

**University of California Santa Barbara**  
**Student Resource Building**



**Technical Assignment 1**

**“Lighting Existing Conditions and Design Criteria Report”**

**Clement Fung**

**Advisor: Dr. Mistrick**

**October 16<sup>th</sup>, 2006**

## **Executive Summary**

The following report seeks to address the conditions of the proposed lighting system at the University of California Santa Barbara Student Resource Building (SRB). The four spaces proposed in the "Lighting Proposal Memo" will be analyzed in the following order:

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

An analysis of each space will consist of following:

- a. Space Description
- b. Pertinent Construction Material Data
- c. Luminaire Layout
- d. Luminaire Schedule
- e. Applicable Light Loss Factor (\*)
- f. Illuminance Data (\*)
- g. Radiosity Renderings
- h. Design Criteria (\*)
- i. Design Evaluation

Section 5 of this report will discuss the power consumption by the currently installed lighting system in the building in reference to California's Title 24 requirements. (\*\*) The SRB is currently under construction and is scheduled for completion in November 2006. The project is aiming for a LEED Silver rating.

The goal of this report is to provide a thorough understanding of lighting currently provided in these spaces and to provide a basis for future redesign that seeks to improve the overall experience of the occupants.

(\*) Reference: IESNA Lighting Handbook, 9<sup>th</sup> Edition

(\*\*) Reference: California Title 24 (2005). ASHRAE 90.1 (2004) will also be used for comparison.

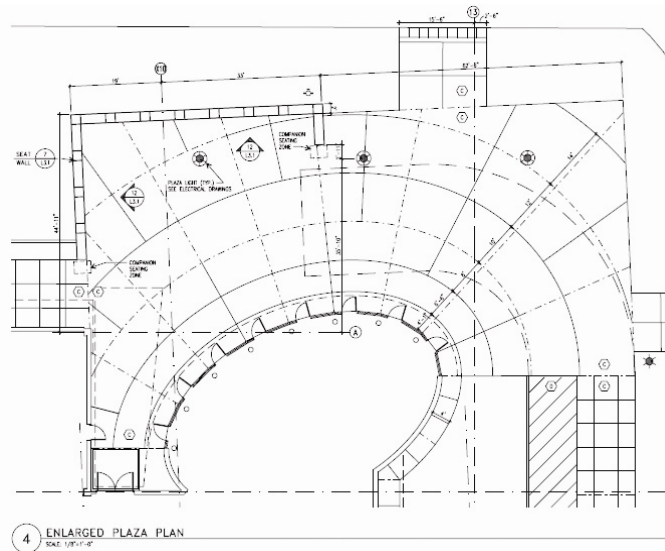
## **Section 1: North-East Plaza**

### **1a. Space Description**

The plaza is located on the north-east corner of the building and covers an area of approximately 5840 sf. It serves to provide a comfortable outdoor environment for social interaction. Semi-elliptical patterns engraved on the concrete ground of the plaza emphasize the presence of the Multipurpose room that gently protrudes into this gathering space. Concrete seating wraps the top-left boundary of this plaza.



**Aerial Perspective**



**Enlarged Plaza Plan**

**1b. Pertinent Construction Material Data**

**Assumed Reflectance Data**

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

**Daylight Elements**

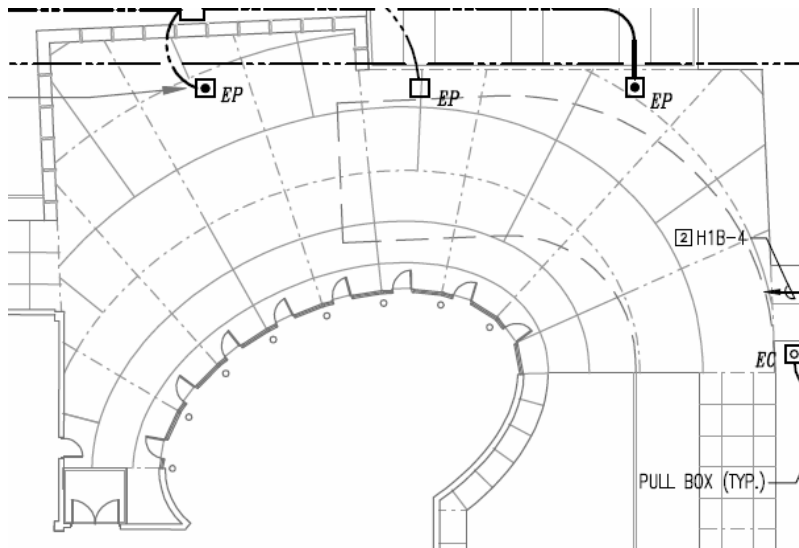
**Window Data**

<b>Window Type</b>	<b>Properties</b>
<b>Operable Windows</b>	U Factor: 0.43-0.62  Solar Transmittance Coefficient: 32-45
<b>Sliding Windows</b>	U Factor: 0.49-0.57  Solar Transmittance Coefficient: 32-35

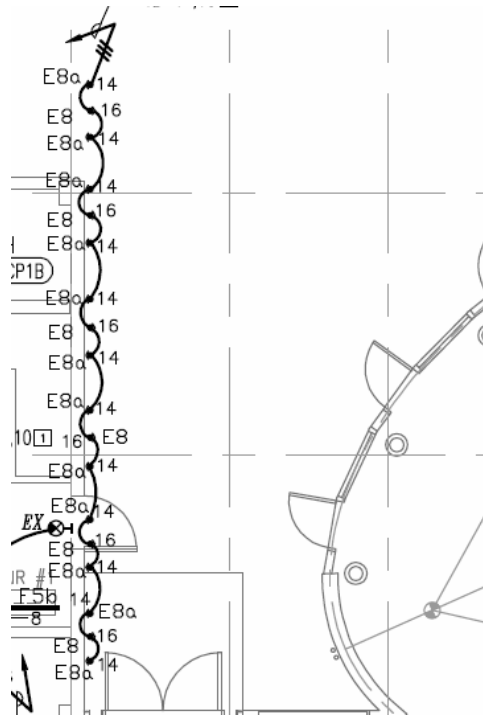
**Glazing Data**

<b>Glass Type</b>	<b>Properties</b>
<b>GL1:</b> Insulating Vision Glass w/ low E <i>(General application on South and West Façade)</i>	<p><u>Transmittance:</u>                      UV: 18%                      Visible Light: 73%                      Total Solar Energy: 38%</p> <p><u>Reflectance:</u>                      Visible Light: 12%                      Total Solar Energy: 40%</p> <p><u>U-Values:</u>                      Winter Night-time: 0.29                      Summer Day-time: 0.28</p> <p>Shading Coefficient (SC): 0.44</p> <p>Solar Heat Gain Coefficient (SHGC): 0.38</p> <p>Light to Solar Gain: 1.84</p>
<b>GL2:</b> Insulating Vision Glass w/o low E <i>(Throughout)</i>	(see GL1)
<b>GL3:</b> 1/4" Clear Monolithic <i>(Throughout)</i>	<p>Visible Light Transmittance: 1.02</p> <p><u>U-Values:</u>                      Winter: 1.02                      Summer: 0.93</p> <p>SHGC: 0.61                      SC: 0.71</p> <p>Outdoor Visible Light Reflectance: 8%</p>

**1c. Luminaire Layouts**



**Plan: Pole Fixtures (EP and EC) Locations**



**Plan: Surface-Mounted Fixtures (E8 and E8A) Layout**

**1d. Luminaire Schedule**

Label	Fixture Description	Location	Lamp Type	Voltage
EP	Exterior Plaza Pole Light w/ indirect Optical System	Plaza	(1) 70W Ceramic Metal Halide	277
EC	Exterior Campus Pole Light	Plaza	(1) 100W Metal Halide	277
E8	Structure-mounted tungsten halogen area light	Entrance Canopy	(1) 75W PAR30 Tungsten Halogen	120
E8a	Structure-mounted tungsten halogen area light	Entrance Canopy	(1) 75W PAR30 Tungsten Halogen	120

**1e. Applicable Light Loss Factors**

**Assumptions**

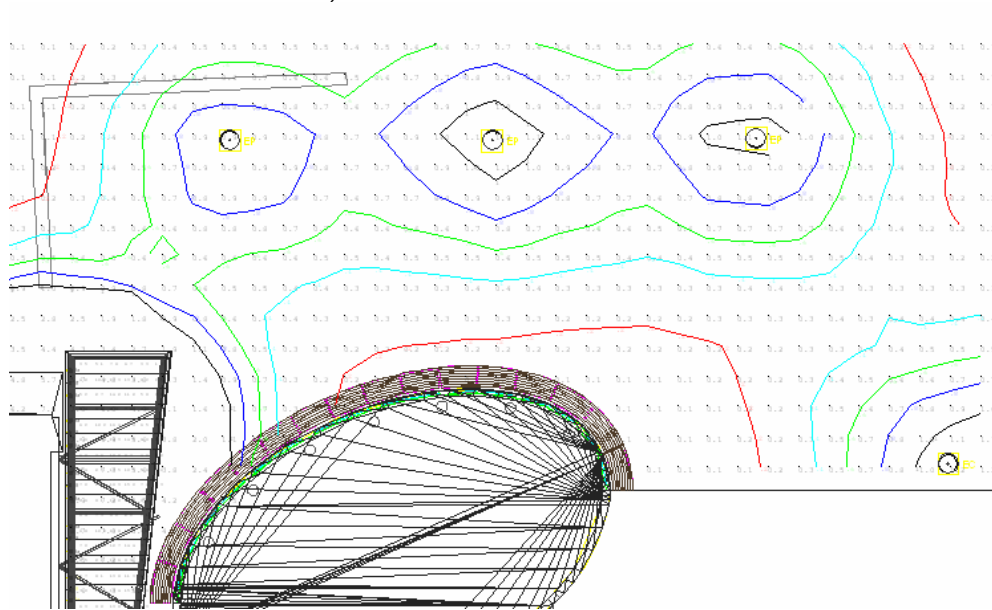
Label	IESNA Maintenance Category	Distribution Type	Environment Cleanliness	Cleaning Cycle
EP	IV	Semi Direct	Medium	12mo
EC	V	Direct	Medium	12mo
E8	IV	Direct	Medium	12mo
E8a	IV	Direct	Medium	12mo

