

## LIGHTING DEPTH STUDY

Five spaces were chosen from the Wheelock College Campus Center and Student Residence building for the lighting analysis. Each study takes into consideration the existing architecture and characteristics of the space. Important design criteria is taken from the IESNA Handbook and analyzed. A new lighting design is then proposed and described. Calculations and renderings are used to evaluate the performance of the systems. The equipment is specified throughout the report.

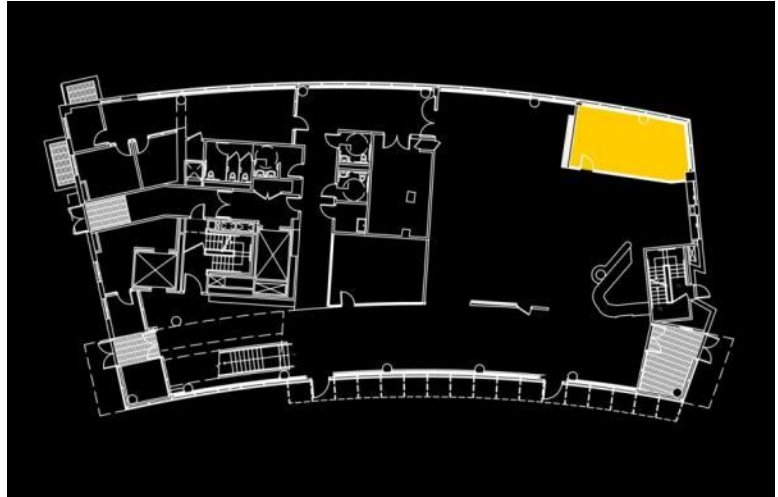
The spaces to be analyzed are the conference room (a work space), student lounge (a circulation space), cafeteria serving space (special purpose space), roof deck (outdoor space) and typical dorm room (a private space).

Information such as luminaire, ballast and lamp specifications, as well as lighting floorplans, may be found in the appendices.

## CONFERENCE ROOM

### SPACE SUMMARY

The conference room is located on the first floor, in the north-west corner of the building. The space is not quite rectangular, with interestingly angled walls and three walls of modern glazing. The room will be used by student organization and faculty conferences, social events and classes of up to 20 people. The room is approximately 340 square



feet, with a ceiling height of 14'-0". The ceiling is a combination of painted drywall and acoustical ceiling tile. The west wall features a LCD television screen for presentations. The furniture in the room is a medium reflectance wooden conference table in the center, surrounded by fabric-covered conference chairs. The exterior walls to the north and east, as well as the interior south wall are glazing with aluminum framing, while the west wall is wood paneling.

**Conference Room Surface Materials and Reflectances**

Location	Material	Reflectance / Transmittance
Wall	Medium toned wood panels	50%
Ceiling	Acoustical Ceiling Tile	80%
Floor	Carpet	18%
Columns	Paint	65%
Glass Façade	Annealed Float Glass	90%
Mullions	Aluminum	85%

## DESIGN CONSIDERATIONS

**TASKS:** Classroom, Conference room, Social space

**TARGET IMPRESSIONS:** As a space, the conference room should portray a feeling of sophistication. With an abundance of glass and metal, the space has a very clean, minimalist appearance. The luminaires selected for this space should be discreet and maintain the simple lines of the space.

Aspects to be considered when designing in this space are daylight integration and control, direct glare, light distribution on the task plane, and facial rendering. There are two glass walls to the exterior on the north and east side of the room, so an abundance of daylight is exposed to the space. Controlling the daylight entering the space and integrating it into the lighting system will greatly improve the room's atmosphere. Therefore, a combination shading system should be used to either blackout the daylight or reduce it. Direct glare is also very important to control, both from daylight and from luminaires in the space. Since there will be a lot of desk tasks performed in the space, there should be no glare to distract the occupants and put them in discomfort. Light distribution on the task plane should be evenly distributed and free of shadows, so it is most comfortable for students and faculty to read, write and perform other tasks. Facial rendering is important for presentations and conferences where communication and recognition of facial expressions is significant.

## EXISTING LIGHTING

The current lighting design offers flexibility for the various functions of the space. Dimmable compact fluorescent circular downlights provide the basic illuminance for the space. The wood paneled west wall is highlighted with compact fluorescent wallwashers, which may be switched separately from the rest of the room during presentations on the LCD television screen. Linear fluorescent suspended up/downlights make a perimeter on the north and east exterior walls. These fixtures are on a daylight sensor, which reduces the light output during the day when there is a significant amount of daylight entering the space. The space also employs motorized blackout shades on the exterior walls to eliminate daylight entering the room for presentation settings, as well as to give occupants more privacy at night.

**Conference Room Existing Luminaire Schedule**

Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F3	Ceiling Recessed	Lightolier	8021CCLW/6132BU	1-CFTR 42W	120V	6" Recessed compact fluorescent downlight with an anodized aluminum parabolic reflector.
F4	Ceiling Recessed	Lightolier	8021CW/6132BU	1-CFTR 42W	120V	6" Recessed compact fluorescent wallwasher with an anodized aluminum parabolic reflector.
F5	Suspended	Lightolier	EG2-1-H-B -L-4'-W	1-F32 T8	120V	Suspended fluorescent up/downlight with 1" deep parabolic louver 2.5"

Assumptions:

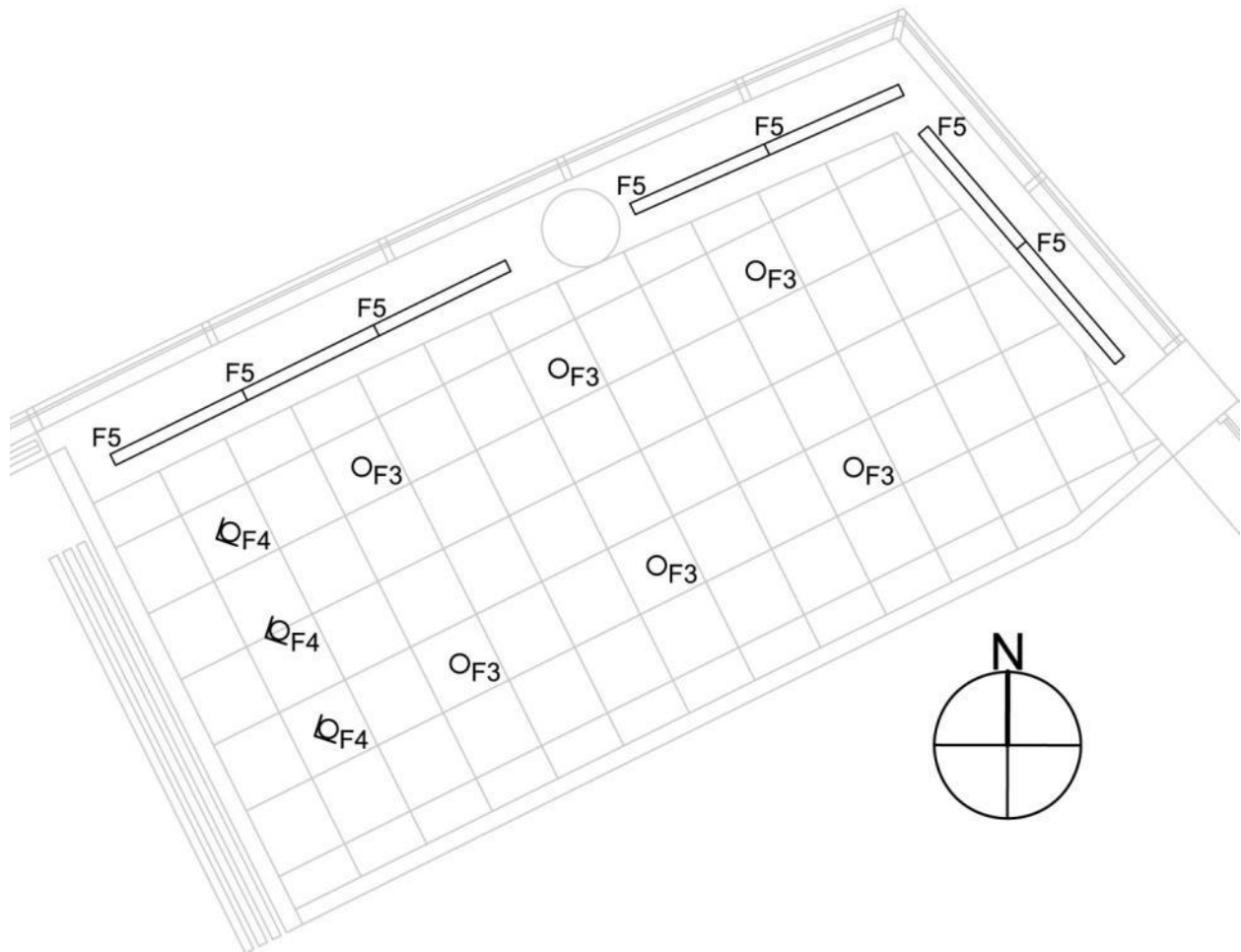
- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 2
- Expected Dirt Depreciation = 12%

**Conference Room Existing Light Loss Factors**

Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F6	IV	Direct	0.98	0.87	0.98	0.86	0.72
F7	IV	Direct	0.98	0.87	0.98	0.86	0.72
F8	II	Semi-Indirect	0.88	0.93	0.94	0.95	0.73

\*all Light Loss Factors in this report are obtained from the IESNA Lighting Handbook

## CONFERENCE ROOM EXISTING LAYOUT



**Conference Room Existing Illuminance Levels**

Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
38.13 fc	30 fc	3.35 fc	5 fc

The existing illuminance level calculations for the conference room are very close to the target illuminance specified in the IESNA Lighting Handbook. The horizontal levels are higher than the recommended levels, but are still satisfactory working conditions. The vertical illuminance levels are just a little bit low from the target levels.

Conference Room Existing Power Density			
Fixture	Watts	Quantity	Total Watts
F3	45	6	270
F4	45	3	135
F5	35	7	245
<b>Space Type</b>			Conference Room
<b>Area (ft<sup>2</sup>)</b>			340
<b>Allowable LPD (W/ft<sup>2</sup>)</b>			1.3
<b>Allowable Watts</b>			442
<b>Actual LPD (W/ft<sup>2</sup>)</b>			1.91
<b>Actual Watts</b>			650

The conference room existing power density calculations are very high compared to the ASHRAE 90.1-2004 code. The LPD for the space is 1.91 W/ft<sup>2</sup>, while the target is 1.3 W/ft<sup>2</sup>. The new design aims to alter the LPD in the room, reducing it to the code level.

## EXISTING EMERGENCY LIGHTING

The emergency lighting in the conference room consists of one F3 compact fluorescent downlight. An emergency generator will provide power to the building when normal grid power fails.

## NEW LIGHTING SOLUTION

The space is intended to be minimalist and give the occupants a feeling of sophistication and simplicity. A combination of CFL and linear downlights are a sleek way to add illuminance on the task plane without being obstructive. The Focal Point linear fluorescent luminaires are flush with the surface and seem to create glowing strips in the ceiling. The compact fluorescent downlights add more directional illuminance and enhance the space. Circular compact fluorescent wallwashers allow occupants to add emphasis to the wood paneled wall.

**Conference Room New Luminaire Schedule**

Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F6	Ceiling Recessed	Lightolier	8081 CLW	1-CFTR26W	277V	6" recessed compact fluorescent wallwasher.
F7	Ceiling Recessed	Focal Point	FAV6-FI-1T5HO-1C-277-D-G1-WH-4'	1-F28T5	277V	Recessed fluorescent troffer.
F8	Suspended	Lightolier	8011 CCLW	1-CFTR18W	277V	4" recessed compact fluorescent downlight.

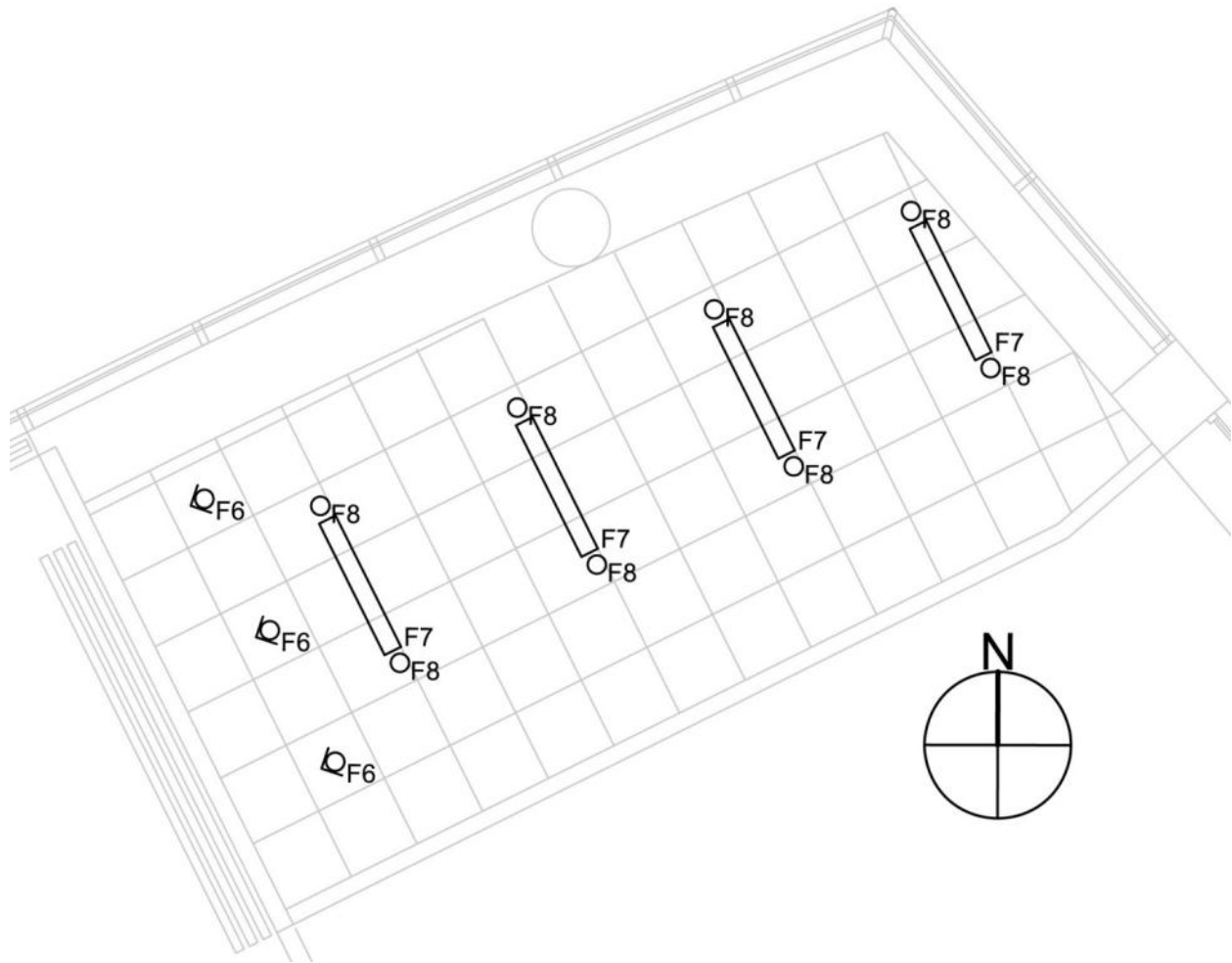
### Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 2
- Expected Dirt Depreciation = 12%

**Conference Room New Light Loss Factors**

Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F6	IV	Direct	0.98	0.88	0.97	0.98	0.82
F7	IV	Direct	1.00	0.88	0.97	0.98	0.84
F8	IV	Direct	0.98	0.88	0.97	0.98	0.82

## CONFERENCE ROOM NEW LAYOUT



**Conference Room New Illuminance Levels**

Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
26.5 fc	30 fc	4.8 fc	5 fc

The new illuminance level calculations are very close to the target illuminance specified in the IESNA Lighting Handbook. The horizontal levels of 26.5 fc fall just a little bit under the target of 30 fc, but are still conducive to a satisfactory work environment. The vertical illuminance levels fall within the acceptable range for the IESNA requirements.



