

Lighting Depth

Introduction

The Student Resource Building will primarily function as a pedestrian gateway in addition to being a gathering point for students. As such, the lighting system proposed herein will be used as an adjective to metaphorically reinforce these two ideals: a pedestrian thoroughfare as well as becoming the modern day interpretation of the piazza of old. The design shall utilize light sources in such a manner as to celebrate the unique architecture of this space on top of providing visual interests to all its occupants.

A complete analysis of the following four spaces will be conducted:

1. North-East Plaza
2. Forum
3. Multi-Purpose Room
4. Student Resource Center

In addition to providing the necessary documentation to accurately describe the physical placement of each luminaire in the four spaces, a full discussion of each proposed lighting system will include but are not limited to: pertinent design criteria, power densities, light loss factors (LLFs), control and light level performance data. Where appropriate, a daylight control study will also be done to determine how much energy savings can be achieved during daylight hours. In all scenarios, the redesign shall be compliant with IESNA lighting requirements as well as satisfy California's Title 24 energy requirements.

Note: *The lighting control intent for each space will be discussed in the electrical depth work.*

Daylight Elements

Window Data

Window Type	Properties
Operable Windows	“Wausau’s 2250, 3250 and 3250H Series” 5” thick U Factor: 0.43-0.62 Solar Transmittance Coefficient: 32-45
Sliding Windows	“Wausau’s 4100HS” 4-1/2” thick U Factor: 0.49-0.57 Solar Transmittance Coefficient: 32-35

Glazing Data

Glass Type

GL1:

"PPG Solarban 60 System"

Inner Light: 1/4" thick

Air Space: 1/2" thick

Outer Light: 1/4" thick

Insulating Vision Glass w/ low E
(General application on South and West
Façade)

Pertinent Locations:

Forum, Student Resource Center

GL2:

"PPG Solarban 60 System"

Insulating Vision Glass w/o low E
(Throughout)

Pertinent Locations:

Forum, Student Resource Center,
Multipurpose Rm

GL3:

"PPG Uncoated Clear Glass"

Min. 1/4" Clear Monolithic Glass

Locations:

(Throughout)

Properties

Transmittance:

UV: 4%

Visible Light: 52%

Total Solar Energy: 20%

Reflectance:

Visible Light: 10%

Total Solar Energy: 8%

U-Values:

Winter Night-time: 0.29

Summer Day-time: 0.28

Shading Coefficient (SC): 0.35

Solar Heat Gain Coefficient (SHGC): 0.31

Light to Solar Gain: 1.68

(see GL1)

Transmittance:

UV: 50%

Visible Light: 79%

Total Solar Energy: 61%

Reflectance:

Visible Light: 15%

Total Solar Energy: 12%

U-Values:

Winter Night-time: 0.47

Summer Day-time: 0.50

Shading Coefficient (SC): 0.81

Solar Heat Gain Coefficient (SHGC): 0.70

Light to Solar Gain: 1.13

North East Plaza

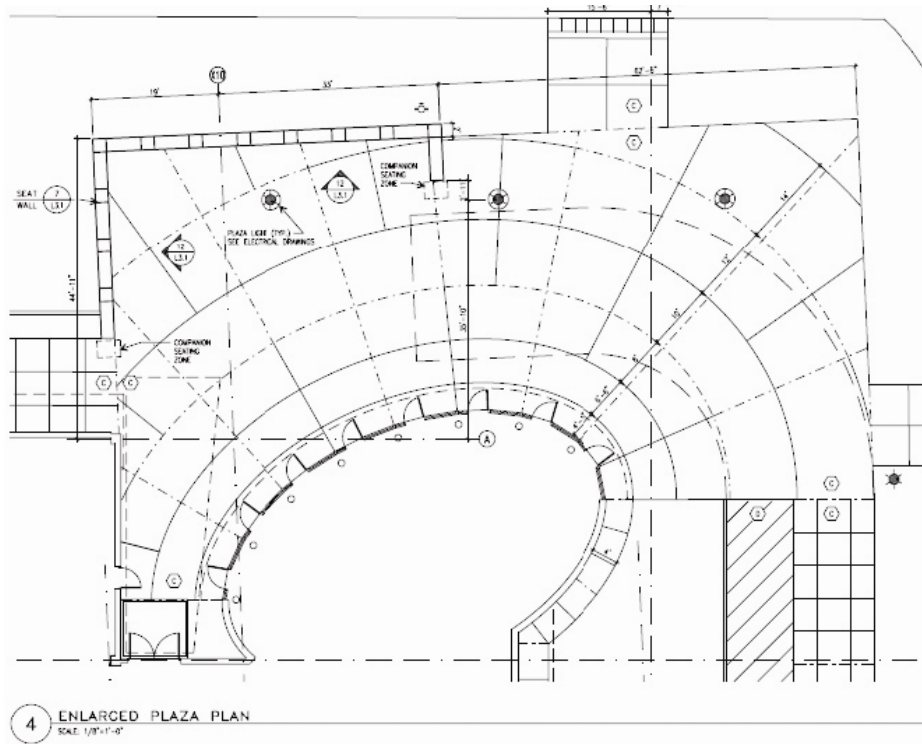


Design Synopsis

As the name suggests, the North-East Plaza is a public space located on the NE corner of the Student Resource Building. It covers an area of approximately 5840 sf and lends itself well to becoming a comfortable outdoor environment for people to socialize. The plaza's orientation opens up to the central campus area. Special architectural features of this space can be seen in the engraved elliptical lines on the concrete paving which resonates the form of the multipurpose room whose façade gently protrudes into the space. Materials that are used in this plaza include: steel, architectural concrete and metal cladding.

Though the original design proposed the use to LED light sources to illuminate the elliptical contours on the ground, this has changed due to power density reasons. After much re-iteration, the new design satisfies this requirement and is still in tune with the original aim of providing a visually interesting space through the careful placement of light.

Existing Layout



Enlarged Plaza Plan

Design Criteria

Space and Luminaire Appearance

The plaza was conceived as a space that allows people to gather and exchange ideas. Therefore, it is crucial that the space appears pleasant and inviting. Luminaire styles should conform to not only campus architecture but more importantly, the modern aesthetics of the SRB.

Color Appearance and Color Contrast

Color tones of the building material contrast with that of a person's skin. Spectral output of selected lamps should account for this to provide good color rendition of space occupants and their surroundings. Color contrast and variation may be desired to make this plaza more visually appealing.

Controls

To satisfy Title 24 requirements for automatic shutoff, all outdoor luminaires installed in this space should have automatic shut off controls which are regulated by photo-control sensors.

Glare Considerations

In order to satisfy the objective of providing a comfortable environment for social interaction, direct and reflected glare should be avoided. Special consideration should be taken to avoid reflected glare from the glazing of the adjacent Multipurpose Room.

Light Distribution and Uniformity

To create a space with a higher degree of visual interest, light should not be too evenly distributed on all surfaces of the plaza. However, a sufficient level of uniformity must be met for public safety.

Light Pollution/ Trespass

In the interest of complying with the Dark Sky Ordinance, light pollution/ trespass should be avoided. Fixtures chosen should comply with the cut-off criteria as stated in California's Title 24 (2006). Light trespass is less of a concern in this space since the plaza is surrounded on all sides

by campus property.

Facial/ Object Modeling

Again, the plaza is used for social interaction. Therefore, facial modeling considerations also warrant design attention.

Points of Interest

The plaza has a very unique form. Light should be used to enhance the architectural details present here.

Shadows and Peripheral Detection

In the interest of public safety, sufficient light levels should be provided to avoid any shadows or overly dark areas in the plaza. Space occupants should be able to see their surroundings.

IESNA Illuminance Recommendations

Horizontal

Cat. A: Public spaces 30 lx (3 fc)



Vertical

Cat. A: Public spaces 30 lx (3 fc)

Schedules and Lighting Layouts

Luminaire Schedule



Location: NE Plaza (Open Area)

Type	Quantity	Catalog No.	Lamping / Ballast	Watts/ Fixture	Ballast/ fixture	Total Watts	Voltage
E1 	4	Bega 8945MH Linear Ceramic Metal Halide Luminaire	1- (L2) GE Lighting 20017 CMH/T/U/942/G12	173	1 - (B1) Advance Transformers: 71A5437BP	692	277V
E2 	11	Bega 8083 Small scale drive over low voltage halogen uplight	1- (L6) GE Lighting 42959 Q5T3/CL	5	-	55	277V

Total Watts: 747 **W**
Space Area: 5348 **SF**
Achieved Power Density: 0.14 **W/SF**
Allowed Power Density: 0.17 **W/SF**
Status: Ok

Luminaire Schedule

Location: NE Plaza (Canopy)

Type	Quantity	Catalog No.	Lamping / Ballast	Watts/ Fixture	Ballast/ fixture	Total Watts	Voltage
E2 	4	Bega 8083 Small scale drive over low voltage halogen uplight	1- (L6) GE Lighting 42959 Q5T3/CL	5	-	20	277V
E3 	4	Bega 4096P Linear fluorescent wall mount fixture	1 - (L7) Philips Lighting 347476 PL-L 50W/830/4P RS	54	1 - (B3) Advance Transformers: REL-1TTS50	216	277V

Total Watts: 236 **W**
Space Area: 492 **SF**
Achieved Power Density: 0.48 **W/SF**
Allowed Power Density: 0.50 **W/SF**
Status: Ok

Ballasts Schedule

Location: NE Plaza

Type	Manuf.	Catalog Name	# Lamps	Ballast Type	Start Method	Input Watts	Ballast Factor	Power Factor	THD (%)	Assoc. Fixture
B1	Advance Transformers	71A5437BP	1 - (L2)	Magnetic Standard	Ignitor	173	1.00	0.9	<10%	E1
B3	Advance Transformers	REL-1TTS50	1 - (L7)	Electronic	Rapid Start	54	0.98	0.98	<20%	E3

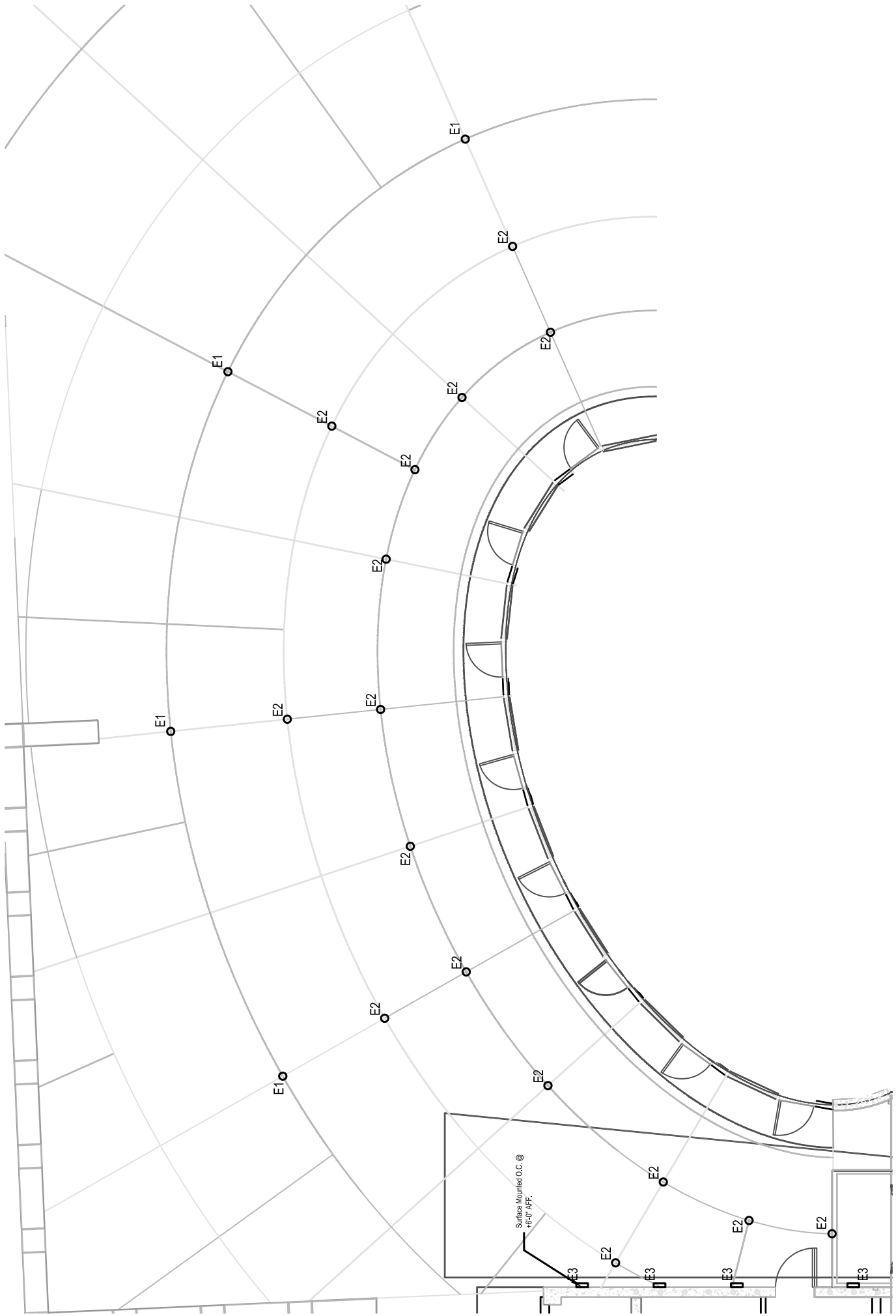
Lamp Types Schedule

Location: NE Plaza

Type	Manuf.	Designation	Rated Wattage	Base	CRI / CCT	Rated Life (hrs)	Initial Lumens	Assoc. Fixture	Assoc. Ballast
L2	General Electric	92584 CMH/TU/942/G12	150	G12	82 / 3000K	12000	14000	F5	B1
L6	General Electric	42959 Q5T3/CL	5	G4	80 / 3000K	2000	60	E2	-
L7	Philips Lighting	347476 PL-L 50W/830/4P RS	50	2G11	82 / 3000K	10000	4000	E3	B3

Notes: Please see Appendix A for all product cutsheets and complete schedules.

Lighting control intent is located in the electrical depth.



UCSB Student Resource Building

NE Plaza - Lighting Plan

Scale: $\frac{3}{8}$ " = 1'-0"



Assumptions

Surface Reflectances

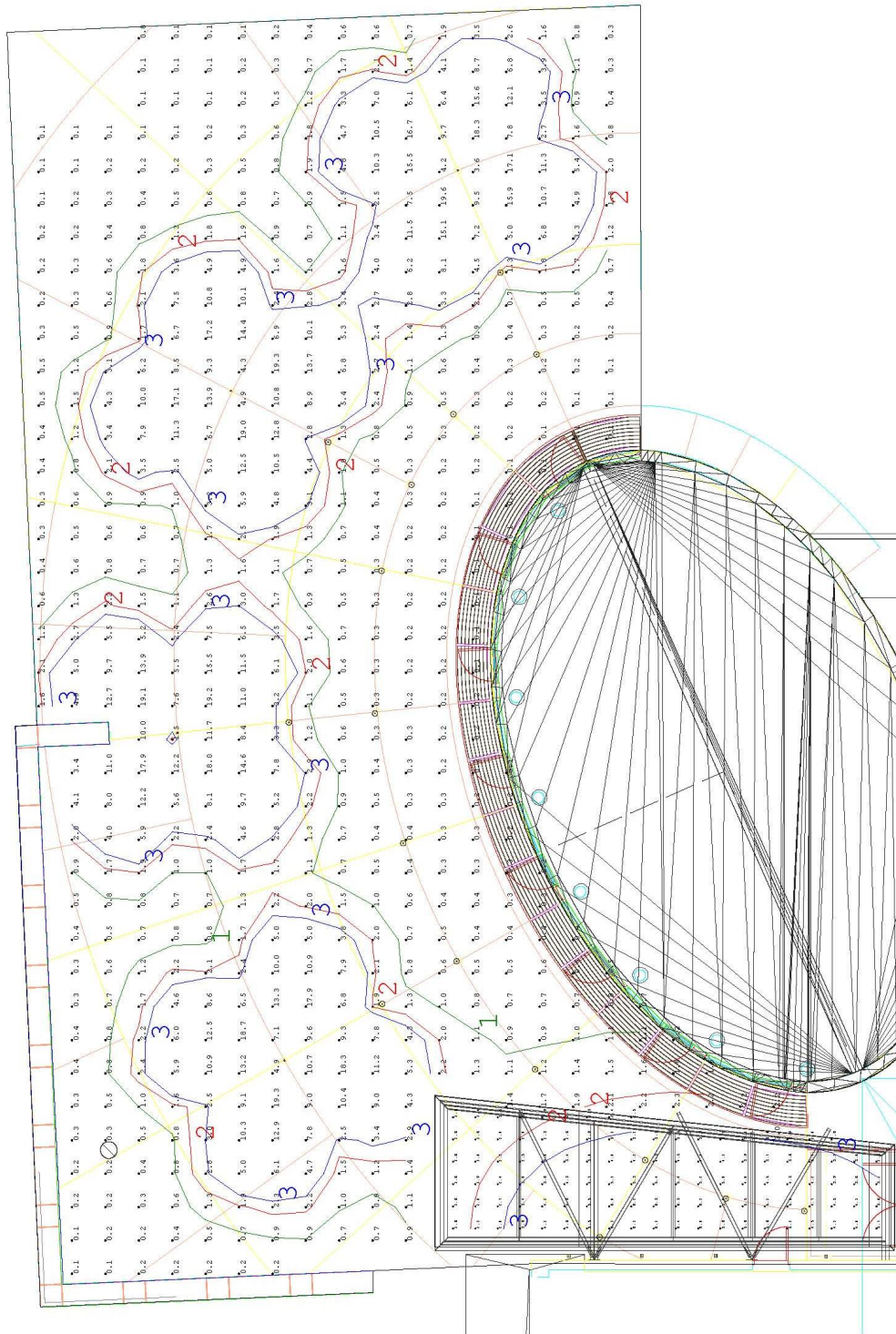
Material	Location	Reflectance (%)
Steel	Canopy Structure	22
Architectural Concrete	Plaza	20
Metal Cladding	Building Facade	30

