Tech Report 1, Part 2:

Lighting Existing Conditions and Design Criteria Report

Sarah Miller
with advisor: Shawn Good
16 September, 2013
University of Maryland: Prince Frederick Hall

files:
AGi32 for Seminar Room:
http://www.personal.psu.edu/slm5413/thesis/tech1-2-seminar.AGI
AGi32 for Dormitory Suite:
http://www.personal.psu.edu/slm5413/thesis/tech1-2-suite.AGI

Executive Summary

Prince Frederick Hall is a new building located on the University of Maryland campus. The building programming provisions space for academic rooms on the ground and first floors of the building. Part of the first floor and all of the second through seventh floors are used for dormitory rooms. The nexus of these spaces occurs in the first floor lobby, where occupants navigate through varying degrees of public and private spaces.

south facade of Prince Frederick Hall (WDG Architecture)

I have selected four spaces for my studies that represent the public vs private aspect of the building: the south entry plaza, the lobby, seminar room, and a typical dormitory suite. After completing a study of the existing conditions in these four spaces, I developed criteria to guide the expression of the spaces' functionality. The criteria for the lobby focus on wayfinding, and the need for visual interest. The seminar room must fulfill its role as a learning environment. Controllability is also required in this space to accommodate different lecture styles and reduce energy usage. The dormitory suite represents the most private of the four spaces I have selected. Designing in this spaces will require a careful balance of lighting for relaxation and lighting for visual tasks like reading and writing. The last space is the entry plaza: the most public of the four. The lighting here must create a space that is safe for students returning to their rooms late at night. It also offers a great opportunity for energy savings because of the high wattage fixtures typically used outdoors.

Sustainability is a major aspect of this project. The current design has energy-reducing features such as: high reflectivity surfaces, low LPDs, and utilization of T5HO and LED lamps. Sustainability, along with reduction of urban sky glow and light trespass, will be a major consideration of my future lighting redesign. Lighting must provide functionality to a space, part of that is the economy of energy use through innovative design. A major goal of this project is to help Prince Frederick Hall achieve LEED Gold.

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Introduction

The four spaces I have chosen to study in the University of Maryland's Prince Frederick Hall are: the lobby, seminar room, a typical dormitory suite, and the main entry plaza. The existing conditions have been investigated, to better understand the lighting design. This includes an assessment of the lighting and furniture plans, lighting equipment, surface reflectances, and daylighting elements. I have also developed a series of criteria to guide my future design. These criteria cover both qualitative and quantitative aspects of lighting design. Finally, this document also provides an evaluation of the existing lighting design.

Existing Conditions

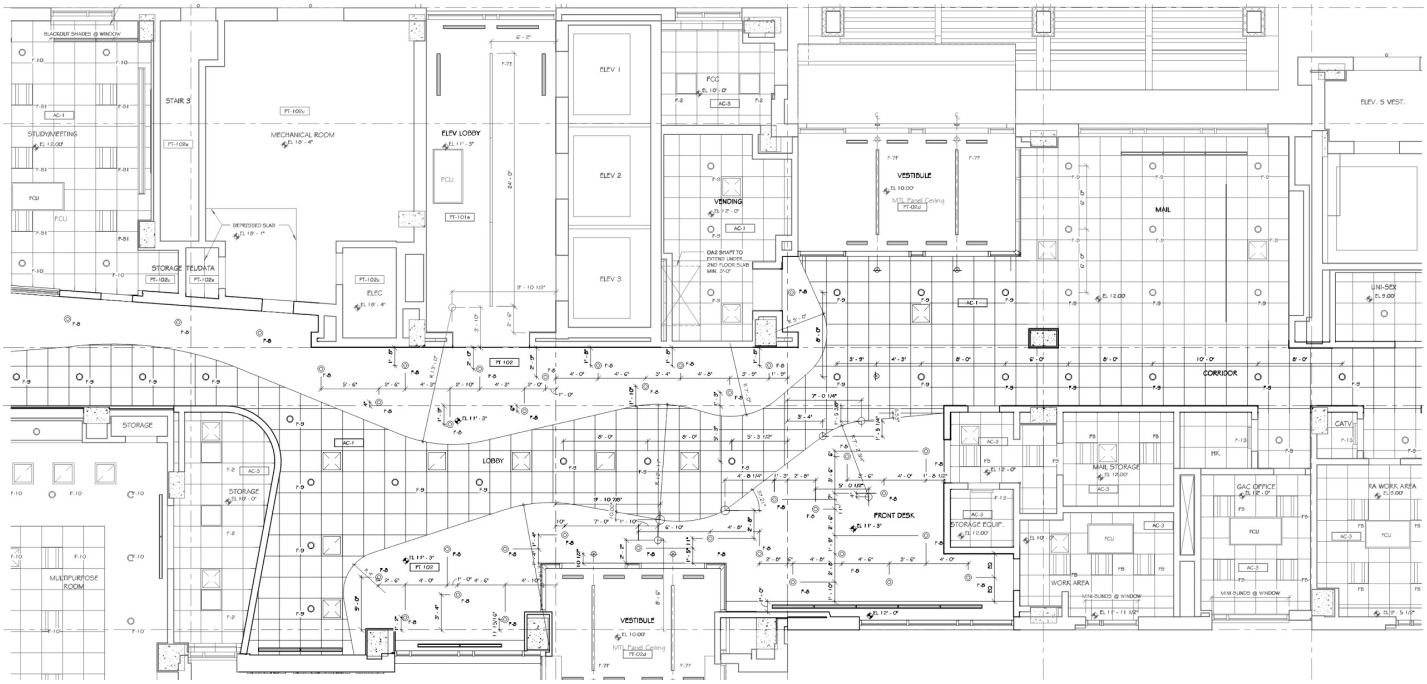
To gain a more in depth understanding of these spaces, I have completed a study of the existing conditions in my four chosen spaces. This study is focused primarily on lighting design: the existing layout, equipment used to complete the design, furniture layout and how it relates to programming, surface materials, and current daylighting systems and possible opportunities.

Lobby

This lobby provides access to all of the main functions of the building. It circulates visitors and residents to several key areas of the building. Because of the building programming involving a spectrum of public and private spaces, the lobby is where these two themes meet. Occupants enter from two vestibules and travel through the lobby to public areas such as: the front desk, a corridor to academic spaces, and the resident mail center. The lobby also serves more private areas such as: the elevator lobby for building residents, and a corridor to living quarters.

LIGHTING LAYOUT

To the west, on the academic side of the lobby, the lighting is placed in cooperation of the architectural ceiling feature, an amorphous wave of acoustical ceiling tiles and gypsum wallboard. Towards the resident mail area and the first floor residential area, the east side of the lobby, the lighting becomes rectilinear, like the ceiling in this area.



LIGHTING EQUIPMENT

Image	Type Mark	Description	Manufacturer	Lamp
	F-8	Recessed CFL Downlight with Decorative Ring	Lightolier	1 - 42W CFL
	F-9	Recessed CFL Downlight - 32W	Gotham	1 - 32W CFL

These are the two types of luminaires used in the main lobby area. Both are circular downlights, but one has an extra decorative ring that redirects some light onto the ceiling. Some of the surrounding areas make use of the same types, such as: the mail area, the front desk, and vending area. The adjacent elevator lobby and the two entry vestibules both introduce a third type of luminaire not found in the lobby, a 3 inch recessed slot fixture.

SPATIAL ENVIRONMENT

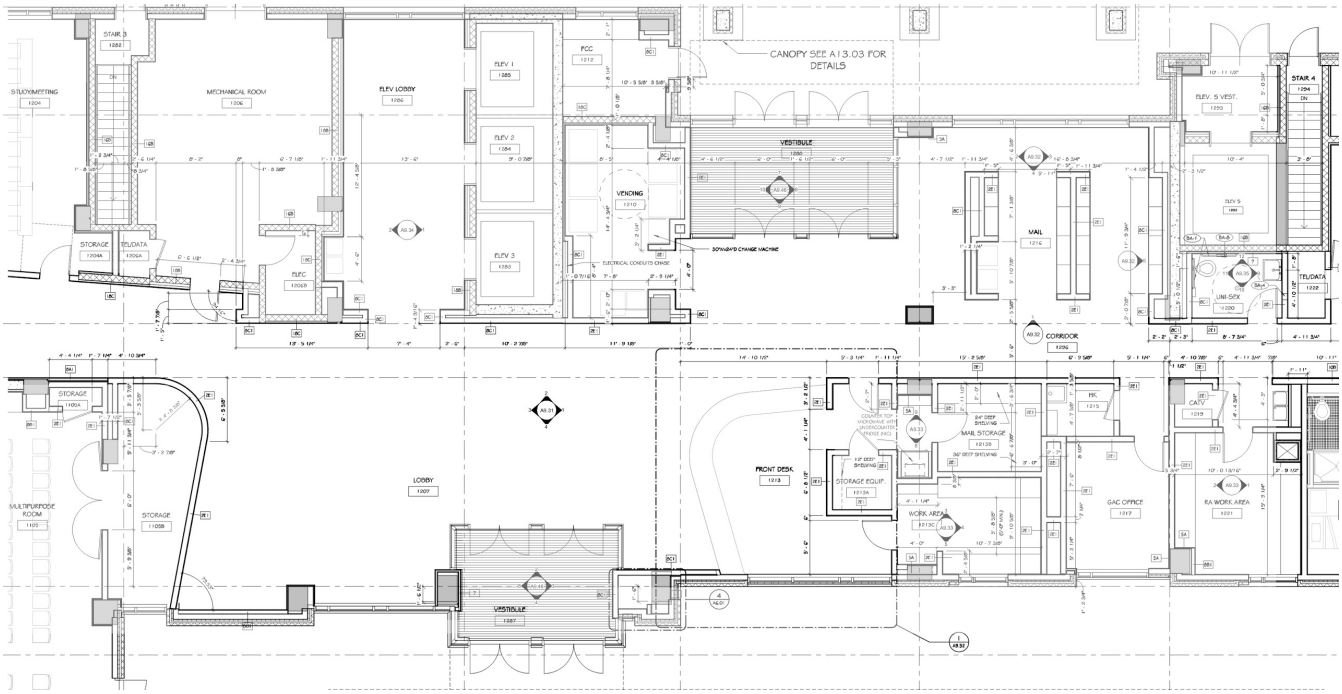
The following image, from WDG Architecture, is a rendering of the lobby. This illustrates how the architecture and lighting currently interact in the space. The wave motif in the ceiling is also visible in this view.