Conference Room New Power Density			
Fixture	Watts	Quantity	Total Watts
F6	28	3	84
F7	61	4	224
F8	20	8	160
<b>Space Type</b>			Conference Room
<b>Area (ft<sup>2</sup>)</b>			340
<b>Allowable LPD (W/ft<sup>2</sup>)</b>			1.3
<b>Allowable Watts</b>			442
<b>Actual LPD (W/ft<sup>2</sup>)</b>			1.43
<b>Actual Watts</b>			488

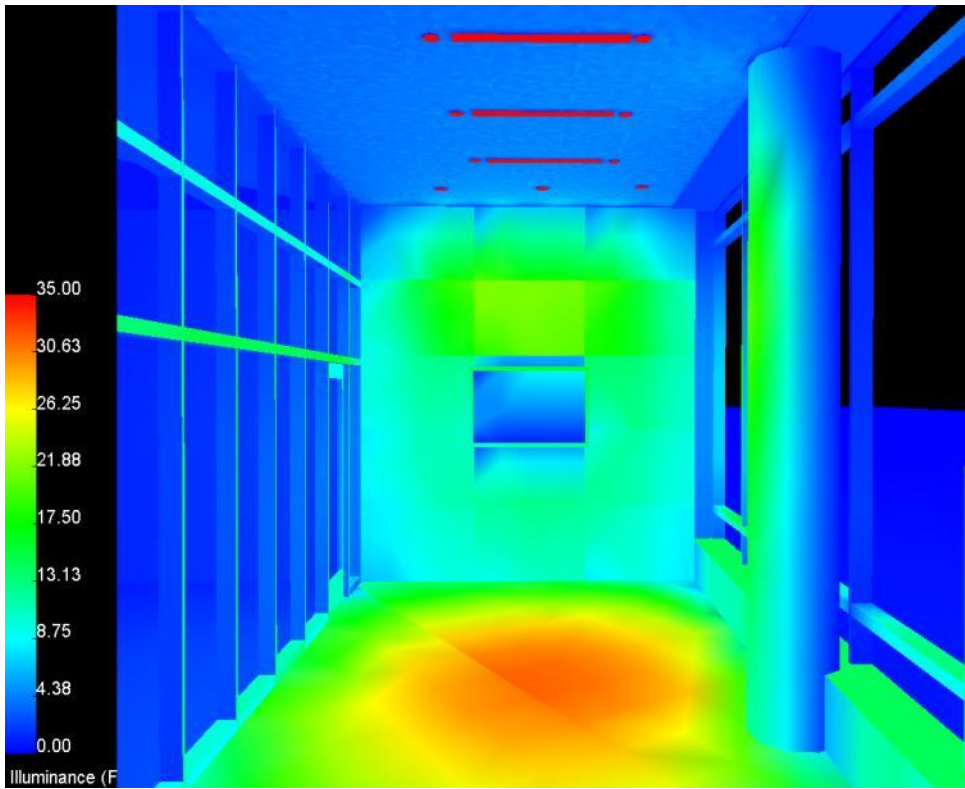
The new power density calculations are much more on target with the recommended ASHRAE 90.1-2004 code than the existing design. While the new power density calculation of 1.43 W/ft<sup>2</sup> is a significant improvement over the existing power density calculation of 1.91 W/ft<sup>2</sup>, it is still a little bit above the target of 1.3 W/ft<sup>2</sup>. Although it is above the code, the power density will be made up in other spaces in the building, and the overall power density for the building will remain to code.

## NEW EMERGENCY LIGHTING

The new emergency lighting in the space will consist of one of the F8 linear fluorescent fixtures. An emergency generator will provide power to the building when normal grid power fails. Enlarged plans showing emergency fixtures are available in Appendix G.

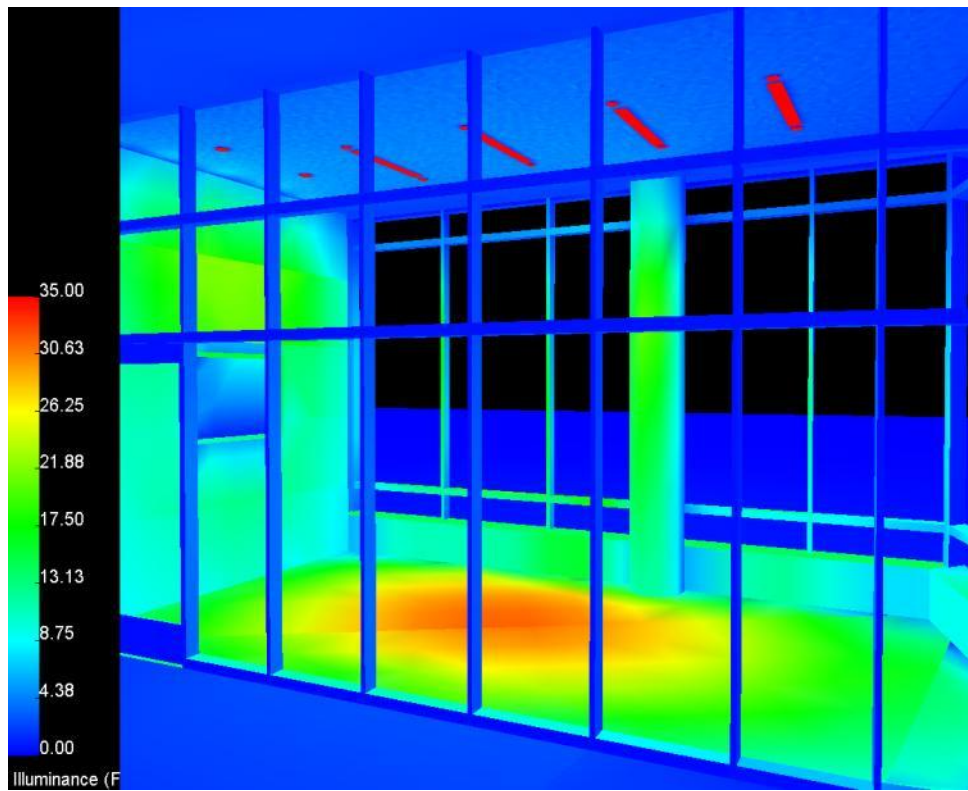


Conference RGB (above) and pseudo color (below) renderings with all fixtures on.



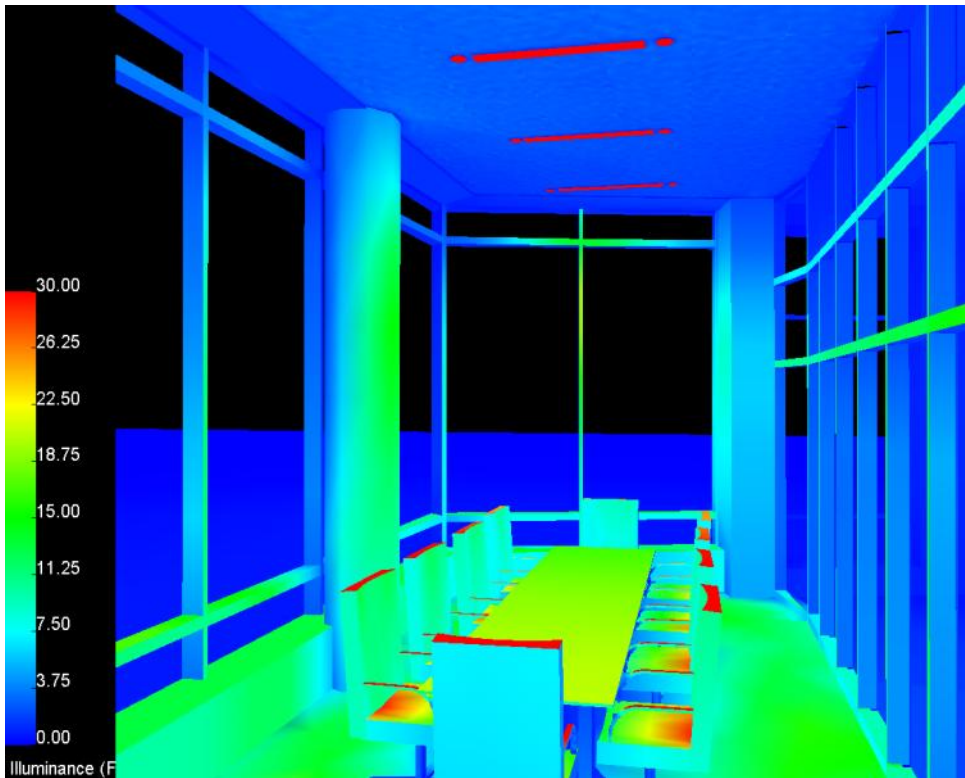


Conference RGB (above) and pseudo color (below) renderings with all fixtures on.



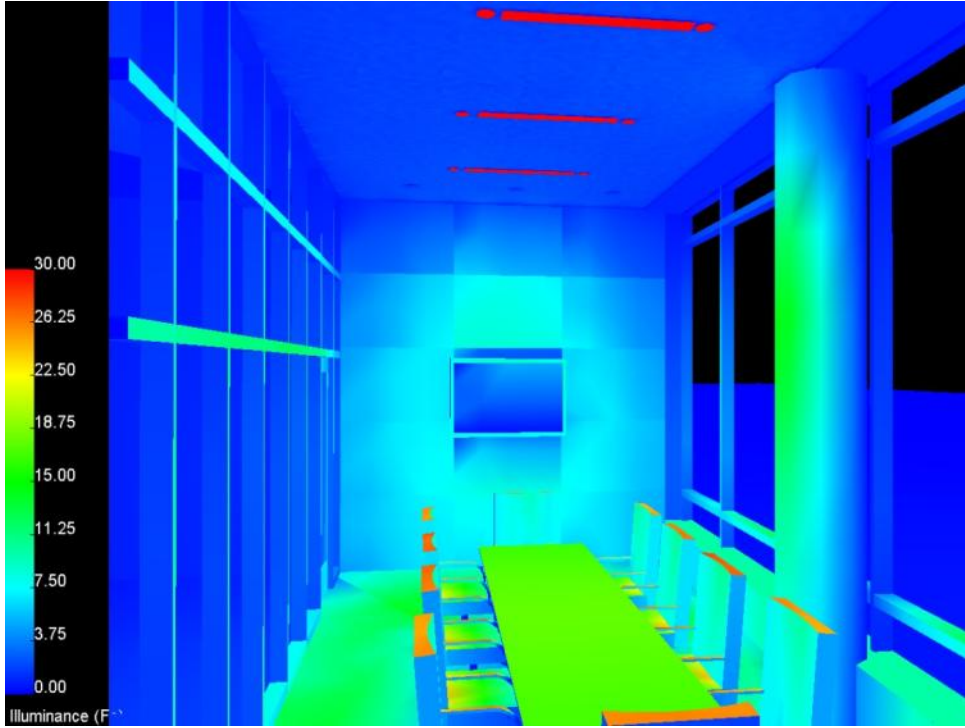


Conference RGB (above) and pseudo color (below) renderings with all fixtures on.





Conference RGB (above) and pseudo color (below) renderings with wallwashers off.

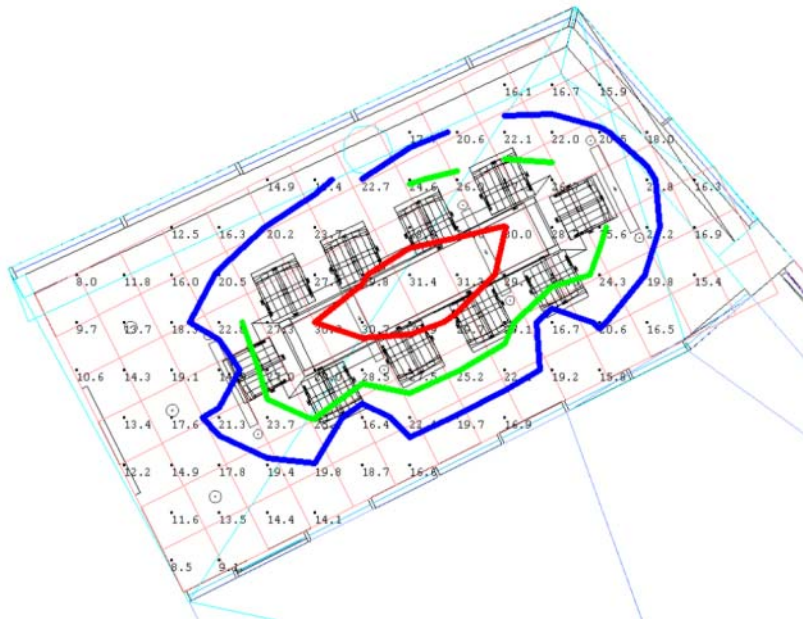


### ISOLINE COLOR KEY

Dark Blue	Green	Red	Purple	Light Blue
15 fc	20 fc	25 fc	30 fc	35 fc



All fixtures on (above), wallwashers off (below)



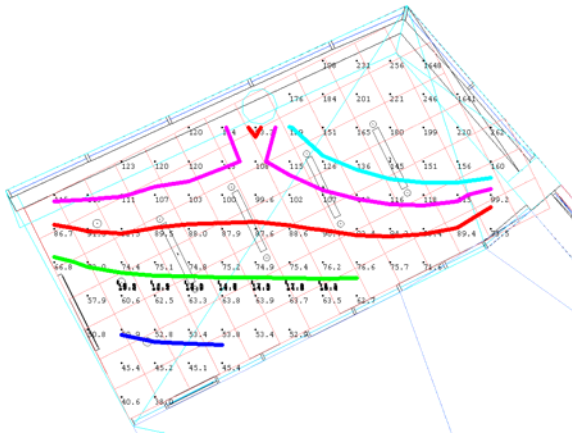
## CONFERENCE ROOM DAYLIGHT STUDY

This study evaluates the need for daylight control in the conference room. Daylight level calculations were performed on the space at various times throughout the day. March 20, 2009 was chosen as the day to calculate because it is the spring Equinox, when the tilt of the earth is aligned neither towards or away from the sun. The analysis was performed at 9:00 AM, 12:00 PM and 3:00 PM on a day with a clear sky, and at 12:00 PM on a day with an overcast sky. An analysis was also performed to measure the light levels if the room utilized a translucent shading system. That calculation was performed at 9:00 AM on a day with a clear sky. The existing system uses a motorized blackout shade to prevent daylight from entering the space, but there is no setting to allow some daylight into the space. The new daylight control system will utilize a combination blackout shading and sheer shading system to allow some light to enter the space while controlling the U/V and heat entering the space. A sheer shading system will also be installed on the café windows, to allow for more privacy during classes and meetings. The system will be a Lutron Sivoia QED. Specifications for the shading system may be found in Appendix C.

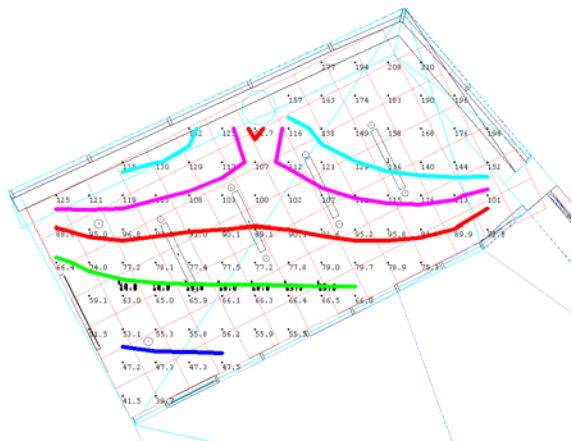
### ISOLINE COLOR KEY

<b>Dark Green</b>	<b>Dark Blue</b>	<b>Green</b>	<b>Red</b>	<b>Purple</b>	<b>Light Blue</b>
<b>30 fc</b>	<b>50 fc</b>	<b>70 fc</b>	<b>90 fc</b>	<b>110 fc</b>	<b>130 fc</b>

Clear Sky – March 20, 2009, 9:00 AM

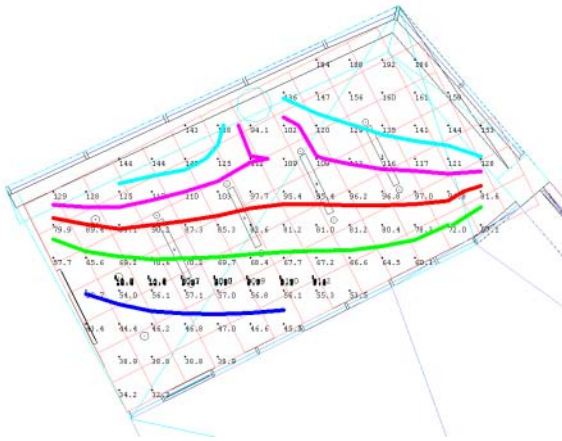


Clear Sky – March 20, 2009, 12:00 PM

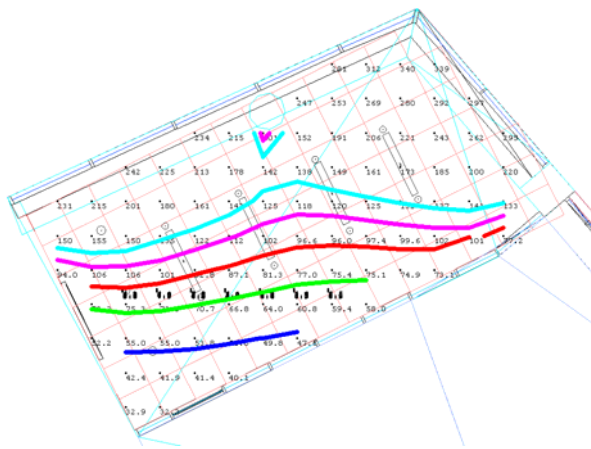




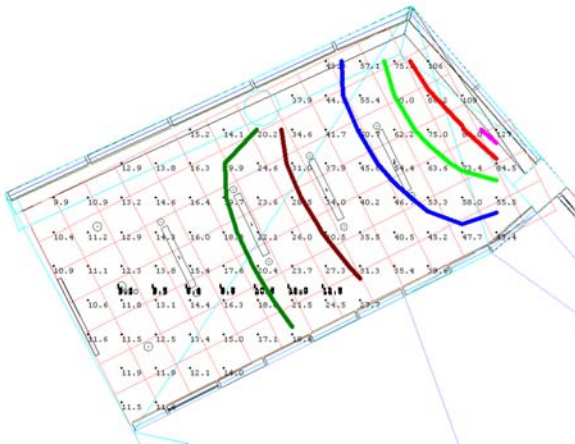
Clear Sky – March 20, 2009, 3:00 PM



Overcast Sky – March 20, 2009, 12:00 PM



Clear Sky – March 20, 2009, 12:00 PM with Shade



# STUDENT LOUNGE

## SPACE SUMMARY

The student lounge space and main staircase of the building span the curved, south-facing interior on the first floor. The area is a main circulation space in the building, and is open to students to use for studying or relaxing during the daytime as well as in the evening. The exterior south facing wall is floor-to-ceiling glazing, with an exterior sun shade to reduce the amount of direct



sunlight in the space during the day. The ceiling height is 14'-0" over the lounge area and 10'0" under the staircase. The ceiling over the lounge is suspended wood panels. The main staircase to the second floor is medium reflectance wood, and the other walls in the space are medium reflectance wood paneling and glazing with aluminum framing. The flooring is a combination of low reflectance slate tile on the high traffic circulation areas and carpet under the seating areas.