**Assumed Light Loss Factors Break Down**

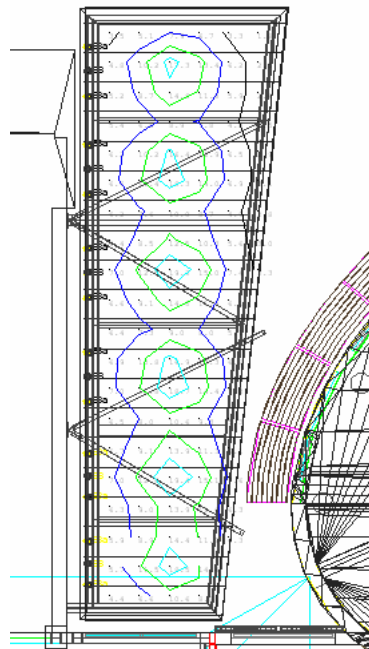
Label	LLD	LDD	LLF RSDD	BF	TOTAL
EP	0.80	0.81	1.00	0.80	0.52
EC	0.80	0.81	1.00	0.80	0.52
E8	0.95	0.81	1.00	1.00	0.77
E8a	0.95	0.81	1.00	1.00	0.77

## **1f. Illuminance Data**

(Software used: AGI32 – v1.91)



**General Plaza Area: Illuminance Contours**



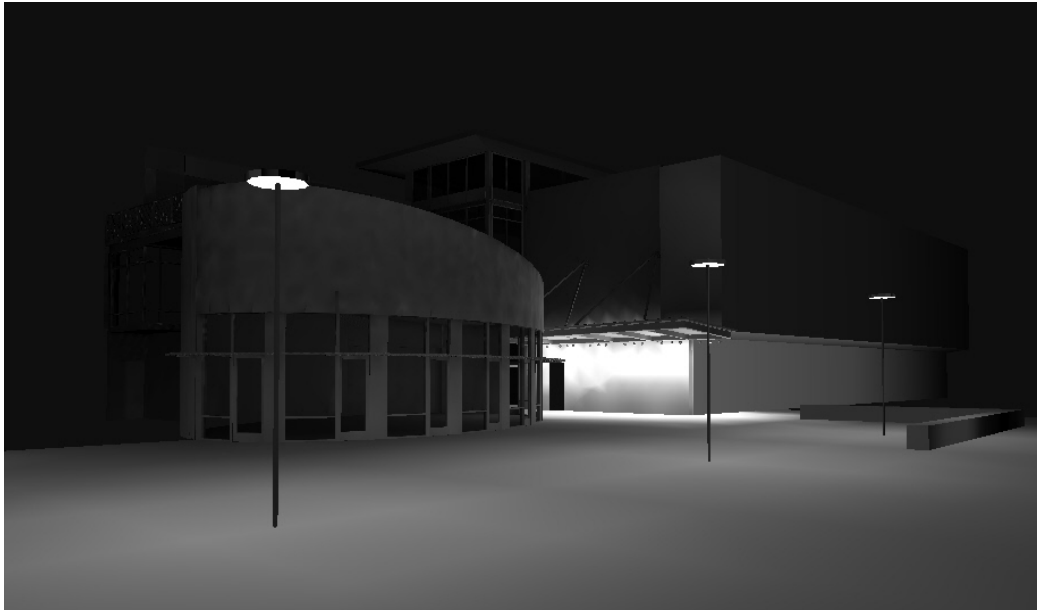
**Covered Canopy Area: Illuminance Contours**



**AGI32-v1.91 Statistical Summary**

<b>Calculation Area</b>	<b>Average Illuminance (fc)</b>	<b>Max. (fc)</b>	<b>Min. (fc)</b>	<b>Avg/min</b>	<b>Max/min</b>
General Plaza Area (Ground-level)	1.26	16.6	0.1	10.8	166
Entrance Canopy Area (Ground-level)	8.92	19.4	1.8	4.96	10.78

**1g. Radiosity Renderings**



**NE Plaza Overview**



**Entrance Canopy Area**

## **1h. 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. Dimming capabilities should also be provided in the event that some level of artificial illumination is required in this public space during daylight hours (i.e. cloudy sky).

### **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 meet full cutoff criteria as classified by the IESNA Lighting Handbook, 9<sup>th</sup> edition. 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)

## **1i. Evaluation**

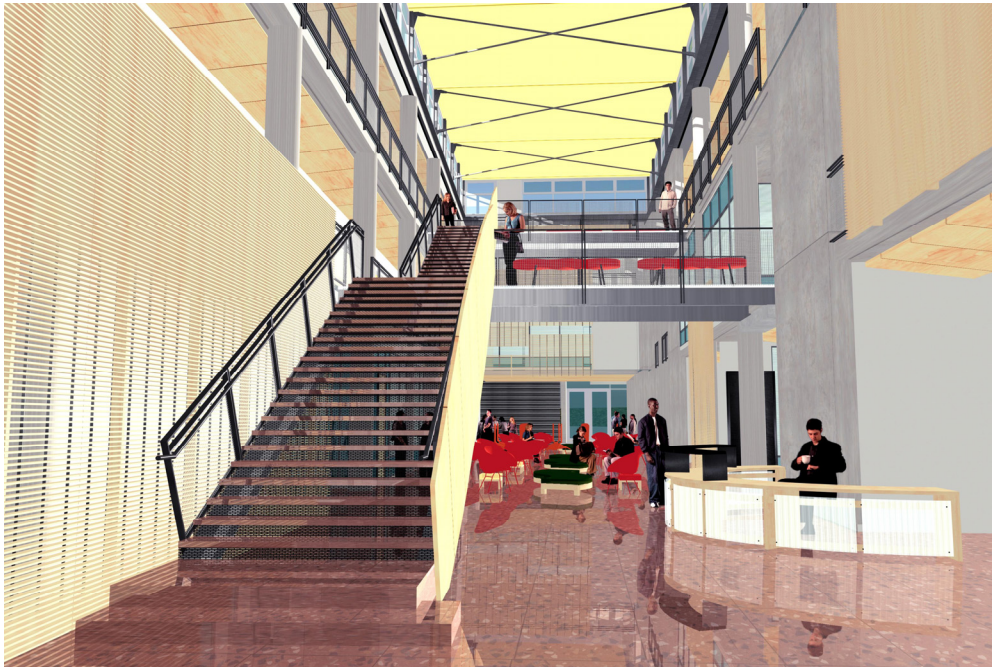
Lighting simulations show that the current luminaire arrangement do not meet the levels recommended by IESNA (1.26 fc vs. 3f c). However, average illuminance ratios were generally quite even under the canopy area and the majority of the plaza area.

The current design satisfies most of the established design criteria for this space. However, I feel that more attention could be made to reinforce the unique architectural form of the plaza in relation to the elliptical shaped multipurpose room. This will be addressed in the redesign of the space.

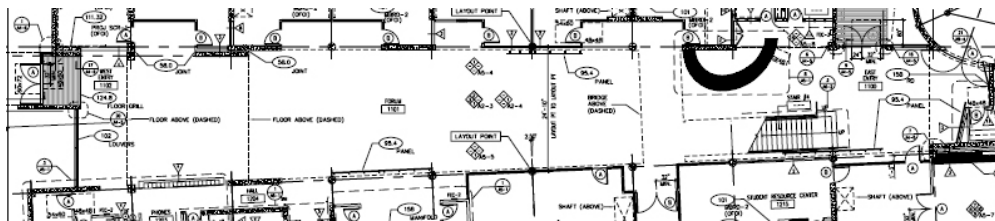
## **Section 2: Forum**

### **2a. Space Description**

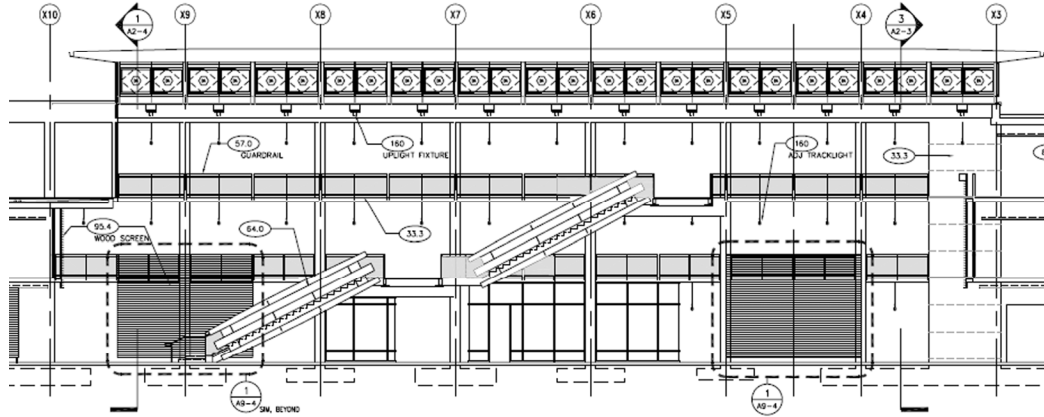
The forum is a linear space that acts as a main pedestrian thoroughfare that establishes a connection between the UC Santa Barbara campus and Isla Vista, an adjacent neighbourhood on the west. The atrium is a triple height space and the roof covering this area is raised to 45'-0", allowing room for clerestories to be positioned along the four facades. This allows for ample daylight to penetrate the space throughout the day. An exposed cross-bracing system provides structural support here. Pedestrian bridges provide access to floors on the upper levels. Seating is provided for on the ground floor as well as on the pedestrian bridges above. A curve-shaped counter is also located on ground level closer towards the eastern end of the space.