COLOR	MATERIAL	PRODUCT CODE	DESCRIPTION	REFLECTANCE	~RGB VALUE
floor					
	terrazzo	TER-101	to match DC107C, Nurazzo	not on website; email sent to Nurazzo	
	terrazzo	TER-102	to match DC726, Nurazzo	not on website; email sent to Nurazzo	
	resilient flooring	RF-101	12 inch by 24 inch Striations Bio Base Tile, Bisque T3614, Armstrong World Industries, Inc	0.85	219,216,203
walls					
	painted surface	PT-101s	OC-131, White Down, Benjamin Moore & Co	0.91	236,231,216
	painted surface	PT-111s	November Rain, OC-50, Benjamin Moore & Co	0.87	225,223,209
	tile	T-101	15cm by 90cm RETT, Golden Wood Collection, Oak 914N3R, Emil Ceramica	0.73	221,181,138
	tile	T-102	15cm by 90cm Decori Listelli cut, Golden Wood Collection, Oak-Teak MCF4N3, Emil Ceramica	0.25	92,57,41
	metal paneling	MTL-01	Stainless Steel, Number 4 finish	0.75	180,198,171

ceiling					
	GWB	PT 102	I-02, Super White, Benjamin Moore & Co	0.95	242,243,239
	ACT	AC-1	acoustic ceiling tile	0.9	estimated
	metal paneling	PT-02d	9967 XL Pewter Centria Sundance Series, Duranar, PPG Industries	0.51	128,132,131

The reflectance values in this space are as noted in the previous table. Typically, the surfaces consist of ACT and gypsum ceilings, gypsum walls, and terrazzo floors. In general, the surfaces have a higher reflectance than the reflectances assumed in unknown situations (80/50/20). One surface that deviates from this is the feature wall, near the elevator lobby. This wall can be seen in the architect's rendering as a light tan wall with dark stripes. This surface uses a tile type T-102, with a reflectance of only 0.25. This seems less reflective than the architect's rendering shows, and will require careful investigation in later steps.

Shown next is the furniture plan for this space. This gives better insight into the programming for the lobby. The only furniture that occupies the space is a front desk, with no other seating for occupants. The criteria developed in the next section reflect that this lobby is meant as a purely transitional space.



DAYLIGHT ELEMENTS

It is most apparent in the architect's rendering that daylight dominates this space during daylight hours. The largest daylighting elements in this space are the two vestibule entrances, but a few extra windows are also present. The south side of the lobby has a curtain wall at the entrance (type AA and AA2: 280 square feet of glazing) and a large window located near the front desk (type N: 140 square feet of glazing). On the north side of the building, the vestibule curtain wall (type DD: 170 square feet of glazing) is slightly smaller than on the south side. A window on this side of the building further increases the daylighting (type M: 170 square feet of glazing). The glazing type for all these openings is G-01. This is PPG's Solarban 70XL double-pane with:

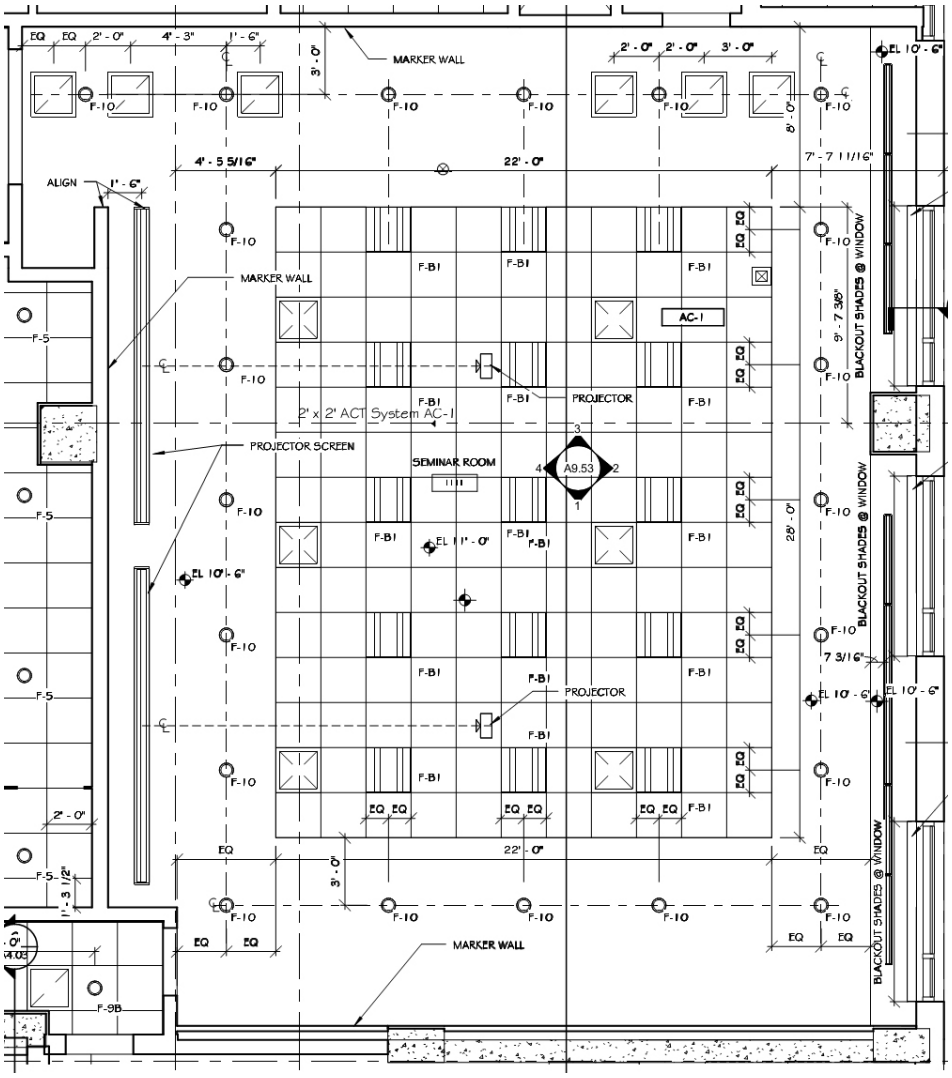
- ¼ inch glass, ½ inch air, ¼ inch glass
- Solar Heat Gain Coefficient (SHGC): 0.27
- Visible Light Transmittance (VLT): 64%
- Light to Solar Gain (LSG) ratio: 2.37

Seminar Room

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

LIGHTING LAYOUT

Most of the lighting in this room comes from direct sources. The 2 foot by 2 foot troffers in the center of the room contribute some indirect lighting from their basket shape. These troffers provide most of the work plane light over the central student seating area. Perimeter lighting and entry lighting is provided by a series of circular downlights. These lights have a distribution capable of lighting both the floor and walls; however, they are spaced such that scalloping occurs on the walls in these areas.



LIGHTING EQUIPMENT

Image	Type Mark	Description	Manufacturer	Lamp
	F-10	Recessed CFL Downlight - 32W	Gotham	1 - 32W CFL
	F-B1	Recessed 2X2 Double Basket	Metalux-Cooper	2 - 14W T5

Two types of luminaries are used in this space. Fifteen 2 foot by 2 foot fluorescent troffers are used in the center of the room, over the majority of the desks. The second type of luminaire is a recessed downlight, similar to the one used in the lobby.

SPATIAL ENVIRONMENT

The reflected ceiling rendering below illustrates the functions of both types of luminaires. General illumination produced by the troffers. The scalloping on the walls, discussed earlier, is demonstrated more clearly by this rendering. The distribution of the downlights can be inferred from the shaped of the scallops. This image also shows the contrast between the illumination on the walls and on the ceiling.