**Student Lounge Surface Materials and Reflectances**

Location	Material	Reflectance / Transmittance
Walls	Medium Toned Wood Panels	50%
Ceiling	Wood Panels	50%
Ceiling	Painted Gypsum Wall Board	80%
Floor	Carpet	20%
Floor	Slate Tiles	30%
Columns	Painted	65%
Glass Façade	Annealed Float Glass	90%
Mullions	Aluminum	85%

## DESIGN CRITERIA

**TASKS:** Lobby, Study area, Circulation space

**TARGET IMPRESSION:** As a space, the lounge should portray a feeling of sophistication and relaxation. It is the first space occupants and visitors see when they enter the building, and it is visible from the exterior as well. With an abundance of glass, metal and wood, the space has a very clean, minimalist appearance. The luminaires selected for this space should be discreet and maintain the simple lines of the space.

The lighting in this space meets the illuminance criteria recommended by IESNA. While the energy code is not quite met, it is assumed that the lighting designers were considering the whole building method when designing this layout, and made up for energy in other areas of the building. Some considerations to make when designing for this space are to keep in mind daylight integration and control, direct glare, light distribution on the task plane and shadows. Daylight integration is very important due to the floor to ceiling glazing along the south wall. Since so much daylight is exposed to the space, controlling it and integrating it into the lighting system will greatly improve the room's atmosphere. Direct glare is also very important to control, both from daylight and from luminaires. Since students will be studying in the space, there should be no glare to distract them and put them in discomfort. Light distribution on the task plane should be evenly distributed and free of shadows, so it is most comfortable for students to study, read and do homework.

## EXISTING LIGHTING

The luminaires over the lounge area are a combination of decorative halogen pendants and recessed compact fluorescent downlights. The halogen pendants add a relaxing, homey feel to the room, while the downlights create non-uniform illuminance on the floor. Underneath the stairs are surface mounted compact fluorescent downlights. LED under-railing lights illuminate the stairs.

### Student Lounge Existing Luminaire Schedule

Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F1	Pendant	DWR	Nelson Pendant Series	1-E26 100W	120V	Translucent plastic is sprayed over a wire frame to allow light through and protect the eye from glare.
F3	Ceiling Recessed	Lightolier	8021CCLW/6132BU	1-CFTR 42W	120V	6" Recessed compact fluorescent downlight with an anodized aluminum parabolic reflector.
F4	Ceiling Recessed	Lightolier	8021CW/6132BU	1-CFTR 42W	120V	6" Recessed compact fluorescent wallwasher with an anodized aluminum parabolic reflector.
F10	Ceiling Surface	Lightolier	8068WH/CS8226LPU	2-CFQ 26W	120V	9" Surface-mounted compact fluorescent downlight with a parabolic louver.
F11	Wall Recessed	Winona	LED-STEP01-RECT-M-001/HO	LED	12V	Recessed extruded aluminum LED steplight.

#### Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 5
- Expected Dirt Depreciation = 12%

### Student Lounge Existing Light Loss Factors

Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F1	II	Semi-Indirect	1.0	0.93	0.92	0.76	0.649
F3	IV	Direct	0.98	0.87	0.97	0.86	0.711
F4	IV	Direct	0.98	0.87	0.97	0.86	0.711
F10	IV	Direct	0.98	0.87	0.97	0.86	0.711
F11	VI	Direct	1.0	0.86	0.97	1.0	0.834

# STUDENT LOUNGE EXISTING LAYOUT



<b>Student Lounge Existing Illuminance Levels</b>			
Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
23.97 fc	10-30 fc	n/a	n/a

The existing illuminance values for the student lounge are on target with the IESNA Lighting Handbook recommendations. The illuminance levels over the seating areas where the students will be studying is higher than the illuminance levels on the walkway, which is appropriate.

<b>Student Lounge Existing Power Density</b>			
Fixture	Watts	Quantity	Total Watts
F1	100	11	1100
F3	45	13	585
F4	45	9	405
F10	45	5	225
F11	7.6/ft	42 ft	319.2
<b>Space Type</b>			Lounge
<b>Area (ft<sup>2</sup>)</b>			2243
<b>Allowable LPD (W/ft<sup>2</sup>)</b>			1.2
<b>Allowable Watts</b>			2691
<b>Actual LPD (W/ft<sup>2</sup>)</b>			1.17
<b>Actual Watts</b>			2634

The existing power density calculations are almost exactly on target with the recommended ASHRAE 90.1-2004 code. The design is actually 0.03 W/ft<sup>2</sup> less than the code requirements, which is 1.2 W/ft<sup>2</sup>. Although this is an excellent design, attempts will be made to improve the LPD in the new design.

## EXISTING EMERGENCY LIGHTING

The existing emergency lighting in the space is made up of alternating F6 and F10 compact fluorescent downlights. An emergency diesel power generator will provide power to the building when normal grid power fails.

## NEW LIGHTING SOLUTION

The new lighting design is intended to emphasize the wood paneled walls, draw people into the space, and be conducive to studying and relaxing. Multiple-lamp fixtures run in an alternating pattern through the length of the space, adding a non-uniform element to the ambient lighting in the space. Linear Fluorescent wallwashers run the length of the wood panel wall in the 14'-0" height of the space. Under the 10'-0" section of ceiling, compact fluorescent wallwashers illuminate the wall. LED steplights lead the way up the main staircase to the second floor.

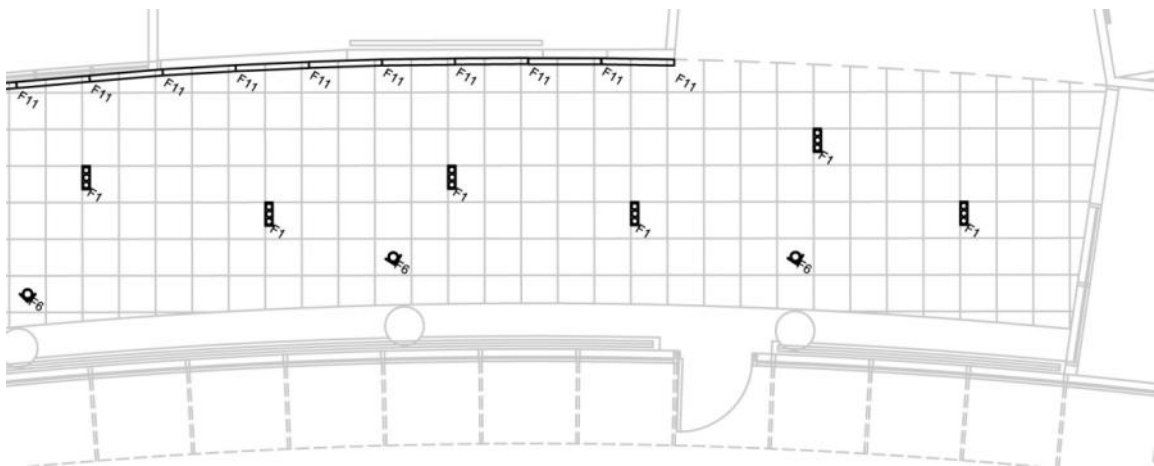
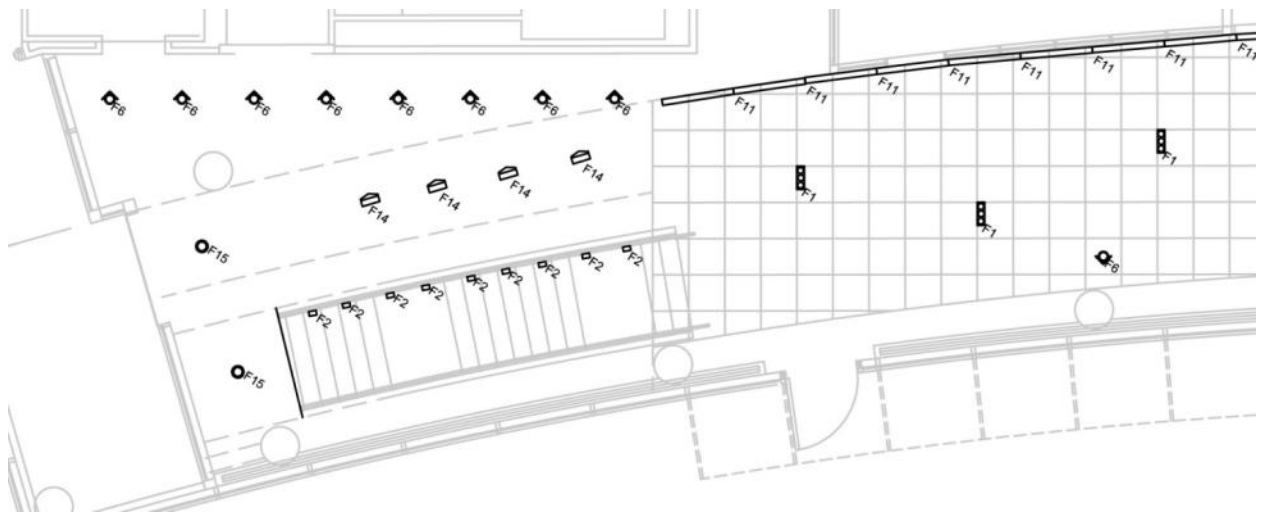
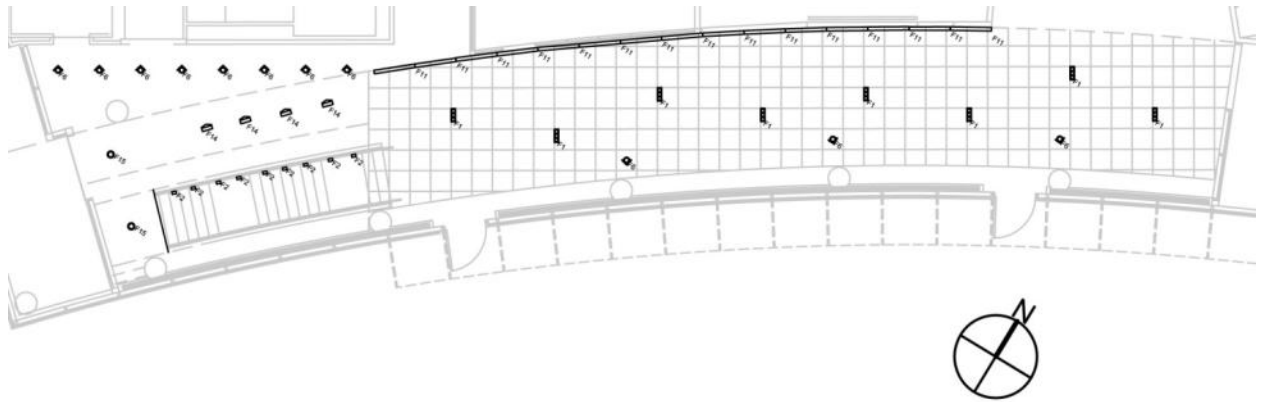
Student Lounge New Luminaire Schedule						
Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F1	Ceiling Recessed	Amerlux	CLYR-3-37-MR16-E-BT-277-WT	3-MR16 35W	277 V	5" recessed halogen accent light.
F2	Semi-Recessed	Lightolier	DSL01SA	LED	12 V	Semi-recessed LED step light.
F6	Ceiling Recessed	Lightolier	8021CW/6132BU	1-CFTR 26W	277 V	6" recessed compact fluorescent wallwasher.
F11	Ceiling Recessed	Mark Lighting	SPR-F-1T5HO-277-EB	1-T5HO 28W	277 V	5" recessed fluorescent wallwasher.
F14	Ceiling Surface	Winona Lighting	P1-SS-CFQ26-277V-SS8-SGW-X-STD	1-CFQ 26W	277 V	12" surface-mounted compact fluorescent wallwasher.
F15	Ceiling Surface	Kurt Versen	P602	2-CFQ 26W	277 V	8" surface-mounted compact fluorescent downlight.

### Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 5
- Expected Dirt Depreciation = 12%

Student Lounge New Light Loss Factors							
Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F1	IV	Direct	0.98	0.87	0.97	1.0	0.83
F2	VI	Direct	1.0	0.86	0.97	1.0	0.83
F6	IV	Direct	0.98	0.87	0.97	0.85	0.70
F11	IV	Direct	0.98	0.87	0.97	0.92	0.76
F14	IV	Indirect	0.98	0.87	0.97	0.85	0.70
F15	IV	Direct	0.98	0.87	0.97	0.85	0.70

# STUDENT LOUNGE NEW LAYOUT





<b>Student Lounge New Illuminance Levels</b>			
Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
25.57 fc	10-30 fc	n/a	n/a

The new illuminance levels in the student lounge are very appropriate considering the IESNA Lighting Handbook recommendations. The lighting is non-uniform in distribution, and maintains an average illuminance level of 25.57 fc, which is acceptable.

<b>Student Lounge New Power Density</b>			
Fixture	Watts	Quantity	Total Watts
F1	120	8	960
F2	4	10	40
F6	28	11	308
F11	32	15	480
F14	28	4	112
F15	54	2	108
<b>Space Type</b>			Lounge
<b>Area (ft<sup>2</sup>)</b>			2243
<b>Allowable LPD (W/ft<sup>2</sup>)</b>			1.2
<b>Allowable Watts</b>			2691
<b>Actual LPD (W/ft<sup>2</sup>)</b>			0.89
<b>Actual Watts</b>			2012

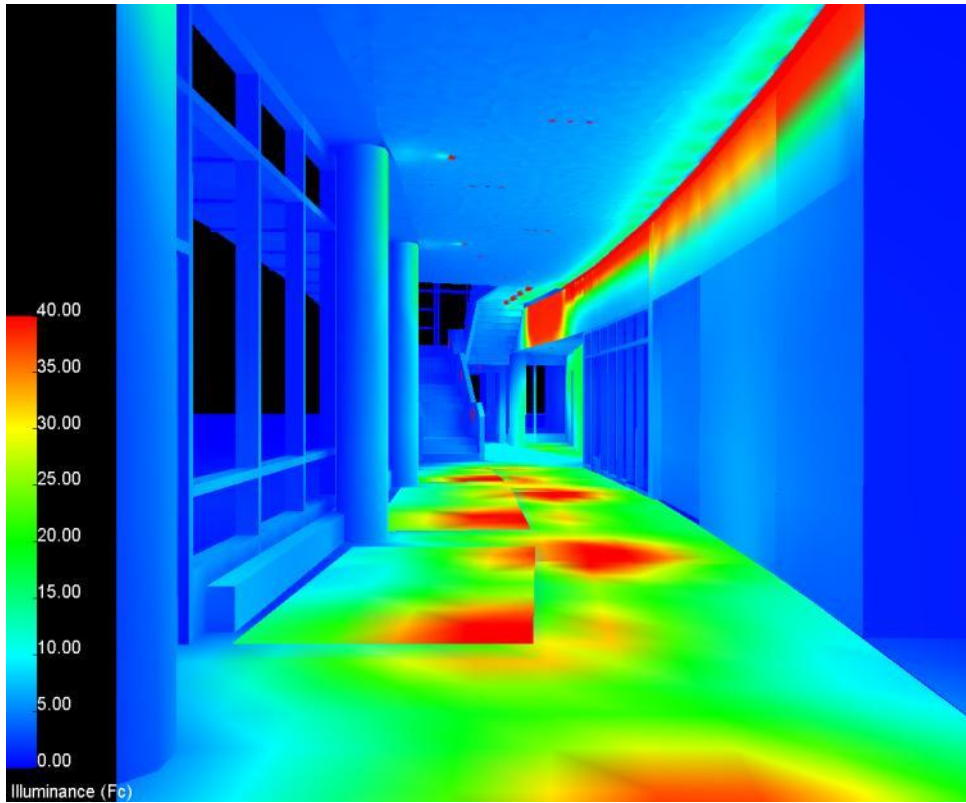
The new power density calculations rates the actual watts (2012 W) significantly less than the allowable watts (2691 W) according to ASHRAE 90.1-2004. This will help to make up for the conference room calculations, which were slightly higher than the allowable watts.