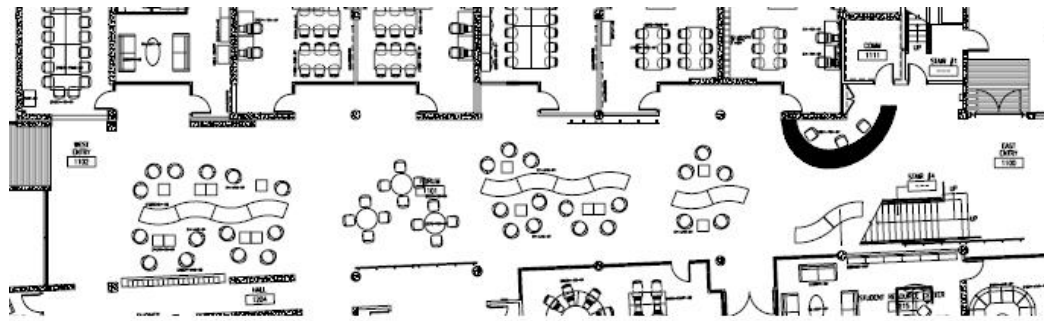
**Interior Rendering**



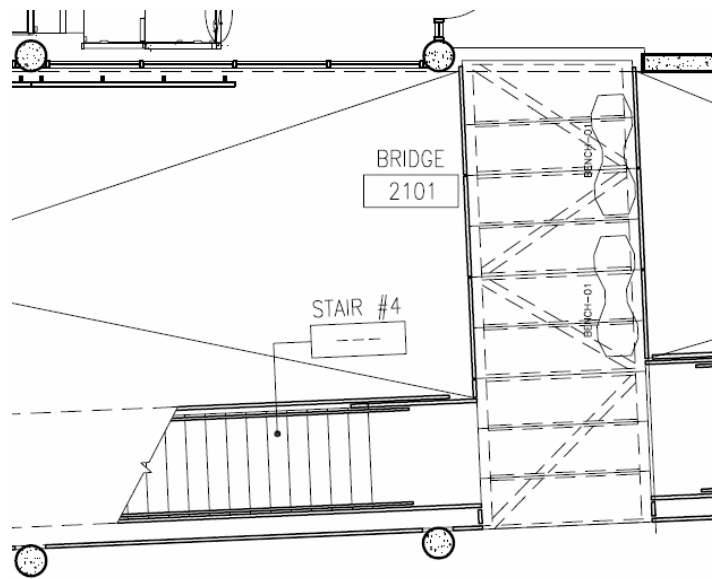
**Enlarged Floor Plan**



**Enlarged Building Section**



**First Floor Furniture Plan**



**Pedestrian Bridge Furniture Plan (Typ.)**

## **2b. Pertinent Construction Material Data**

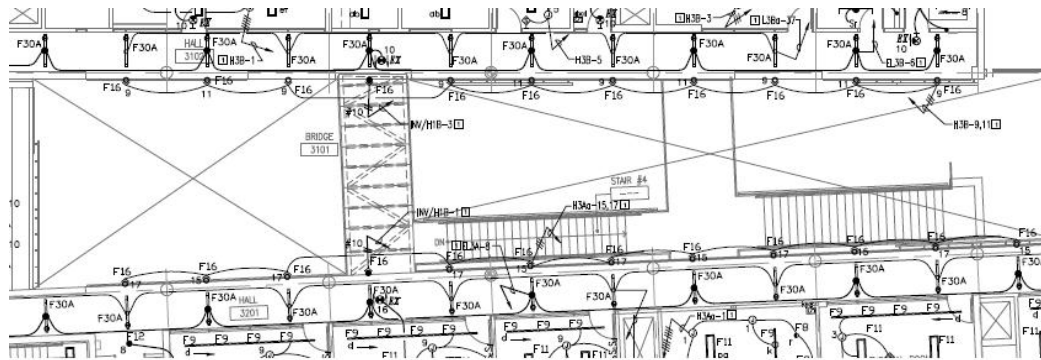
### **Assumed Reflectance Data**

<b>Material</b>	<b>Location</b>	<b>Reflectance (%)</b>
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

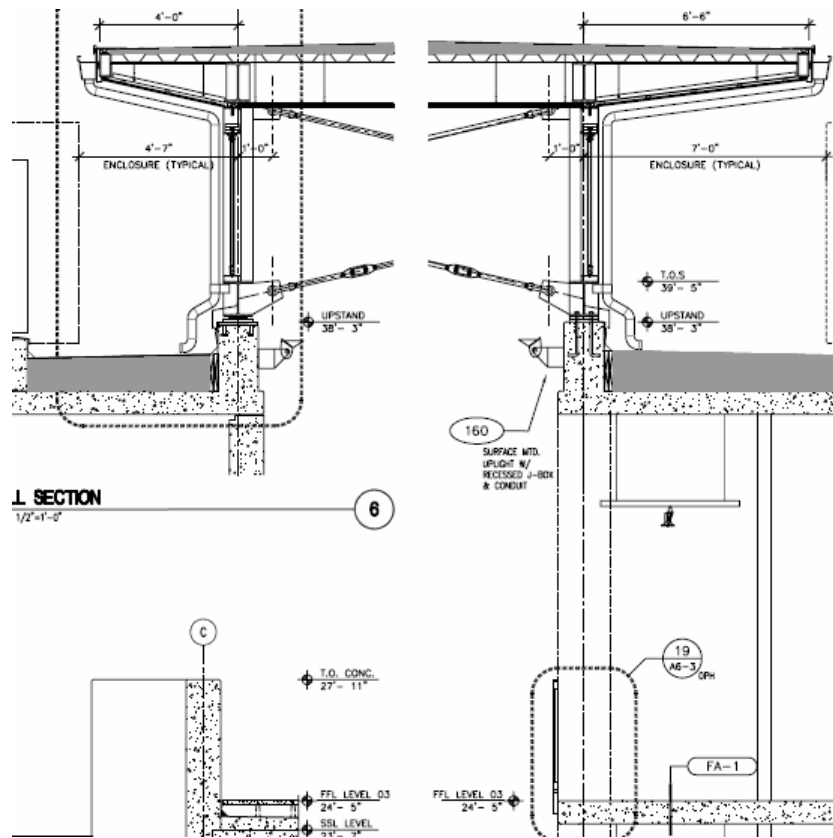
**NOTE:** Refer to Section 1b. for glazing information



**2c. Luminaire Layouts**



**Plan: Surface Mounted Uplight (F16) and Typical F30 Series Adjustable Accent Locations**



**Section: Surface Mounted Uplight (F16) Locations**

**2d. Luminaire Schedule**

<b>Label</b>	<b>Fixture Description</b>	<b>Location</b>	<b>Lamp Type</b>	<b>Voltage</b>
F1	7" aperture recessed compact fluorescent downlight	Forum	(1) 32W T4 Triple Tube Compact Fluorescent	277
F16	Surface-mounted ceramic metal halide uplight	Forum	(2) 150W T6 Ceramic Metal Halide	277
F30A	Pendant-mounted tungsten halogen adjustable accent light	Forum	(1) 75W PAR38 Tungsten Halogen	120
F30B	Pendant-mounted tungsten halogen adjustable accent light	Forum	(1) 75W PAR38 Tungsten Halogen	120
F30C	Pendant-mounted tungsten halogen adjustable accent light	Forum	(1) 75W PAR38 Tungsten Halogen	120

**2e. Applicable Light Loss Factors**

**Assumptions**

<b>Label</b>	<b>IESNA Maintenance Category</b>	<b>Distribution Type</b>	<b>Environment Cleanliness</b>	<b>Cleaning Cycle</b>
F1	VI	Indirect	Clean	12mo
F16	VI	Indirect	Clean	12mo
F30A	IV	Direct	Clean	12mo
F30B	IV	Direct	Clean	12mo
F30C	IV	Direct	Clean	12mo

**Assumed Light Loss Factors Break Down**

<b>Label</b>	<b>LLD</b>	<b>LDD</b>	<b>LLF RSDD</b>	<b>BF</b>	<b>TOTAL</b>
F1	0.84	0.88	0.96	0.96	0.68
F16	0.79	0.90	0.90	0.88	0.56
F30A	0.95	0.81	0.97	1.00	0.75
F30B	0.95	0.81	0.97	1.00	0.75
F30C	0.95	0.81	0.97	1.00	0.75

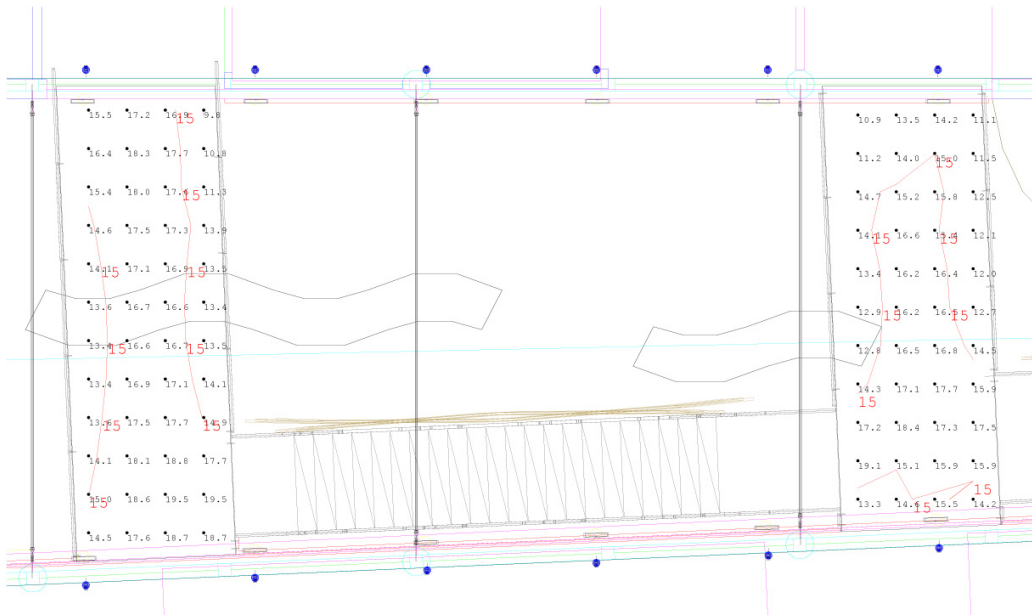
(\*) Value adjusted to reflect the fact that the clerestory windows are open most of the time to allow natural air ventilation for most parts of the building. As this is the case, dirt is less likely to deposit on the luminaire and room surfaces due to their proximity to the clerestory windows.