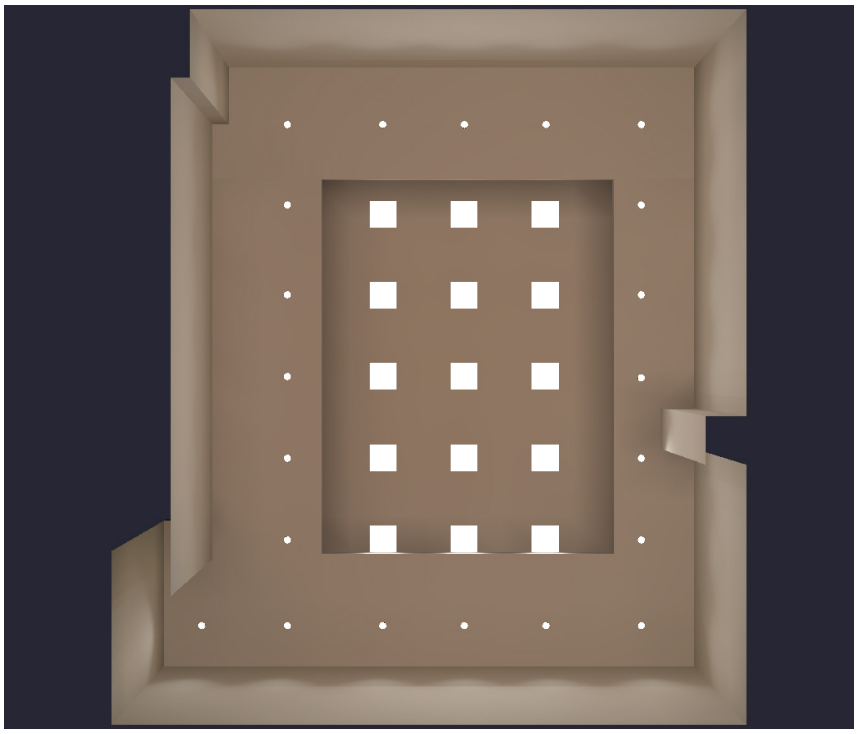
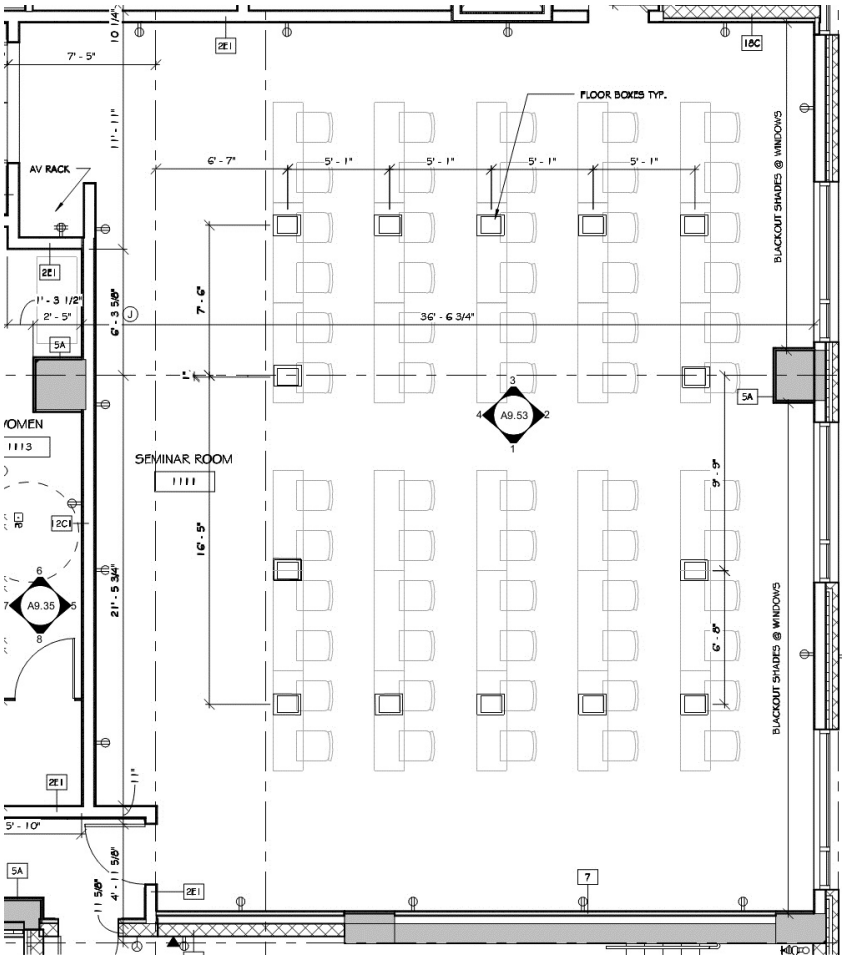


IMAGE	MATERIAL	PRODUCT CODE	DESCRIPTION	REFLECTANCE	~RGB VALUE
floor					
	carpet	CPT-102	Carpet tile, 24 inch by 24 inch, Aura 02619, Magical 19504, Tandus Contract	0.37	126,87,62
walls					
	painted surface	PT-110s	Silver Sage 506, Benjamin Moore & Co	0.83	211,213,197
	chair rail	SSUR-110	Anthracite, Corian, EI du Pont de Nemours & co	0.19	49,48,53
	markerboard	no code		0.95	243,243,243
	blackout shades	no code		0.2	estimated
ceiling					
	ACT	AC-1	acoustic ceiling tile	0.9	estimated
	GWB	need code	estimated to match PT-202u	0.95	242,243,239

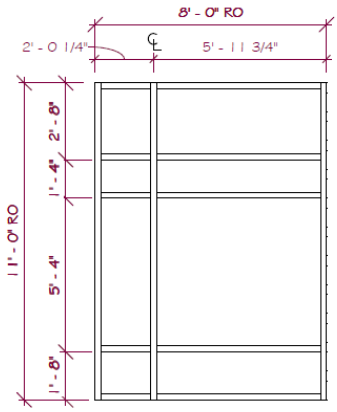
Also important to this particular space is the furniture layout. The arrangement of student desks shows how 60 students are intended to be seated. The rectilinear array of desks falls in the same area where the troffers are arrayed in the space. This drawing also shows floor boxes in this space, indicating a potential heavy use of electronic devices.



DAYLIGHT ELEMENTS

Across the back of the room, behind the student seating area, there are 3 large windows that face directly east. Each window has approximately 73 square feet of daylight opening. Glazing type G-01 is used on the windows. This type is PPG's Solarban 70XL double-pane with:

- ¼ inch glass, ½ inch air, ¼ inch glass
- Solar Heat Gain Coefficient (SHGC): 0.27
- Visible Light Transmittance (VLT): 64%
- Light to Solar Gain (LSG) ratio: 2.37



TYPE J

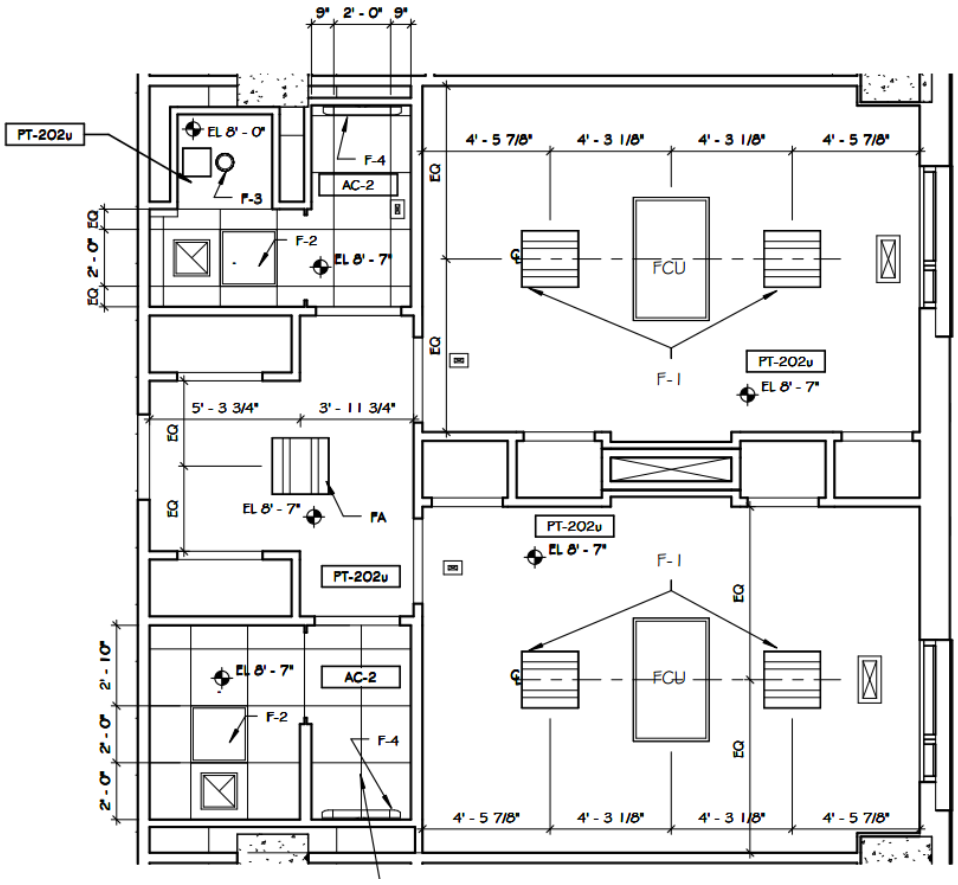
Additionally, the existing design shows blackout shades located at each window for daylight control.

Dormitory Suite

The dormitory room I have chosen to study is one of the typical suites found on the 2nd - 7th floors. It is one of several different typical dorm rooms, but represents the living quarter for a little more than one-third of the 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

The lighting in this space is very typical of university dormitories. Lighting in the bedrooms is provided by two bright troffers located in the center of the room. Similar troffers are used in the vestibule area and in both the bath areas. A few other specialty luminaires are located in the shower and vanity areas. A wet location rated fixture is used above the shower, and surface-mounted horizontal fixtures are used above each vanity.