## NEW EMERGENCY LIGHTING

The new emergency lighting in the space will consist of a combination of several F6 and F1 fixtures. An emergency generator will provide power to the building when normal grid power fails. Enlarged plans showing emergency fixtures are available in Appendix G.

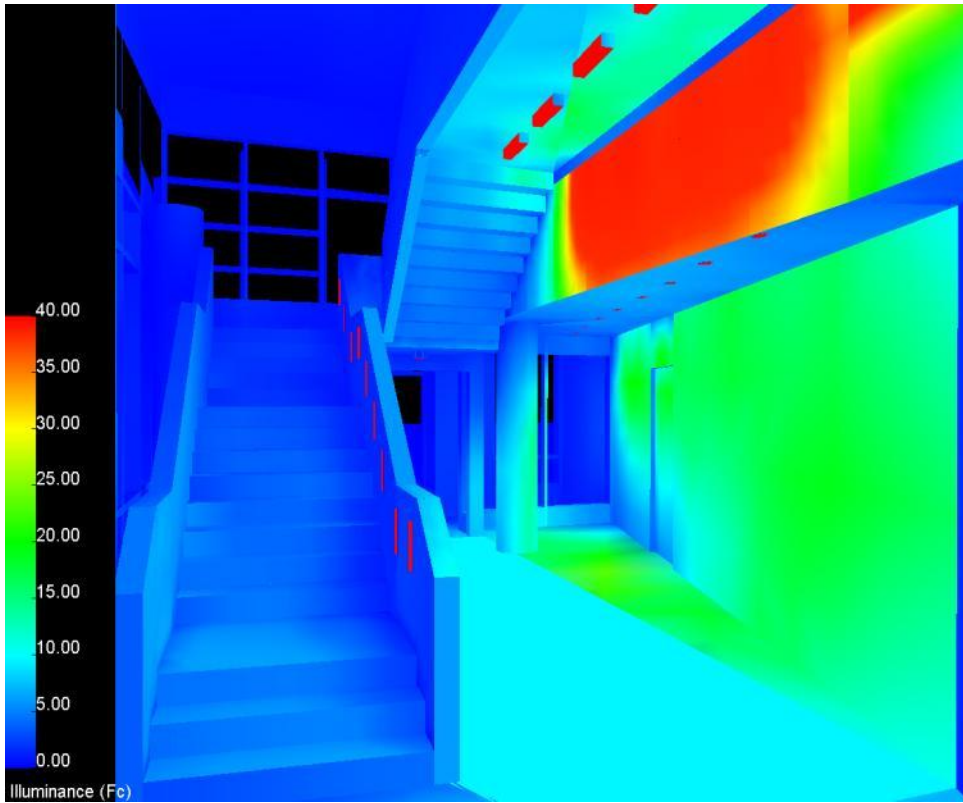


Lounge RGB (above) and Pseudo Color (below) Renderings



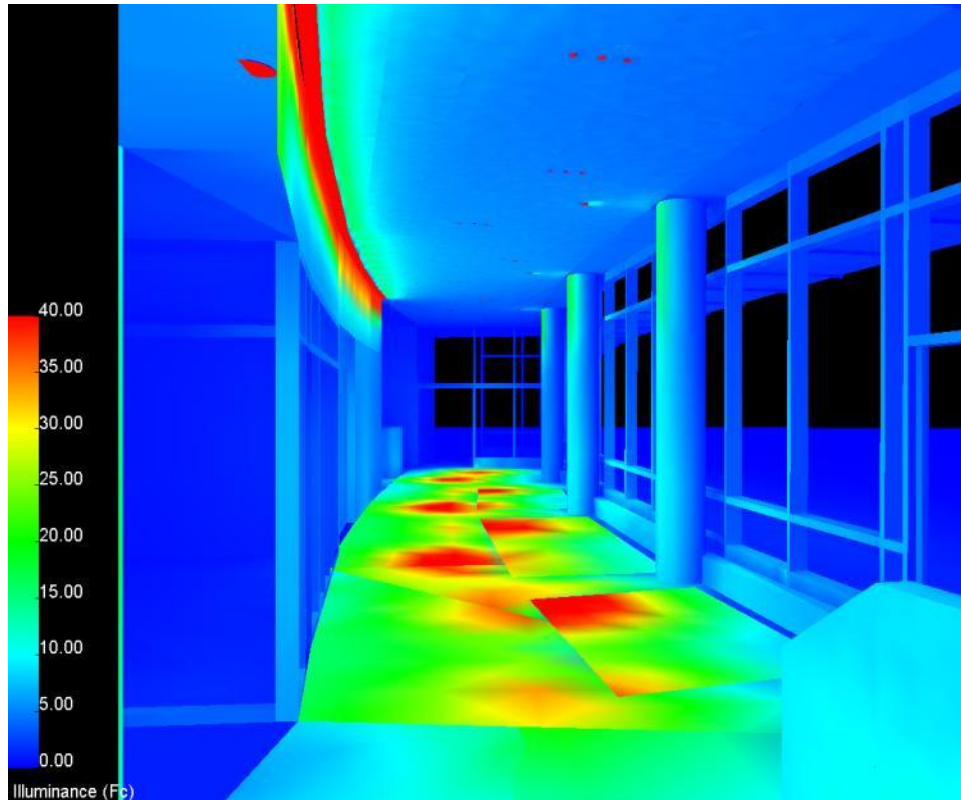


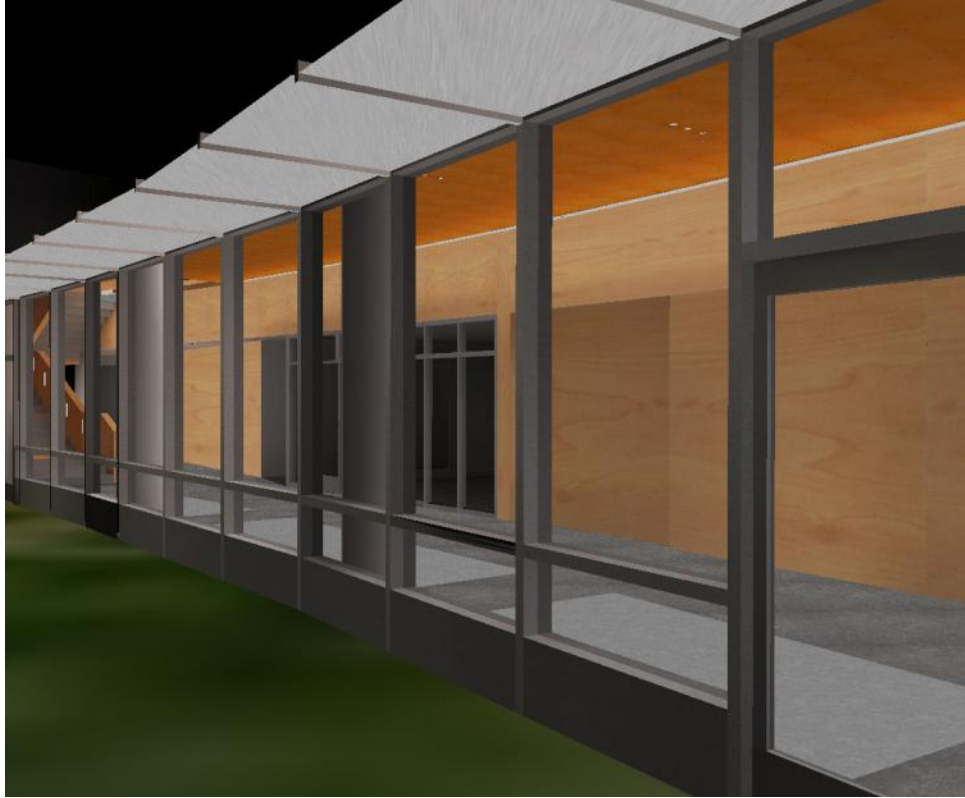
Lounge RGB (above) and Pseudo Color (below) Renderings



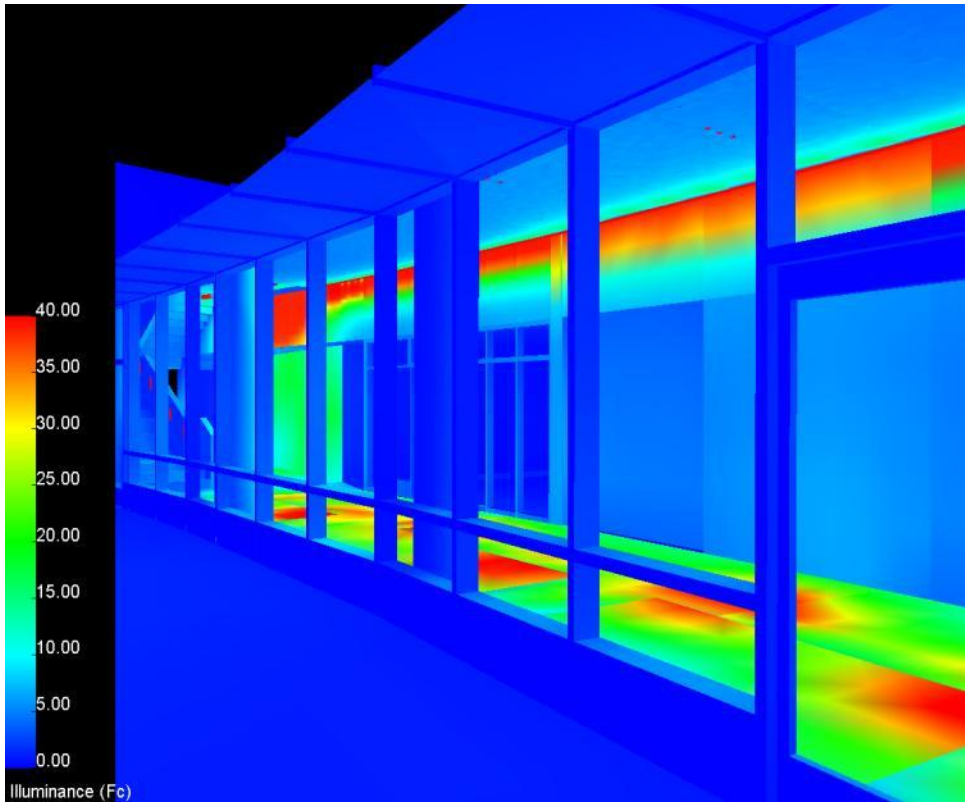


Lounge RGB (above) and Pseudo Color (below) Renderings



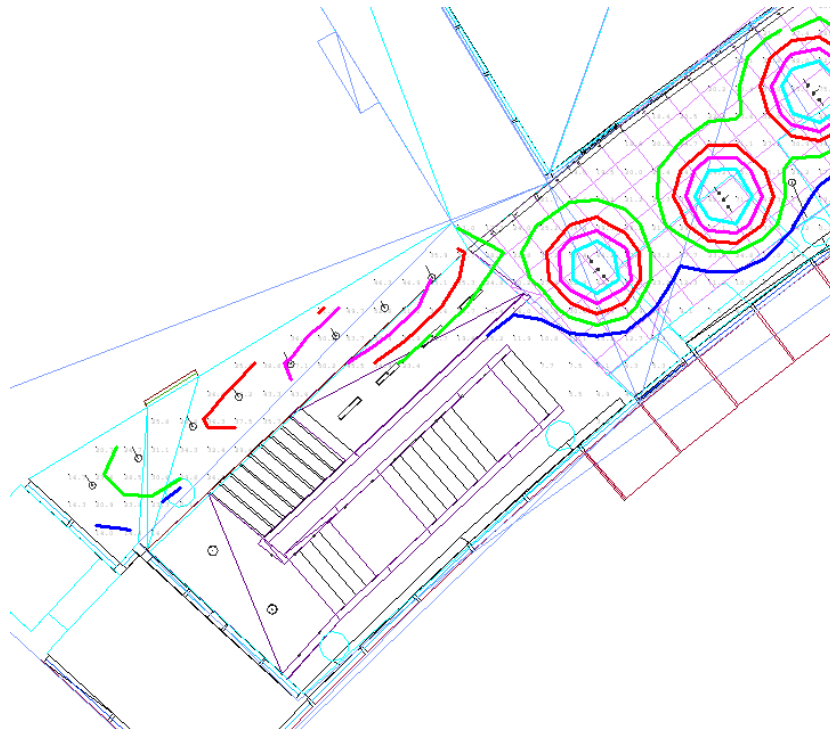


Lounge RGB (above) and Pseudo Color (below) Renderings



### ISOLINE COLOR KEY

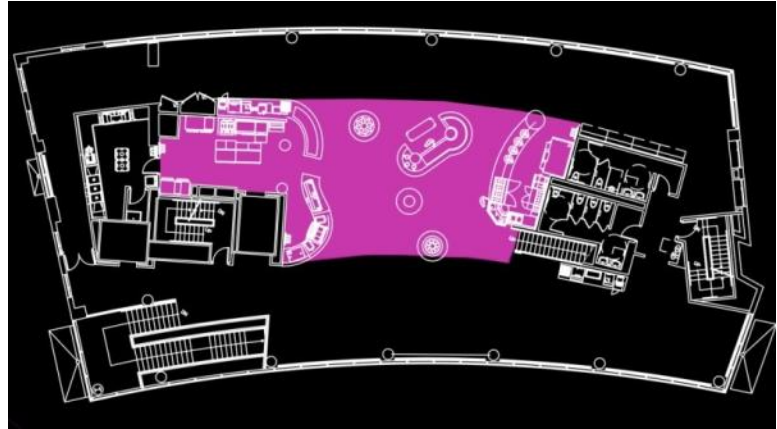
Dark Blue	Green	Red	Purple	Light Blue
15 fc	25 fc	35 fc	45 fc	55 fc



## CAFETERIA SERVING SPACE

### SPACE SUMMARY

The main campus cafeteria serving area is located on the second floor of the Wheelock College Campus Center and Student Residence building. Students will gather here to eat breakfast, lunch and dinner. The space features curved serving bars, round condiment stations, and kitchen and cooking areas. In the center of the space is a specialty bar, with made-to-order items. The space will also have moveable tables and chairs for students to eat. The ceiling height is 8'-0" and is suspended 2x4 acoustical ceiling tile. The north and south sides are open to the hallway, while the east and west walls are painted gypsum wall board.



**Cafeteria Serving Surface Materials and Reflectances**

Location	Material	Reflectance / Transmittance
Floor	Wood Flooring	50%
Wall/Columns	Painted Gypsum Wall Board	70%
Ceiling	2x4 Acoustical Ceiling Tile	80%
Counter Tops	Black Marble	90%
Counters	Painted Wood	40%
Kitchen Equipment	Stainless Steel	80%

## DESIGN CONSIDERATIONS

**TASKS:** Food preparation, Food serving area

**TARGET IMPRESSION:** The serving area of the cafeteria needs to be functional and a fun place for students to get food and eat. The atmosphere should be relaxed and youthful.

The architectural design of the space is very open, with counters on the east and west side and in the center of the space. There are also circular condiment stations and movable tables and chairs throughout the space. The flooring is tile, and the walls are painted gypsum wall board. Using neutral color temperature of about 3500 would be comfortable for the occupants. The light should also have a good color rendering index to enhance the colors of the food being served. Direct glare could be a problem in the food preparation areas and serving areas when the kitchen staff is trying to prepare and serve meals. The contrast between the bright glare and the background could potentially be dangerous if the staff cannot see what they are doing when using sharp cutlery. Light distribution throughout the room should be non-uniform to promote relaxation and pleasantness. Emphasis should be placed on the food serving areas. Some peripheral emphasis would also be good design to add to the pleasantness of the space.

## EXISTING LIGHTING

The luminaires are a combination of track mounted decorative pendants, and recessed downlights. The T4 halogen pendants illuminate the space over the serving counters, while the compact fluorescent downlights add non-uniform ambient light over the kitchen preparation areas and throughout the space.



