n/a	n/a	0.90	0.90	**0.81**	138
	LE-2	124.1	n/a	n/a	0.90	0.90	**0.81**	1.4
	LE-3	57	n/a	n/a	0.90	0.90	**0.81**	8.6