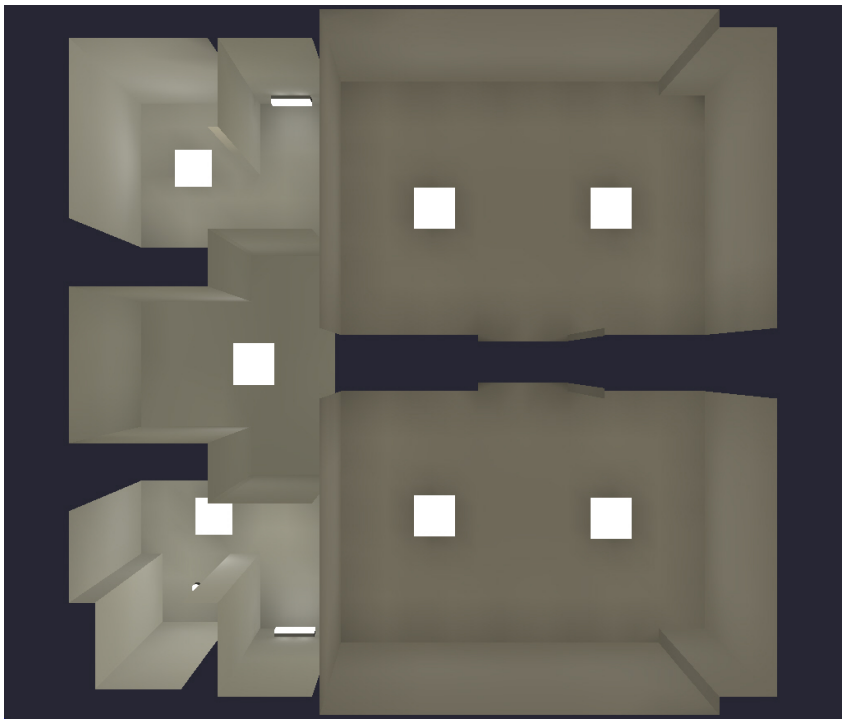
LIGHTING EQUIPMENT

Image	Type Mark	Description	Manufacturer	Lamp
	F-1	Typical Resident Bedroom Recessed 2X2 Double Basket	Metalux-Cooper	2 - 14W T5
	F-2	Recessed Lensed 2X2 at Unit Bathroom	Metalux-Cooper	2 - 24W T5
	F-3	Recessed CFL Lensed Downlight at Unit Shower	Gotham	1 - 18W CFL
	F-4	Typical Unit Vanity Light	Access Lighting	1 - 24W T5HO
	FA	Typical Resident Bedroom 2X2 Double Basket	Metalux-Cooper	2 - 14W T5

These types of luminaires found in the dormitory suite offer a robust design for private space. The troffers in the bedrooms lack minute controllability, but provide enough light for the occupants to read and write regardless of location in the room. The same luminaire is used to light the vestibule area. Similar troffers are located in the bath areas as well. In the shower area, a specific wet-location luminaire is used. In the vanity areas, the only non-direct luminaire is used over the mirrors. This is the only semi-decorative luminaire in this space.

SPATIAL ENVIRONMENT

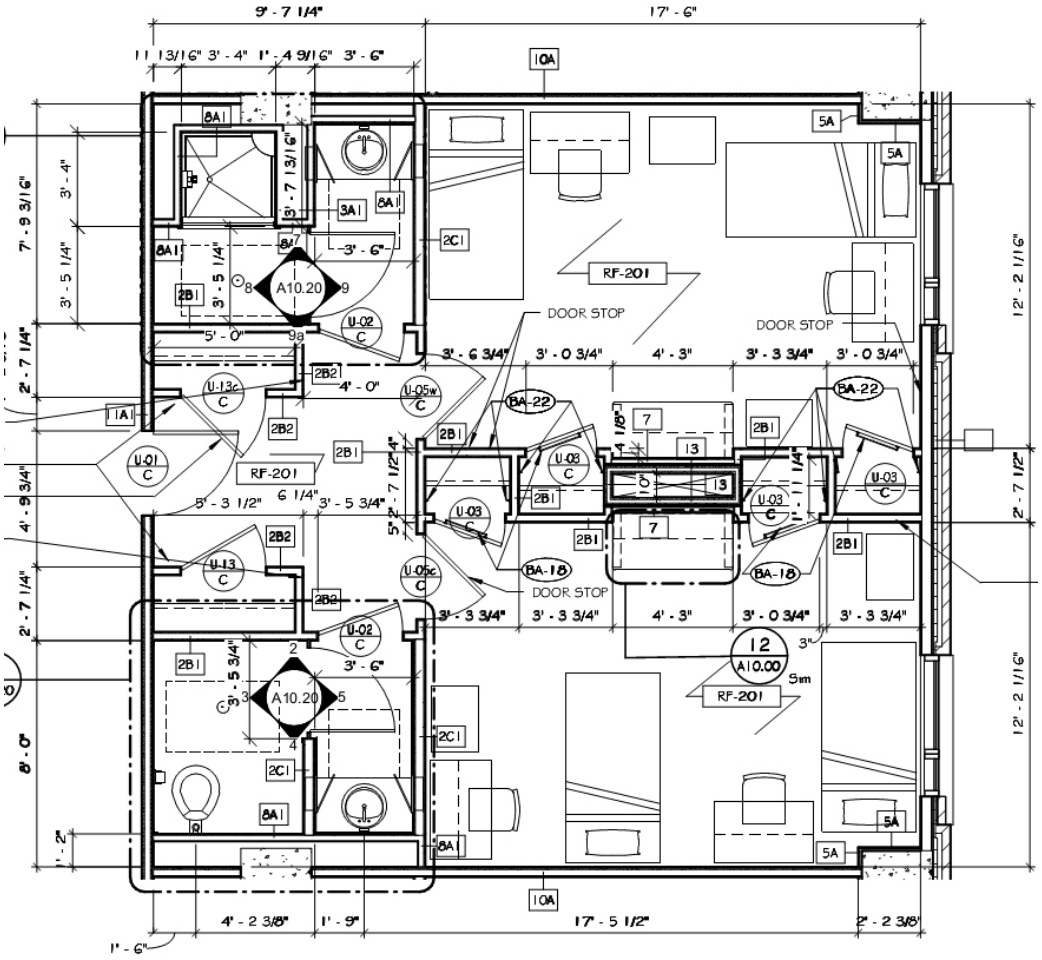
Typical dormitory suites are made of five main spaces: two bedrooms, two bath areas, and a vestibule. These five spaces are represented below in a rendering of the reflected ceiling lighting plan. This gives an idea of the relative brightness of each space. It also shows how dark the ceiling and walls are, particularly in the bedrooms.



For this rendering, and the calculations for this space, the following reflectance values were used. Like in the lobby, the colors applied to this space are relatively light, compared to the standard assumed reflectance of 80/50/20.

IMAGE	MATERIAL	PRODUCT CODE	DESCRIPTION	REFLECTANCE	~RGB VALUE
floor					
	resilient flooring	RF-201	12 inch by 12 inch Standard, Sandrift white 51858, Excelon Imperial Texture Vinyl Tile, Armstrong World Industries, Inc.	0.8	217,204,182
	tile	T-210	2 inch by 2 inch Keystones Tile, Urban Putty, SPC D201, Daltile	0.76	207,193,174
	tile	T-211	1 inch by 1 inch Keystones tile, Almond, D335, Daltile	0.87	231,220,200
walls					
	GWB	need code	estimated to match PT-202u	0.95	242,243,239
ceiling					
	painted surface	PT-202u	I-02, Super White, Benjamin Moore & Co	0.95	242,243,239
	ACT	AC-2	acoustic ceiling tile	0.9	estimated

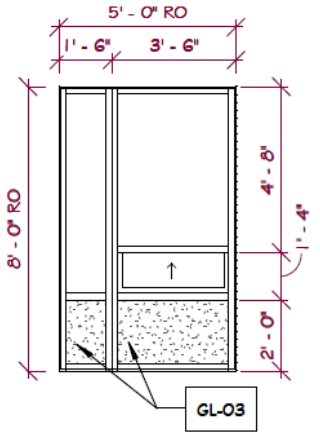
Also important to understanding the lighting design is the furniture plan. The programming for each space is made apparent with a visualization of what furniture is in each area. The bedrooms also show that at least two different layouts are possible with the given furniture, meaning that the lighting has to be flexible enough to allow this.



DAYLIGHT ELEMENTS

This typical dormitory suites offers a unique opportunity to study daylighting. Half of the units are located with east facing windows and the other half have west facing windows; however, both facades of the building are treated in the same manner. Regardless of orientation, the glazing type G-01 is used on the windows. This type is PPG's Solarban 70XL double-pane with:

- ¼ inch glass, ½ inch air, ¼ inch glass
- Solar Heat Gain Coefficient (SHGC): 0.27
- Visible Light Transmittance (VLT): 64%
- Light to Solar Gain (LSG) ratio: 2.37



TYPE D1

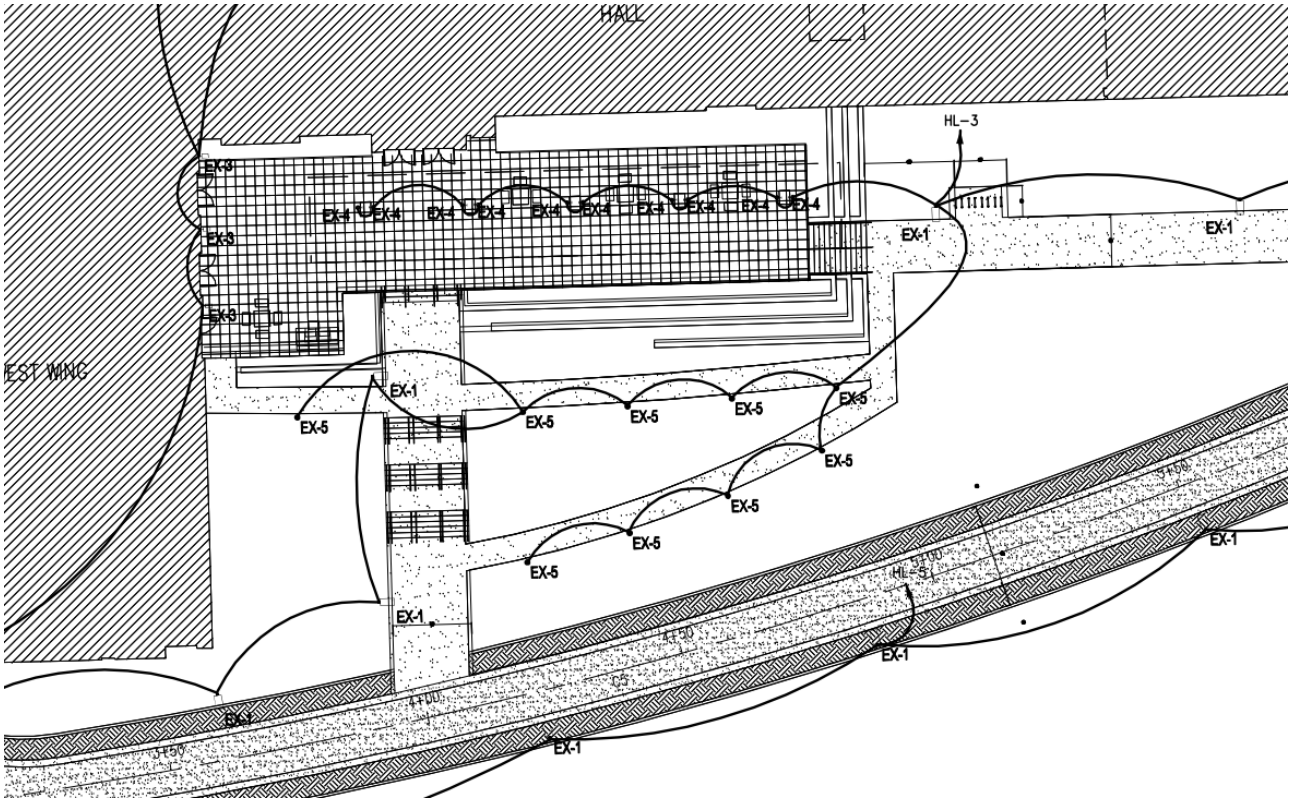
The total daylight opening is approximately 28 square feet, per bedroom, as seen in the image of window type D1.