Light Loss Factors

Label	IESNA Maintenance Category	Distribution Type	Environment Cleanliness	Cleaning Cycle	LLF				TOTAL
					LLD	LDD	RSDD	BF	
E1	VI	Direct	Dirty	12mo	0.79	0.88	0.95	1.00	0.66
E2	VI	Direct	Dirty	12mo	0.85	0.88	0.95	1.00	0.71
E2	VI	Direct	Dirty	12mo	0.94	0.88	0.95	0.98	0.77

Illuminance Data

(Software used: AGI32 – v1.92)

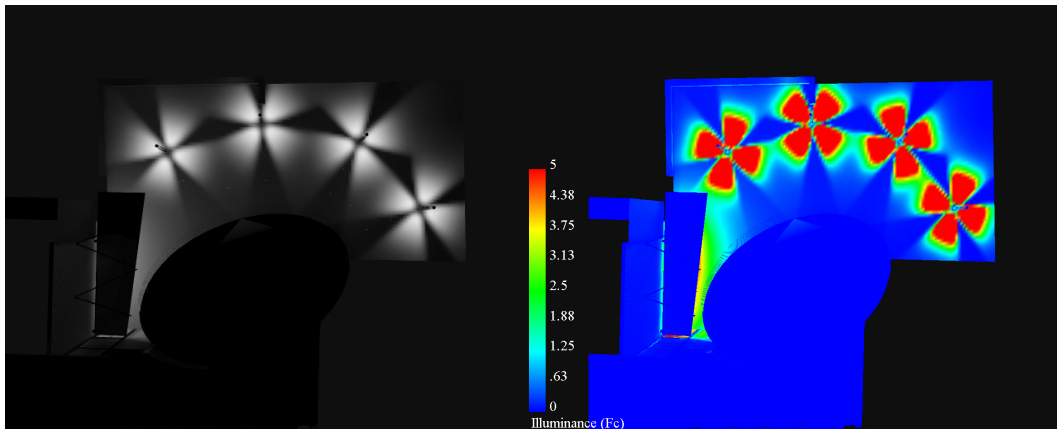


AGI32-v1.92 Statistical Summary

Calculation Area	Average Illuminance (fc)	Max. (fc)	Min. (fc)	Avg/min	Max/min
General Plaza Area (Ground-level)	3.1	19.6	0.1	2.7	196.0
Entrance Canopy Area (Ground-level)	3.8	6.4	1.4	5.0	10.8

Radiosity Renderings

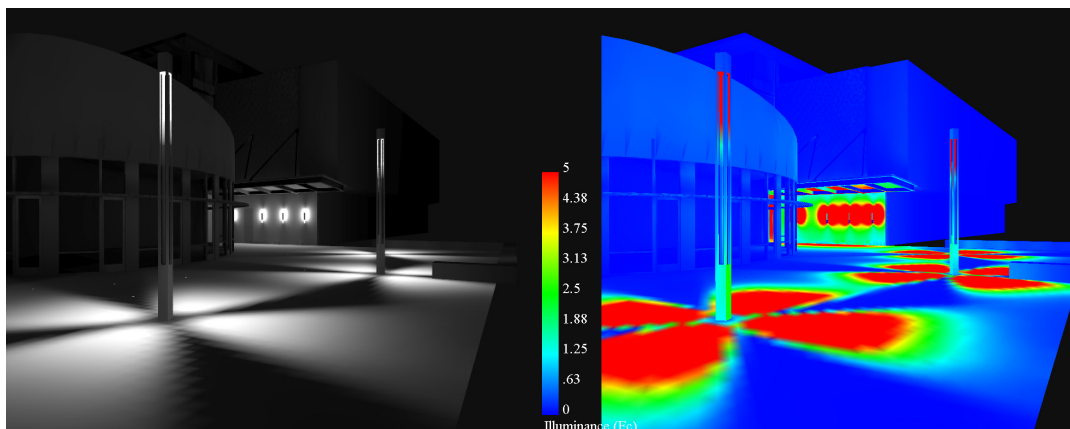
Plan View



Rendering

Pseudo Rendering

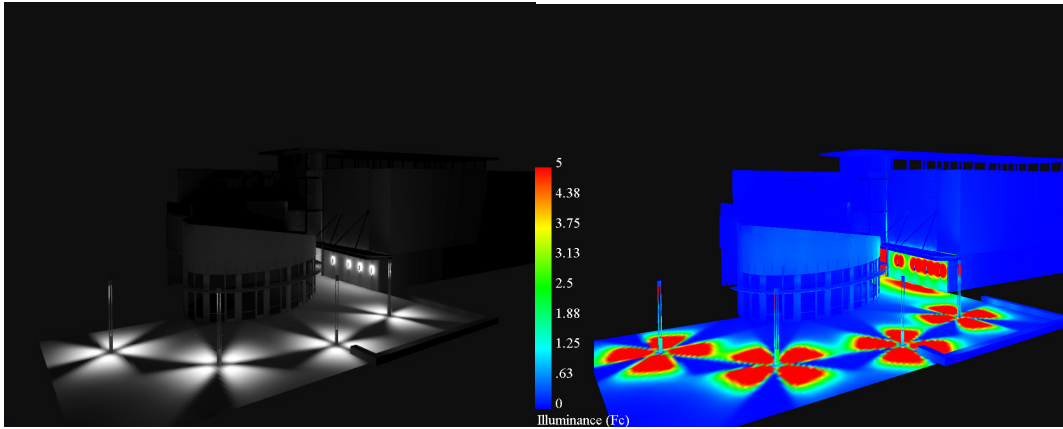
Approach from Central Campus



Rendering

Pseudo Rendering

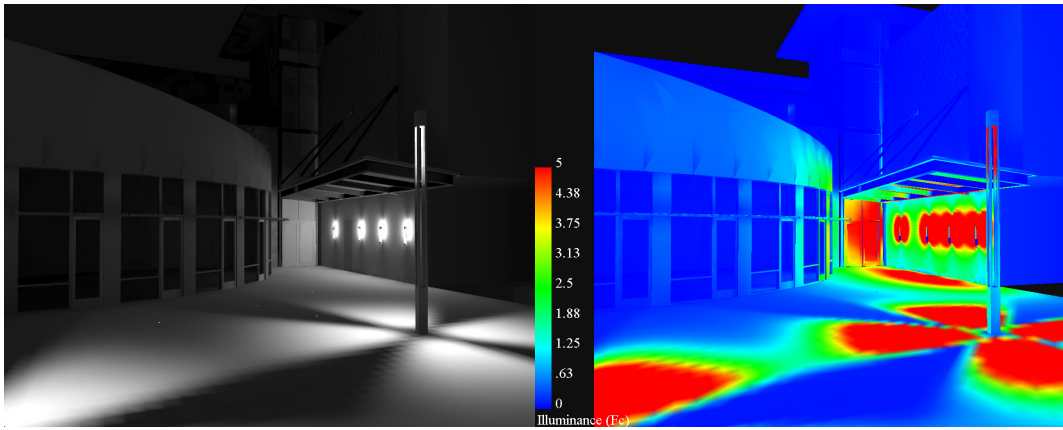
Perspective View



Rendering

Pseudo Rendering

View of Entrance Canopy



Rendering

Pseudo Rendering



Night Time Rendering

Evaluation

In addition to providing visual interest to the space, the lighting system that has been implemented satisfies the basic illumination requirements described by the IESNA that are typical of an outdoor gathering space. The adaptation of the existing elliptical form of this plaza as a regulatory constraint of the placement of lights has successfully created a lighting solution that ties together this space and the adjacent Multipurpose Room.

Forum



(View from east end)

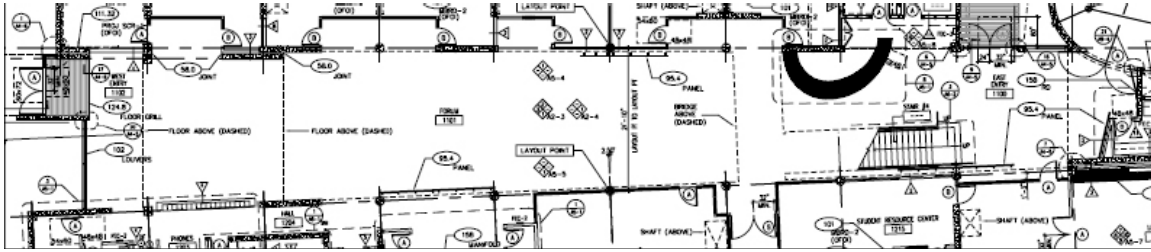
Design Synopsis

At the heart of the Student Resource Building is the triple height Forum. This space serves as the main pedestrian thoroughfare between inner campus and the adjacent neighborhood of Isla Vista. An exposed staircase provides access to the upper levels where corridors have views that overlook into the space. The roof covering this portion of the roof is raised, allowing space for clerestories to wrap around all four sides hence allowing ample daylight penetration throughout the year.

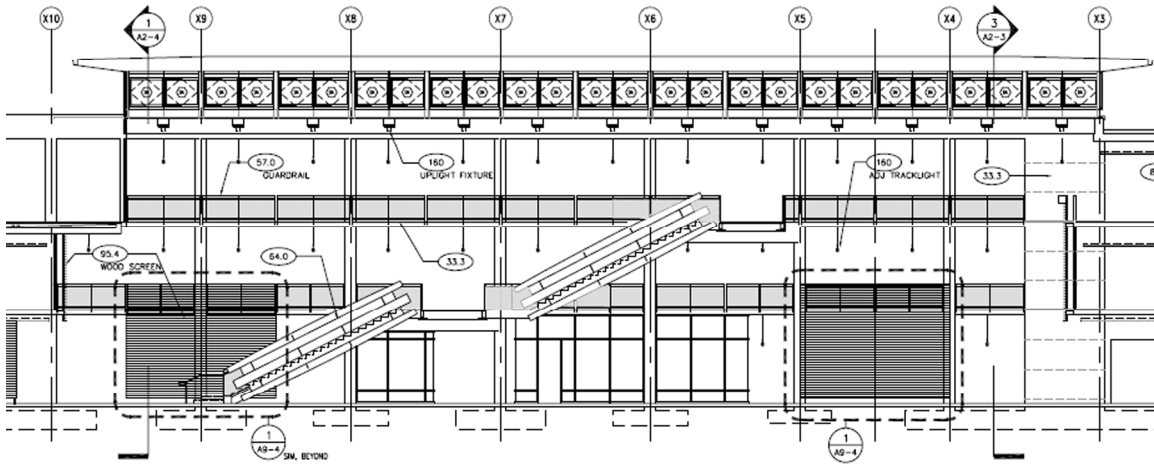
After reflecting on the comments at the schematic design presentations, some adjustments have been made to the design. For example, instead of relying on reflected light from the ceiling to provide for the ambience required in this space, a series of localized linear pole lights have been put in place at ground level to provide for a design that has a more “human-scale”

Other changes include the installation of LED under-railing lights to provide sufficient light on the stairs and pedestrian bridges as well as the led panels on the walls. In consideration of the overall power density in this space, the linear fluorescent strip lights originally proposed to highlight the wood screen has been deleted from the original design.

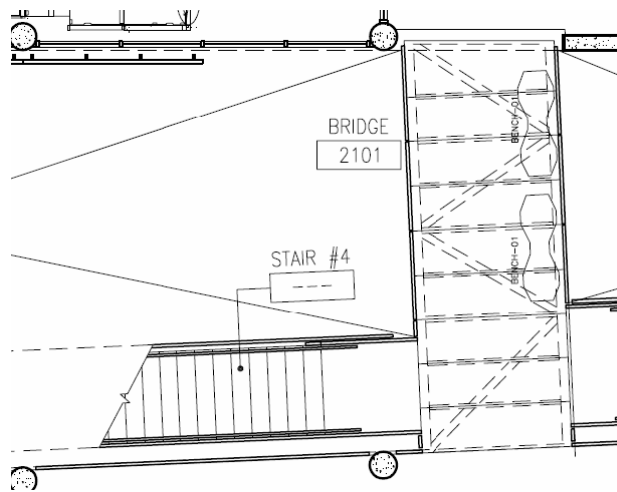
Existing Layout



1F Floor Plan



Forum Section



Pedestrian Bridge Plan (Typ.)

Design Criteria

Space and Luminaire Appearance

The space is subject to a high pedestrian volume due to the fact that it connects Isla Vista with UCSB. Therefore, lights should be placed in such a manner as to make the architecture of this space more visually appealing. Like the North-East Plaza, people will also use this place to socialize and as such, a comfortable and inviting appearance will also be desired. Luminaire appearance should conform to the architectural design in this space and if possible, hidden from view.

Color Appearance and Color Contrast

Selected lamps should provide for balanced color rendition of people and materials in this space. Color contrast and variation may be desired to increase visual interest in this space.

Daylight Integration and Controls

Clerestories in this area provide a great opportunity for daylight integration. Daylight harvested should aim at providing all ambient illumination during the day and if necessary be supplemented by the light installed here. This system should be controlled by strategically placed roof-top photocells that will monitor available daylight levels throughout the day and respond by adjusting the level of artificial illumination. Direct and reflected glare from the sun should also be avoided and if necessary, provide additional shading devices within the atrium space.

Glare Considerations

As most of the surrounding office spaces on either side of the atrium on all three levels utilize a glass façade, direct and reflected glare both from the sun or installed lighting should be avoided to satisfy the need for providing a comfortable environment for social interaction.

Light Distribution and Uniformity

A sufficient level of uniformity should be provided to meet the needs of occupant safety but some variation is desired to create visual interests.

Surface Luminances

The goal is use light as a means to draw people from point to point across this atrium; therefore overly uniform luminance levels on surfaces of this space should be avoided. For task-areas such as on the tables and counter, luminance ratio should be optimized to allow for best possible task-visibility. IESNA recommends the following luminance ratios:

3:1 Task and Adjacent Surround

10:1 Task and Non-Adjacent Surfaces

This is especially critical for the projection screen near the west end of the forum area to allow for good visibility.

Facial/ Object Modeling

In any space that caters for social interaction, good facial rendition is required.

Points of Interest

The psychological experience of this space by occupants should be considered. By nature, people are drawn to areas of higher luminance and so with that in mind, points of interest should be created to provide visual interests as well as draw people from one end to the other. Light should also be used in such a manner as to draw attention to the unique architectural features of this space such as the exposed staircase and the cross bracing system that supports the clerestory area.

Shadows

Sufficient illumination should be provided to avoid any over dark/ shadowed areas. This is particularly important on the study tables and ceramic counter top areas on the ground level.

Source/ Task/ Eye Geometry

Sources should be positioned to avoid reflected glare on the task plane.

Surface Characteristics

There are a variety of different surfaces in this atrium. Though light should be used to accentuate their materiality, special care should be given to those surfaces that have a relatively higher level of reflectance (i.e. ceramic counter area) to avoid discomfort glare.

IESNA Illuminance Recommendations

Horizontal

Cat. B: Simple orientation for short visits	50 lx (5 fc)
Cat C: Working spaces where simple visual tasks are preformed	100 lx (10 fc)







Vertical

Cat. A: Public spaces	30 lx (3 fc)
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Schedules and Lighting Layouts

Luminaire Schedule

Location: Forum

Type	Quantity	Catalog No.	Lamping / Ballast	Watts/ Fixture	Ballast/ fixture	Total Watts	Voltage
F1 	144	Ambisol UK, SlabLight™ (0.5 x 1 FT) Surface-mounted LED panel w/ non transparent fascia	(L1) White Philips LumiLEDs	1	-	144	277 V
F2 	22	Color Kinetics, Colorblast 123-000005-00	36 High intensity RGB LEDs	50	-	1100	277 V
F5 	10	Bega 8945MH Linear Ceramic Metal Halide Luminaire	1- (L2) GE Lighting 20017 CMH/T/U/942/G12	173	1 - (B1) Advance Transformers: 71A5437BP	1730	277V
F6 	177	IO Lighting, Lux Rail 0-06-SSS-1-PM-GL-45-5K-1-277-1	9 LEDs (6 warm white, 3 cool white)	8	-	1416	277V
F7 	8	Selux, "M100": MIRS-1T5HO-OD-RC-008-WH-277-DM Thin Profile Recessed Fixture	1 - (L5) GE Lighting 39982 F28W/T5/830	33	1 - (B2) Lutron Eco-10: ECO-T528-277-2	264	277V
F9 	9	IO Lighting, Line Series 2.0 0-04-1-3k-90-100-1-18-2-4	LEDs (warm white)	15	-	135	277

Total Watts:	4789	W
Space Area:	4052	SF
Achieved Power Density:	1.18	W/SF
Allowed Power Density:	1.20	W/SF
Status:	Ok	

Based on calculations, the implemented design falls under the 1.20 W/sf allowed for this type of space as specified by California's Title 24 (2006).