**Cafeteria Serving Existing Luminaire Schedule**

Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F2a	Pendant	Wilmette	600-MO-CNG-C	T4 50W Halogen	120V	Monorail mounted halogen pendant.
F3a	Ceiling Recessed	Lightolier	D7A02-8022FCL- S7142BU	1-CFTR 42W	120V	6" Recessed compact fluorescent downlight with an anodized aluminum parabolic reflector and decorative Vetro dropped glass ring.
F12	Ceiling Recessed	Lightolier	8097FWHW/7132BU	1-CFTR 42W	120V	7" Recessed compact fluorescent downlight with anodized aluminum parabolic reflector.

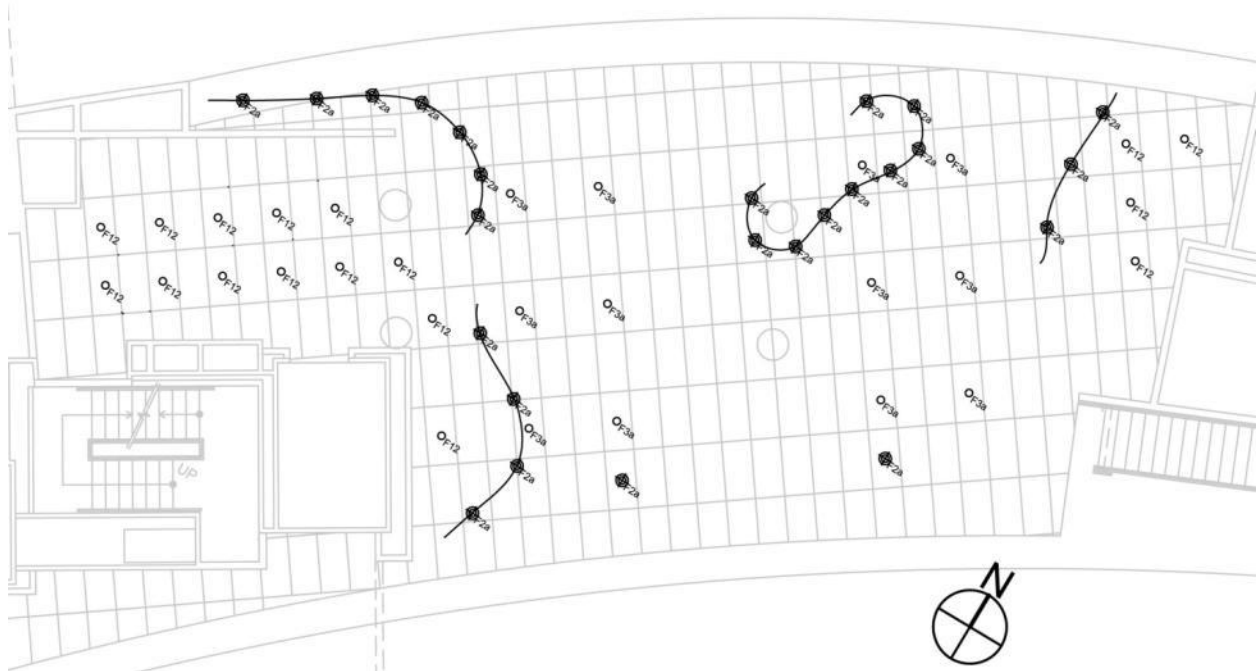
Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 5
- Expected Dirt Depreciation = 12%

**Cafeteria Serving Existing Light Loss Factors**

Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F2a	IV	Direct	0.98	0.87	0.97	0.86	0.711
F3a	VI	Direct	1.0	0.86	0.97	1.0	0.834
F12	IV	Direct	0.98	0.87	0.97	0.86	0.711

## CAFETERIA EXISTING LAYOUT



**Cafeteria Serving Existing Illuminance Levels**

Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
12.8 fc	10-30 fc	3.38 fc	3-5 fc

The existing illuminance levels in the cafeteria serving space are similar to the values recommended by the IESNA Lighting Handbook. The horizontal levels on the floor average 9.3 fc, which is very close to the 10 fc recommendation. The illuminance levels on the serving counters average to 18.76 fc, which is lower than the 30 fc recommendation. The lighting in the food preparation area averages 26.8 fc, which is a little bit low, but still acceptable for food preparation. The vertical illuminance levels are acceptable according to the IESNA recommendations.

<b>Cafeteria Serving Existing Power Density</b>			
<b>Fixture</b>	<b>Watts</b>	<b>Quantity</b>	<b>Total Watts</b>
F2a	15	25	375
F3a	45	12	540
F12	45	17	765
<b>Space Type</b>			Cafeteria
<b>Area (ft<sup>2</sup>)</b>			2048
<b>Allowable LPD (W/ft<sup>2</sup>)</b>			1.4
<b>Allowable Watts</b>			2867
<b>Actual LPD (W/ft<sup>2</sup>)</b>			0.82
<b>Actual Watts</b>			1680

The existing power density calculations rates the actual watts (1680 W) significantly less than the allowable watts (2867 W) according to ASHRAE 90.1-2004. Although the power density is rated very low in this space, it is reflected in illuminance values which do not meet the IESNA recommendations.

#### EXISTING EMERGENCY LIGHTING

The existing emergency lighting in the space consists of a combination of F12 and F3a compact fluorescent downlights. There are five F12 and six F3a emergency fixtures in the space. An emergency generator will provide power to the building when normal grid power fails.

## NEW LIGHTING SOLUTION

The space is intended to feel comfortable to occupants, as well as to direct them to the food serving counters, and promote circulation. A uniform spread of compact fluorescent recessed downlights gives the space a general illuminance while remaining sleekly concealed in the low 8'0" ceiling. Pendants hanging over the counters lead students to the food, and add a decorative touch to the space. The linear fluorescent fixtures in the food preparation area allow for a bright, uniformly lit space to properly prepare food. Linear fluorescent wallwashers on the walls behind the counters bring the focus to the peripheral, and give the space a more relaxing feel.

**Cafeteria Serving New Luminaire Schedule**

Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F4	Recessed	Lightolier	8091 CCLW	1-CFTR 26W	277 V	6" recessed compact fluorescent downlight.
F5	Recessed	Focal Point	FLU-24-B-2-T5HO-E-277-G	2-F28T5	277 V	2'x4' recessed indirect with perforated center basket.
F9	Pendant	Delray Lighting	2310-S-18-2-E	1-CFTR 18W	277 V	9" suspended compact fluorescent downlight.
F10	Pendant	Winona Lighting	LED-POPS01-6-ARC-M-001-ND12V-BAL-X-STD	LED	12 V	Suspended LED chandelier.
F11	Ceiling Recessed	Mark Lighting	SPR-F-1T5HO-277-EB	1-T5HO 28W	277 V	5" recessed fluorescent wallwasher.

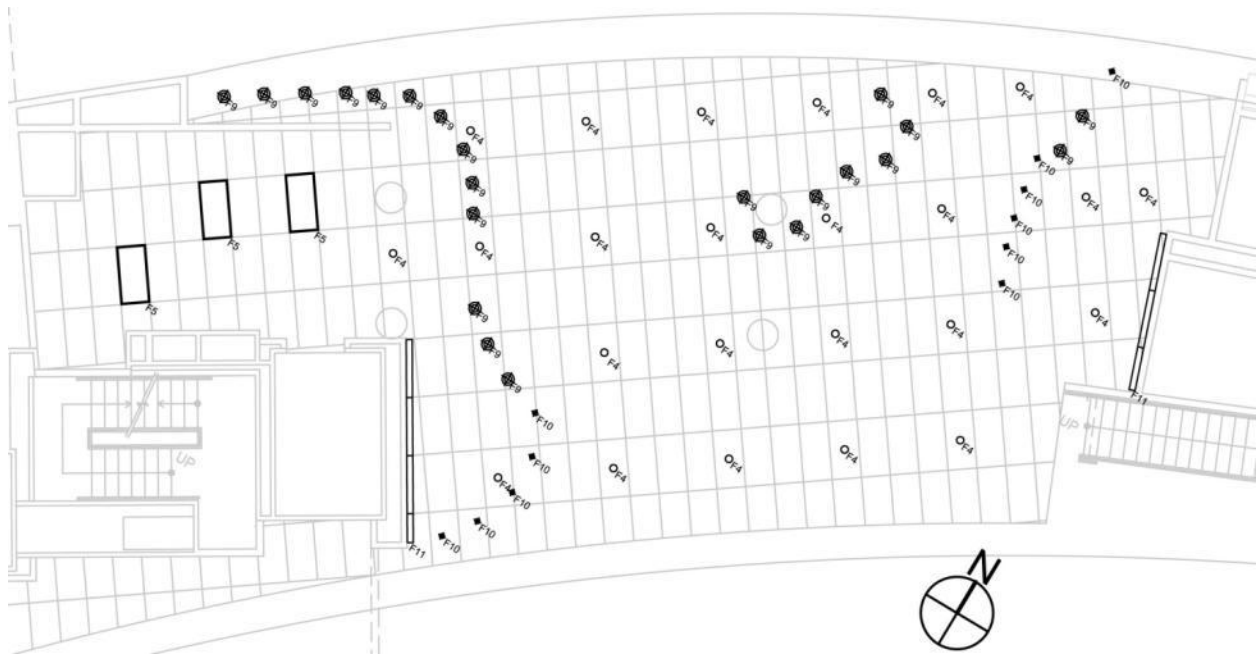
### Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 5
- Expected Dirt Depreciation = 12%

**Cafeteria Serving New Light Loss Factors**

Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F4	IV	Direct	0.98	0.87	0.96	0.85	0.70
F5	IV	Semi-Direct	0.98	0.87	0.92	0.92	0.72
F9	IV	Direct	0.98	0.87	0.96	0.84	0.67
F10	II	Direct/Indirect	1.0	0.93	0.91	1.0	0.85
F11	IV	Direct	0.98	0.87	0.96	0.92	0.75

## CAFETERIA NEW LAYOUT



**Cafeteria Serving New Illuminance Levels**

Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
17.3 fc	10-30 fc	3.38 fc	3-5 fc

The new illuminance levels for the cafeteria serving space and kitchen are a lot more appropriate than the existing levels. The kitchen area has an average illuminance of 28.6 fc, which is very close to the recommended IESNA levels of 30 fc. The lighting in the serving space is more evenly spaced, so although the distribution is still non-uniform on the ground, there are no spots that fall below 7 fc. The average illuminance on the floor is 11.68 fc, and on the serving counters is 43.7 fc. The vertical illuminance is 3.38, which is in the range of appropriate light levels.

<b>Cafeteria Serving New Power Density</b>			
<b>Fixture</b>	<b>Watts</b>	<b>Quantity</b>	<b>Total Watts</b>
F4	28	23	644
F5	63	3	189
F9	20	21	420
F10	4	11	44
F11	32	7	224
<b>Space Type</b>			Cafeteria
<b>Area (ft<sup>2</sup>)</b>			2048
<b>Allowable LPD (W/ft<sup>2</sup>)</b>			1.4
<b>Allowable Watts</b>			2867
<b>Actual LPD (W/ft<sup>2</sup>)</b>			0.74
<b>Actual Watts</b>			1515

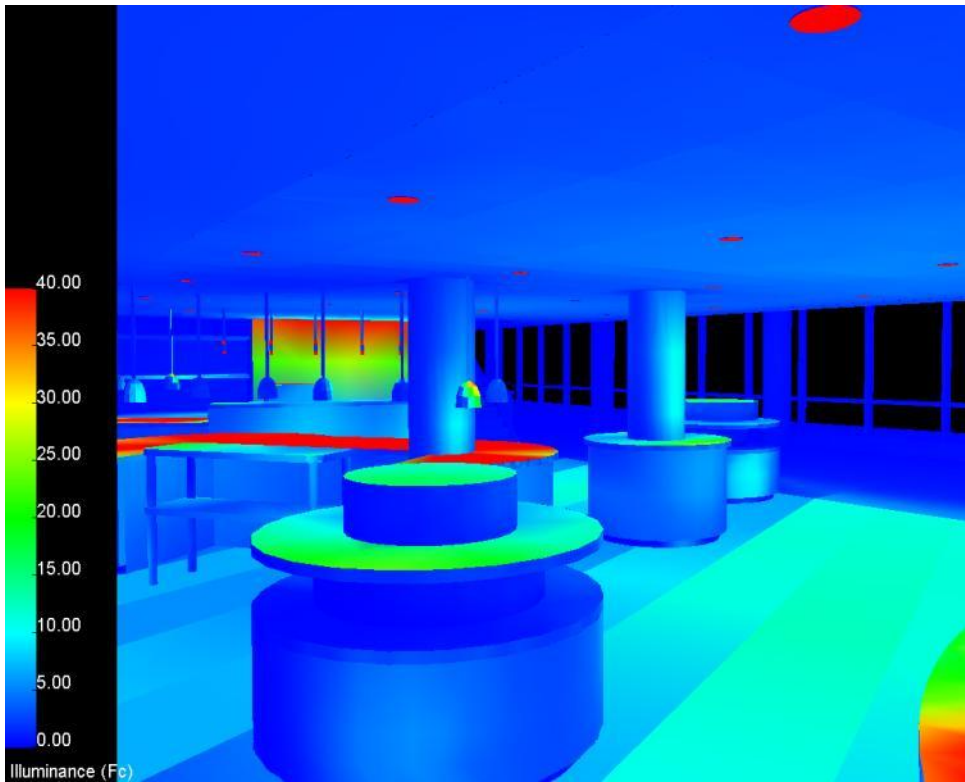
The new power density calculations rates the actual watts (1515 W) significantly less than the allowable watts (2867 W) according to ASHRAE 90.1-2004. This rating is also better than the original LPD calculation by 0.08 W/ft<sup>2</sup>.

## NEW EMERGENCY LIGHTING

The new emergency lighting in the cafeteria serving space consists of several F4 compact fluorescent downlights. An emergency generator will provide power to the building when normal grid power fails. More information about the emergency lighting can be found in Appendix G.

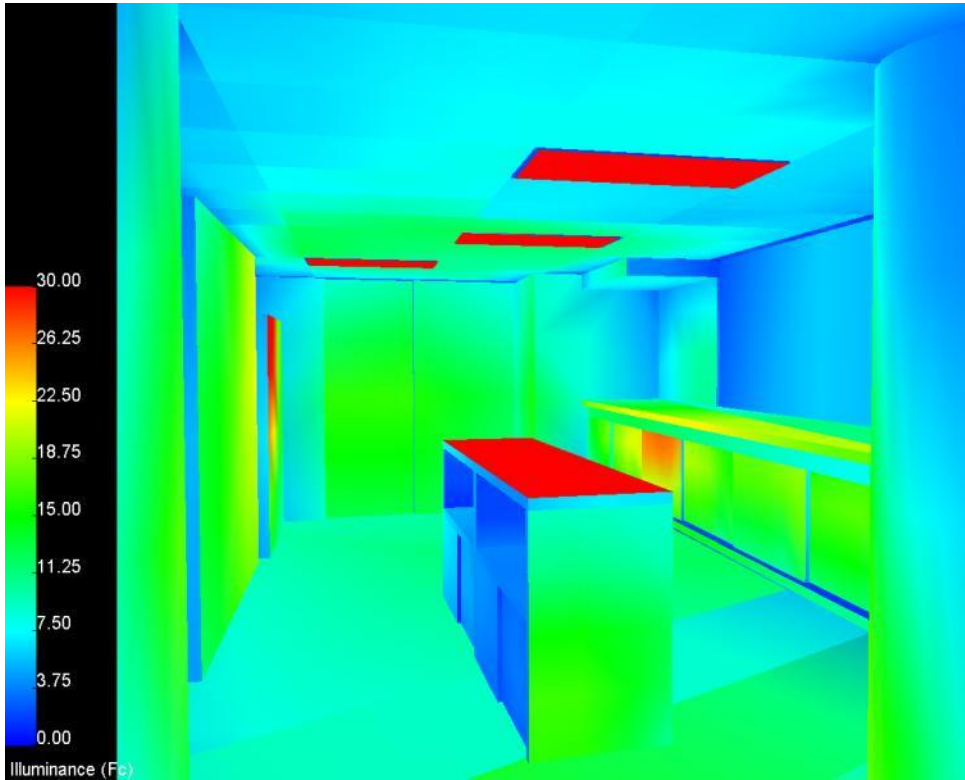


Serving Space RGB (above) and Pseudo Color (below) Renderings





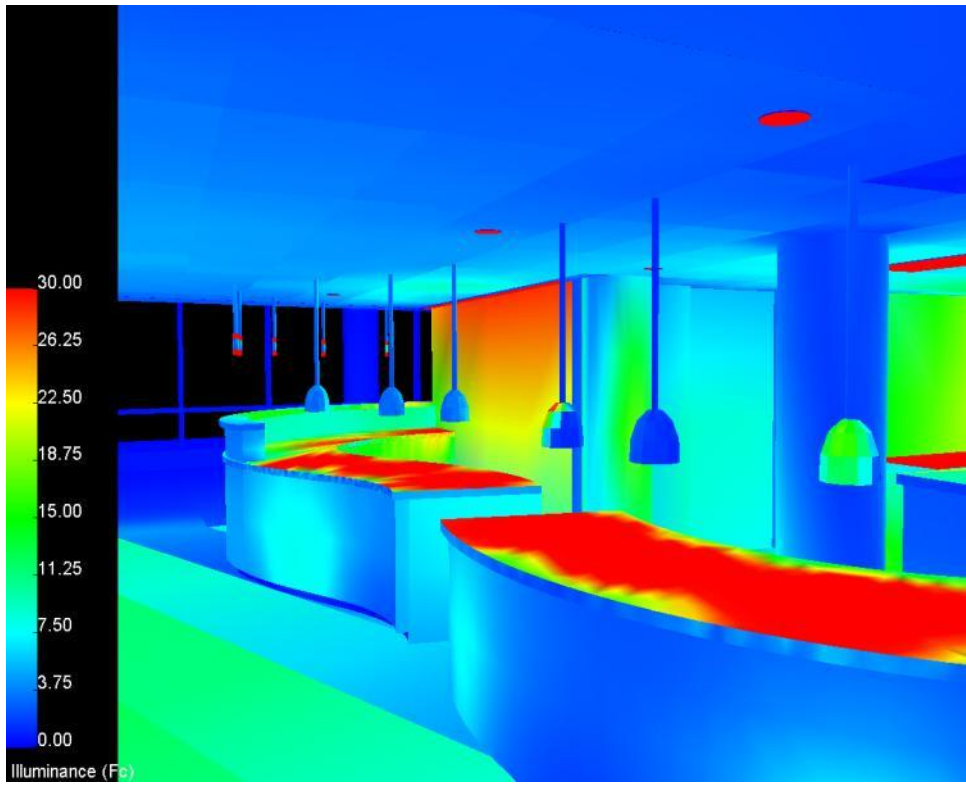
Kitchen RGB (above) and Pseudo Color (below) Renderings