Entry Plaza

This is the main entrance to the building, located on the south side. The plaza can be accessed from two sidewalks, and the main surface of the plaza is paving brick. It is largely uncovered, except for a shade trellis covering part of the plaza. Some seating is located under the trellis. The two double doors on the south side of the plaza enter into the main lobby.

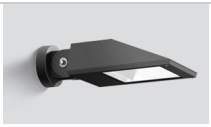
LIGHTING LAYOUT

The lighting in this area is minimal for a building main entrance. The side entrance, into a large multipurpose classroom, is lit with a few wall-mounted downlights. The seating area under the trellis has light provided by bracket-mounted luminaires. Just outside of the plaza area, bollards light the sidewalks that serve the building. And further from the building, UMD's standard light poles are used. No fixtures are used outside the building to light the building's main entrance.



LIGHTING EQUIPMENT

Four different types of luminaires are used in the entry plaza area. The light poles, the fixtures shown here that are farthest from the building, are 15 feet tall. The bollards that light the sidewalk area are relatively short, only 9 inches tall. The other two luminaires in the entry plaza area are both wall-mounted and provide light only in a downward direction. These are used on the building face to light a classroom entrance and the seating area. All exterior fixtures used in this area are LED.

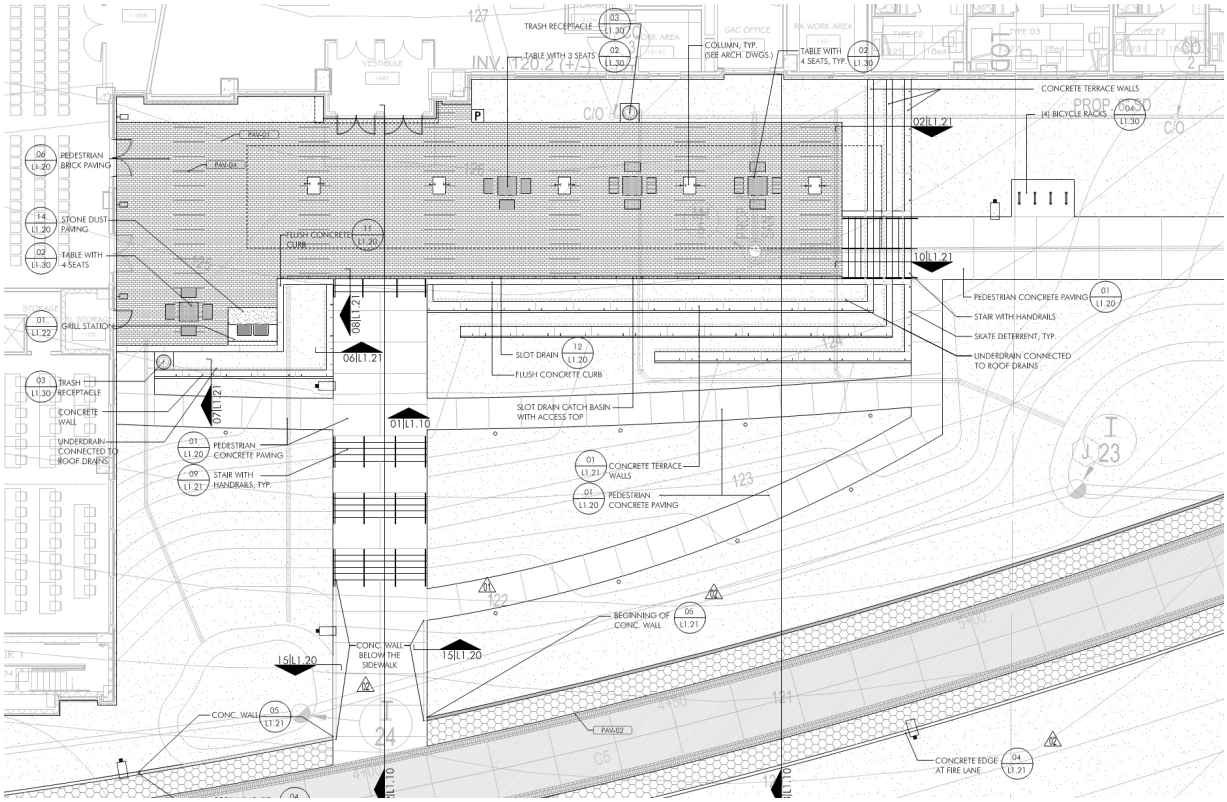
Image	Type Mark	Description	Manufacturer	Lamp
	EX-1	Exterior 15' UMD Standard LED Pole	LSI Industries	138W; 1000 lumens; 5800k white LED
	EX-3	Wall mounted LED downlight	Bega	44.7W; 4000k; white LED
	EX-4	Bracket mounted LED downlight	BK Lighting	25W; 4000k; white LED
	EX-5	Small LED Bollard	Bega	24.5W; 4000k; white LED

SPATIAL ENVIRONMENT

IMAGE	MATERIAL	PRODUCT CODE	DESCRIPTION	REFLECTANCE	~RGB VALUE
paving					
	brick paving	PAV-04			
	brick paving	PAV-01			
	stone dust paving	no code			
	concrete paving	no code			
facade					
	brick	MAS-01	Redland Calvert Special Blend two thirds 103 Georgian and one third 237 Calver	0.55	185,129,119
	cast stone	MAS-03	Concrete masonry unit, Reflective series, Dominion, E Dillon & co	color not listed in spec	217,204,182
	metal paneling	PNL-02		color not listed in spec	128,132,131
	curtain wall	PT-02d	9967 XL Pewter, Centria Sundance Series, Duranar, PPG Industries	0.51	128,132,131

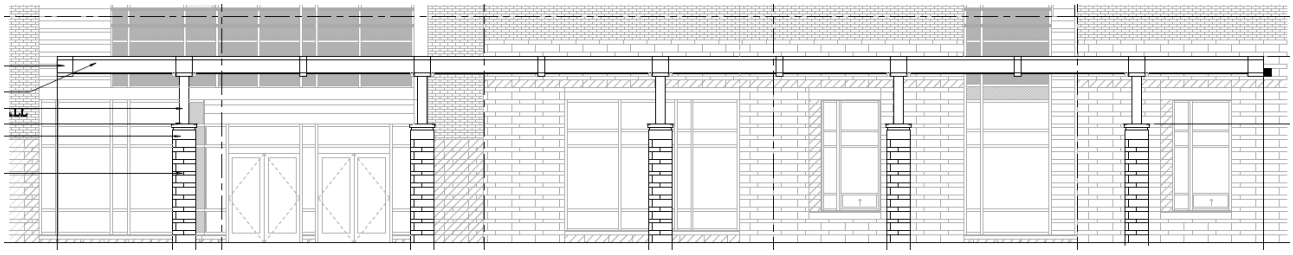
The reflectances for the surface materials in this area are shown above. Most of the materials are masonry, or similar. The color of the red brick facade will have important ramifications later, when selecting color temperature. Similarly, the exact color of the brick plaza was not listed in the specifications, but will most likely compliment the red color of the facade.

Next, the furniture plan below indicates exactly where seating is located on the plaza. At night, these areas are lit by luminaires mounted above on the trellis. This plan also very clearly shows the three different building entrances that can be accessed from the plaza: to the main vestibule, to the large multipurpose room, and to an academic corridor.



DAYLIGHT ELEMENTS

Unlike the other three spaces discussed above, this space is located entirely outdoors. However, one important daylighting element is the trellis. This feature is located above the seating area on the plaza. Shown below is a south elevation of the trellis; in plan, it projects about 20 feet from the building's facade.



Design Criteria

The criteria I have developed for these four spaces are both qualitative and quantitative in nature. The qualitative criteria are based on relevant aesthetic goals of the lighting design, and as they pertain the the architecture and occupants, also opportunities for lighting accents. The quantitative criteria are based on recommendations from the IES Handbook and ASHRAE 90.1, 2010. These criteria are listed in broad terms for the purposes of schematic design.

Lobby

This is the very first impression that visitors will have of this building. It should set the appropriate mood for those circulating through the space. Occupants transition in this area to residential areas and academic areas. Making the distinction between public and private spaces will be important to setting the mood and critical for wayfinding. The lobby should feel spacious and welcoming to those entering the building. And part of that involves the safety of students returning the building at night. The feeling of safety partially comes from bright and even illumination, but it can be reinforced by applying quantitative metrics to the design.