Lamp Types Schedule

Location: Forum

Type	Manuf.	Designation	Rated Wattage	Base	CRI / CCT	Rated Life (hrs)	Initial Lumens	Assoc. Fixture	Assoc. Ballast
L1	Philips Lighting	LumiLEDS	(see F1)	n/a	70 / 4500K	50000	120	F1	-
L2	General Electric	92584 CMH/T/U/942/G12	150	G12	82 / 3000K	12000	14000	F5	B1
L5	General Electric	46704 F28W/T5/830/ECO	28	G5	85 / 3000K	30000	2900	F4	B2

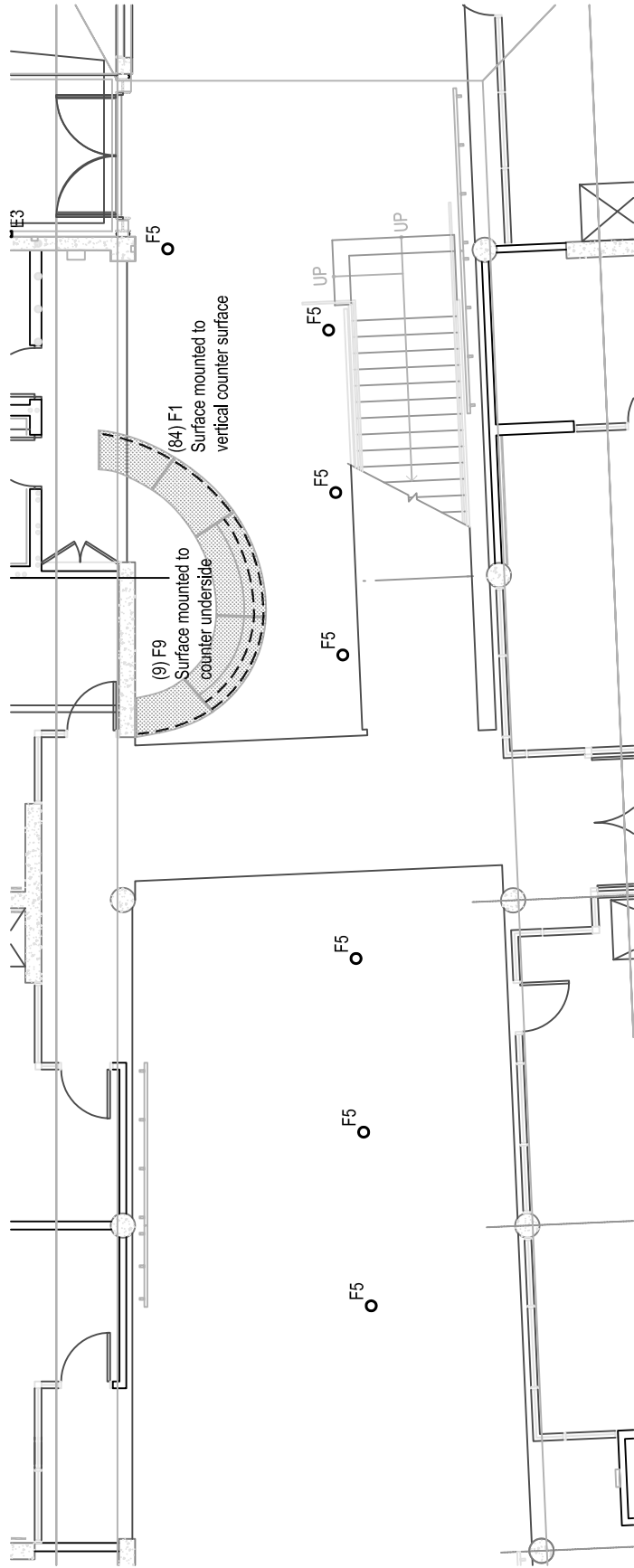
Ballasts Schedule

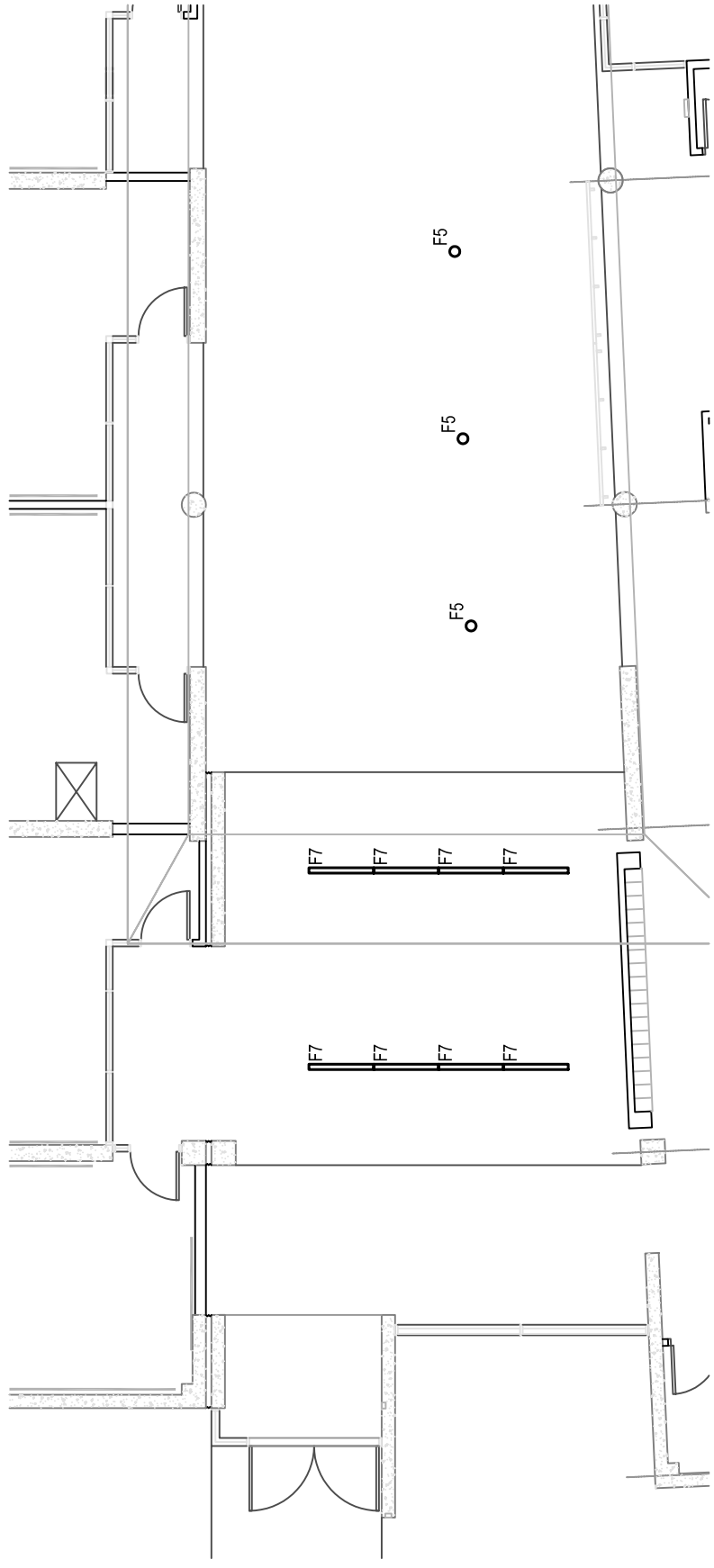
Location: Forum

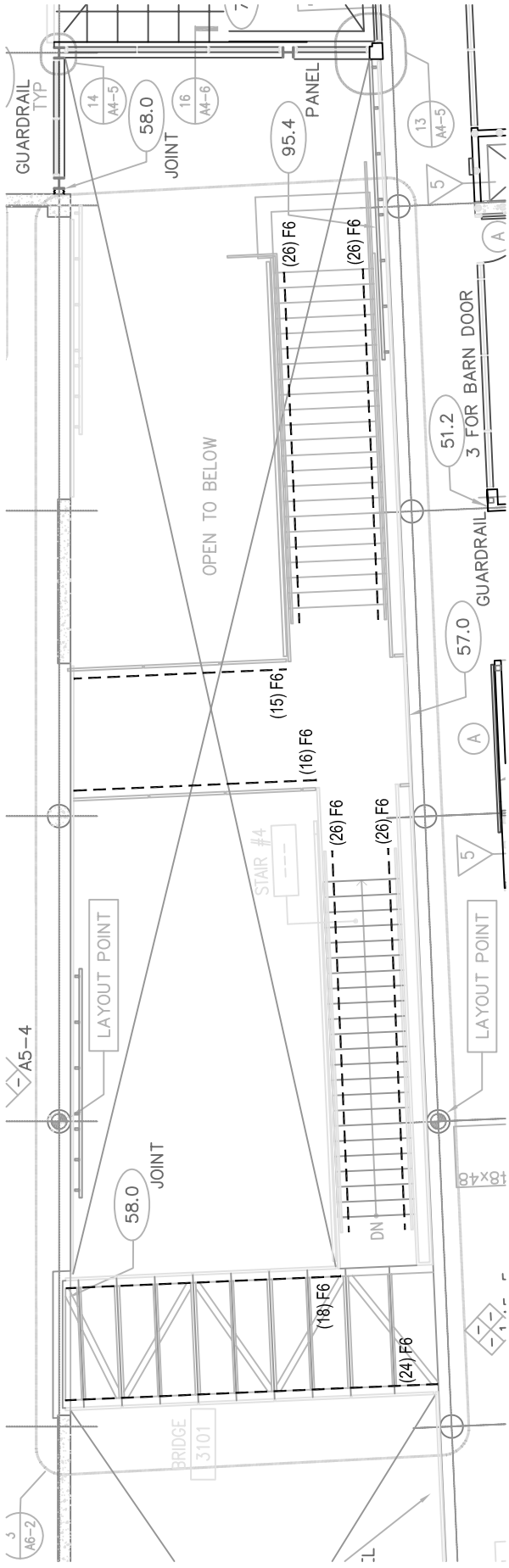
Type	Manuf.	Catalog Name	# Lamps	Ballast Type	Start Method	Input Watts	Ballast Factor	Power Factor	THD (%)	Assoc. Fixture
B1	Advance Transformers	71A5437BP	1 - (L2)	Magnetic Standard	Ignitor	173	1.00	0.9	<10%	F5
B2	Lutron	Lutron Eco-10: ECO-T528-277-2	2 - (L5)	Electronic Dimming (10%)	Programmed Rapid Start	66	1.00	>0.95	<10%	F4, F7

Notes: Please see Appendix A for all product cutsheets and complete schedules.

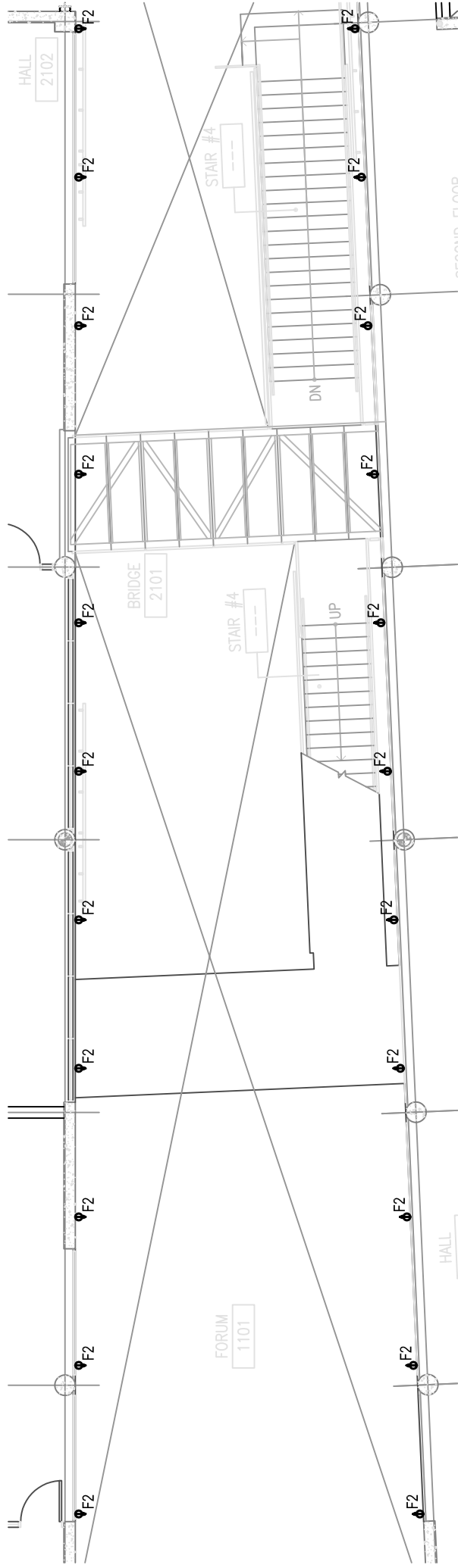
Lighting control intent is located in the electrical depth.



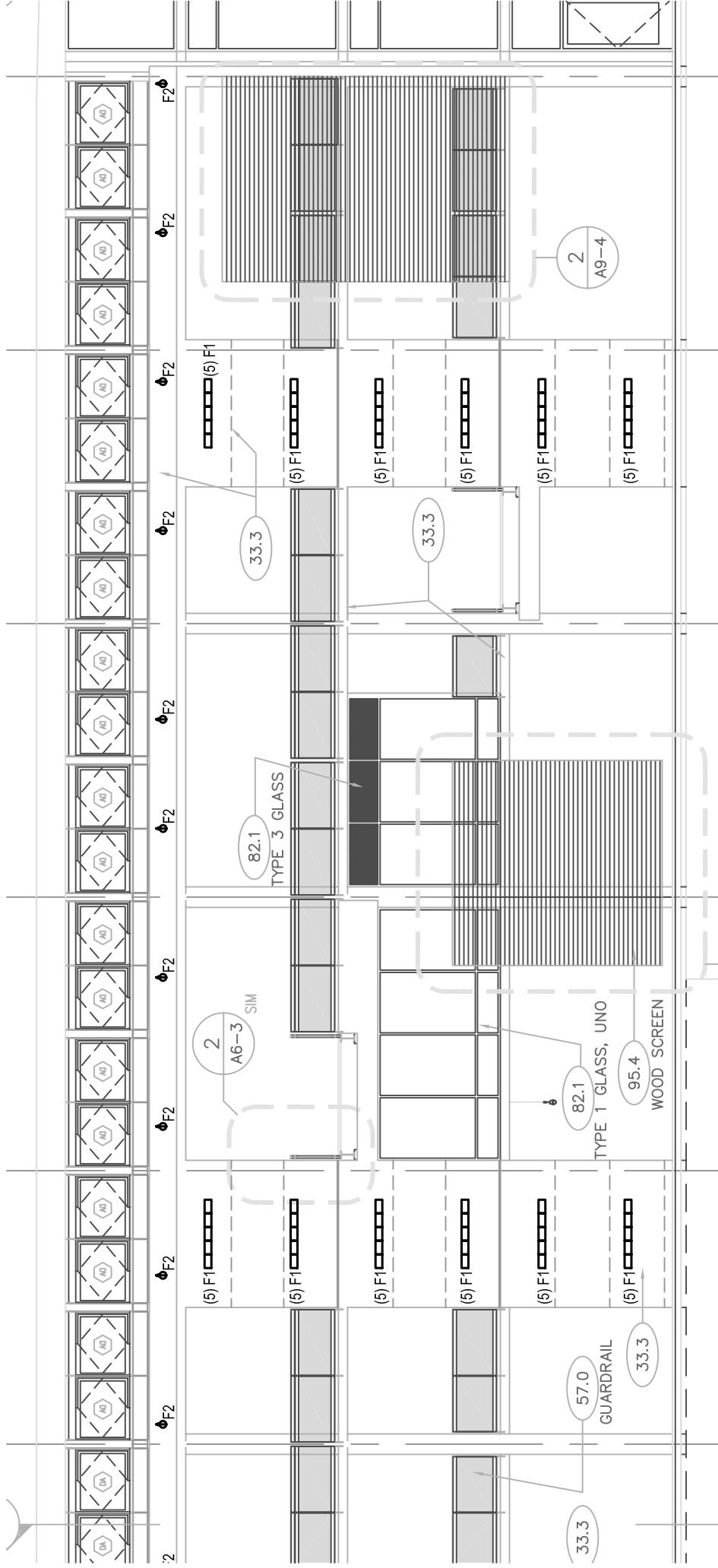




All F6 fixtures mounted @ 42" above tread height



All F2 fixtures mounted @ 37'-6" AFF.