## **2f. Illuminance Data**

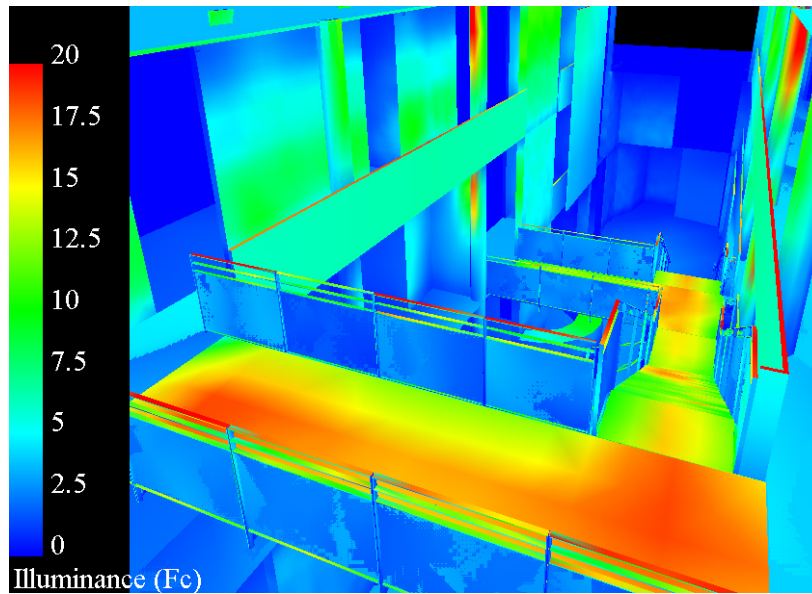
*(Software used: AGI32 – v1.91)*



**Forum First Floor: Ground Level Illuminance Contours**

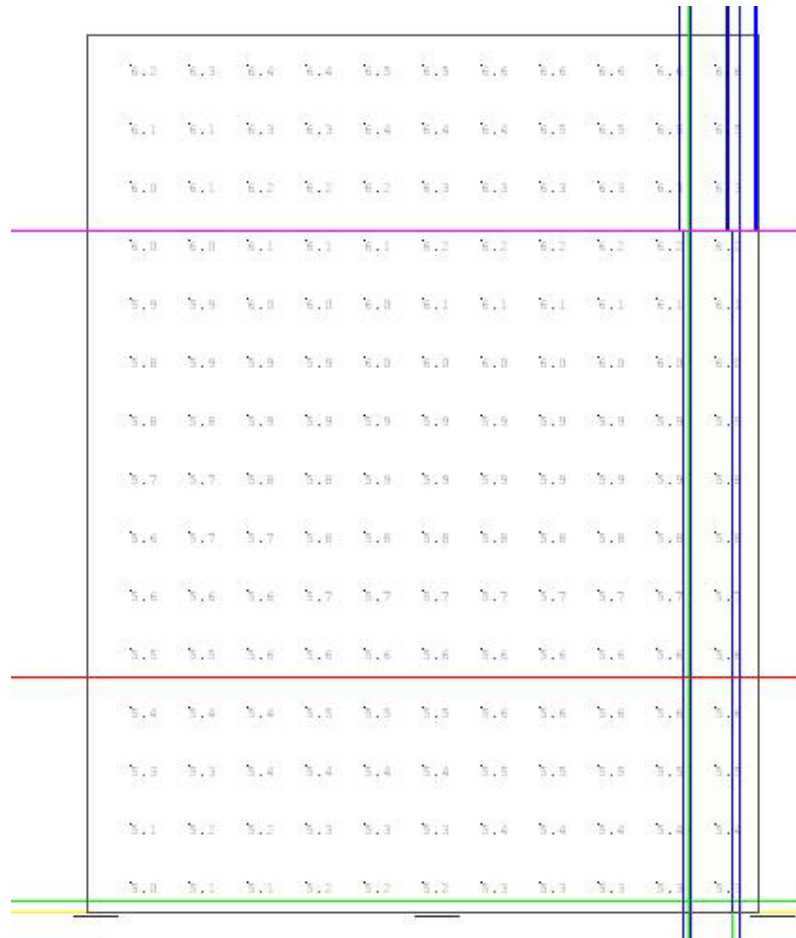


**Pedestrian Bridges: Illuminance Contours  
(Left - 3F, Right - 2F)**



**Pedestrian Bridges: Pseudo Rendering**





Vertical Projection Screen: Illuminance Data (Typ.)

**AGI32-v1.91 Statistical Summary**

<b>Calculation Area</b>	<b>Average Illuminance (fc)</b>	<b>Max. (fc)</b>	<b>Min. (fc)</b>	<b>Avg/min</b>	<b>Max/min</b>
First Floor Ground * (open area)	6.81	11.2	1.0	6.81	11.20
First Floor Ground (covered area including west entry area)	8.78	14.5	1.3	6.75	11.15
Pedestrian Bridge (2F)	14.89	19.1	10.9	1.37	1.75
Pedestrian Bridge (3F)	15.96	19.5	9.8	1.63	1.99
Curved Seating (Ground-level)	9.52	10.0	9.1	1.05	1.10
Ceramic Counter Top (ground level)	8.01	11.3	4.4	1.82	2.57
Table Top (ground level)	11.58	11.9	11.3	1.05	1.10
Projection Screen (vertical illuminance)	5.83	6.6	5.0	1.17	1.32

(\*) Values exclude calculation points which were directly shielded by the staircase and the pedestrian bridge from the light reflected off the raised ceiling.



**2g. Radiosity Renderings**



**View from Staircase**



**Raised Roof and Exposed Crossing Bracing System**



**View of Upper Level Corridors**

## **2h. 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)
-----------------------	--------------

## **2i. Evaluation**

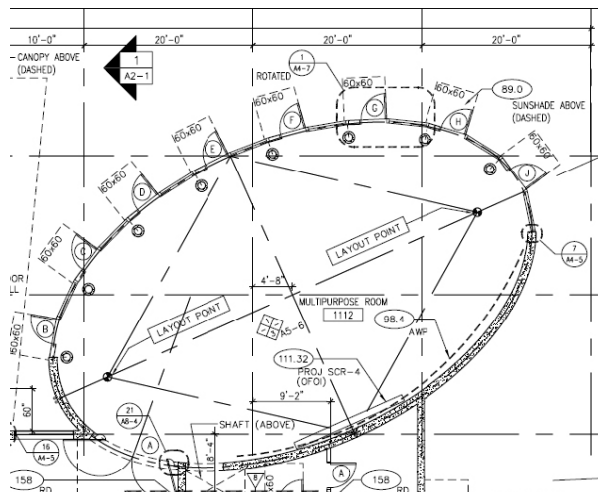
The combination of indirect illumination from the surface mounted uplights as well as from the carefully aimed track fixtures along the corridor areas on the upper levels provided sufficient illumination on the ground floor of this triple height space. Analysis also showed that the system was capable of providing sufficient light on most task surfaces located on the ground floor as well. In general, the existing system satisfies most of the design criteria established in the previous section.

For redesign, I intend to use additional accents to highlight the exposed staircase as well as other architectural features (i.e. the wood screens and the cross-bracing system) located here. Different control scenes will also be implemented to allow for visual variations in space appearance. The system will also be optimized for daylight.

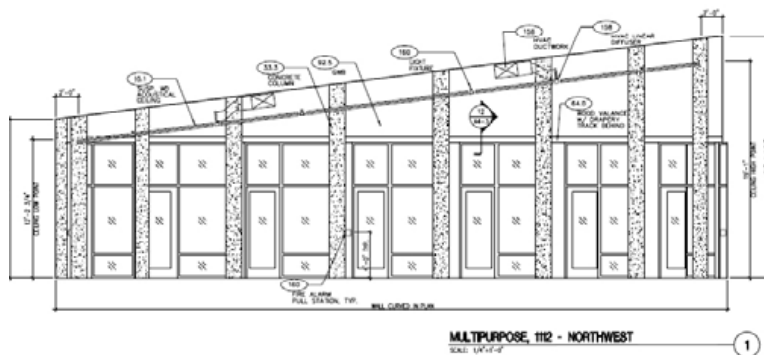
### Section 3: Multipurpose Room

#### 3a. Space Description

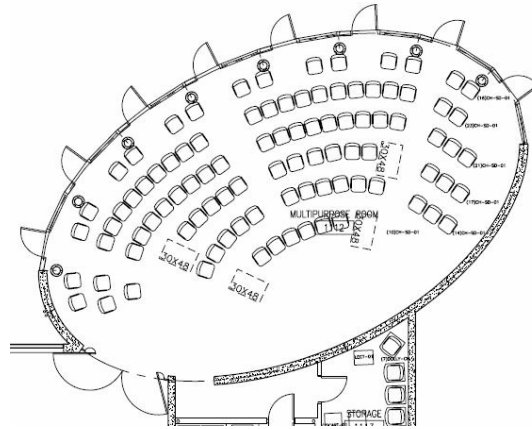
As the name implies, this 1590 sf Multipurpose room was designed to serve many different functions. Besides social functions, it also has a seating capacity for approximately 94 people to allow for presentation/ lecture type events. Tables may also be brought in here for meetings. The elliptical form of the Multipurpose room gives this space its architectural distinctiveness and is echoed by the sloped elliptical ceiling above. Suspended wood acoustical ceiling panels also add another layer of architectural distinctiveness. Wood panels are used for the flooring here. The southern façade is predominately made of architectural concrete and positioned near the center is a projection screen which allows for events requiring VDT display. Daylight integration is provided for the by the glazing on the northern façade of the room which faces into the North-east Plaza which was discussed in part 1 of this report. If an event requires privacy or a dim environment (i.e. VDT presentations), vermilion color drapery located behind the columns on the northern façade can also be used.