METRICS

Transition Spaces: Lobby (Chapter 24 IES Handbook)

illuminance

day: 100 lux	h @ ground
night: 50 lux	h @ ground

min & max

within +/- 10% of target value

uniformity

day: 3:1	avg:min
night: 3:1	avg:min

luminance limit (from Architectural Lighting Design, table 4.8)

luminaire: 500 fL
surfaces: 500 fL
daylight media: 1000 fL

Transition Spaces: Information Desk (Chapter 24 IES Handbook)

illuminance

300 lux	@ 30"

min & max

within +/- 10% of target value

uniformity

workspace: 5:1	max:min (table 12.6 IES Handbook)
desk: 1.5:1	avg:min (table 12.6 IES Handbook)

Dormitories: Mailboxes (Chapter 24 IES Handbook)

illuminance

50 lux h @ ground
100 lux v @ mailbox faces

min & max

within +/- 10% of target value

uniformity

target: 3:1 avg:min (table 12.6 IES Handbook)

ENERGY USE

control method

- full automatic-on is allowed
  source: ASHRAE 90.1 2010, section 9.4.1c

power usage

LPD: 0.90 W/ft^2
RCR Threshold: 4
source: ASHRAE 90.1 2010, Table 9.6.1: Space-by-Space Method

SUSTAINABILITY

This building is targeting LEED Gold certification. Some possible points include:

- innovation in design (1-5 pts): green design education opportunity
- minimum energy performance (prereq): comply with applicable energy code

PRIORITIZATION

The most important goal of the lighting in this area is to provide a safe space for students returning to their dormitories at night. Because this is such a large space, it will also be very important to meet, or improve upon, energy usage goals. The next goal is to augment wayfinding for occupants, while still accomplishing the first two goals. This is also the first impression the building will make on visitors, so providing some extra sparkle to the lobby will help make this feel like a special place.

OTHER CONSIDERATIONS

High uniformity is good for making a space feel public and welcoming, but I would like to still provide accent lighting on a focus wall, possibly the tile wall near the elevator lobby. This addition of peripheral lighting will also help to increase the sense of space in the lobby, especially after dark, when the windows will not be able to provide this type of light.

Seminar Room

Aesthetically, this room should feel light and energetic. It must be inviting to students and provide an engaging atmosphere for learning. This can be accomplished through uniformly lit surfaces, a bright ceiling, and bright walls. The uniform glow of these surfaces will be best achieved through iterative design calculations, involving tests of different luminaires, and quantitative goals to strive for.

METRICS

Auditoria: Lecture Hall, no AV (Chapter 24 IES Handbook)

illuminance

100 lux	h @ 2' AFF
40 lux	v @ 4' AFF

min & max

within +/- 10% of target value

uniformity

target: 2:1	avg:min

luminance limit (from Architectural Lighting Design, table 4.8)

luminaire: 250 fL
surfaces: 250 fL
daylight media: 250 fL

Auditoria: Lecture Hall, AV and notes (Chapter 24 IES Handbook)

illuminance

50 lux	h @ 2' AFF
15 lux	v @ 4' AFF

min & max

within +/- 10% of target value

uniformity

target: 2:1	avg:min

Auditoria: Lecture Hall, AV and no notes (Chapter 24 IES Handbook)

illuminance

10 lux	h @ ground
6 lux	v @ 4' AFF

min & max

within +/- 10% of target value

uniformity

target: 2:1	avg:min

Classrooms: Whiteboard (Chapter 24 IES Handbook)

illuminance

300 lux v @ whiteboard

min & max

within +/- 10% of target value

uniformity

target: 3:1 avg:min

ENERGY USE

control method

- at least one control step between 30% and 70% (inclusive) of full lighting power in addition to all off
- an occupant sensor to automatically turn the lighting off within 30 minutes of occupants leaving the space
  source: ASHRAE 90.1 2010, section 9.4.1.2

power usage

LPD: 1.24 W/ft^2
RCR Threshold: 4
source: ASHRAE 90.1 2010, Table 9.6.1: Space-by-Space Method

SUSTAINABILITY

This building is targeting LEED Gold certification. Some possible points include:

- recycled content (1-2 pts): blackout shades could help meet this goal
- minimum energy performance (prereq): comply with applicable energy code
- daylight & views (2 point): 75% space daylit and 90% with view to outdoors
- innovation in design (1-5 pts): optimization of architecture and daylighting

PRIORITIZATION

The very most important aspect of this lighting design is to provide enough light for the visual clarity of the occupants, while still meeting energy usage goals. Next, because of the projection screens in the room, there needs to be enough controllability to accommodate different lecture styles. This controllability is also a requirement of ASHRAE 90.1, but I would like to go over and above what is required. In order for the controls to be properly utilized, they need to be easy for professors to quickly learn and use.

OTHER CONSIDERATIONS

The treatment of lighting on the peripheral walls will have a large impact on the mood of the room. The current design creates rhythmic scalloping on the walls, but that may not be the best option, and could be distracting while viewed in the peripheral vision of

students writing notes. Similarly, the color (reflectance) of the walls will have affect how the work surface illumination is perceived by the occupants. I will develop schematic design sketches for this space to gain a better understanding of what type of lighting scheme will work best in this situation.

Dormitory Suite

Unlike the previous two spaces, this one is very much a private space. It should have a comforting and residential style to it. This can be implemented with lighting on a personal scale that is intimate instead of overwhelming. However, this is also a work space, and therefore requires that certain light levels are met for the visual comfort of the occupant.

METRICS

Dormitories: Desk (Chapter 24 IES Handbook)

illuminance

400 lux	h @ 30"
150 lux	v @ 4' AFF

min & max

within +/- 10% of target value

uniformity

workspace: 5:1	max:min (table 12.6 IES Handbook)
desk: 1.5:1	avg:min (table 12.6 IES Handbook)

Dormitories: General (Chapter 24 IES Handbook)

illuminance

40 lux	h @ ground
15 lux	v @ 5' AFF

min & max

within +/- 10% of target value

uniformity

target: 4:1	avg:min

ENERGY USE

control method

- must have at least one control device within each space
- [EXEMPTED] at least one control step between 30% and 70% (inclusive) of full lighting power in addition to all off, except in spaces with LPD allowance of less than 0.6 W/ft^2
  source: ASHRAE 90.1 2010, section 9.4.1.2

power usage

LPD: 0.38 W/ft^2
RCR Threshold: 8
source: ASHRAE 90.1 2010, Table 9.6.1: Space-by-Space Method

PSYCHOLOGICAL REINFORCEMENT

For the the design of this space, I will use psychological reinforcement to promote the private nature of this space. Non-uniform lighting, particularly on the walls can be used to increase the private feeling of a room. Generally speaking, people feel more comfortable outside of the "spotlight." By directing light away from the occupants of the space, it becomes more intimate. This can be further enhanced with the application of darker finishes on the surfaces of a space.

SUSTAINABILITY

This building is targeting LEED Gold certification. Some possible points include:

- minimum energy performance (prereq): comply with applicable energy code
- optimize energy performance (1-19 pts): tune lighting design for low energy
- controllability of lighting systems (1 point): control for 90% of occupants
- daylight & views (2 point): 75% space daylit and 90% with view to outdoors

PRIORITIZATION

For the students that live here, this may be their only place to truly relax while attending school. For this reason, it is most important that each space is private and personal in a way that promotes relaxation. However it is also important to encourage good work habits, so light must be provided in the work areas to allow for studying. The controls in this space will be implemented in a way that encourages energy savings.

OTHER CONSIDERATIONS

Controls must be carefully placed to ensure ease of use and maximize personalization in each bedroom for the occupants. Unlike in the seminar room, occupants will have months to use these controls, so adjustability will be an important factor for occupant comfort.

Entry Plaza

At night, it is important that people feel safe near this building. Lighting should be applied to this area to decrease dark corners and provide a clear path to the entrance. This is the main entrance and should be inviting to visitors of the building. The vestibule is already mostly glass and will glow with the light spill from the lobby. The lighting in this area should utilize that light and accent it for a powerful effect.

METRICS

Entrance has been determined to be type LZ2 as per table 26.4 IES Handbook.

LZ3 Moderately High Ambient Lighting: "Areas of human activity where the vision of human residents and users is adapted to moderately high light levels…"

Canopied Entries: High Activity (Chapter 22 IES Handbook)

illuminance

30 lux	h @ ground
15 lux	v @ 5' AFF

min & max

within +/- 10% of target value

uniformity

target: 2:1	avg:min
target: 4:1	max:avg

Atria and Courtyards: Late Curfew (Chapter 22 IES Handbook)

illuminance

30 lux	h @ ground

uniformity

target: 2:1	avg:min

ENERGY USE

control method

- must automatically shut off lighting when enough daylight is available
- [EXEMPTED] at least one control step between 30% and 70% (inclusive) of full lighting power in addition to all off, except in spaces with LPD allowance of less than 0.6 W/ft^2
  source: ASHRAE 90.1 2010, section 9.4.1.7

lighting zone

As per Table 9.4.3A (ASHRAE 90.1, 2010), lighting zone 3, all other areas, shall be used to determine the individual lighting power allowances for this building's exterior.

power usage

TRADEABLE SPACES

LPDs for building grounds, entrances/exits, canopies, and overhangs may be traded

Walkways less than 10 feet wide: 0.80 W/linear ft
Walkways greater than 10 feet wide: 0.16 W/ft^2
Plaza areas: 0.16 W/ft^2
Stairways: 1 W/ft^2
Main entries: 30 W/linear foot of door width
source: ASHRAE 90.1 2010, Table 9.6.3B

NON TRADABLE SURFACES

Building facades (by surface): 0.15 W/ft^2 for each illuminated wall or surface
Building facades (by length): 3.75 W/linear foot for each illuminated wall or surface
source: ASHRAE 90.1 2010, Table 9.6.3B

SUSTAINABILITY

This building is targeting LEED Gold certification. One possible point is:

- light pollution reduction (1 point): minimize light trespass

PRIORITIZATION

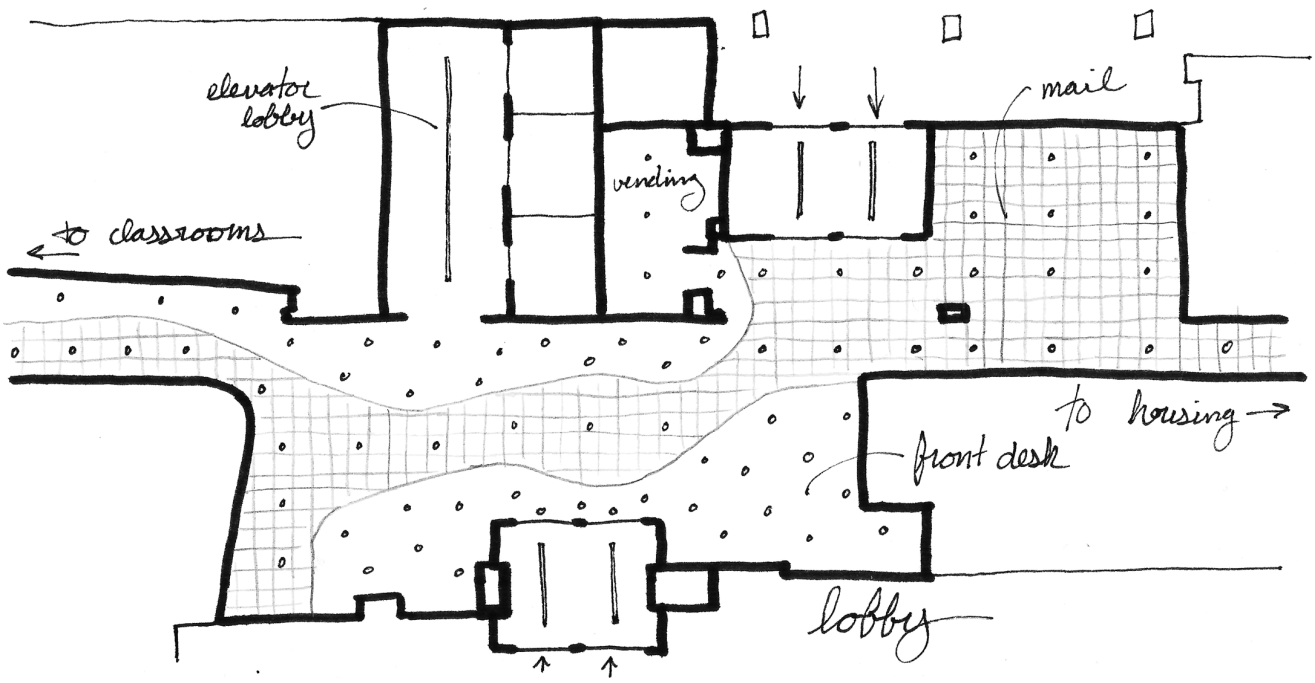
I would like to create a design for this space that accomplishes the goal of increasing safety on campus while minimizing light trespass and upward light. However, nothing is more important than the safety of the students. by minimizing light trespass, I also hope to minimize power use for this area's lighting design. Optimizing daylight sensors in this area will also increase energy savings.

Evaluation of Existing Design

The lighting in this building is very effective at using few fixture types in many different applications. The resulting design is optimized for ease of installation, and long-term system maintenance. However, it also means that some walls are washed by circular downlights and generic fixtures are used in potentially decorative locations. Many of the spaces feel like the lighting is a burden that is in place because it is required. The design is very effective at providing an adequate amount of light, but does little to enhance the occupants' visual experience.

Lobby

The lighting in this area consists of two different types of downlights: one has a glass ring on the surface, and the other is a typical circular downlight. These luminaires are arrayed throughout the space to reflect the curving of the ceiling as it transitions from gypsum wallboard to acoustical ceiling tiles. During the day, numerous windows allow daylight to dominate the space.



QUALITATIVE EVALUATION

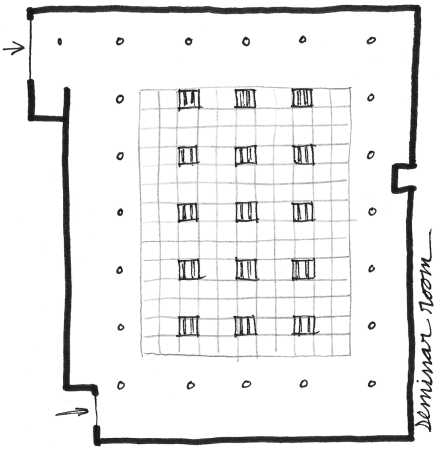
The integration with the architectural forms on the ceiling works well in this space. Playful curves of the ceiling seem to lead occupants towards the academic wing of the building, where they are most likely headed. While the rectilinear forms on the residential wing work well with the forms created by the necessity of the dormitory rooms.

However there are several opportunities that have been missed by this design. The

direct lighting approach is a good way to push light onto the work plane, but it leaves the ceiling feeling dark. During the day, this is an unnoticed flaw, but at night there isn't any daylight to fill in the darkened ceiling. The second problem is that there is a feature wall located near the entrance into the elevator lobby. The wall has tiles with a wood pattern on them. This could have been highlighted better. Lastly, the front desk area has lots of light from all the downlights, but it could have used some extra sparkle feature to make it seem more like a destination.

Seminar Room

Two different luminaire types are used in this space. The primary function of this space is a classroom, so direct/indirect troffers provide most of the light to the work plane. The perimeter of the room is lined with circular downlights. The entrance into the room is also lit with a circular downlight.



PERFORMANCE EVALUATION

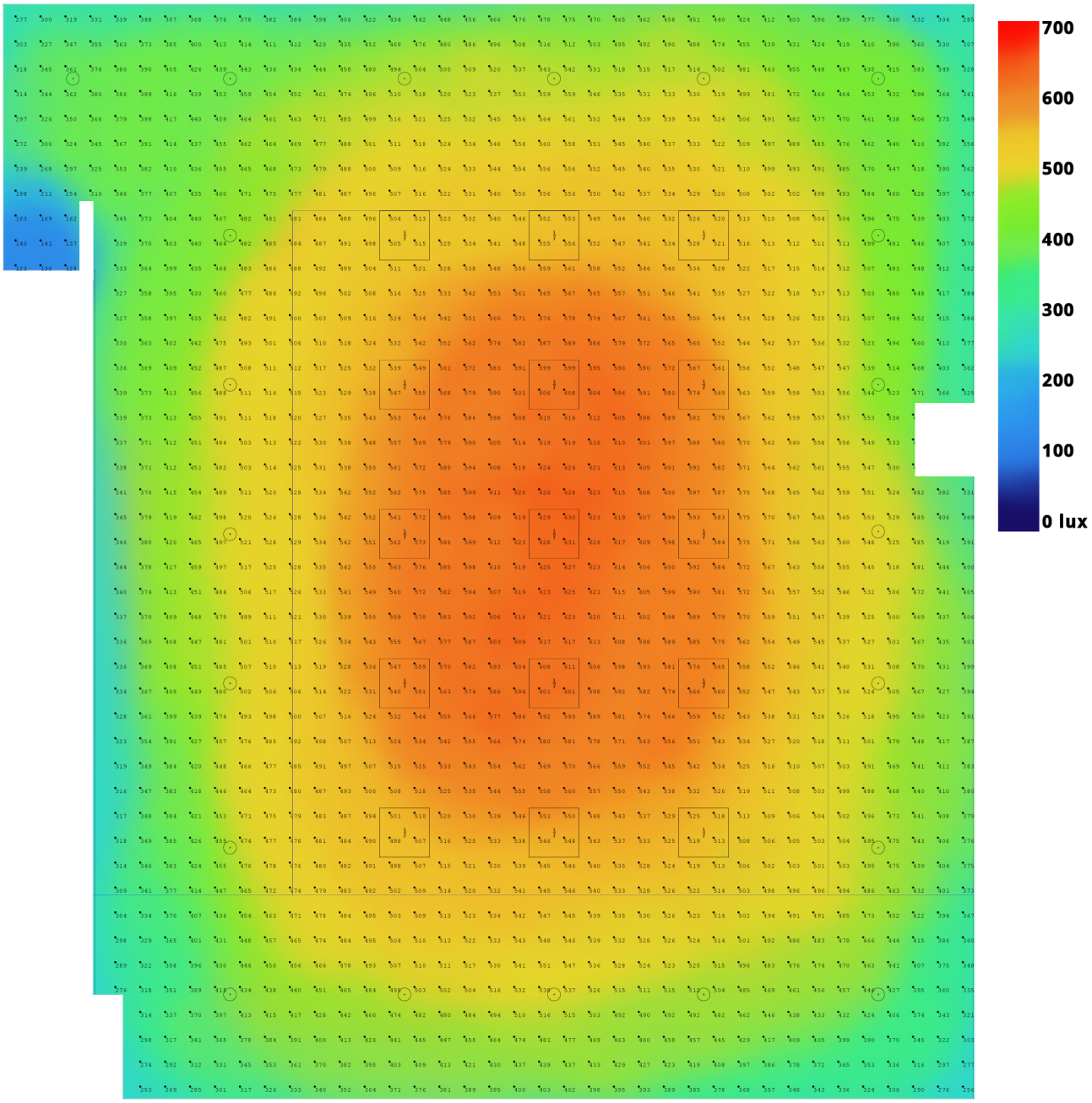
illuminance:	480 lux
min & max:	120 lux & 630 lux
uniformity (avg:min):	4:1
LPD:	0.82 W/ft^2

LLF Calculation

Type Mark	Lamp	Initial Lumens	Mean Lumens	BF	LDD	LLD	Total	Input Watts
F-10	1 - 32W CFL	2400	2040	0.98	0.9	0.85	**0.75**	36
F-B1	2 - 14W T5	1350	1275	1.1	0.9	0.94	**0.94**	36 (for 2)

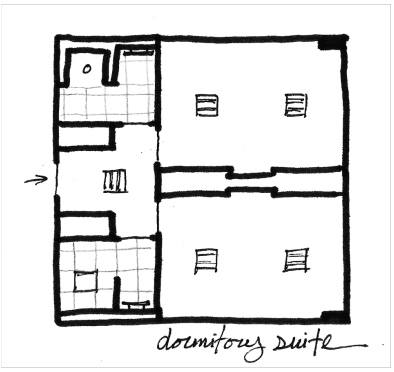
QUALITATIVE EVALUATION

The direct/indirect troffers in this space are very effective at providing adequate light for the occupants. These were definitely a good choice over the traditional parabolic troffers commonly found in spaces like this. The downlights along the perimeter are a good choice as well, as lighting the wall is important to creating a space that feels well-lit to the occupants. However, this could have been accomplished using a number of different wall wash specific luminaires. Perhaps downlights were selected to provide enough illuminance at the work plane, but in this case, it would be worth looking into alternate options to accomplish lighting both the wall and work plane.