UCSB Student Resource Building

Forum - Lighting Detail : F1 Location

Scale: 3/8" = 1'-0"



Assumptions

Surface Reflectances

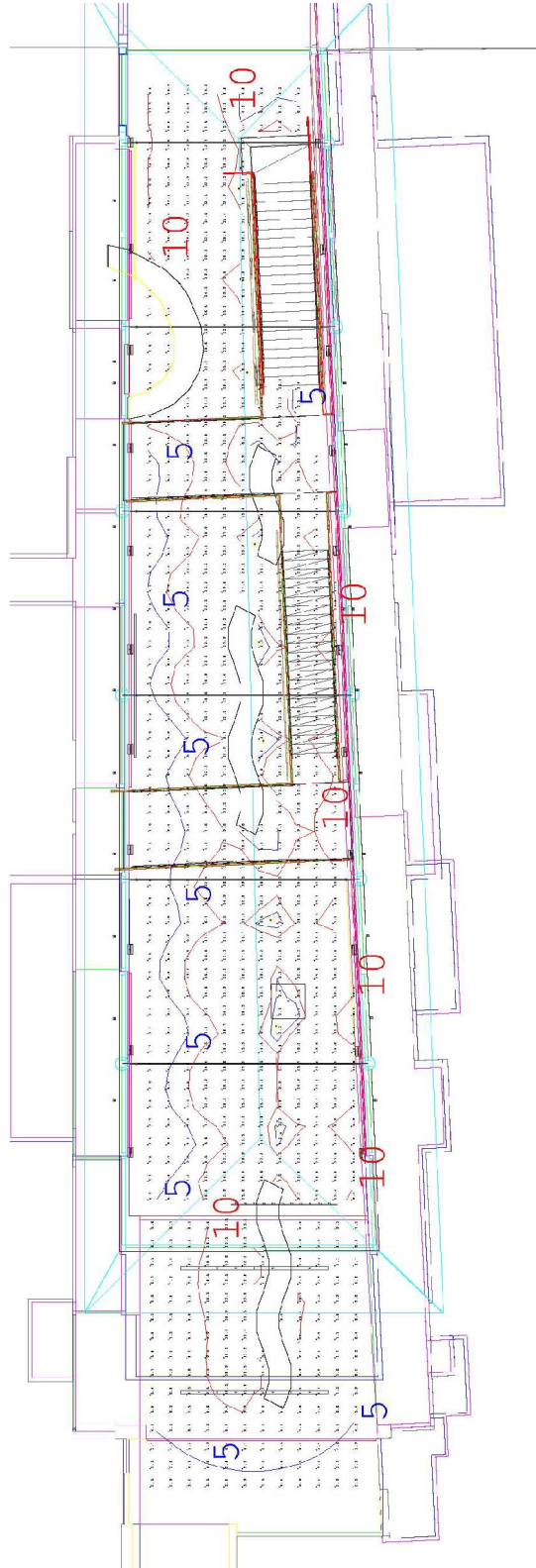
Material	Location	Reflectance (%)
Steel	Stairs and Cross Bracing	22
Ceramic Floor Tiles	1F	42
Walls	-	50
Wood	Decorative screen adjacent to stairs	8
Ceiling	-	80
Stone Counter	1F Counter	40
Carpet	2F and 3F	27
Projector Screen	-	50
Architectural Concrete	Throughout	20

Light Loss Factors

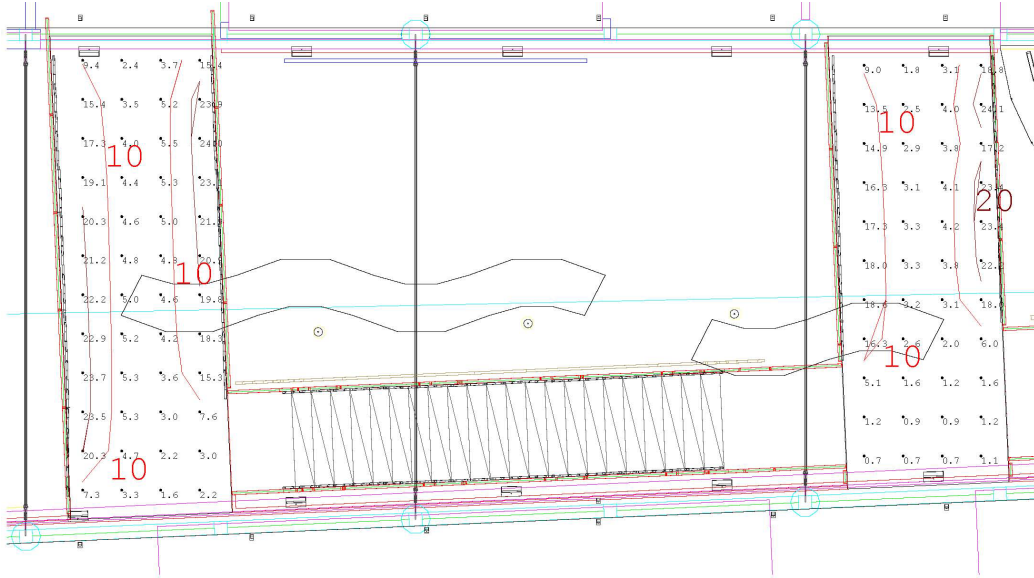
Label	IESNA Maintenance Category	Distribution Type	Environment Cleanliness	Cleaning Cycle	LLF				TOTAL
					LLD	LDD	RSDD	BF	
F1	VI	Direct	Clean	12mo	0.98	0.86	0.95	1.00	0.80
F2	VI	Direct	Clean	12mo	0.98	0.88	0.98	1.00	0.85
F5	VI	Direct	Clean	12mo	0.79	0.88	0.96	1.00	0.67
F6	IV	Direct	Clean	12mo	0.94	0.88	0.96	1.00	0.79
F7	V	Direct	Clean	12mo	0.94	0.88	0.97	1.00	0.80
F9	IV	Direct	Clean	12mo	0.94	0.88	0.98	1.00	0.81

Illuminance Data

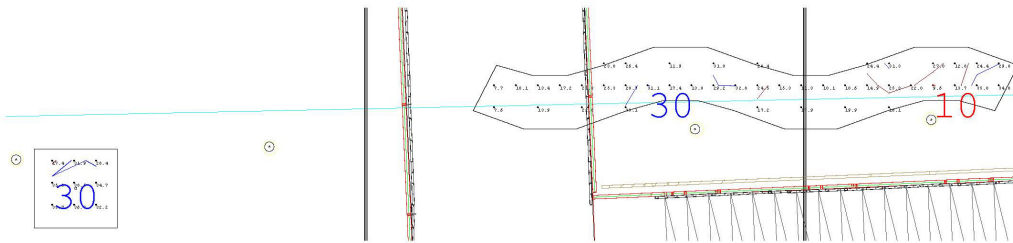
(Software used: AGI32 – v1.92)



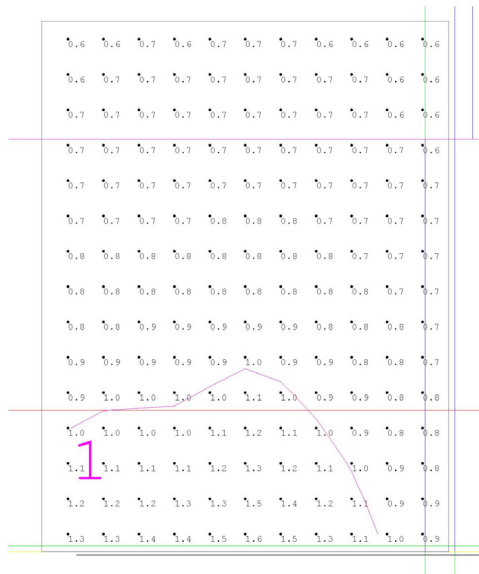
1F Ground: Illuminance Contours



Pedestrian Bridges: Illuminance Contours



1F Furniture: Illuminance Contours



Vertical Projection Screen: Illuminance Contours

AGI32-v1.92 Statistical Summary

Calculation Area	Average Illuminance (fc)	Max. (fc)	Min. (fc)	Avg/min	Max/min
First Floor Ground * (open area)	13.2	39.7	1.4	9.4	28.4
First Floor Ground (covered area including west entry area)	7.6	13.1	2.5	3.0	5.2
Pedestrian Bridge (2F)	7.9	24.2	0.7	11.3	34.6
Pedestrian Bridge (3F)	10.6	24.1	1.7	6.4	14.2
Curved Seating (Ground-level)	19.7	33.4	3.8	5.2	8.8
Info Desk (ground level)	34.1	145.0	2.6	13.1	55.9
(see note) Table Top (ground level)	23.8	34.4	5.5	4.3	6.3
Projection Screen (vertical illuminance)	1.0	1.8	0.7	1.4	2.6

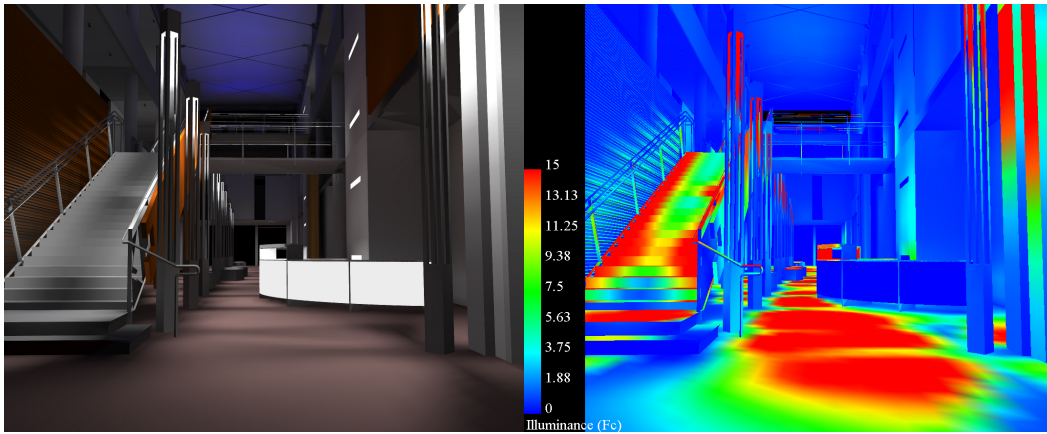
(*) Vertical Illuminance Data

(**) Assumed to be 2.5 ft AFF

Note: Task lighting system implemented may be dimmed to suit needs of user.

Radiosity Renderings

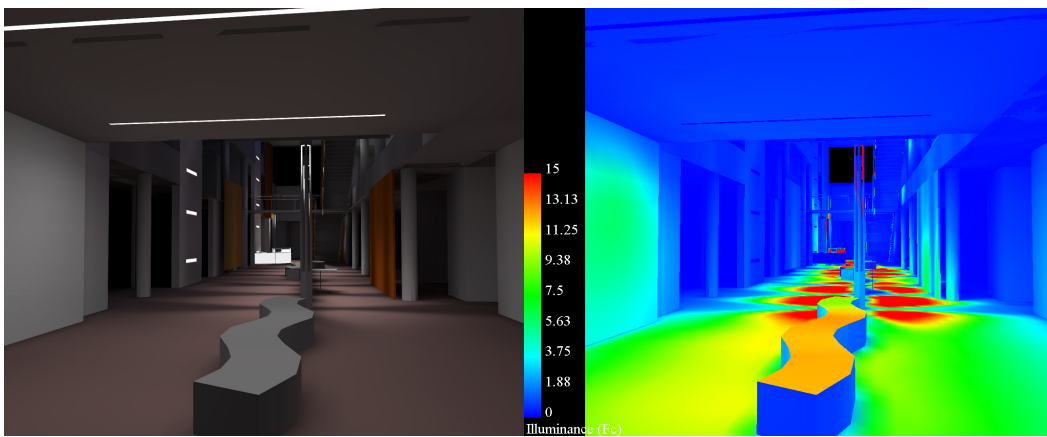
View from East End



Rendering

Pseudo Rendering

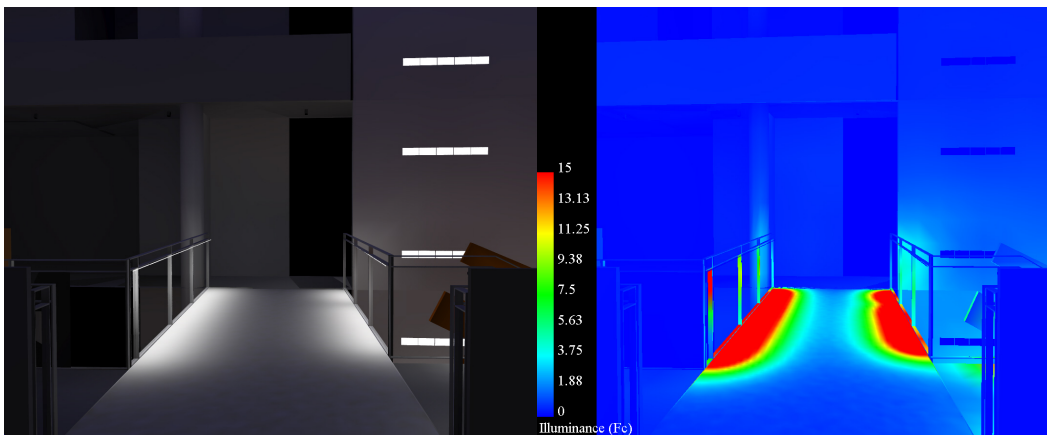
View from West End



Rendering

Pseudo Rendering

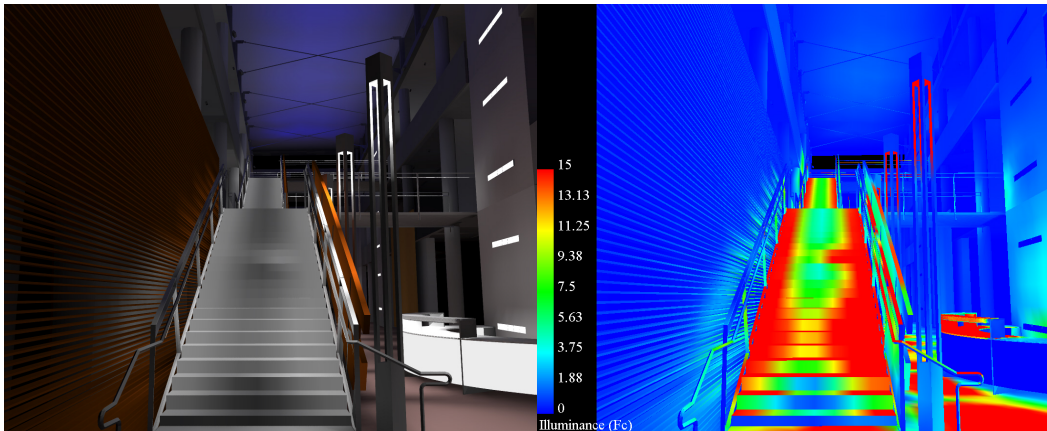
2F Pedestrian Bridge



Rendering

Pseudo Rendering

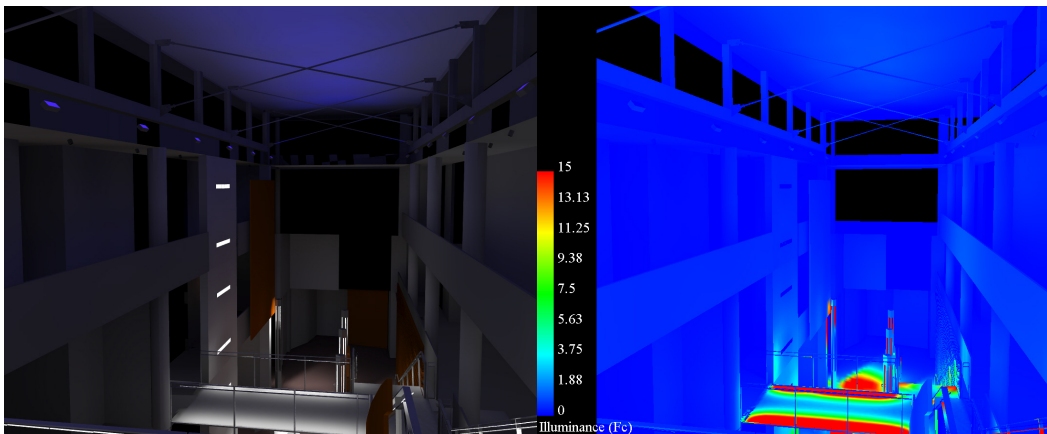
Exposed Staircase



Rendering

Pseudo Rendering

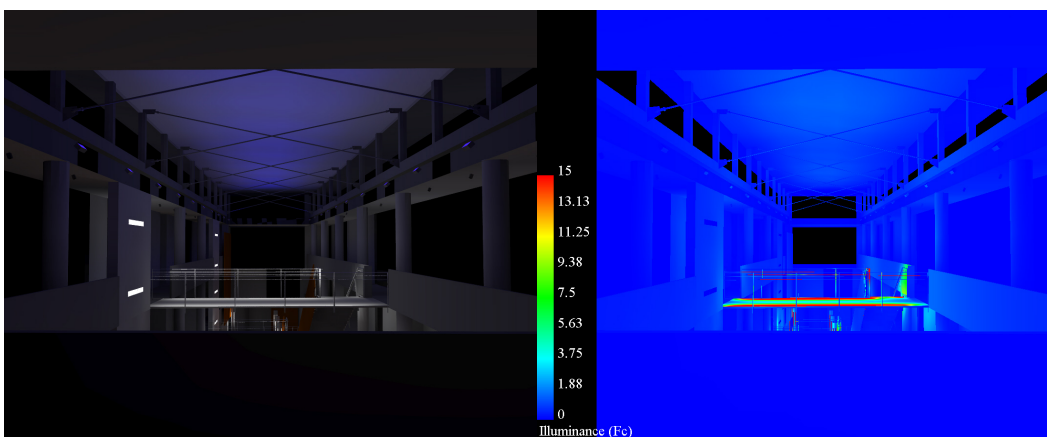
View from 3F Pedestrian Bridge



Rendering

Pseudo Rendering

View from 3F Forum



Rendering

Pseudo Rendering

Daylight Control

For most days throughout the year, a large amount of natural light enters this space through the clerestories that wrap on four sides above. Daylight analysis shows that the system implemented can be essentially switched off between 8am to 4pm after which artificial illumination will be necessary for most areas in this space. As this facility is open 24 hours a day during normal school operation, the ability to rely entirely on natural light for approximately 9 hours a day represents a considerable amount of energy savings. This is illustrated in the following calculation:

Total System Watts: 4.65 KW

$$4.65 \text{ KW} \times 9 \text{ hrs} \times 30 \text{ days/month} = 1255.5 \text{ KWH} / \text{month}$$

Energy Charge - \$/KWH/Meter/Month

<i>Summer Season:</i>	<i>On-Peak</i>	<i>\$ 0.23523</i>
	<i>Mid-Peak</i>	<i>\$ 0.20293</i>
	<i>Off-Peak</i>	<i>\$ 0.15792</i>

<i>Winter Season:</i>	<i>On-Peak</i>	<i>-</i>
	<i>Mid-Peak</i>	<i>\$ 0.16205</i>
	<i>Off-Peak</i>	<i>\$ 0.15792</i>