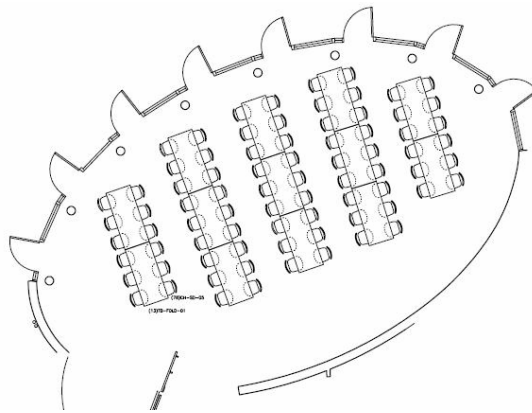
Enlarged Floor Plan



Interior-North West Elevation



**Furniture Configuration 1**



**Furniture Configuration 2**

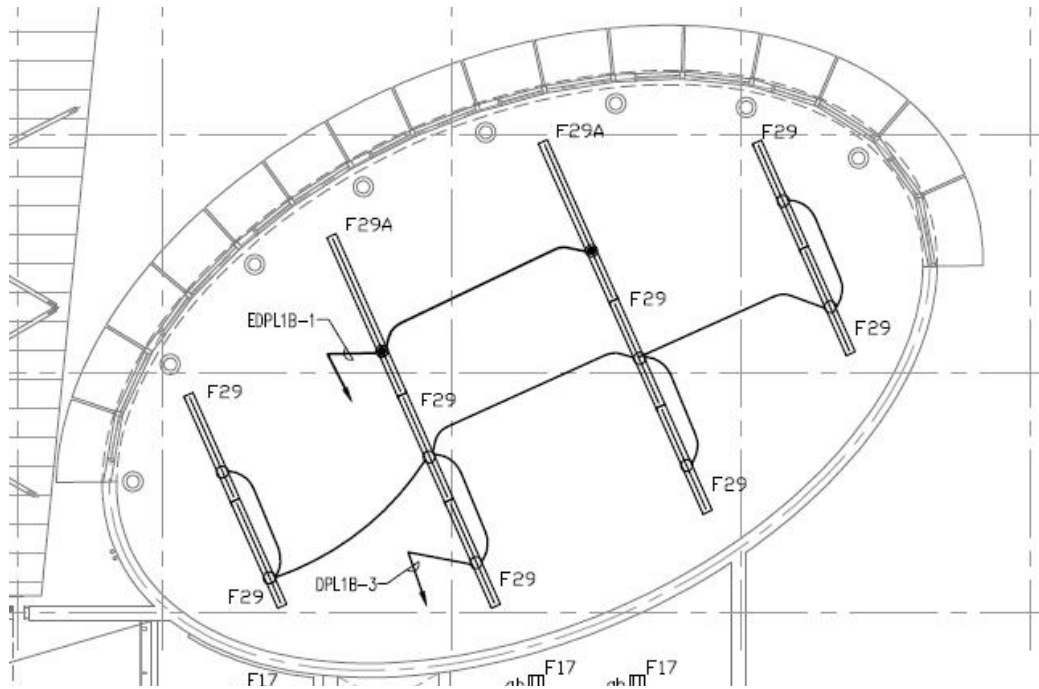
### **3b. Pertinent Construction Material Data**

#### **Assumed Reflectance Data**

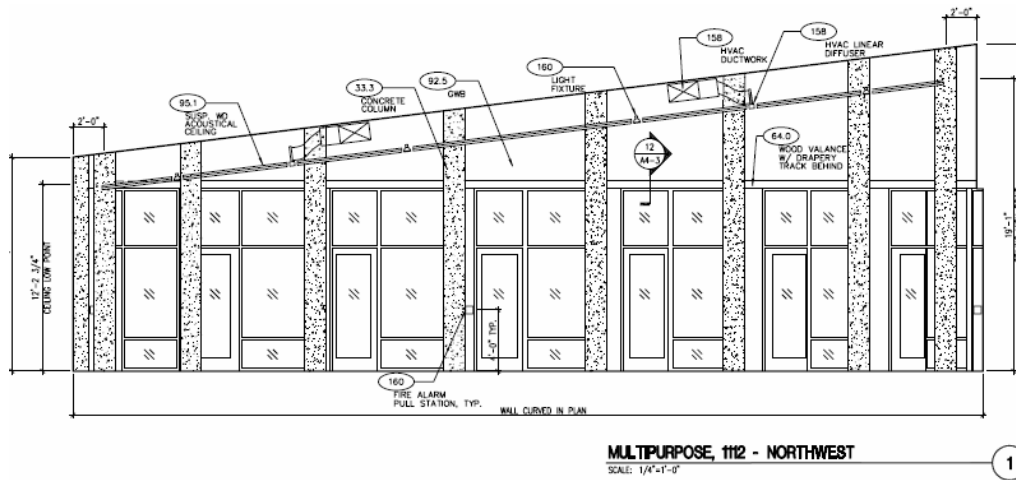
<b>Material</b>	<b>Location</b>	<b>Reflectance (%)</b>
Architectural Concrete	Walls and Ceiling	20
Wood Plank	Floor	8
Projection Screen	-	50
Gypsum Wall Board	Walls	75
Suspended Wood Acoustical Ceiling Panel	Suspended Ceiling	44
Vermillion Drapery	North Façade	36

**NOTE:** Refer to Section 1b. for glazing information

**3c. Luminaire Layouts**



**Plan: Pendant Mounted Downlight (F29 and F29a) Locations**



**North-West Section: Pendant Mounted Downlight (F29 and F29a) Locations**



### **3d. Luminaire Schedule**

<b>Label</b>	<b>Fixture Description</b>	<b>Location</b>	<b>Lamp Type</b>	<b>Voltage</b>
F29	Pendant-mounted fluorescent downlight (row length = 8'-0")	Multipurpose Rm.	(2) 32W T8 Fluorescent	277
F29a	Pendant-mounted fluorescent downlight (row length = 12'-0")	Multipurpose Rm.	(2) 32W T8 Fluorescent	277

### **3e. Applicable Light Loss Factors**

#### **Assumptions**

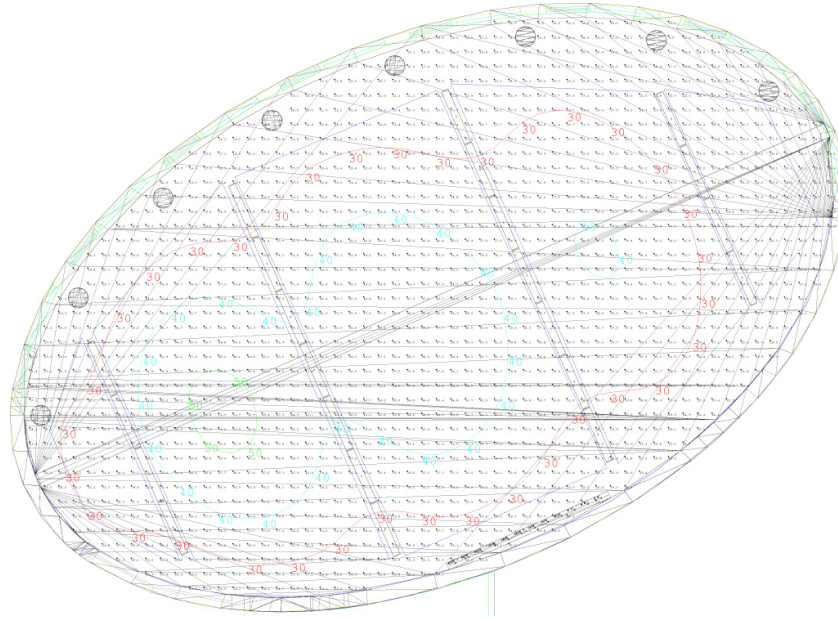
<b>Label</b>	<b>IESNA Maintenance Category</b>	<b>Distribution Type</b>	<b>Environment Cleanliness</b>	<b>Cleaning Cycle</b>
F29	IV	Direct	Clean	12mo
F29a	IV	Direct	Clean	12mo