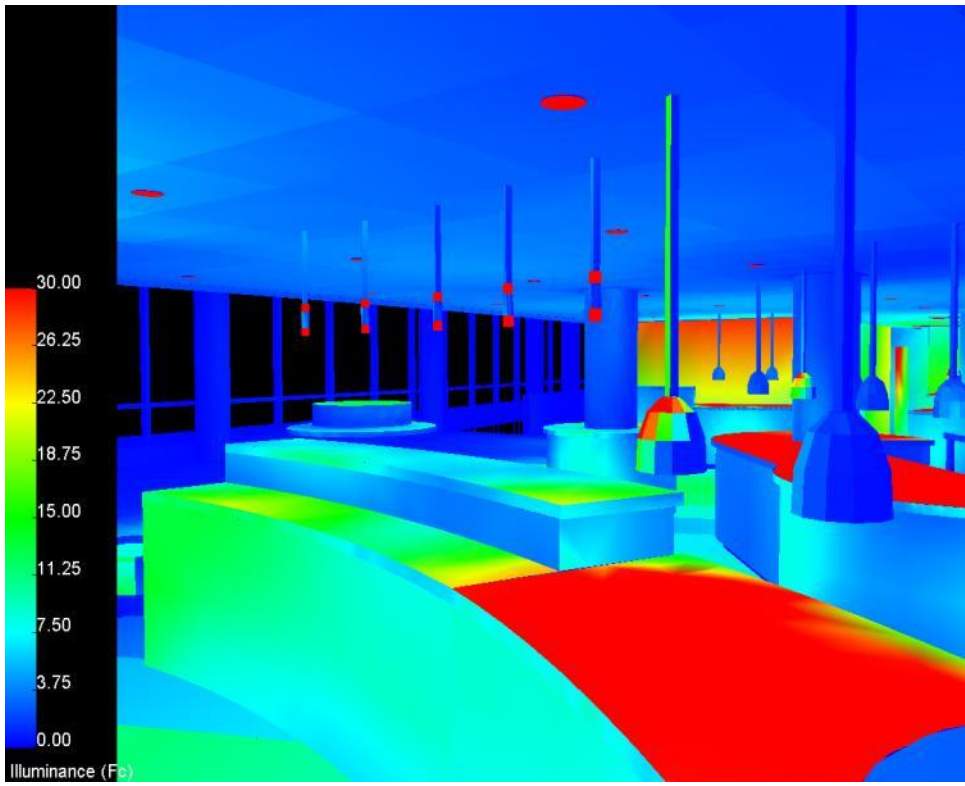


Serving Space RGB (above) and Pseudo Color (below) Renderings



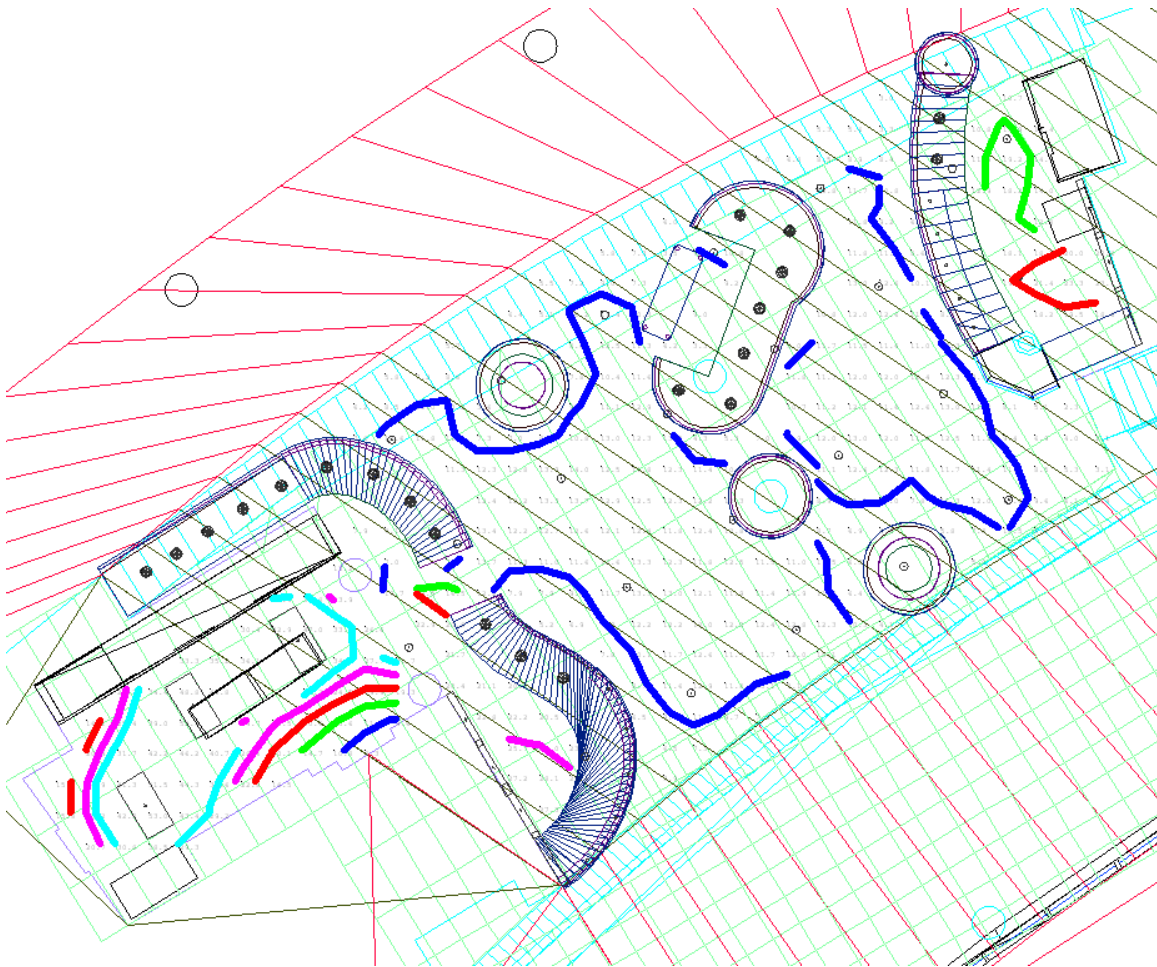


Serving Space RGB (above) and Pseudo Color (below) Renderings



### ISOLINE COLOR KEY

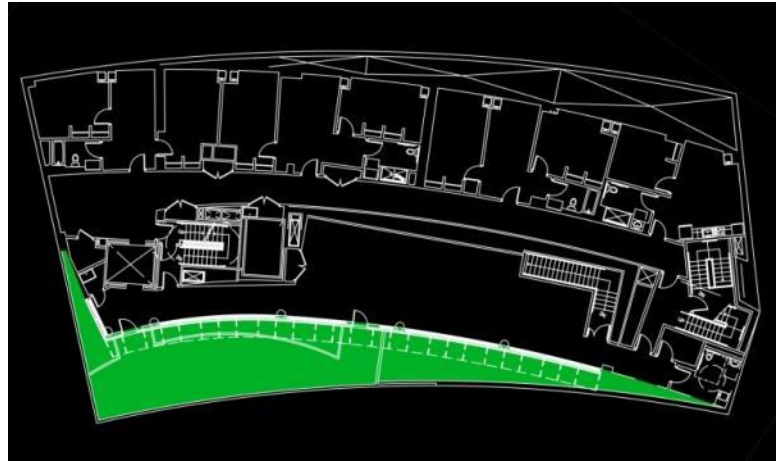
Dark Blue	Green	Red	Purple	Light Blue
10 fc	15 fc	20 fc	25 fc	30 fc



## ROOF DECK

### SPACE SUMMARY

The third floor outdoor deck is located on the south facing side of the building. The deck features vegetation areas, potted plants and a glass railing. The exterior wall is glazing with aluminum framing. Students will be able to use this space for studying and relaxing. The flooring is roof pavers, and the



vegetation boxes are concrete unit pavers on a pedestal system with granite coping at the joints which may be used as seating for occupants. There is currently no lighting system in place on the roof deck, but it would be an ideal place to illuminate during the evening for students to sit and relax.

**Roof Deck Surface Materials and Reflectances**

Location	Material	Reflectance / Transmittance
Floor	Slate Tile	30%
Walls	Stone Walls	30%
Glass Façade	Annealed Float Glass	90%
Mullions	Aluminum	85%

## DESIGN CONSIDERATIONS

**TASKS:** Relaxation, Conversation

**TARGET IMPRESSION:** The new lighting design for the space is intended to make the space usable and pleasant at night. The roof deck should be a place where students can relax during nice nights, and use as a social gathering area.

The roof deck is adjacent to a glass curtain wall and an interior dining area, so it is important that the color temperature be similar to the indoor space. The assumed color temperature of the interior space is 3500K, so the outdoor deck should be similar. Color rendering is not very important in this space due to the lack of tasks being performed. A CRI of 70 or above would be sufficient. Direct glare from daylight and luminaires should be taken into consideration when designing for the space. For safety reasons some degree of uniformity must be maintained throughout the space. However, to create visual interest and textures of the landscaping of the space, non-uniform lighting should be utilized. Points of interest in the space are the vegetation. Possibly highlighting some of the landscaping would be a good design idea. There is a lot of landscaping in the area, and the plants will be increasing in size yearly, so being aware of projected plant growth in subsequent years is important. The use of shadows in this space may be used to enhance the dimensions of the space and give it more visual interest.

## EXISTING LIGHTING

There is currently no lighting system in this space.

## NEW LIGHTING

Compact fluorescent path lights lead occupants out onto the deck, and illuminate the floor. The non-uniform patterns created by these path lights will make the space more relaxing and inviting. Landscape lighting draws the eye to the planters and shrubbery. The ground mounted uplights have a dual purpose of illuminating the bushes to add depth and texture, and illuminating the bottoms of the sun shades to create the effect of a ceiling over the space.

Roof Deck New Luminaire Schedule						
Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F3	In Ground	Winona	CELED-1003-12V-L1-BKS	LED	277V	Surface-mounted LED landscape light.
F13	Wall Surface	Lumiere	1235-RD-M-4LED-120/12-BK	1-CFTR13W	277V	Recessed compact fluorescent step light.

### Assumptions:

- Maintenance Category: Dirty
- Cleaning Intervals: 18 Months
- RCR = 5
- Expected Dirt Depreciation = 25%

Roof Deck New Light Loss Factors							
Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F3	VI	Direct	1.0	0.72	0.92	1.0	0.66
F13	IV	Direct	0.98	0.69	0.92	0.97	0.59

## ROOF DECK NEW LAYOUT



**Roof Deck New Illuminance Levels**

Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
4.13 fc	3-5 fc	4.52 fc	1-3 fc

The calculated horizontal illuminance levels of 4.13 fc fall within the target range of 3-5 fc specified in the IESNA Lighting Handbook. The horizontal levels fall just a little bit under the target, and are still conducive to a satisfactory work environment. The vertical illuminance levels are slightly above the recommended levels, but are still appropriate for the space.

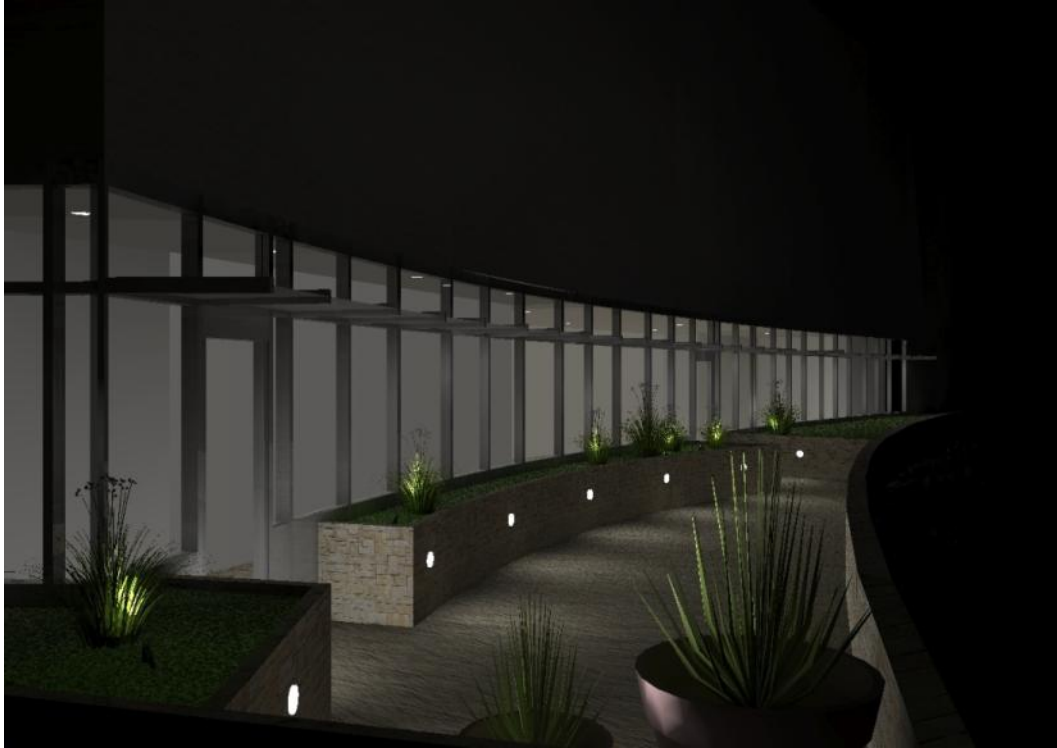
Roof Deck New Power Density			
Fixture	Watts	Quantity	Total Watts
F3	4	10	40
F13	16	8	120
<b>Space Type</b>			Conference Room
<b>Area (ft<sup>2</sup>)</b>			750
<b>Allowable LPD (W/ft<sup>2</sup>)</b>			0.2
<b>Allowable Watts</b>			150
<b>Actual LPD (W/ft<sup>2</sup>)</b>			0.22
<b>Actual Watts</b>			168

The new power density calculations are very close to the recommended ASHRAE 90.1-2004 code. The actual LPD is 0.02 W/ft<sup>2</sup> higher than the allowable, which will not make a large difference on the total building load.