Approximate Average: \$0.18321

Therefore: 1255.5 KWH/month x \$0.18321 = \$230 savings per month

Over the course of a year: \$230 x 12 = \$2760 savings per year

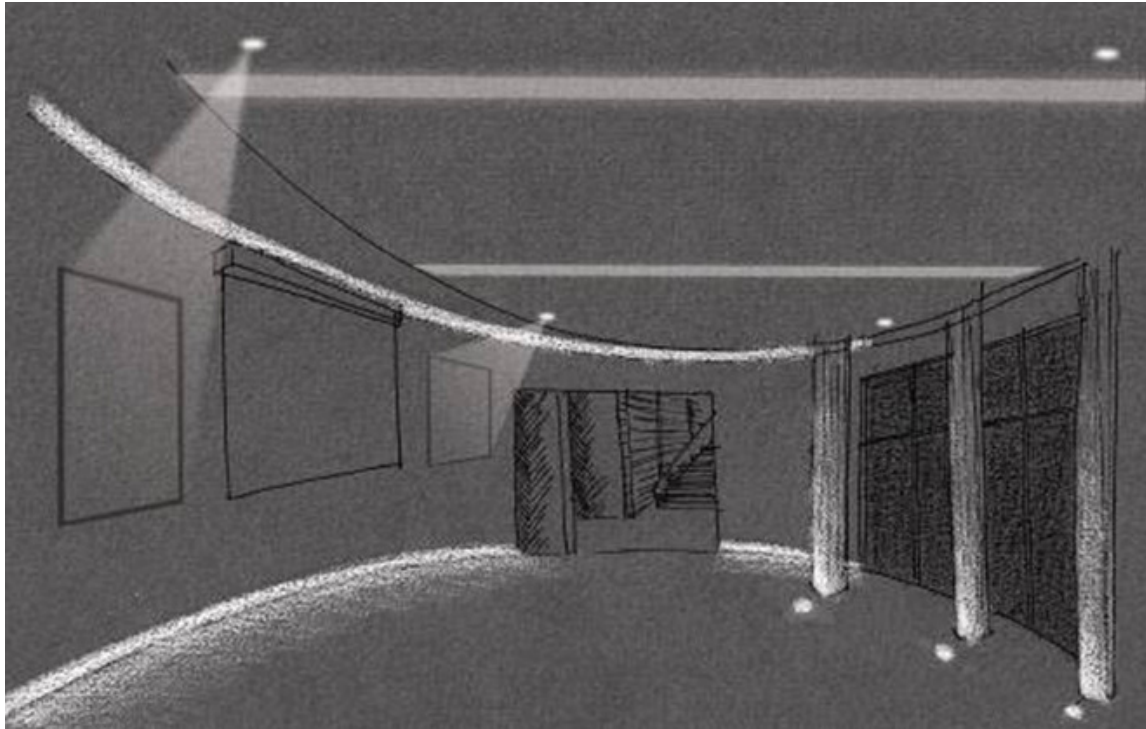
Assuming that the Student Resource Building lasts approximately 40 years, this represents an approximate savings of \$110,400 during its lifetime. If we consider the fact that energy cost are rising, the total savings over the same period can be expected to be more than what was just calculated.

Note: Please consult Appendix C for this space's existing daylight conditions.

Evaluation

In addition to providing visual interest to the space, the lighting system that has been implemented satisfies the basic illumination requirements described by the IESNA that are typical for a transitional space. The LED ceiling wash system implemented adds visual interest in this space during non-daylight hours as it creates an artificial night sky within this transition space by shading it with a solid blue color. Other elements include the linear LED panels that provide visual cues for movement and localized light columns that transform the space into an exterior streetscape.

Multipurpose Room



(Original schematic)

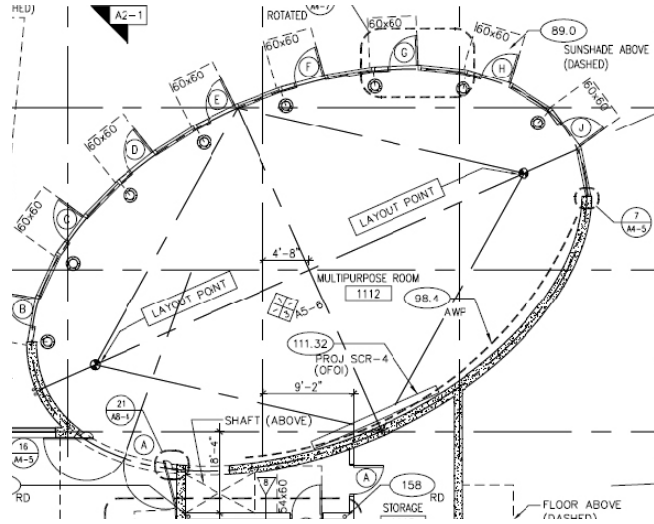
Design Synopsis

The 1590 sf Multipurpose room will be a place that will cater to many different functions. The space's elliptical form gently protrudes into the adjacent North East Plaza. On the interior south façade, acoustical wall panels have been put in place as a decorative element in addition to a tackable display rail, allowing vertical wall space for potential displays.

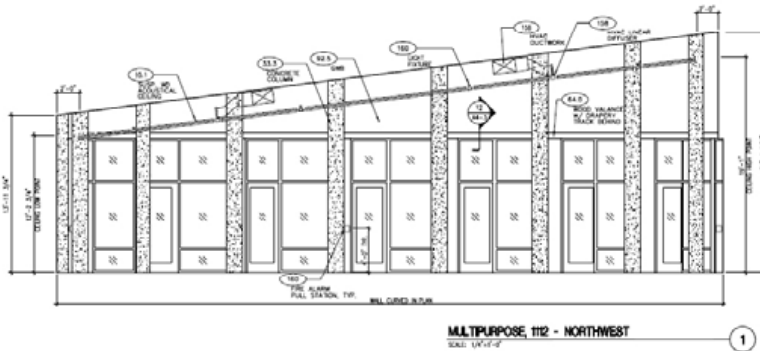
Since the schematic design presentation, some adjustments to the original concept have been made. For instance, the vertical recessed LED cove that wraps around the North Façade has been replaced by a very thin profile surface-mounted LED panel. In addition, the proposed ingrade uplights to highlight the columns along the north façade have now been removed due to lighting power density constraints as required by California's Title 24 (2005).

Adjustable accents shall still be used to provide sufficient illumination levels for vertical displays or exhibition pieces in addition to general overhead linear lighting to provide for necessary ambience.

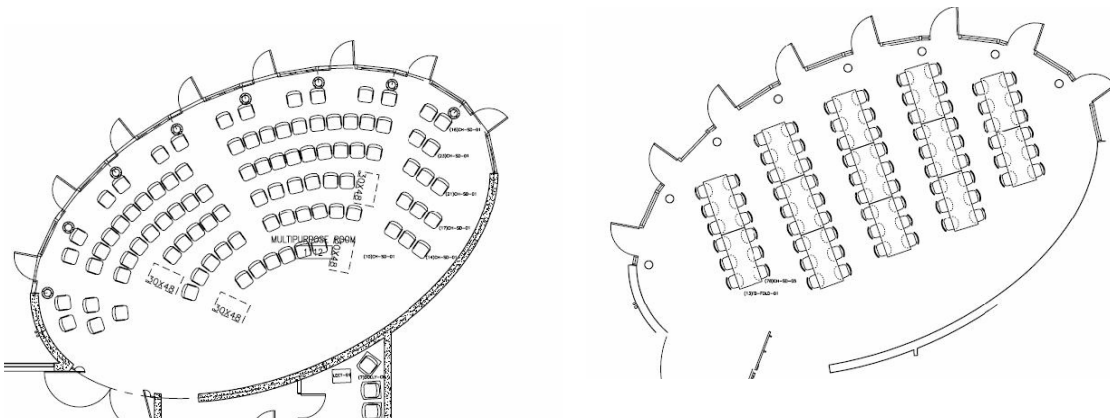
Existing Layout



Enlarged Floor Plan



Interior-North West Elevation



Proposed Furniture Configurations

Design Criteria

Space and Luminaire Appearance

The multipurpose room will serve many different social functions. Therefore, the space should be visually appealing to create a pleasant and comfortable environment that encourages social interaction. The room's unique elliptical form is also an architectural feature that should also be considered.

Special attention should be paid to the fact that the space is visible from the exterior by people who are in the adjacent North-East plaza. Design considerations of these two adjacent spaces should be considered collectively to enhance the overall visual appearance of this area of the SRB. That being said, the appearance of the luminaire should conform to the overall design of the two spaces to provide a "luminous connection" between them, whereby the two separate spaces will visually appear as one under the influence of the implemented lighting design.

Color Appearance and Color Contrast

Proper color rendition is crucial in this space, especially in terms of facial rendering since this room will cater to many social events. Color contrast and variation may be desired to increase visual interest in this space.

Controls

As the space will be infrequently used, an occupancy sensor shall be put in place to reduce the amount of waste light in order to conserve energy. The user shall also have the ability to control the ambient light level as needed to cater for the different visual tasks that may occur in this space during different types of events.

Glare Considerations

Special care must be taken to avoid direct and reflected glare from the sun. Sufficient shading devices must be installed to avoid this. Luminaires should also be placed as to avoid discomfort glare on the space occupants. Glare should also be avoided on vertical surfaces such as artwork that may be hung in the space.

Light Distribution and Uniformity

Although not required at all times, sufficient uniformity should be provided during situations when important visual tasks are performed within the space (i.e. VDT presentations and lectures). On other occasions, variation can add to the visual appeal of this room.

Surface Luminances

For task-related functions such as the performance of visual tasks, the IESNA Lighting Handbook recommends the following luminance ratios:

- 3:1 Task and Adjacent Surround
- 10:1 Task and Non-Adjacent Surfaces

For other events, this is of lesser importance but should be addressed for safety reasons.

Facial/ Object Modeling

To accommodate for the high level of social interaction that will occur in this room, good facial rendition is very important. Other distinct architectural features or objects that will be placed in this room also warrant design attention (i.e. during exhibitions). Installed lighting should also be able to provide high quality illumination of objects that may be exhibited in this space.

Points of Interest

This is desired to create a more visually appealing room. Luminance ratios should suggest to people using this room that there are areas of varying importance.

Shadows

Illumination provided should avoid shadow shadows on the task-plane when the space is configured for such purposes. For social gatherings, eye-socket shadows should be avoided as well.

Source/ Task/ Eye Geometry

This is very important as the room will be used to cater for events where tasks requiring a relatively high degree of visual acuity are required. Sources should be positioned accordingly to optimize source/task/eye geometry for such scenarios to avoid reflected glare on the task plane.

IESNA Illuminance Recommendations

Horizontal

Cat. C: Working spaces where simple visual tasks are performed 100 lx (10 fc)

Cat. D: Performance of visual tasks of high contrast and large size 300 lx (30 fc)

Vertical


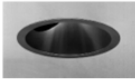

Cat. C: Working spaces where simple visual tasks are performed 100 lx (10 fc)

Cat. D: Performance of visual tasks of high contrast and large size 300 lx (30 fc)

Schedules and Lighting Layouts

Luminaire Schedule

Location: Multipurpose Room

Type	Quantity	Catalog No.	Lamping / Ballast	Watts/ Fixture	Ballast/ fixture	Total Watts	Voltage
F1 	133	Ambisol UK, SlabLight™ (0.5 x 1 FT) Surface-mounted LED panel w/ non transparent fascia	(L1) White Phillips LumiLeds	1	-	133	277 V
F3A 	10	Zumtobel, "Spec-3": S3D4360-S2-4660TC Recessed Adjustable Low Voltage Halogen Downlight	1 - (L3) GE Lighting 20843 Q50MR16/C/NFL25	71	-	710	12 V
F4 	16	Zumtobel, "Synto T5": SY5U-14-2285-W-DE277 (1 x 4 FT) Recessed Fixture	2 - (L5) GE Lighting 39982 F28W/T5/B30	66	1 - (B2) Lutron Eco-10: ECO-T528-277-2	1056	277V

Total Watts:	1899	W
Space Area:	1590	SF
Achieved Power Density:	1.19	W/SF
Allowed Power Density:	1.40	W/SF
Status:	Ok	

Based on calculations, the implemented design falls under the 1.40 W/sf allowed for this type of space as specified by California's Title 24 (2006).

Lamp Types Schedule

Location: Multipurpose Room

Type	Manuf.	Designation	Rated Wattage	Base	CRI / CCT	Rated Life (hrs)	Initial Lumens	Assoc. Fixture	Assoc. Ballast
L1	Philips Lighting	LumiLEDS	(see F1)	n/a	70 / 4500K	50000	120	F1	-
L3	General Electric	20835 Q50MR16/C/NFL25	50	Gx5.3	100 / 3050K	6000	720	F3A	-
L5	General Electric	46704 F28W/T5/B30/ECO	28	G5	85 / 3000K	30000	2900	F4	B2

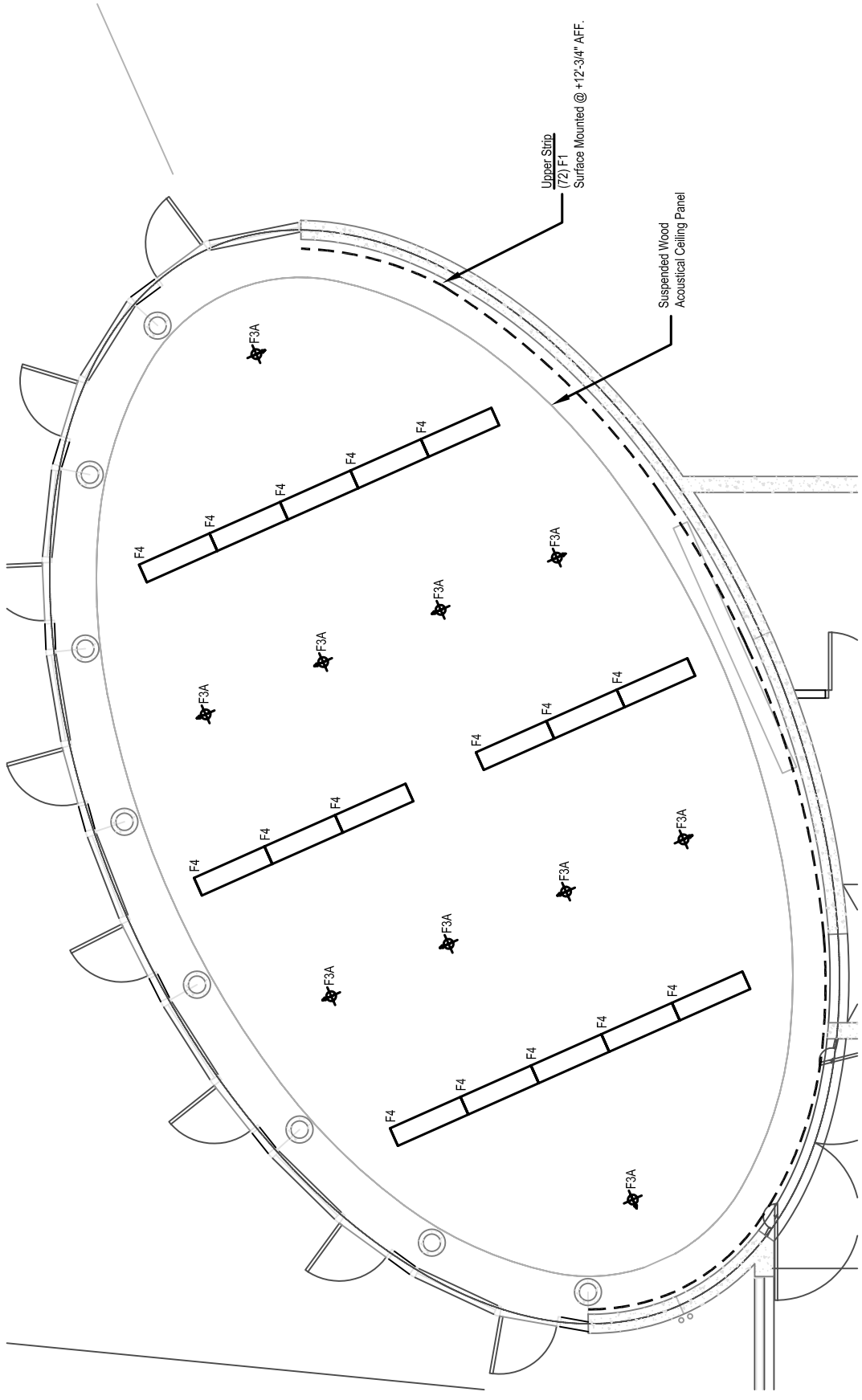
Ballasts Schedule

Location: Multipurpose Room

Type	Manuf.	Catalog Name	# Lamps	Ballast Type	Start Method	Input Watts	Ballast Factor	Power Factor	THD (%)	Assoc. Fixture
B2	Lutron	Lutron Eco-10: ECO-T528-277-2	2 - (L5)	Electronic Dimming (10%)	Programmed Rapid Start	66	1.00	>0.95	<10%	F4

Notes: Please see Appendix A for all product cutsheets and complete schedules.

Lighting control intent is located in the electrical depth.