#### **Assumed Light Loss Factors Break Down**

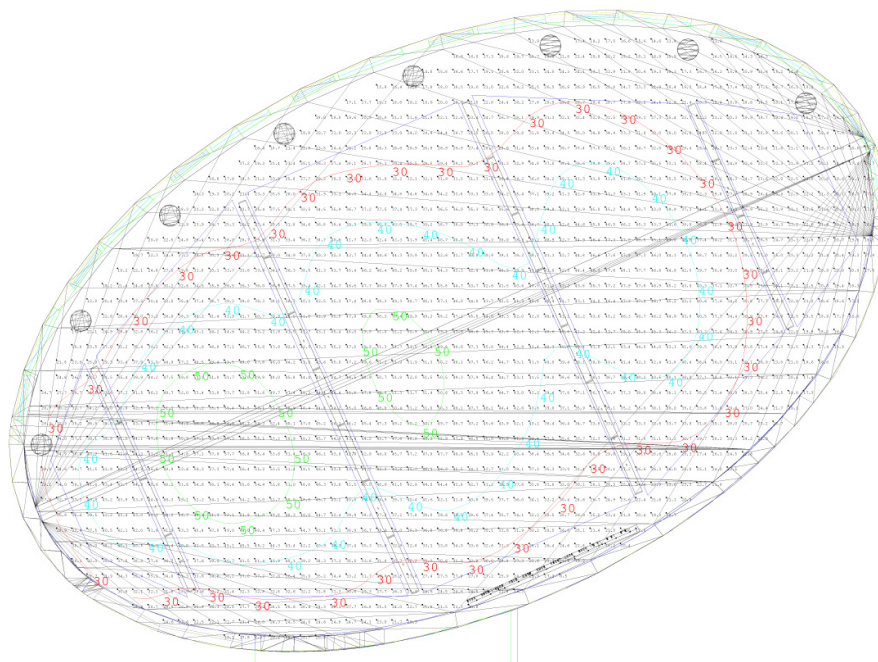
<b>Label</b>	<b>LLD</b>	<b>LDD</b>	<b>LLF RSDD</b>	<b>BF</b>	<b>TOTAL</b>
F29	0.94	0.88	0.97	0.98	0.79
F29a	0.94	0.88	0.97	0.98	0.79

### 3f. Illuminance Data

(Software used: AGI32 – v1.91)



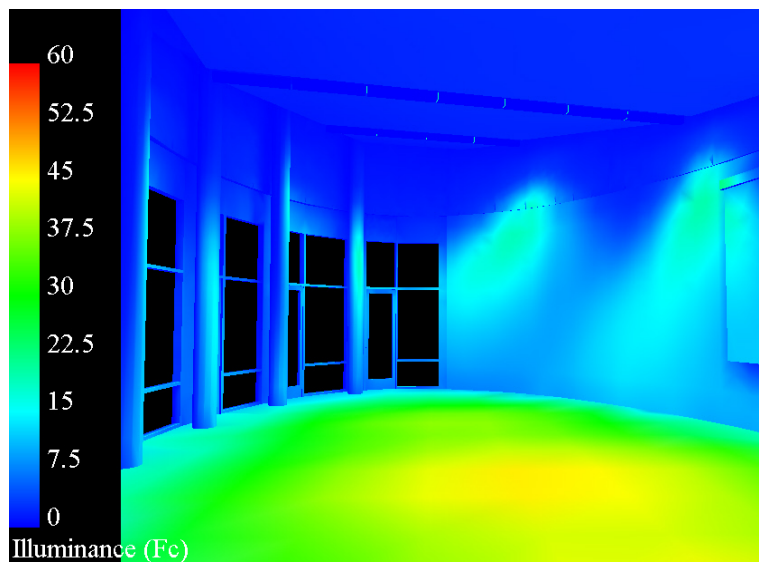
Floor Plane: Illuminance Contours



Work Plane: Illuminance Contours

19.8	15.5	10.0	5.8	3.7	2.8	2.5	2.4	2.4	2.5	2.8	3.6
18.7	16.4	12.5	8.6	5.5	3.8	3.0	2.7	2.7	3.0	4.0	6.9
17.2	16.0	13.4	10.4	7.5	5.3	4.0	3.4	3.4	4.3	6.6	11.0
15.7	15.1	13.5	11.3	9.0	6.9	5.3	4.6	4.9	6.5	9.4	13.2
14.4	14.2	13.2	11.6	9.9	8.2	7.0	6.5	7.1	8.8	11.4	14.1
13.4	13.3	12.7	11.7	10.5	9.4	8.6	8.5	9.2	10.6	12.5	14.3
12.6	12.6	12.3	11.7	11.0	10.4	10.2	10.3	11.0	11.9	13.1	14.1
12.1	12.1	12.0	11.8	11.5	11.4	11.4	11.7	12.2	12.8	13.4	13.9
11.7	11.8	11.9	12.0	12.0	12.1	12.3	12.6	13.0	13.3	13.6	13.6

**Vertical Projection Screen: Illuminance Data**



**Overall Room: Pseudo Rendering**

**AGI32-v1.91 Statistical Summary**

<b>Calculation Area</b>	<b>Average Illuminance (fc)</b>	<b>Max. (fc)</b>	<b>Min. (fc)</b>	<b>Avg/min</b>	<b>Max/min</b>
Floor Plane	31.64	51.9	5.9	5.36	8.8
Projection Screen*	9.98	17.65	5.3	2.32	4.44
Work Plane**	34.58	57.90	6.5	5.32	8.91

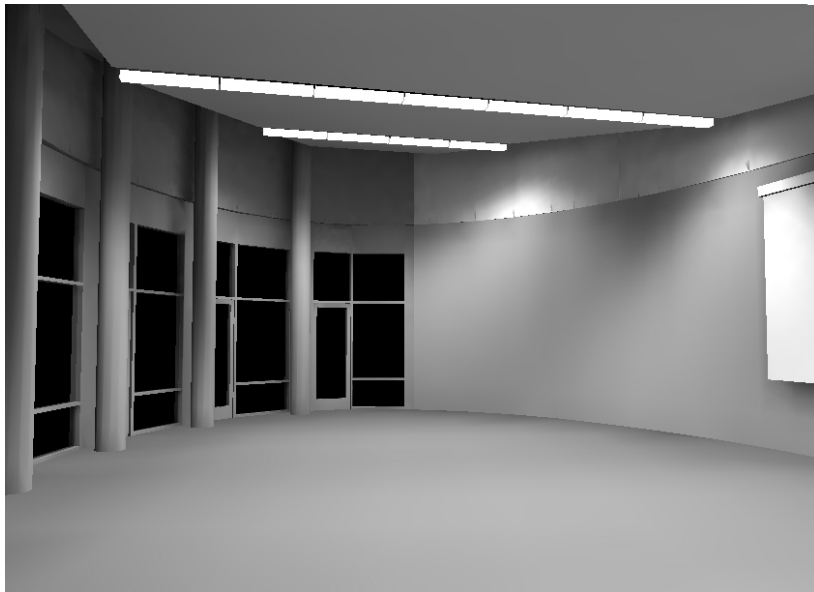
(\*) Vertical Illuminance Data

(\*\*) Assumed to be 2.5 ft AFF

**3g. Radiosity Renderings**



**View from Exterior**



**View from North West Corner**

### **3h. 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.

#### **Daylight Integration and Controls**

The glazing along the north façade allows for daylight to penetrate into the space during the day. Special considerations should be made to select the appropriate glazing material to avoid excessive daylight and solar heat gains into the space. Currently a semi-elliptical sunshade system hugs the northern façade. Redesign should address the efficiency of this system and make changes as necessary to optimize daylight control into the space. Another mechanism that should also be analyzed is the efficiency of the current drapery installed along the northern façade in preventing daylight penetration into the space. Photosensors coupled with dimming systems should be integrated into this space to effectively control the amount of supplemental artificial illumination required to meet IESNA illuminance recommendations in response to external daylight conditions. Occupancy sensors should also be used to avoid the need of providing excessive illumination when the space is not occupied.

#### **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 is 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 100 lx (30 fc)

#### **Vertical**

Cat. E: Performance of visual tasks of high contrast and small size or visual tasks of low contrast and large size 500 lx (50 fc)

### **3i. Evaluation**

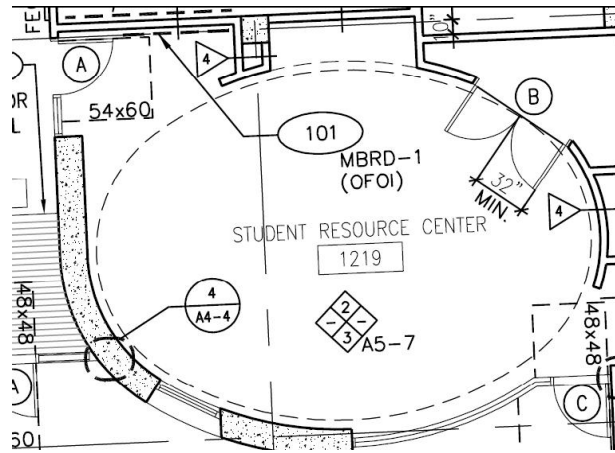
Simulations show that the current system satisfies IESNA light level recommendations. Illuminance levels on all surfaces analyzed were quite uniform. A higher level of vertical illumination is recommended than what would be required for VDT displays in order to cater for events that require visuals to be mounted on the walls.

The unique architecture of this space warrants the use of light to reinforce its form. Again, because of the Multipurpose room's relation to the North-East plaza, I will find ways during the redesign process to use light as a means to connect the two spaces.

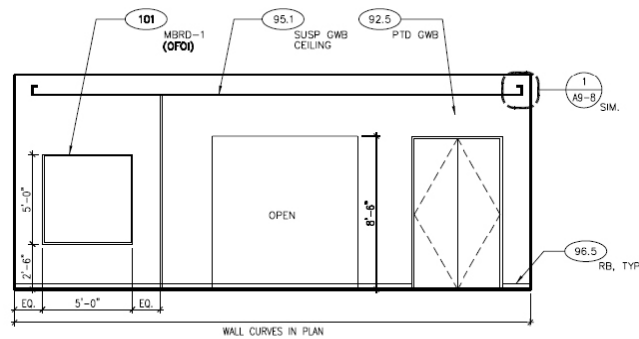


### Section 4: Student Resource Center

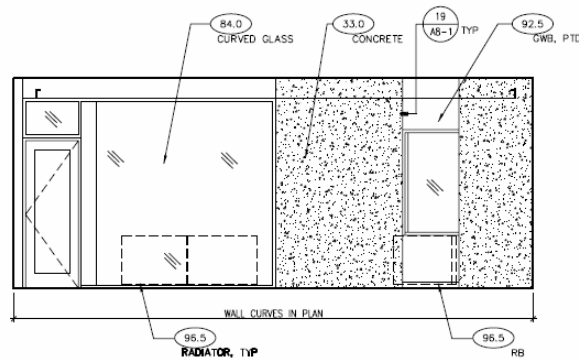
The Student Resource Center will serve as an information kiosk for students that desire to find out about university-wide activities as well as other campus-related information. The elliptical form of the room resembles that of the Multipurpose Room discussed in the previous section. The curved glazing on the southern façade provides a view into the adjacent plaza on the south-east corner of the site.