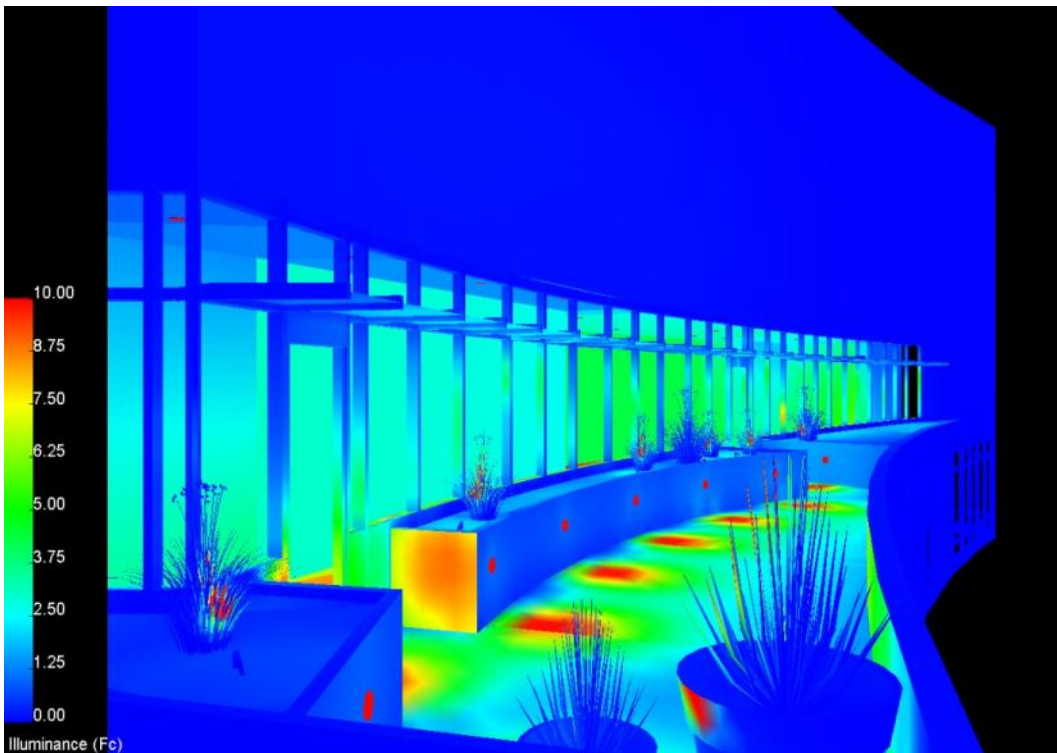
## NEW EMERGENCY LIGHTING

There will be no emergency lighting in the new space.



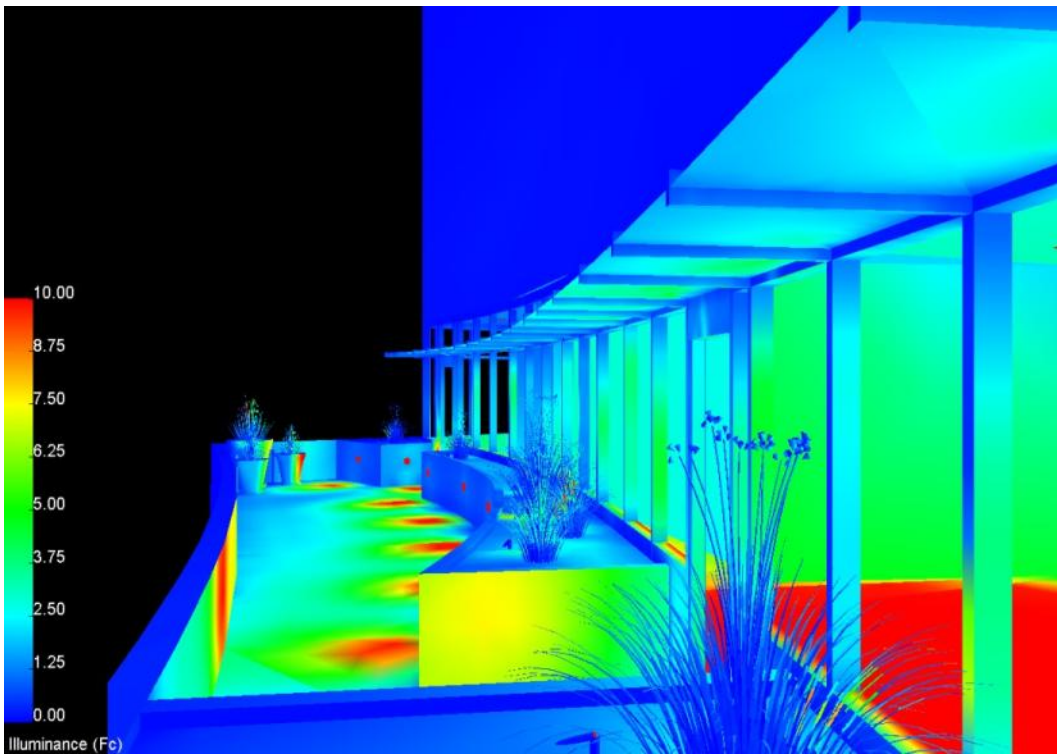


Deck RGB (above) and Pseudo Color (below) Renderings



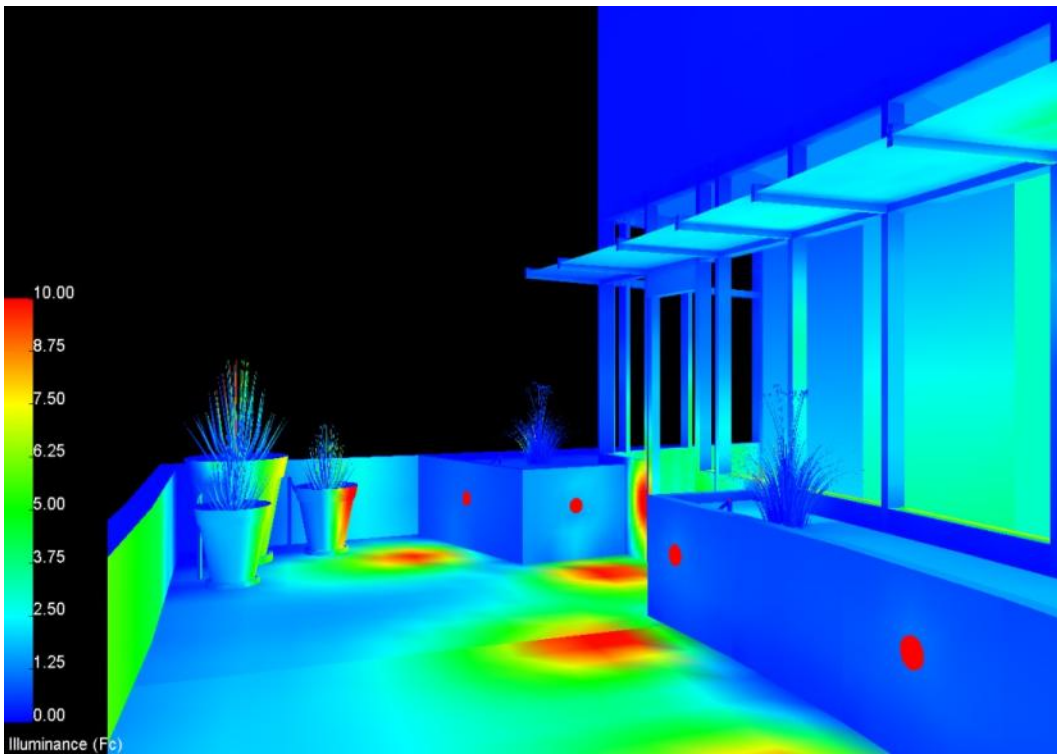


Deck RGB (above) and Pseudo Color (below) Renderings



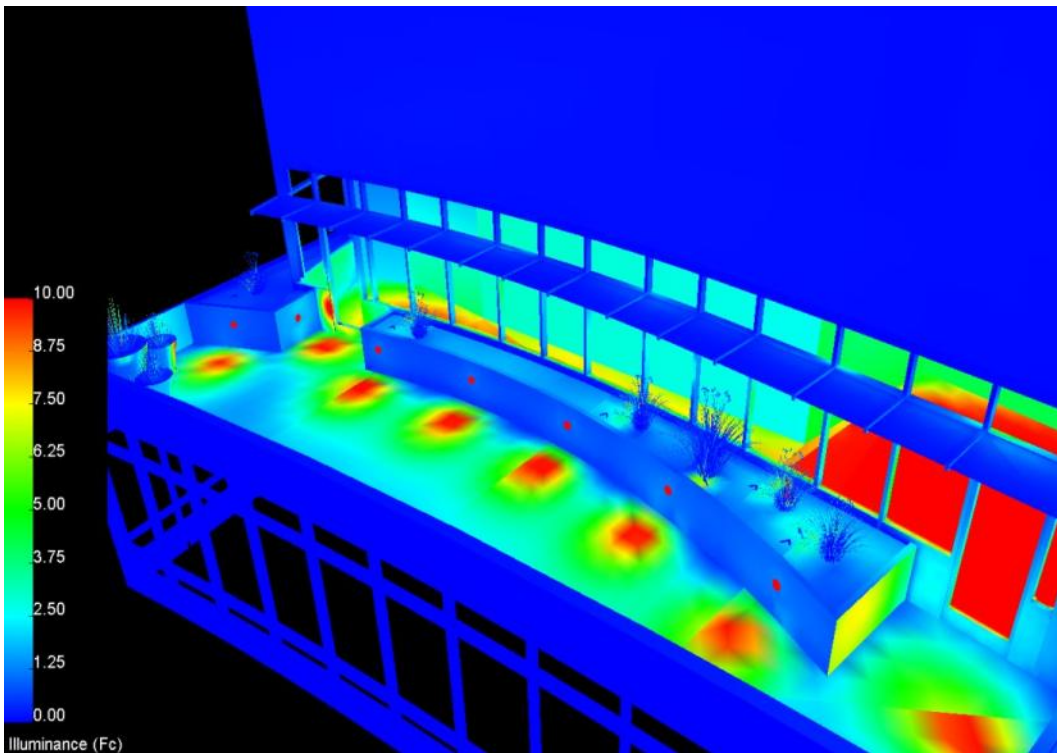


Deck RGB (above) and Pseudo Color (below) Renderings



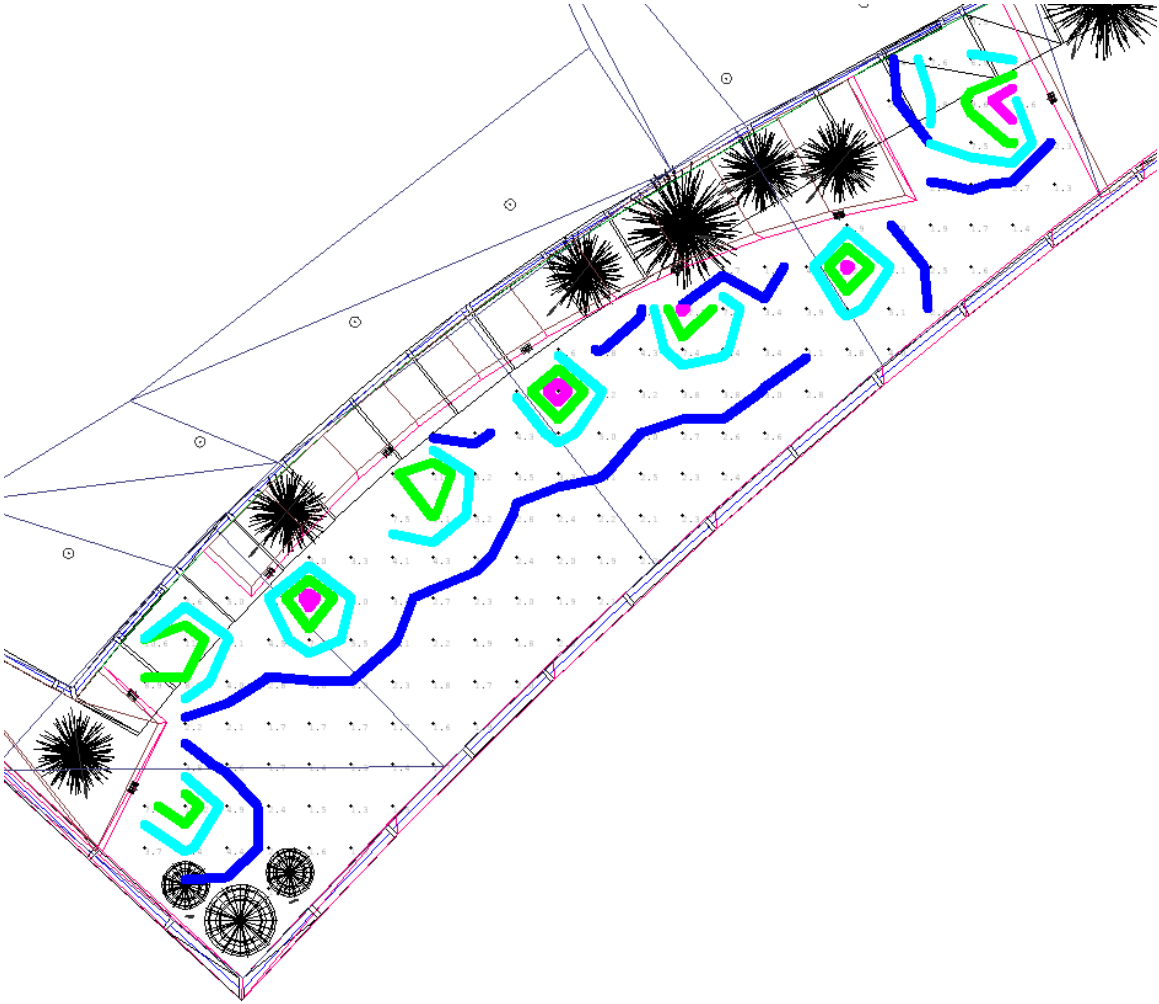


Deck RGB (above) and Pseudo Color (below) Renderings



ISOLINE COLOR KEY

Dark Blue	Light Blue	Green	Purple
3 fc	5 fc	7 fc	9 fc



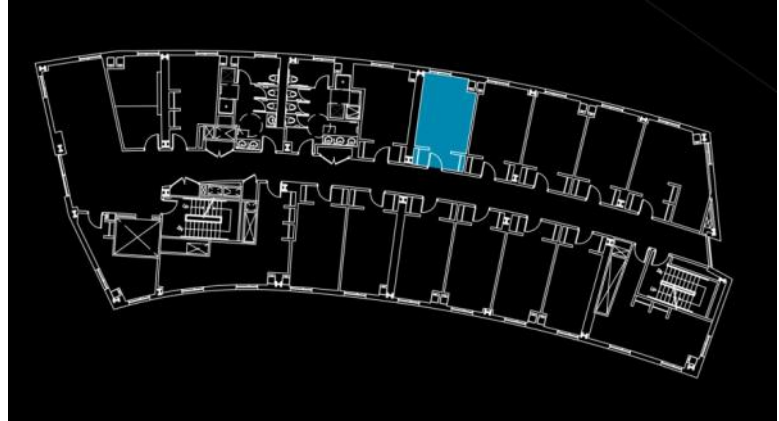
## TYPICAL DORM ROOM

### SPACE SUMMARY

The typical two-bed student dorm rooms are located on the fourth and fifth floors of the building. The dorm rooms are used as sleeping, studying and living areas for student residents. The rooms feature two beds, two closets and two desks.

The rooms are approximately 240 square feet, with 8'-0" ceiling

height, but the square footage may vary due to the shape of the building. The walls are gypsum wall board, and the ceilings are suspended gypsum wall board.



**Dorm Room Surface Materials and Reflectances**

Location	Material	Reflectance / Transmittance
Floor	Carpet	25%
Wall	Painted Gypsum Wall Board	70%
Ceiling	Painted Gypsum Wall Board	70%
Furniture	Medium Toned Wood	50%

## DESIGN CONSIDERATIONS

**TASKS:** Living Space, Reading, Computer use

**TARGET IMPRESSIONS:** The dorm rooms are meant to be relaxing. The students will call this room “home” for 9 months out of the year, so it needs to reflect a feeling of coziness.

The design allows a lot of room for students to add their unique touch, so the walls and ceiling are plain, painted gypsum wall board. The luminaires should be simple and provide the space with ambient light. A warmer color temperature of 3000K would be good design for this space, to make the room feel cozier and livable. Direct glare in the space is undesirable, since students will be studying, reading and doing homework in the space. For a comfortable work plane, direct glare should be eliminated. Harsh light distributions on surfaces should be avoided, but having a non-uniform lighting scheme would be acceptable. It is important to have uniform light distribution on the desks. Students will be studying and reading there, and non-uniform light levels would distract from the task. The most important surfaces to be lit in the space are the desk area and the closet. The task plane is located on the desk, and it is where students will be doing most of their homework and studying.

## EXISTING LIGHTING

The luminaires in the dorm rooms are simple surface mounted fixtures. There are two luminaires in the center of the room for general ambient light, and one over each closet for task lighting.