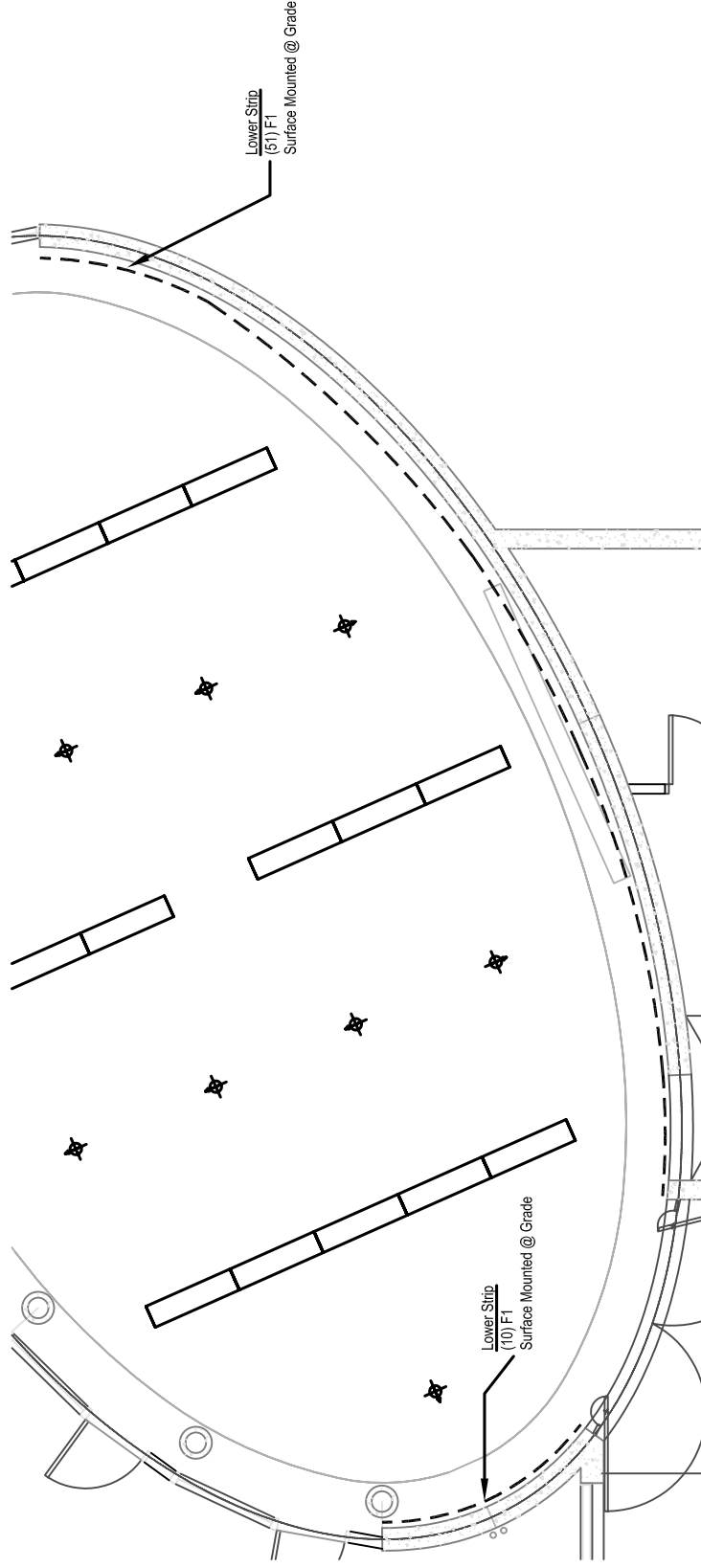


UCSB Student Resource Building

Multipurpose Room - Lighting Plan

Scale: 3/8" = 1'-0"





UCSB Student Resource Building

Multipurpose Room - Lower Strip Mounting Detail
 Scale: $\frac{1}{8}'' = 1'-0''$

Assumptions

Surface Reflectances

Material	Location	Reflectance (%)
Architectural Concrete	Walls and Ceiling	20
Wood Plank	Floor	8
Projection Screen	-	50
Gypsum Wall Board	Walls	75
Suspended Wood Acoustical Ceiling Panel	Suspended Ceiling	44
Vermillion Drapery	North Façade	36

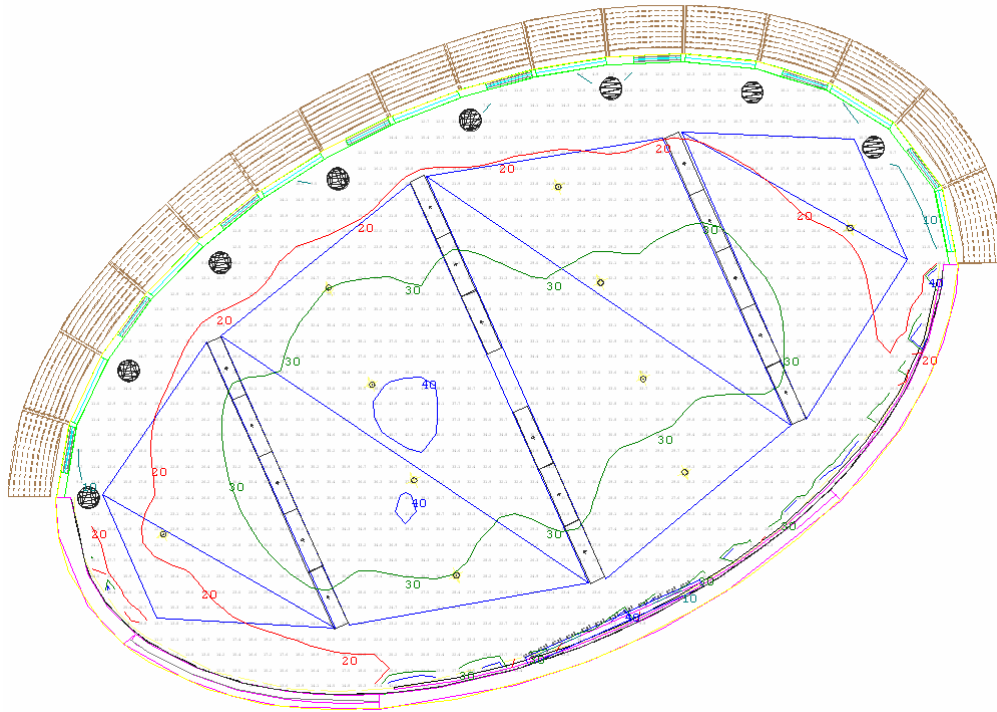
Note: Refer to Section 1b. for glazing information

Light Loss Factors

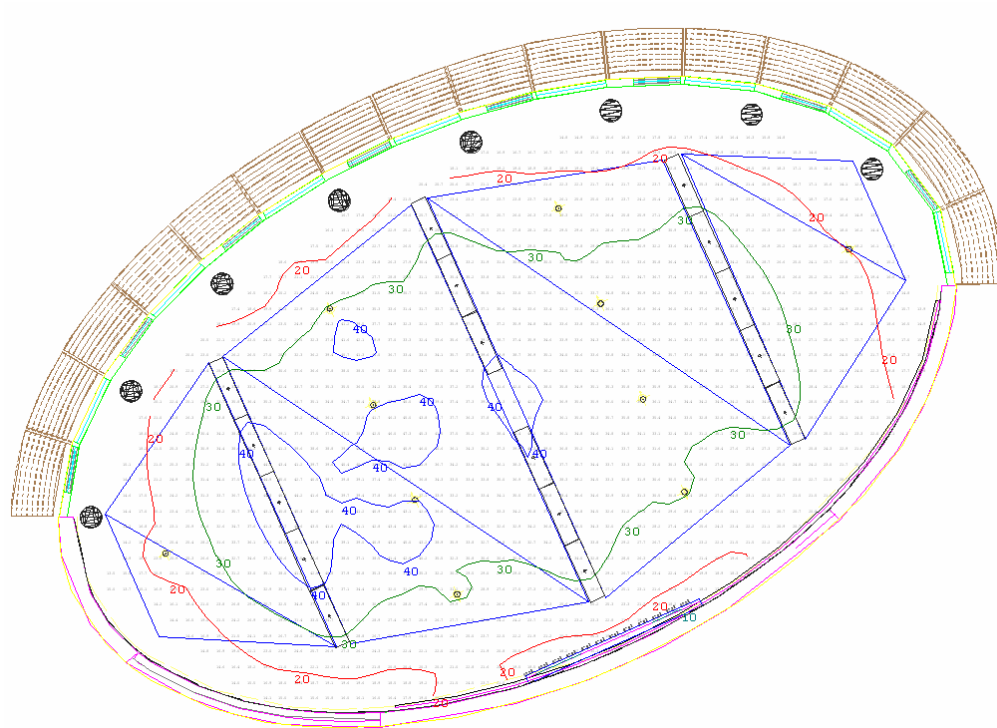
Label	IESNA Maintenance Category	Distribution Type	Environment Cleanliness	Cleaning Cycle	LLF				TOTAL
					LLD	LDD	RSDD	BF	
F1	VI	Direct	Clean	12mo	0.98	0.86	0.95	1.00	0.80
F3A	IV	Direct	Clean	12mo	0.85	0.88	0.97	1.00	0.73
F4	IV	Direct	Clean	12mo	0.94	0.88	0.97	1.00	0.80

Illuminance Data

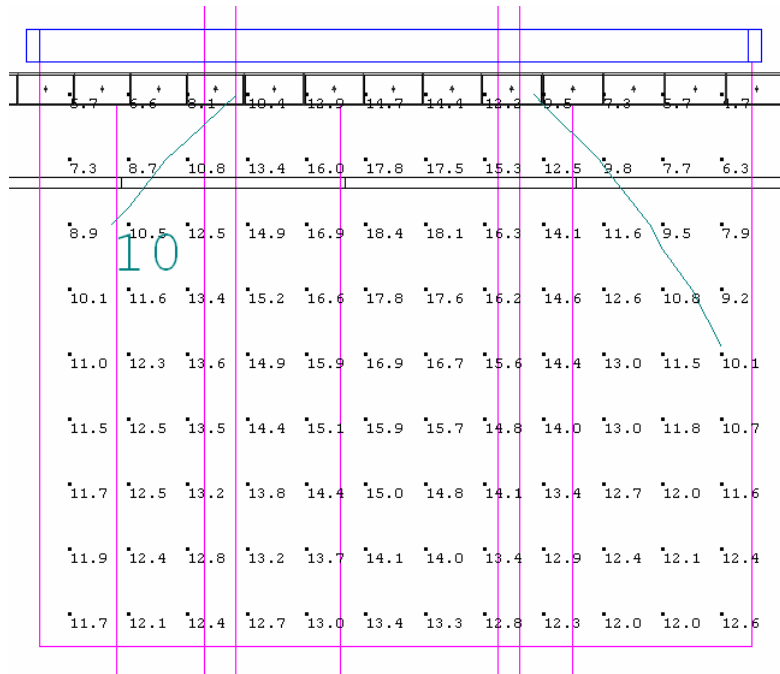
(Software used: AGI32 – v1.92)



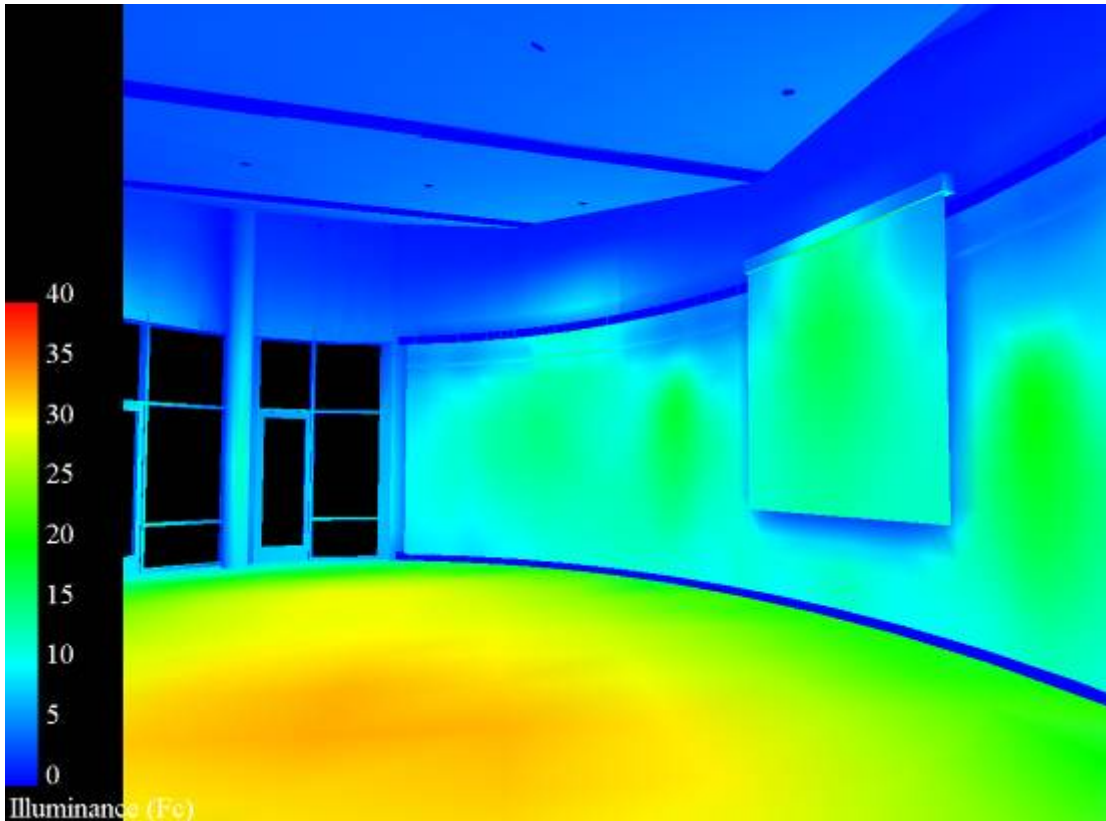
Floor Plane: Illuminance Contours



Work Plane: Illuminance Contours



Vertical Projection Screen: Illuminance Data



Overall Room: Pseudo Rendering

AGI32-v1.92 Statistical Summary

Calculation Area	Average Illuminance (fc)	Max. (fc)	Min. (fc)	Avg/min	Max/min
Floor Plane	25.9	98.2	3.3	2.3	3.7
Projection Screen* (see note)	12.7	18.4	4.7	2.7	3.9
Work Plane**	29.0	47.4	12.8	2.3	3.7

(*) Vertical Illuminance Data

(**) Assumed to be 2.5 ft AFF

Note: Average illuminance data calculated when the entire lighting system is on. In the event that the projector screen is required, it is assumed that the system will be off.

Radiosity Renderings

Full System On



Interior View



Exterior View

Exhibition Mode



Interior View



Exterior View

Night-Time



Interior View



Exterior View

Artificial Light Control

Though the glass façade faces North, analysis shows that there is a lot of daylight entering this space throughout the year. However, because this room will only be used during special events, an occupancy sensor has been installed in lieu of a photosensor along with a manual override provided for by the Graphik Eye control unit located by the main entrance.

Note: Please consult Appendix C for this space's existing daylight conditions.

Evaluation

Based on lighting simulations, the proposed system described above satisfies both IESNA light level recommendations as well as California Title 24 requirements. The flexibility of the system is now aligned with the diverse nature of this space through the utilization of multiple levels of control.

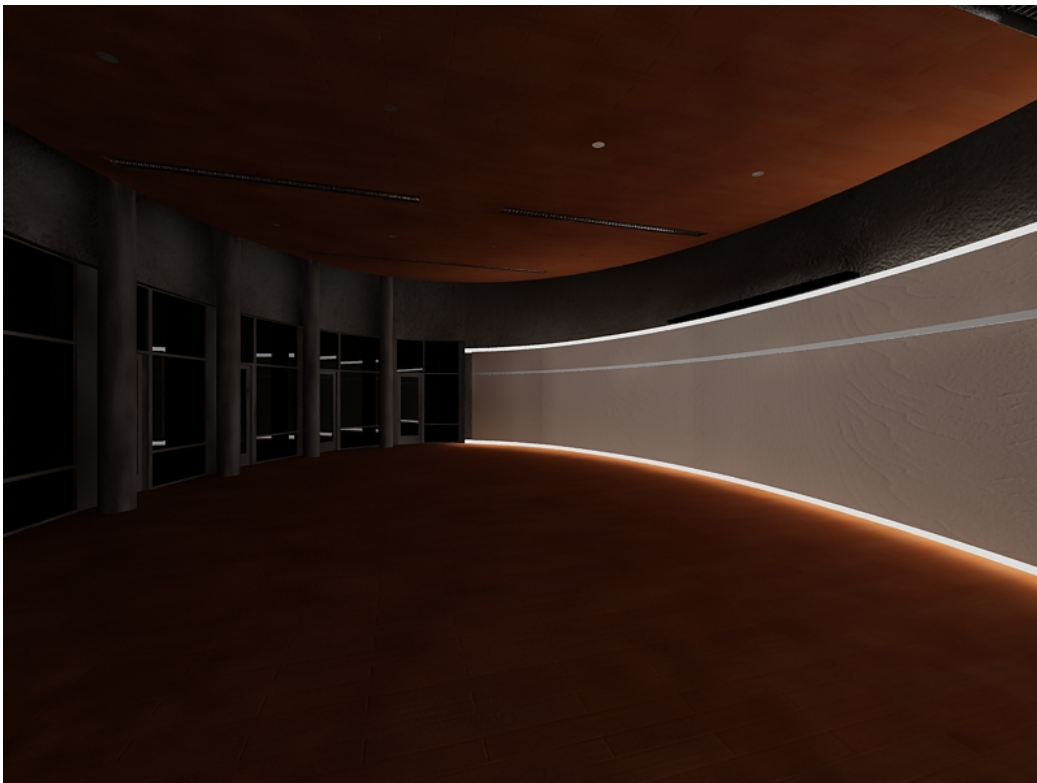
From an aesthetics standpoint, additional visual interest is added to the space through the utilization of the curved LED panel system that highlights the elliptical form of the room. This provides a better visual connection between this space and the adjacent North East Plaza.