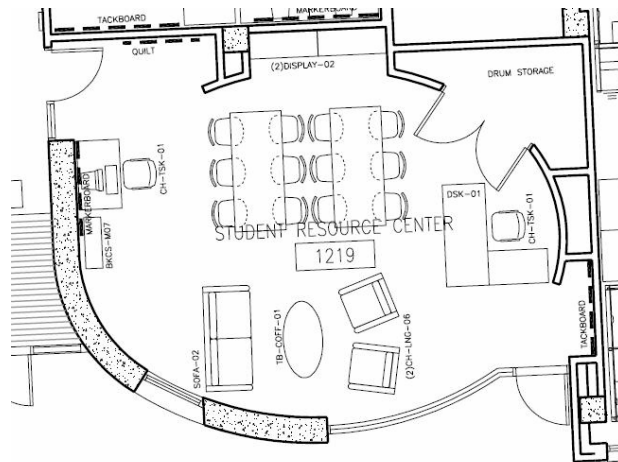
Floor Plan



Interior North Elevation



Interior South Elevation



**Furniture Plan**

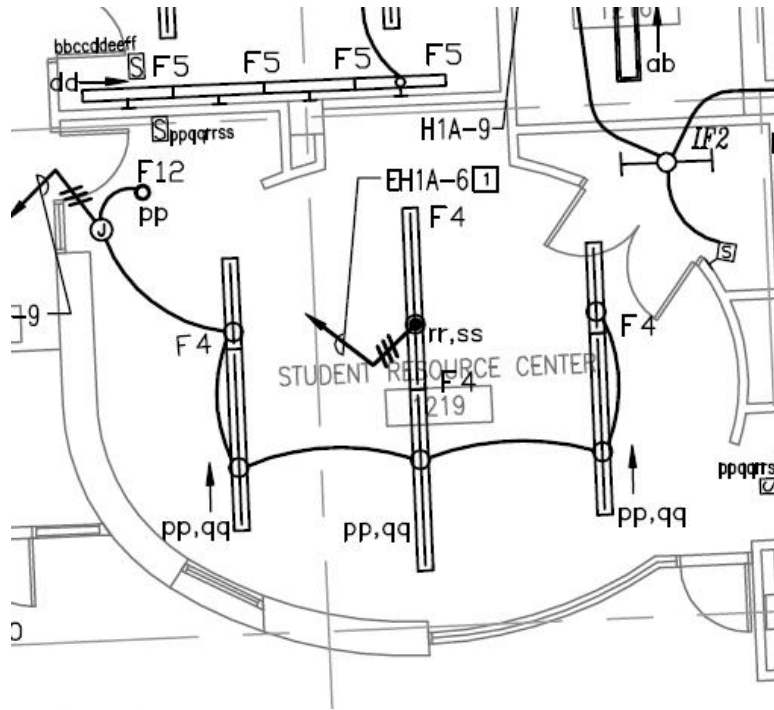
#### **4b. Pertinent Construction Material Data**

##### **Assumed Reflectance Data**

<b>Material</b>	<b>Location</b>	<b>Reflectance (%)</b>
Architectural Concrete	Walls and Ceiling	20
Rubber Floor Tiles		
"Blue Skies 702"		63
"Soft Jade 653"	Floor	80
"Arizona Sunset 602"		54
"Slate Gray 766"		45
Gypsum Wall Board (GWB)	Walls	75
Suspended GWB Ceiling	Suspended Ceiling	75
Wood	Furniture	8

**NOTE:** Refer to Section 1b. for glazing information

**4c. Luminaire Layouts**



**Plan: Luminaire (F4 and F12) Locations**

**4d. Luminaire Schedule**

Label	Fixture Description	Location	Lamp Type	Voltage
F4	Pendant-mounted fluorescent up/down light	Student Resource Center	(3) 32W T8 Fluorescent	277
F12	12" aperture recessed compact fluorescent downlight	Student Resource Center	(1) 32W T4 Triple Tube Compact Fluorescent	277

**4e. Applicable Light Loss Factors**

**Assumptions**

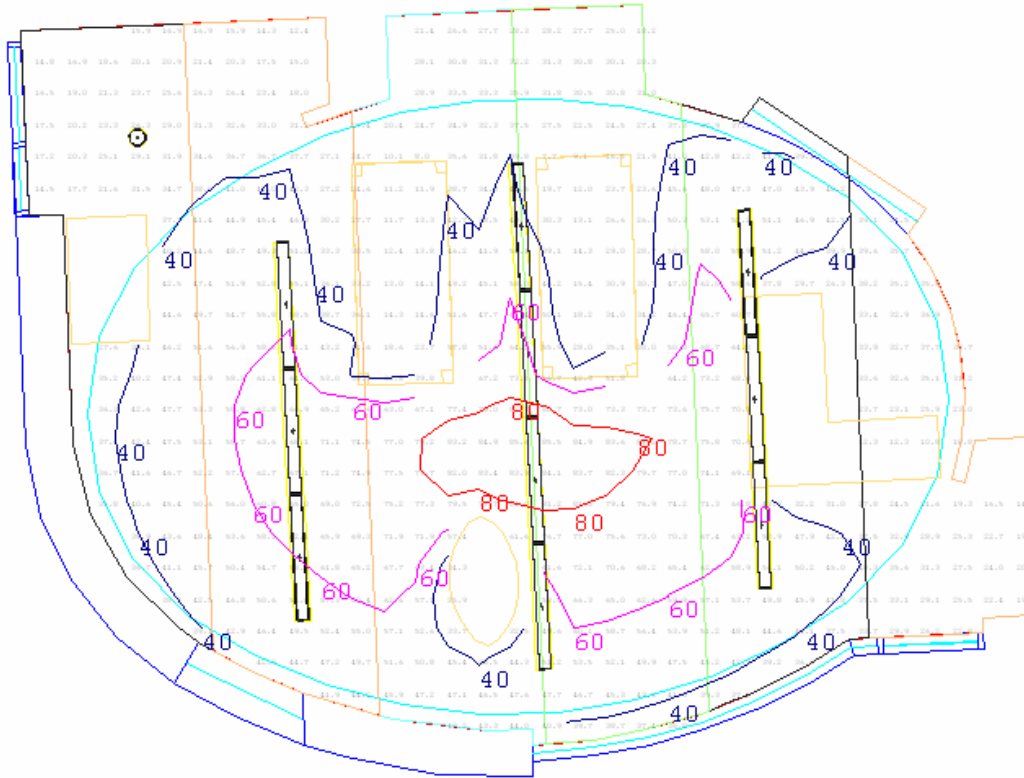
Label	IESNA Maintenance Category	Distribution Type	Environment Cleanliness	Cleaning Cycle
F4	II	Semi-Indirect	Clean	12mo
F12	IV	Direct	Clean	12mo

**Assumed Light Loss Factors Break Down**

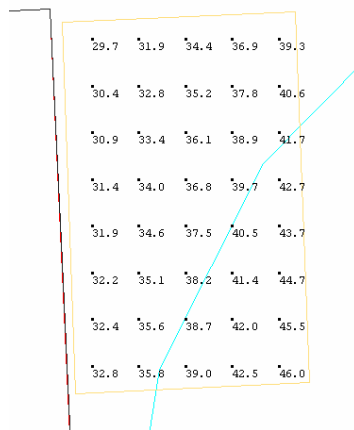
Label	LLD	LDD	LLF RSDD	BF	TOTAL
F4	0.94	0.94	0.89	0.98	0.77
F12	0.84	0.88	0.96	0.96	0.68

**4f. Illuminance Data (Assuming all fixtures ON)**

(Software used: AGI32 – v1.91)



**Floor Plan: Illuminance Contours**



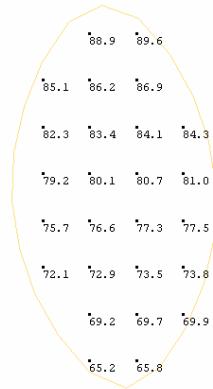
**Computer Desk: Illuminance Data**

61.7	62.8	63.9	65.1	66.3	67.7
65.8	67.0	68.3	69.6	70.8	72.3
69.7	71.2	72.7	74.1	75.4	76.9
74.0	75.4	77.1	78.5	79.8	81.4
78.1	79.6	81.3	82.8	84.2	85.8
82.2	83.7	85.5	87.0	88.4	89.9
86.2	87.7	89.4	91.0	92.4	93.9
89.7	91.3	93.0	94.6	95.8	97.3
93.0	94.6	96.3	97.8	99.3	100.9
96.1	97.7	99.3	100.9	102.3	103.8
98.8	100.4	102.0	103.4	104.9	106.5
101.1	102.6	104.2	105.7	107.2	108.4
102.9	104.4	106.0	107.4	108.8	110.0
104.2	105.8	107.3	108.8	110.0	110.2