**Dorm Existing Luminaire Schedule**

Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F13	Ceiling Surface	Tiella	800FM360LS-CF	2-CFT 13W	120V	11" Surface-mounted compact fluorescent downlight with a frosted glass diffuse white lens.
F14	Ceiling Surface	Tiella	800FM360SS	1-T4 G9 40W	120V	6" Surface-mounted halogen downlight with a frosted glass diffuse white lens.

Assumptions:

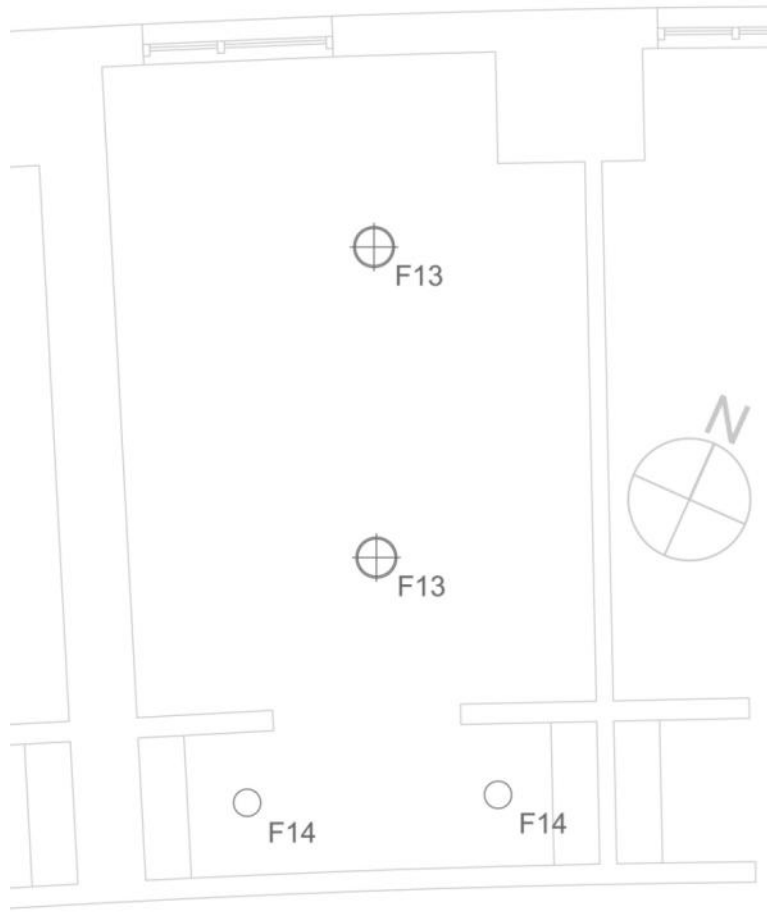
- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 5
- Expected Dirt Depreciation = 12%

**Dorm Existing Light Loss Factors**

Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F13	IV	Direct	0.98	0.87	0.97	0.86	0.711
F14	IV	Direct	1.0	0.87	0.97	1.0	0.844



## DORM ROOM EXISTING LAYOUT



**Dorm Existing Illuminance Levels**

Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
7.26 fc	10-30 fc	6.08 fc	3-5 fc

The illuminance level calculations are very different than the target illuminance specified in the IESNA Lighting Handbook. The horizontal levels fall under the target, and are not conducive to a satisfactory work environment, possibly straining students' eyes if they read too long in this environment. The vertical illuminance levels are very close to IESNA requirements.

<b>Dorm Existing Power Density</b>			
<b>Fixture</b>	<b>Watts</b>	<b>Quantity</b>	<b>Total Watts</b>
F13	56	2	112
F14	20	2	40
<b>Space Type</b>			Dorm Room
<b>Area (ft<sup>2</sup>)</b>			240
<b>Allowable LPD (W/ft<sup>2</sup>)</b>			1.1
<b>Allowable Watts</b>			264
<b>Actual LPD (W/ft<sup>2</sup>)</b>			0.63
<b>Actual Watts</b>			152

The existing power density calculations are below the recommended ASHRAE 90.1-2004 code. The actual LPD is 0.47 W/ft<sup>2</sup> lower than the allowable. While the energy savings throughout all the dorm rooms add up, the illuminance levels are too low, and students will be forced to bring their own luminaires which will be using more energy.

#### EXISTING EMERGENCY LIGHTING

There are no emergency lighting fixtures in the dorm rooms.

## DORM ROOM NEW LIGHTING

The new lighting design in the dorms will focus more on peripheral and task emphasis. The main illuminance in the room will come from wall surface up/downlights, located on the walls above the desks. A Kurt Versen ceiling surface mounted compact fluorescent downlight gives the room some extra ambient non-uniform light if its occupants desire. Linear fluorescent strip lights mounted under the shelves in the closet allow for illuminance in the closets.

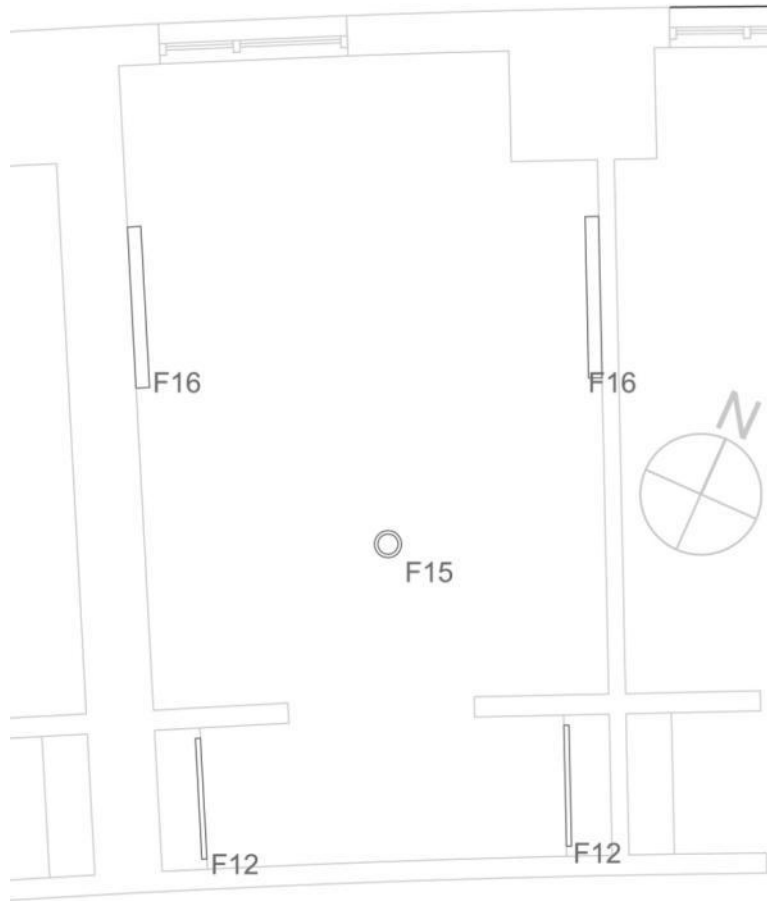
Dorm New Luminaire Schedule						
Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F12	Ceiling Surface	Prudential Lighting	P-T5-STD-1T5-03-BWE-277	1-F28T5	277 V	Surface-mounted fluorescent strip light, rigid housing.
F15	Ceiling Surface	Kurt Versen	P602	2-CFQ26W	277 V	8" surface-mounted compact fluorescent downlight.
F16	Wall Surface	Mark Architectural	DUW-4-1T5-277-EB	1-F28T5	277 V	Wall-mounted fluorescent up/downlight.

### Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 3
- Expected Dirt Depreciation = 12%

Dorm New Light Loss Factors							
Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F12	IV	Direct	0.98	0.87	0.98	0.92	0.79
F15	IV	Direct	0.98	0.87	0.98	0.85	0.71
F16	I	Direct/Indirect	0.98	0.93	0.95	0.92	0.79

## DORM ROOM NEW LAYOUT



**Dorm New Illuminance Levels**

Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
22.0 fc	10-30 fc	6.3 fc	3-5 fc

The illuminance level calculations are very close to the target illuminance specified in the IESNA Lighting Handbook. They allow for a non-uniform distribution, with light levels between 7.7 fc and 43.2 fc. The horizontal levels are slightly above the recommended illuminance levels, and are still conducive to a satisfactory work environment.

<b>Dorm New Power Density</b>			
<b>Fixture</b>	<b>Watts</b>	<b>Quantity</b>	<b>Total Watts</b>
F12	32	2	64
F15	54	1	54
F16	63	2	112
<b>Space Type</b>			
<b>Area (ft<sup>2</sup>)</b>			Dorm Room
<b>Allowable LPD (W/ft<sup>2</sup>)</b>			240
<b>Allowable Watts</b>			1.1
<b>Actual LPD (W/ft<sup>2</sup>)</b>			264
<b>Actual Watts</b>			1.01
<b>Actual Watts</b>			244

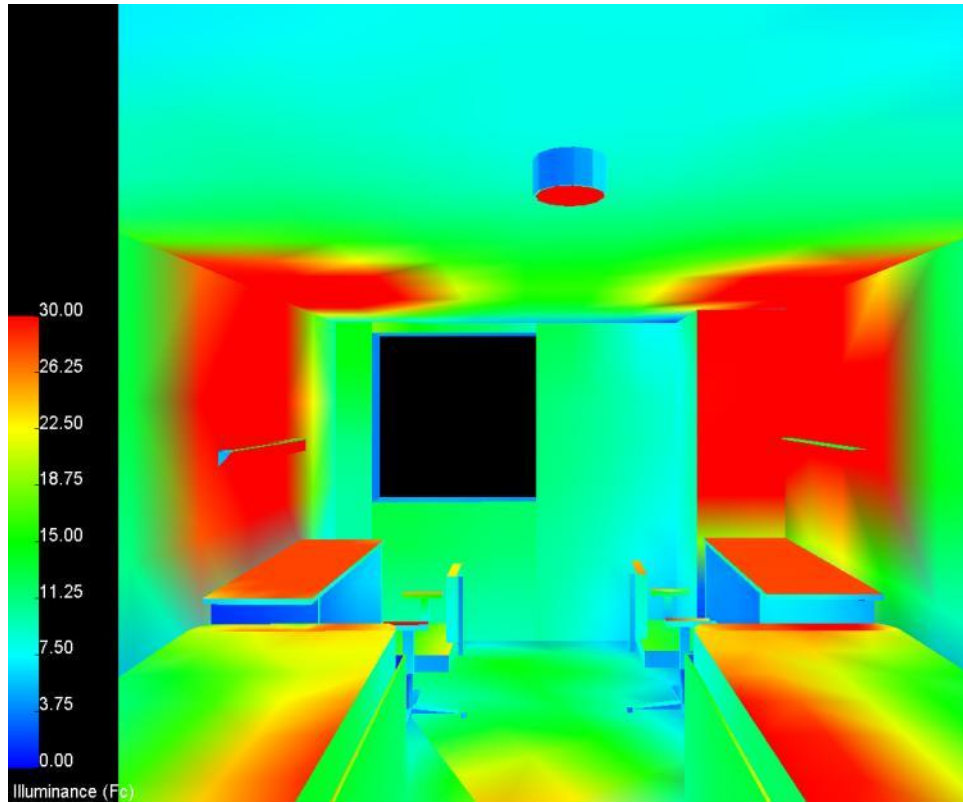
The new power density calculations are still considerably under the recommended ASHRAE 90.1-2004 code. The actual LPD is 0.09 W/ft<sup>2</sup> lower than the allowable. Throughout all 29 dorm rooms in the building, 580 W are saved as opposed to using the maximum allowable watts.

## NEW EMERGENCY LIGHTING

There will be no emergency lighting in the new dorm room design.

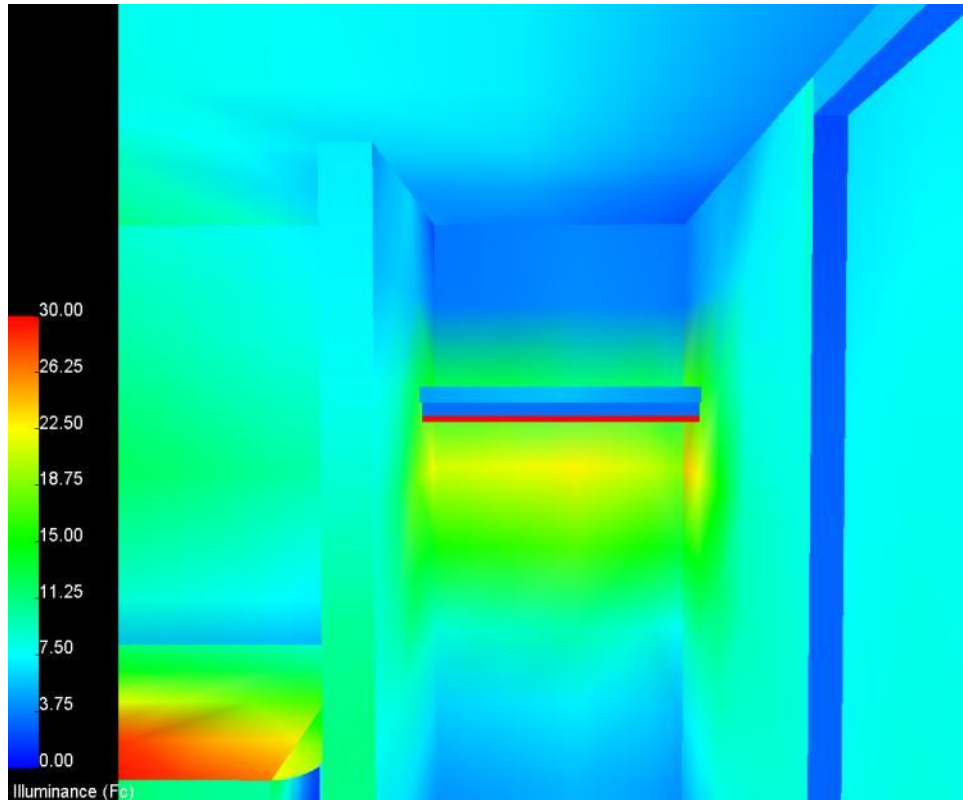


Dorm Room RGB (above) and Pseudo Color (below) Renderings



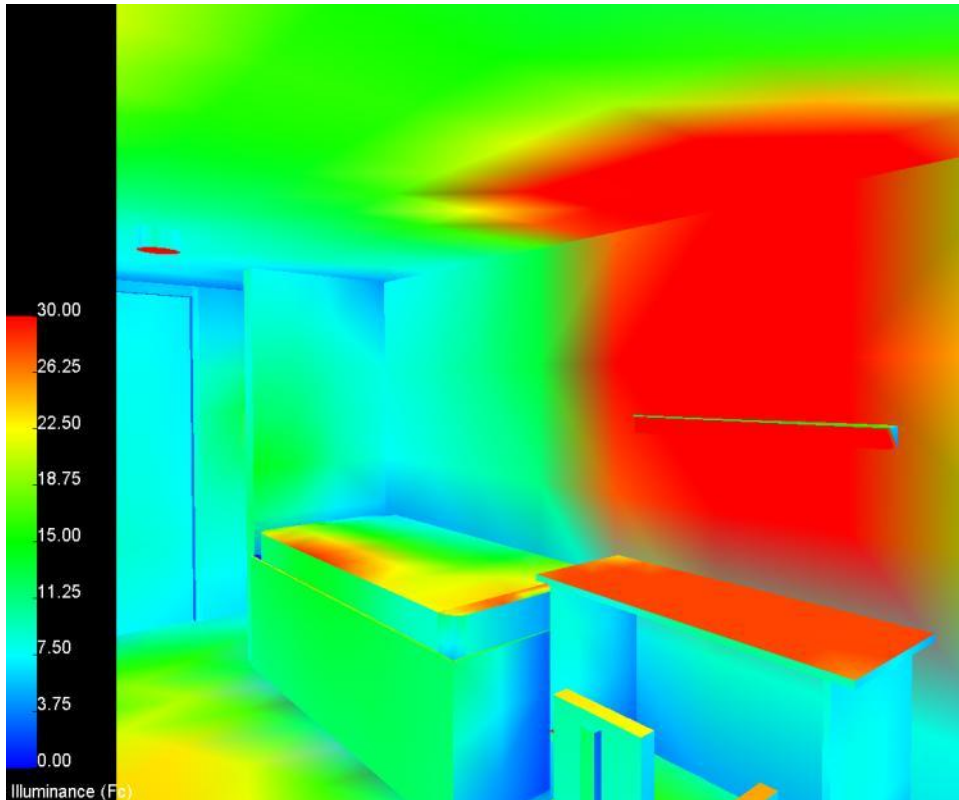


Dorm Room Closet RGB (above) and Pseudo Color (below) Renderings





Dorm Room RGB (above) and Pseudo Color (below) Renderings





**ISOLINE COLOR KEY**

Dark Blue	Green	Red	Purple
15 fc	25 fc	35 fc	45 fc