All On



LED and Adjustable Downlights



LED Only

Student Resource Center



(Original schematic)

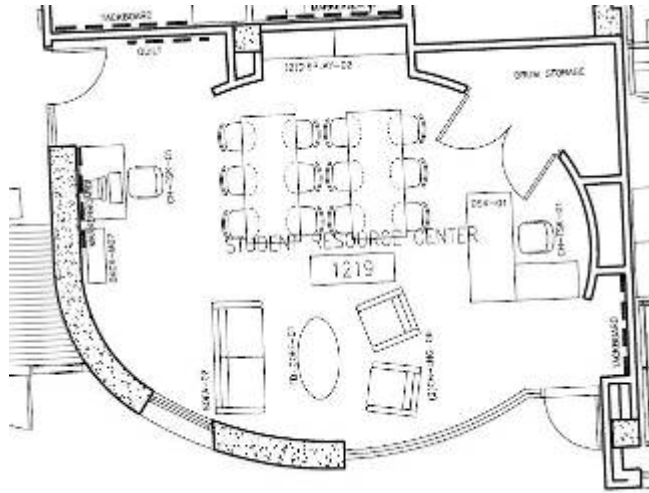
Design Synopsis

As the name suggest, the Student Resource Center serves as an information kiosk for students who desire to get information pertaining to university-wide activities as well as other campus-related information. Though there are many offices like this in this building, this one is worth studying because of its elliptical form that resonates that of the Multipurpose room discussed previously.

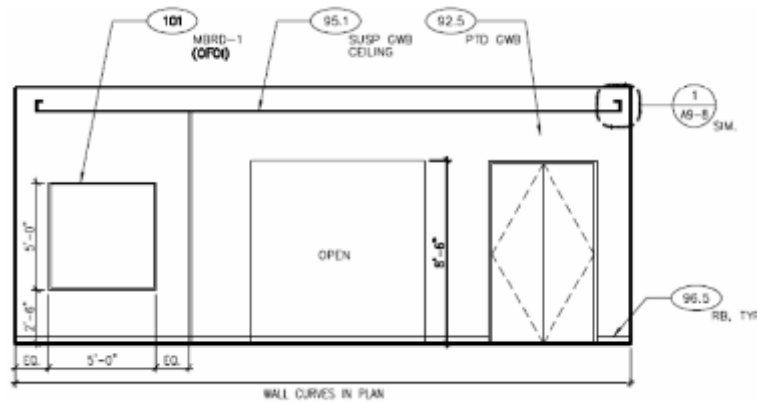
The curved glazing on the southern façade provides a view into the adjacent plaza on the south-east corner of the site. As this space will mostly be in operation during the day, appropriate controls shall be implemented to maximize daylight utilization.

Two alternative solutions for this space has been considered with the second being the final one implemented. It is important to note that the design has been modified since the schematic design presentation.

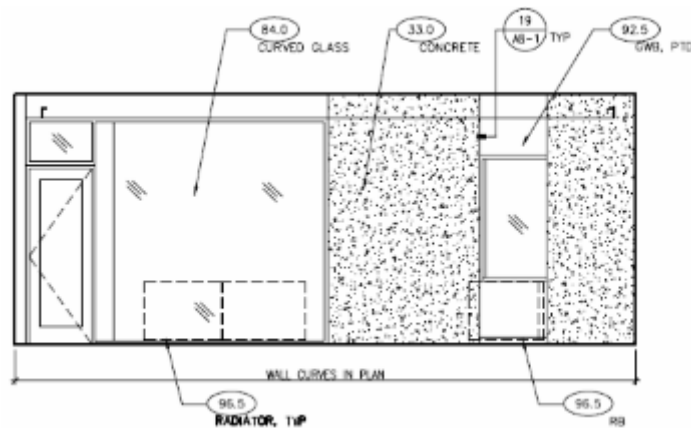
Existing Layout



Proposed Furniture Plan



Interior North Elevation



Interior South Elevation

Design Criteria

Space and Luminaire Appearance

The space is used for serving students who seek campus related information. With that in mind, the space should appear pleasant and inviting. A key architectural feature of this space is its elliptical form which is similar to that of the Multipurpose Room analyzed in the previous section. Another distinctive feature is the curved window on the southern façade of the space. Luminaire selection should fit with the overall design of the room to provide a visually pleasing environment for the occupants.

Color Appearance and Color Contrast

Proper color rendition is crucial satisfy the need for social interaction in this space. Color contrast could also be implemented to add visual appeal to this space.

Daylight Integration and Controls

Daylight illumination of the interior is provided for by the curved window on the southern façade. Careful attention should be made to ensure that excessive daylight does not cause discomfort glare inside as well as an increase in cooling load due to solar radiation. Therefore, dimming systems should be employed that are coupled with a photosensor to adjust the level of artificial illumination as necessary throughout the day. Occupancy sensors should also be installed to prevent wasting excess power to illuminate the space when it is unoccupied.

Glare Considerations

Reflected and direct glare from installed fixtures should also be avoided to maintain a comfortable environment for occupants.

Light Distribution and Uniformity

This is as the furnishing suggests that tasks which require good visual acuity will be performed here. Such tasks would include but not limited to: reading, writing and VDT usage. Therefore ideally, a sufficient level of uniformly distributed illumination will be required on tasks surfaces (i.e. table tops) to meet these needs.

Surface Luminances

In a space like this student resource center, good luminance ratios must be implemented to meet the needs of performing visual tasks. Again, the IESNA Lighting Handbook recommends the following:

3:1 Task and Adjacent Surround

10:1 Task and Non-Adjacent Surfaces

This is particularly important in this room since it is primarily a work space.

Shadows

Harsh/ dark shadows should be avoided as much as possible since this primarily a work space. Luminaires should also be placed as to avoid eye-socket shadows on the people working here.

Source/ Task/ Eye Geometry

It can be assumed that besides VDT usage a lot of written and reading tasks will occur in this space. Therefore, source/ task/ eye geometry is of particular importance to ensure that people are able to perform the tasks required.

IESNA Illuminance Recommendations

Horizontal

Cat. D: Performance of visual tasks of high contrast and large size 300 lx (30 fc)

Vertical

Cat. A: Public Spaces 30 lx (3 fc)

Alternative Design Option

On a purely functional basis, the first design option that will be considered is the use of a single row of luminaires positioned at the center of the room. Given that this building is in California, it is crucial that the strict requirements imposed by Title 24 be followed. This is shown below:

Schedules

Luminaire Schedule

Location: Student Resource Center (Alternative Layout)

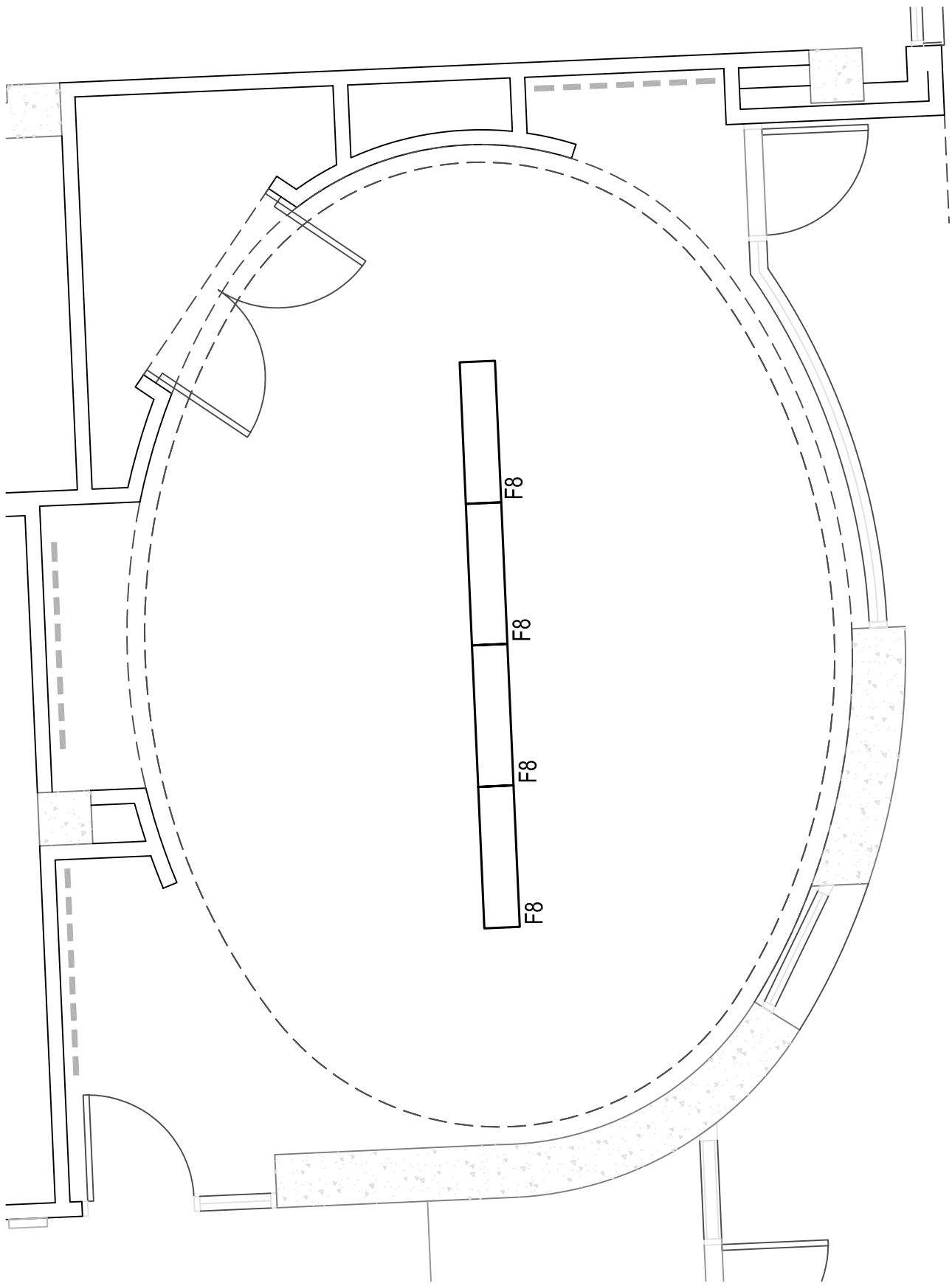
Type	Quantity	Catalog No.	Lamping / Ballast	Watts/ Fixture	Ballast/ fixture	Total Watts	Voltage
F8	4	Zumtobel, "Light Fields HE": LFHU-14-2545-MP-DH277 (1 x 4 FT) Recessed Fixture	2 - (LB) GE Lighting 46759 F54W/T5/830	125	1 - (B4) Lutron Eco-10: ECO-T554-277-2	500	277
						Total Watts:	500 W
						Space Area:	553 SF
						Achieved Power Density:	0.90 W/SF
						Allowed Power Density:	1.20 W/SF
						Status:	Ok

Based on calculations, the implemented design falls under the 1.20 W/sf allowed for this space as specified by California's Title 24 (2006).

Notes: Please refer to Lamp and Ballast schedules under "Final Design Option" for more product information.

Light Loss Factors

Label	IESNA Maintenance Category	Distribution Type	Environment Cleanliness	Cleaning Cycle	LLF				TOTAL
					LLD	LDD	RSDD	BF	
F8	IV	Direct	Clean	12mo	0.94	0.88	0.97	1.00	0.80



UCSB Student Resource Building

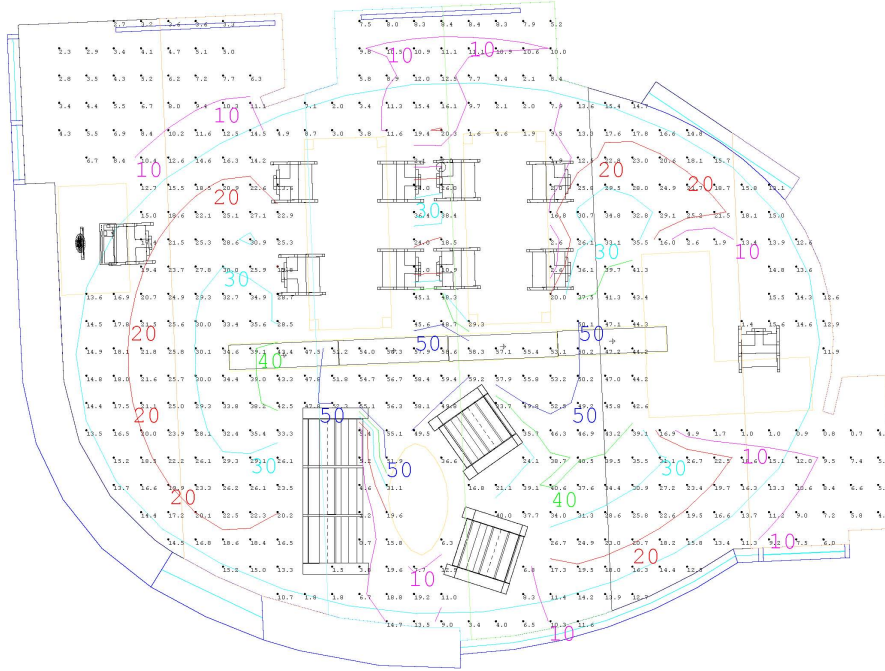
Student Resource Center - Lighting Plan (Alt.)

Scale: 3/4" = 1'-0"

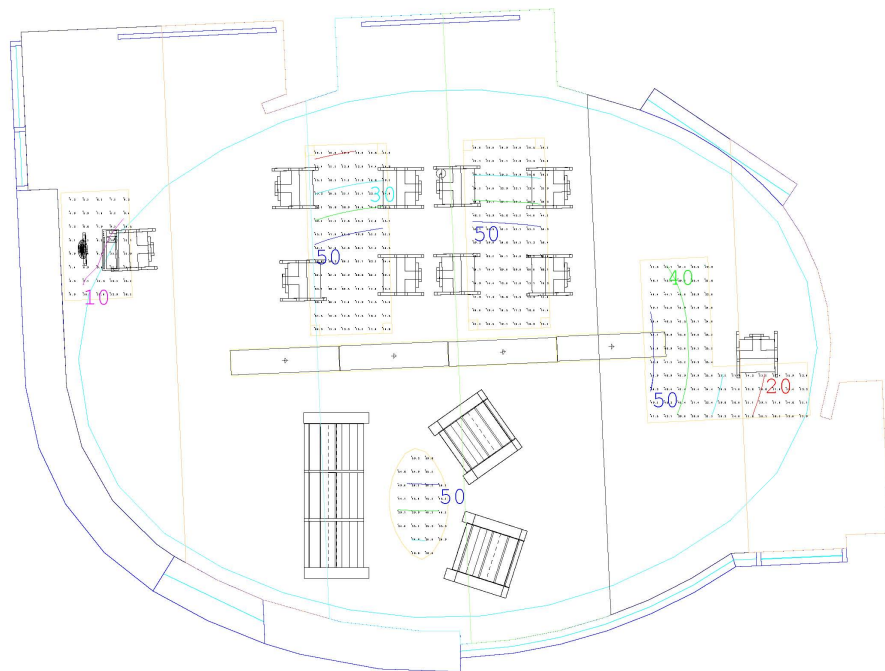


Illuminance Data

(Software used: AGI32 – v1.92)



Floor Plan: Illuminance Contours



Work Surfaces: Illuminance Contours

AGI32-v1.92 Statistical Summary

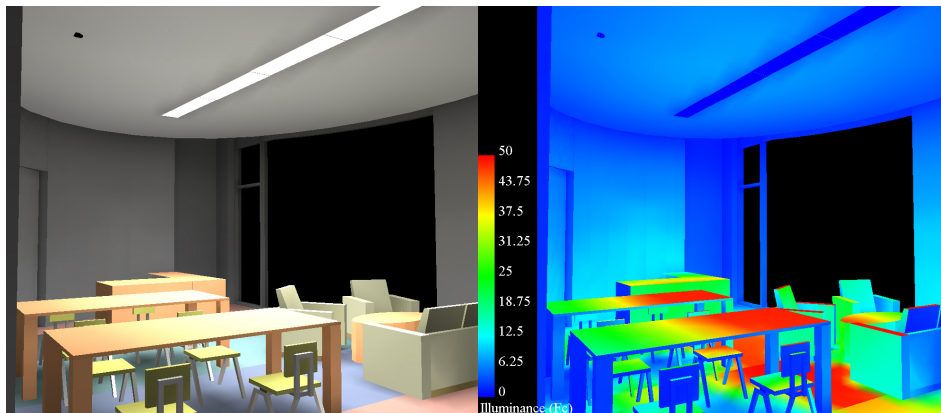
Calculation Area	Average Illuminance (fc)	Max. (fc)	Min. (fc)	Avg/min	Max/min
Floor Plane	21.0	59.4	0.7	30	84.86
Computer Desk*	8.8	16.2	0.7	12.6	23.1
Work Table 1*	50.0	78.6	18.1	12.6	23.1
Work Table 2*	52.9	81.1	20.	2.6	4.0
Help Desk*	34.8	51.0	11.9	2.9	4.3
Coffee Table	42.7	59.6	26.6	1.6	2.2

Notes: (*) Assumed to be 2.5 ft AFF

Room surface reflectances are discussed in the following section.