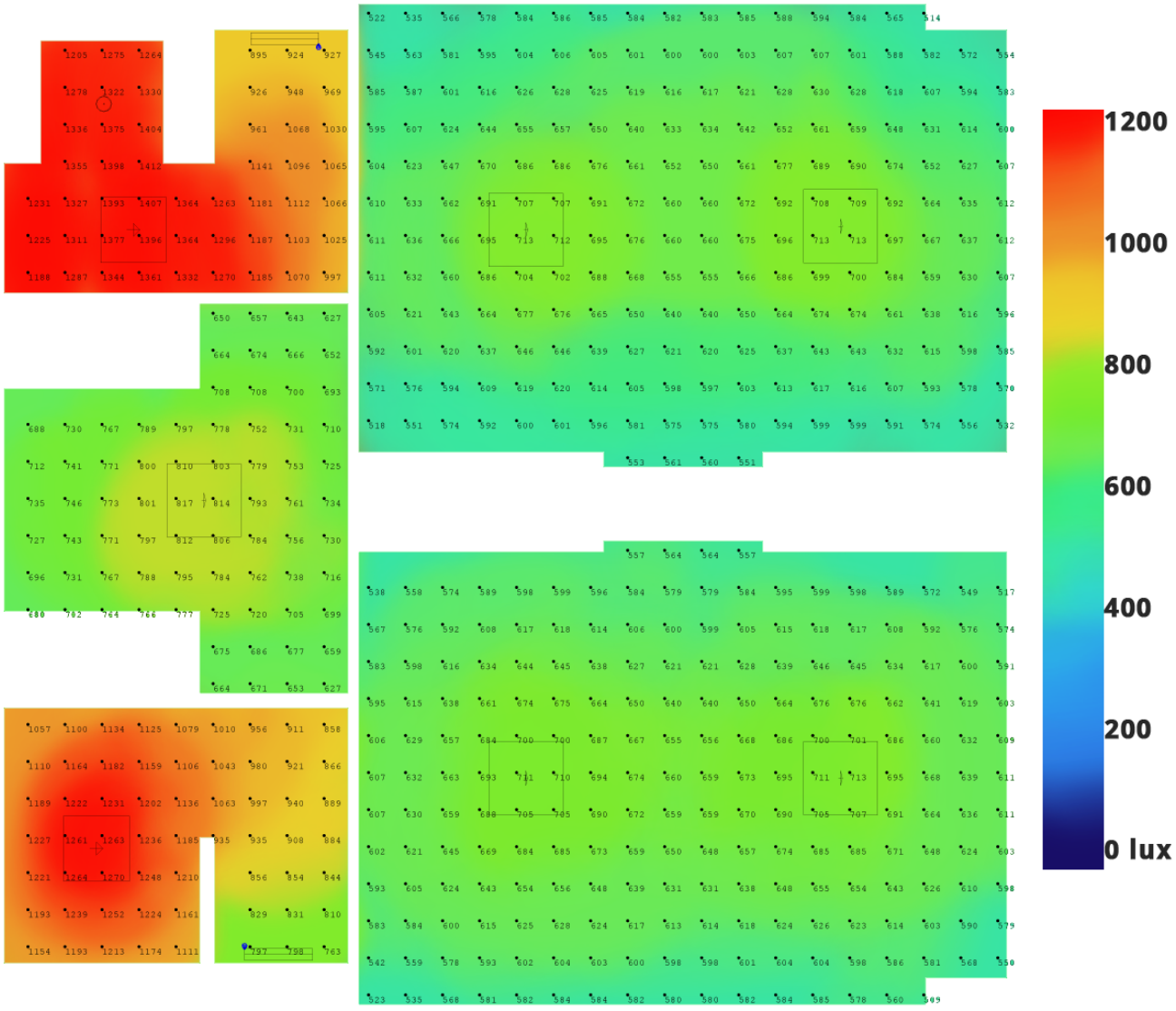
calculation from AGi32

Dormitory Suite



There are five main areas in this space: a vestibule, two bedrooms, and two bath/vanity areas. The vestibule has a single 2 foot by 2 foot troffer. Each bedroom has two of the same fixtures. And the bath areas feature specialty lighting for the shower and over the vanities.

PERFORMANCE EVALUATION



calculation from AGi32

vestibule

illuminance (at 30"): 730 lux
min & max: 620 lux & 800 lux
uniformity (avg:min): 1.2:1

bedroom

illuminance (at 30"): 625 lux
min & max: 500 lux & 700 lux
uniformity (avg:min): 1.25:1

bath area

illuminance (at 30"): 1100 lux
vertical at mirror: 1000 lux
min & max: 650 lux & 1400 lux
uniformity (avg:min): 1.7:1

LPD: 0.55 W/ft^2

LLF Calculation

Type Mark	Lamp	Initial Lumens	Mean Lumens	BF	LDD	LLD	Total	Input Watts
F-1	2 - 14W T5	1350	1275	1.1	0.9	0.94	**0.94**	36 (for 2)
F-2	2 - 24W T5	2100	2000	1.02	0.9	0.95	**0.87**	49 (for 2)
F-3	1 - 18W CFL	1250	1070	1.05	0.9	0.86	**0.81**	20
F-4	1 - 24W T5HO	2000	1900	1.02	0.9	0.95	**0.87**	27
FA	2 - 14W T5	1350	1275	1.1	0.9	0.94	**0.94**	36 (for 2)

QUALITATIVE EVALUATION

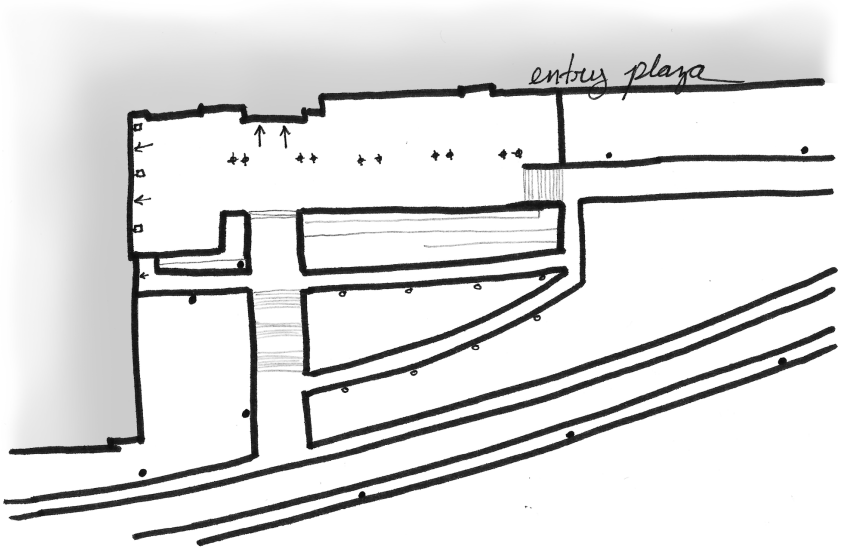
Providing lighting for a dormitory room is a difficult problem. It is a balance between using fixtures that will add a residential feel and using fixtures that will withstand a flow of new students year after year. In this case, the design errs on the side of durability and longevity. For example, the fixtures in this space are all fluorescent. This is great from a maintenance standpoint, but it provides a quality of light that is very distant from the warm CCT of incandescent lighting commonly found in residential design. The lighting in this space really lacks attention to the privacy of the space. However it does so at the gain of durable, long-lasting, and powerful fixtures.

Entry Plaza

Lighting on the plaza area consists of downlights mounted near the entrance/exit to a large classroom and over the seating area under the trellis. This plaza serves as the main entrance into the building, but the lighting for that entrance is only provided as spill light from inside the large, glass vestibule. Farther from the building, short bollards light the sidewalks, and tall poles light the road that serves the building.

QUALITATIVE EVALUATION

One great part of the exterior lighting on this building is the reduction in uplight. This kind of attention to reducing urban sky glow is the way of the future of lighting. All the exterior lighting is aimed to where it will be most helpful to the campus occupants: the ground level. Lighting near the entrances into the building helps to guide students back to their dorm rooms at night, and a few downlights on the trellis provide light on the plaza seating area.


entry plaza

Summary

The four spaces of University of Maryland's Prince Frederick Hall I plan to study are: the lobby, seminar room, a typical dormitory suite, and the entry plaza. The lobby is the main circulation space in this building. It provides access to dormitory rooms and academic rooms. The seminar room is a lecture and presentation classroom located on the first floor of the building. It has seating for approximately 60 students and features two motorized projection screens. The dormitory suite consists of two bedrooms, a vestibule, and two bath areas. This is a typical room found on the 2nd through 7th floors. The entry plaza is located on the south side of the building. It provides a transition space into one side of the lobby. These four spaces represent a sample of the programming for Prince Frederick Hall.

The current lighting for this building is a functionally-based design. There are few fixture types and even fewer lamp types. This is important to both ease of installation and long term maintenance. For my design, I would like to introduce lighting that will enhance the occupants' experience of the architecture and visual activities. My design will be guided by criteria that will not only minimize energy use by the lighting systems, but will create spaces optimized for learning, health, and comfort.