Radiosity Renderings

View from Interior Entrance



Rendering

Pseudo Rendering

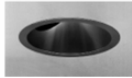

Final Design Option

Though the first design is very functional and creates a less cluttered appearance on the ceiling, it was decided that the space deserves additional vertical illumination on the walls to add an additional layer of visual appeal to this space. Given that there was still an allowance of 164 W in the first design; additional lights were added to meet this need. After the implementation of downlights in this space, the single row of luminaires was divided into two and re-orientated to create a more balanced appearance on the ceiling. This is shown below:

Schedules

Luminaire Schedule

Location: Student Resource Center

Type	Quantity	Catalog No.	Lamping / Ballast	Watts/ Fixture	Ballast/ fixture	Total Watts	Voltage
F3B 	4	Zumtobel, "Spec-3": S3D4360-S2-4660TC	1- (L4) GE Lighting 20826 Q35MR16/C/SP20	35	-	140	12 V
F8 	4	Zumtobel, "Light Fields HE": LFHU-14-2545-MP-DH277 (1 x 4 FT) Recessed Fixture	2 - (L8) GE Lighting 46759 F54W/T5/830	125	1 - (B4) Lutron Eco-10: ECO-T554-277-2	500	277
Total Watts:						640	W
Space Area:						553	SF
Achieved Power Density:						1.16	W/SF
Allowed Power Density:						1.20	W/SF
Status:						Ok	

Based on calculations, the implemented design falls under the 1.20 W/sf allowed for this space as specified by California's Title 24 (2006).

Lamp Types Schedule

Location: Student Resource Center

Type	Manuf.	Designation	Rated Wattage	Base	CRI / CCT	Rated Life (hrs)	Initial Lumens	Assoc. Fixture	Assoc. Ballast
L4	General Electric	20926 Q35MR16/C/SP20	35	GX5.3	100 / 3000K	5000	625	F3B	-
L8	General Electric	46759 F54W/T5/830	54	G5	85 / 3000K	20000	5000	F8	B4

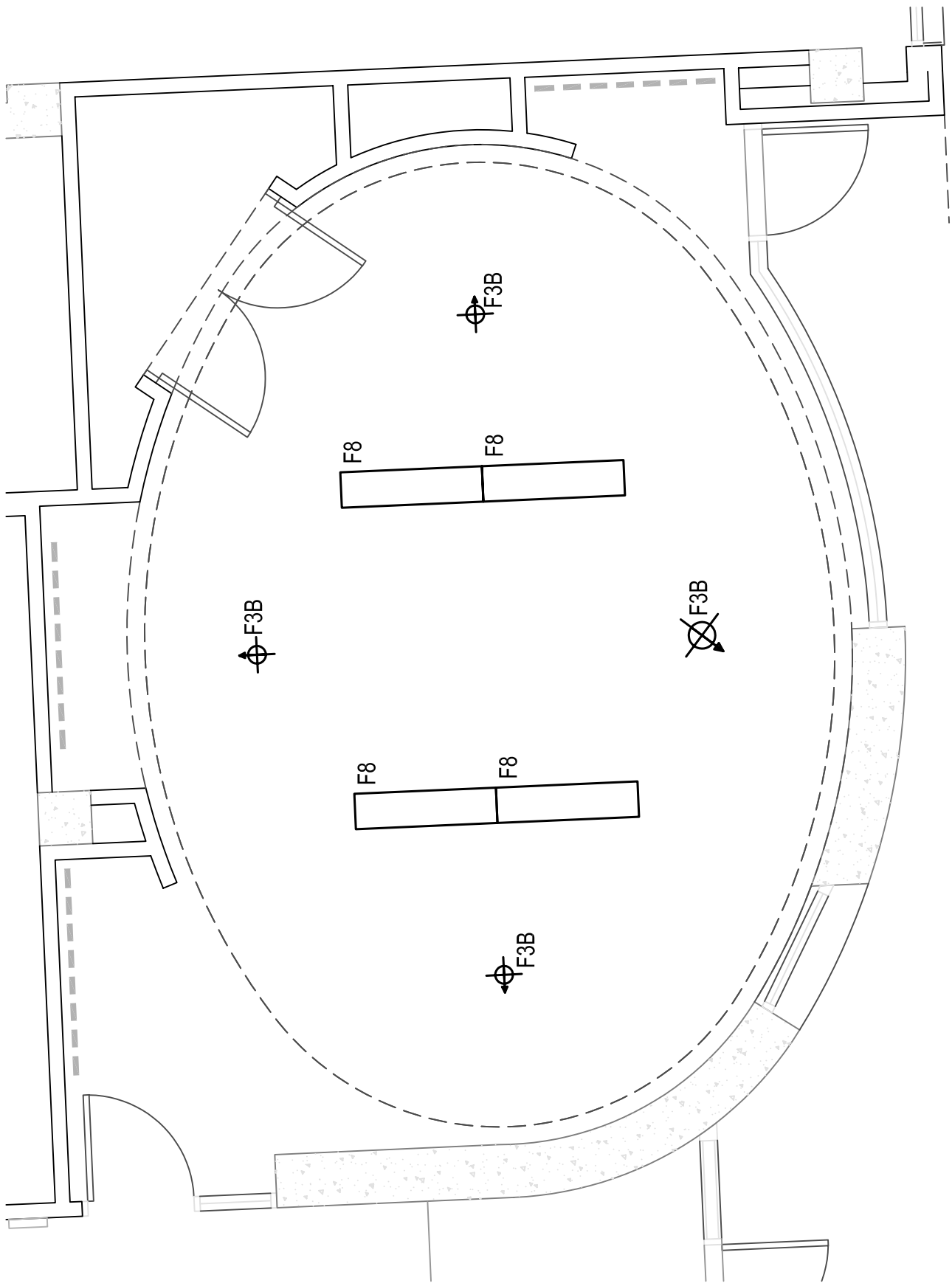
Ballasts Schedule

Location: Student Resource Center

Type	Manuf.	Catalog Name	# Lamps	Ballast Type	Start Method	Input Watts	Ballast Factor	Power Factor	THD (%)	Assoc. Fixture
B4	Lutron	Lutron Eco-10: ECO-T554-277-2	2 - (L8)	Electronic Dimming (10%)	Programmed Rapid Start	54	1.00	>0.95	<10%	F8

Notes: Please see Appendix A for all product cutsheets and complete schedules.

Lighting control intent is located in the electrical depth.



Assumptions

Surface Reflectances

Material	Location	Reflectance (%)
Architectural Concrete	Walls and Ceiling	20
Rubber Floor Tiles		
"Blue Skies 702"		18
"Soft Jade 653"	Floor	26
"Arizona Sunset 602"		27
"Slate Gray 766"		9
Gypsum Wall Board (GWB)	Walls	75
Suspended GWB Ceiling	Suspended Ceiling	75
Wood	Furniture	8

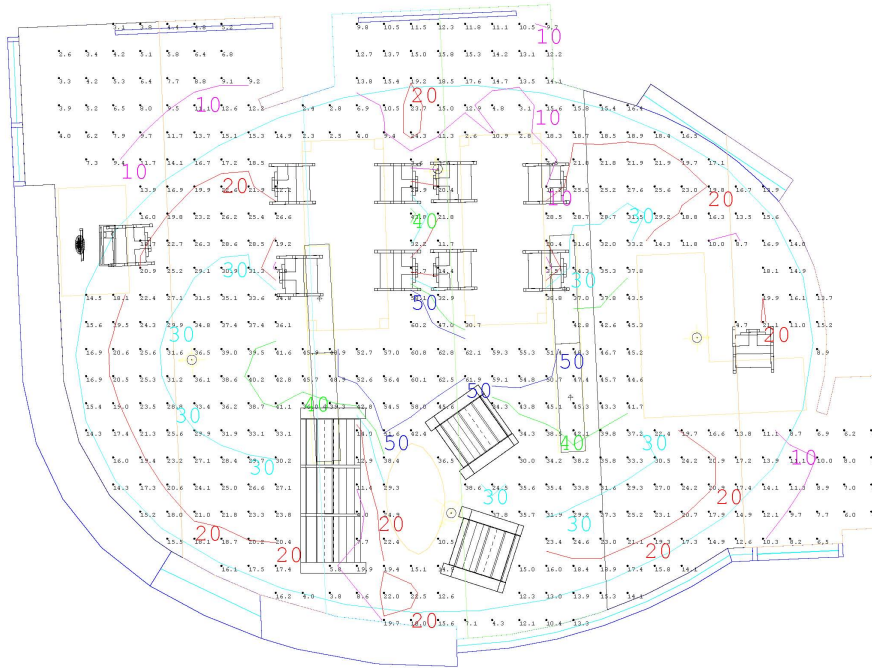
Note: Refer to Section 1b. for glazing information

Light Loss Factors

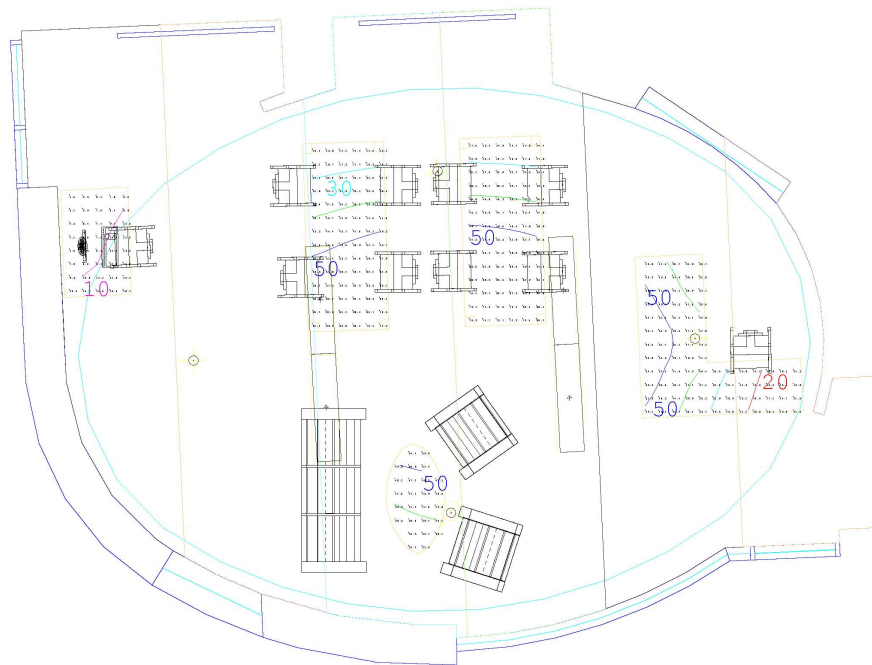
Label	IESNA Maintenance Category	Distribution Type	Environment Cleanliness	Cleaning Cycle	LLF				TOTAL
					LLD	LDD	RSDD	BF	
F3B	IV	Direct	Clean	12mo	0.85	0.88	0.97	1.00	0.73
F8	IV	Direct	Clean	12mo	0.94	0.88	0.97	1.00	0.80

Illuminance Data

(Software used: AGI32 – v1.92)



Floor Plane: Illuminance Contours



Work Surfaces: Illuminance Contours

AGI32-v1.92 Statistical Summary

Calculation Area	Average Illuminance (fc)	Max. (fc)	Min. (fc)	Avg/min	Max/min
Floor Plane	22.0	62.1	2.1	10.5	29.6
Computer Desk*	8.8	15.9	0.9	9.8	17.7
Work Table 1*	46.9	71.9	22.8	2.1	3.2
Work Table 2*	49.5	74.8	24.1	2.1	8.1
Help Desk*	37.4	55.4	11.7	3.2	4.7
Coffee Table	42.8	54.6	30.7	1.4	1.8

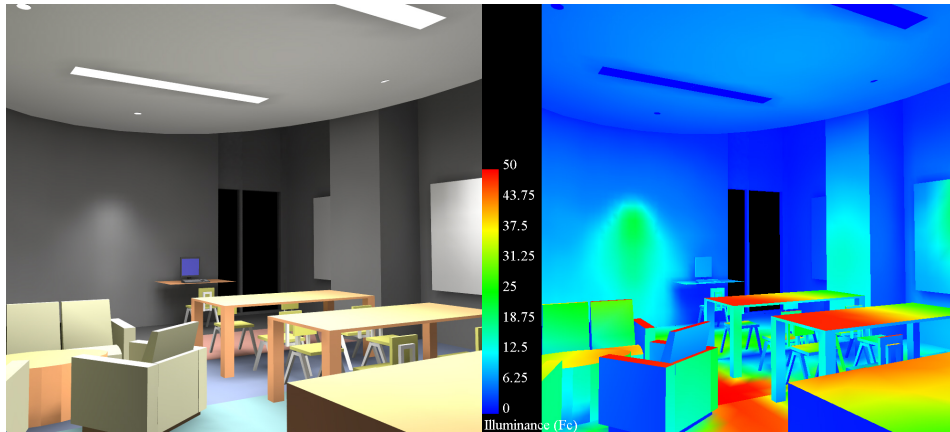
(*) Assumed to be 2.5 ft AFF

Statistical Data Comparison

Based on analysis, it was shown that the final design option created a higher level of uniformity in this space. This was probably due to the fact that more light was delivered to the periphery through the addition of adjustable downlights that throw light along the vertical surfaces. Light level uniformity is a crucial aspect to consider in an interior work space. Average illuminances of the two arrangements are comparable in the two designs with the final option delivering slightly higher levels.

Radiosity Renderings

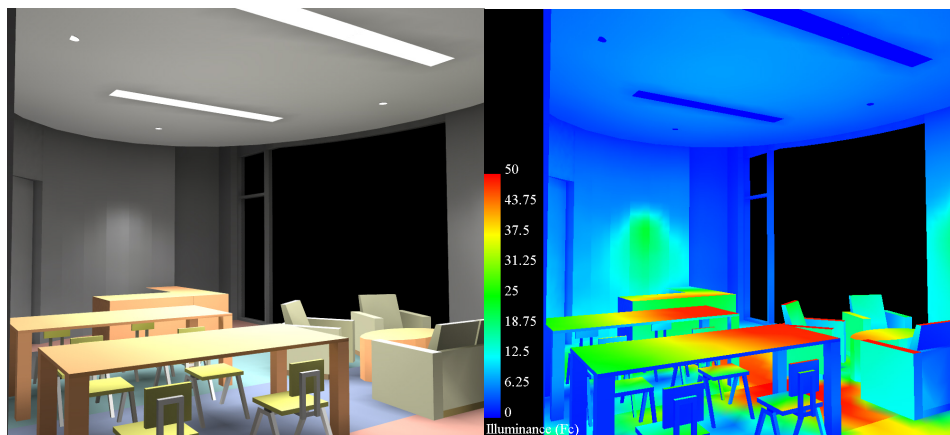
View from Help Desk



Rendering

Pseudo Rendering

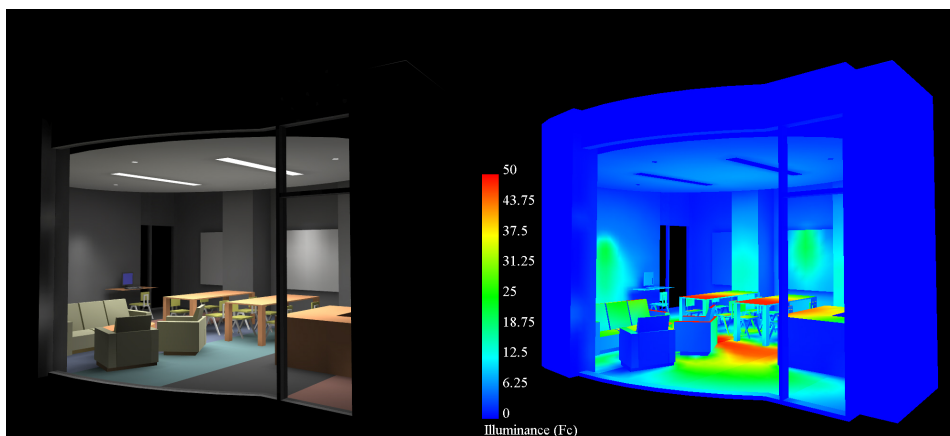
View from Interior Entrance



Rendering

Pseudo Rendering

View from Exterior



Rendering

Pseudo Rendering

Daylight Control

Daylight simulations show that for most days during the year, a large proportion of natural light enters this space through the glazing on the south facing façade. As the building will mostly be used during the regular school year, only the Equinox and Solstice dates were processed. Results show that enough daylight enters the space between the hours of 8am to 4pm after which artificial illumination will be supplemented to achieve the adequate light levels required. Depending on the day's sky condition, typical percentage cost savings during this time frame ranges from approximately 54% to 87%.

If we assume that this room is only in use from 8am to 10pm, no artificial illumination is required for about 60% of the total hours that this room is in operation. That being said, the space can rely on daylight for approximately 9 hours a day and as such represents a considerable amount of energy savings. This is illustrated in the following calculation:

Calculated average savings: 0.32 KW

$$0.32 \text{ KW} \times 9 \text{ hrs} \times 30 \text{ days/month} = 86.4 \text{ KWH} / \text{month}$$

Approximate Average Demand Charge: \$0.18321

*Therefore: 86.4 KWH/month x \$0.18321 = **\$15.82 savings per month***

*Over the course of a year: \$15.82 x 12 = **\$189.95 savings per year***

Again, if we assume the building last 40 years, the system saves approximately \$7598.09 during its life time. This value is a conservative estimate as the energy cost can be expected to increase during this period.

Note: Please consult Appendix D for the dimming analysis results for this space.

Evaluation

The final lighting solution for this space now provides additional visual interests to the space. In addition to general ambient illumination provided for by the linear lighting system, adjustable downlights provide the necessary vertical illumination on the different surfaces. Both IESNA and Title 24 criteria were satisfied by the proposed design.

In terms of daylight energy savings, since the linear fixtures will all be on one circuit in both options, energy savings will be exactly the same as described in the previous section. The only benefit from the first option was that less luminaires were specified and as such represents a reduction in first cost of the overall system proposed for this space. However, in light of the need to provide a visually appealing space for people to use, the final option takes precedence.