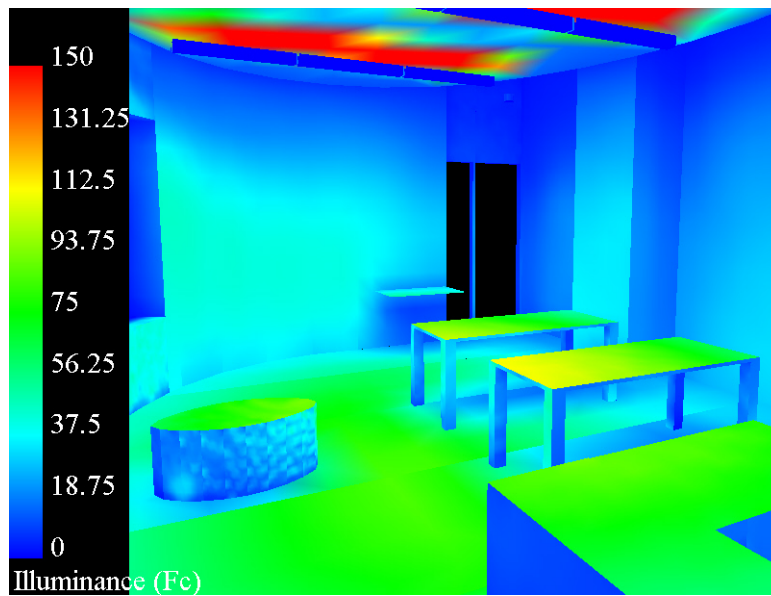
**Work Table: Illuminance Data (Typ.)**

66.2	67.2	68.5	69.1	68.8
69.7	69.5	68.0	67.1	67.7
69.6	68.5	67.9	64.0	69.5
66.2	67.2	68.4	69.7	70.0
67.4	66.2	66.6	66.4	62.9
68.7	68.0	62.7	67.1	68.5
68.7	68.4	62.6	67.6	69.0
68.4	68.2	62.6	67.5	68.0
68.2	66.9	62.2	67.0	68.0
68.7	66.1	60.7	62.6	62.4
68.0	67.7	69.5	68.5	68.5
68.7	68.1	68.2	66.0	62.2
68.7	68.0	62.0	66.7	64.5
64.7	62.0	67.5	69.2	64.5
68.0	68.7	62.6	67.5	67.5

**Help Desk: Illuminance Data**



**Coffee Table: Illuminance Data**



**Overall Room: Pseudo Rendering**



Construction documents note that the outer and inner rows can be switched separately. Therefore three trials were done to test the three possible luminaire on/off configurations. The illuminance data is presented below:

**Trial 1: All Fixtures On**

**AGI32-v1.91 Statistical Summary**

Calculation Area	Average Illuminance (fc)	Max. (fc)	Min. (fc)	Avg/min	Max/min
Floor Plane	44.1	85.6	7.7	5.7	11.1
Computer Desk*	37.1	46.0	29.7	1.3	1.6
Work Table 1*	79.7	102.0	51.7	1.5	2.0
Work Table 2*	85.4	107.0	57.9	1.5	1.9
Help Desk*	70.7	88.7	39.7	1.8	2.2
Coffee Table	78.1	89.6	65.2	1.2	1.4

(\* ) Assumed to be 2.5 ft AFF

**Trial 2: Middle Row On Only**

**AGI32-v1.91 Statistical Summary**

Calculation Area	Average Illuminance (fc)	Max. (fc)	Min. (fc)	Avg/min	Max/min
Floor Plane	18.8	45.4	0.8	23.5	56.8
Computer Desk*	12.0	16	8.2	1.5	2.0
Work Table 1*	40.3	54.9	25.8	1.6	2.1
Work Table 2*	49.7	64.5	31.3	1.6	2.1
Help Desk*	17.8	26.8	7.6	2.3	3.5
Coffee Table	44.1	50.6	37.1	1.2	1.4

(\* ) Assumed to be 2.5 ft AFF

**Trial 3: Outer Rows On Only**

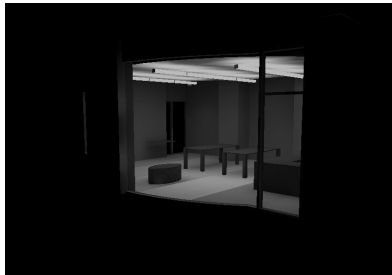
**AGI32-v1.91 Statistical Summary**

<b>Calculation Area</b>	<b>Average Illuminance (fc)</b>	<b>Max. (fc)</b>	<b>Min. (fc)</b>	<b>Avg/min</b>	<b>Max/min</b>
Floor Plane	26.3	45.3	4.5	5.8	10.1
Computer Desk*	31.1	38.2	25.3	1.2	1.5
Work Table 1*	40.0	56.7	23.6	1.69	2.4
Work Table 2*	36.8	50.0	22.7	1.6	2.2
Help Desk*	52.9	62.0	32.1	1.7	1.9
Coffee Table	34.1	39.7	27.7	1.2	1.4

(\*) Assumed to be 2.5 ft AFF

**4g. Radiosity Rendering Comparison**

**“All Fixtures On”**



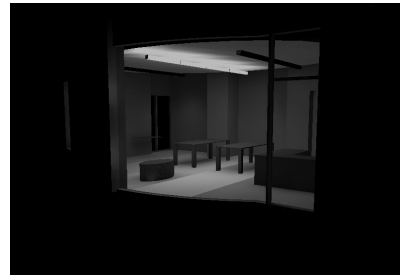
**View from Exterior**

**“Outer Rows On”**



**View from Exterior**

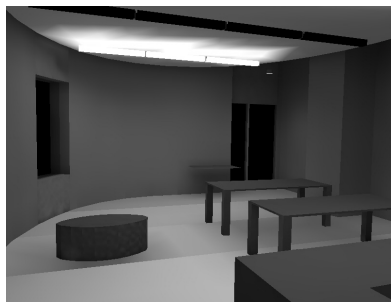
**“Inner Row On”**



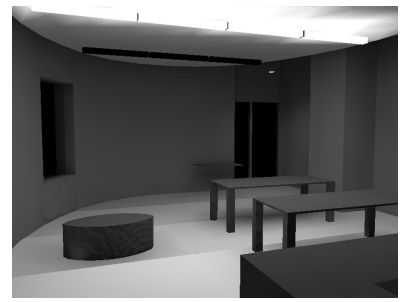
**View from Exterior**



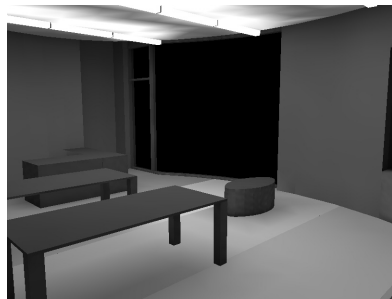
**View from Exterior Entrance**



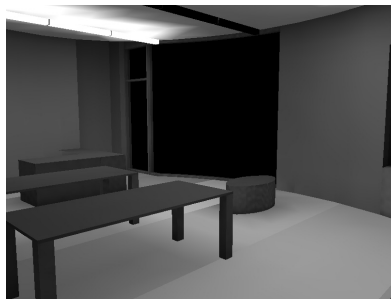
**View from Exterior Entrance**



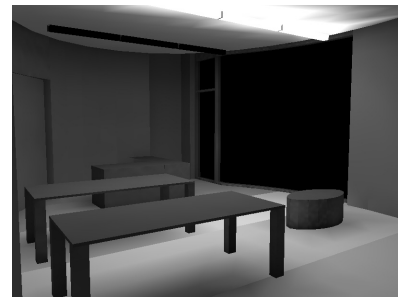
**View from Exterior Entrance**



**View from Interior Entrance**



**View from Interior Entrance**



**View from Interior Entrance**

#### **4h. 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. Automated shading devices should be implemented to allow for optimized control of daylight penetration into the space. 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**

Direct and reflected glare from the sun should be avoided by installing the appropriate shading device and/or installation of an alternative shading strategy. 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 shadow 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)
-----------------------	--------------

#### **4i. Evaluation**

The current lighting system provides ample illumination levels under all three configurations tested. Illuminance levels were excessive when all three rows of luminaires were turned on as shown by the results of trial 1. Subsequent simulations done for trials 2 and 3 showed that either provided illuminance levels that better conformed to what the IESNA had recommended. The system could reap further benefits if a dimming system was utilized.

Design criteria were met by the proposed lighting installation although visual interest could be created by providing more variation in light distribution across the different areas in the space.

## **Section 5: Power Density Analysis**

Under California's Title 24 requirements, the installed lighting at the UCSB Student Resource Building complies with the power density requirements under the complete building method. This is illustrated as follows:

**NOTE:** Using this method, the UCSB Student Resource Building is classified as an "Office Building" with an allowed power density of 1.20 w/sf. (146(b) - Table 5-2, 2003)

Total Watts Consumed by All Fixtures:	70099 W
Portable Lighting	1334.4 W
Less Control Credit Watts:	1447.6 W
Adjusted Actual Watts	69986 W
<b>W/sf:</b>	<b>1.02</b>
<b>Allowed W/sf:</b>	<b>1.20</b>
Area:	68413 sf
Allowed watts:	82096 W

At the time when the lighting compliance was submitted, Title 24 (2003) did not have any exterior lighting requirements. Therefore under the current version, the amount of consumed watts exceeds that which is allowed.

### **Lighting Allowances under Title 24 (2005)**

#### **Indoor Lighting**

Allowed W/sf:	1.10/sf
Consumed w/sf:	1.02/sf*
*see above	

**NOTE:** Under the latest 2005 version of Title 24, the allowed power density is **1.10 w/sf** for the same type of building classification. As this is still higher than the actual power density utilized by the current lighting system, the proposed indoor electrical lighting system still complies with code.

The installation also complies with the standards set in ASHRAE 90.1-2004. Table 9.5.1 indicates that educational facilities are given a **1.20 w/sf** for lighting which is more than what is consumed by the installed system.

#### **Outdoor Lighting**

Under the US Census Department (2000), the area of Santa Barbara is considered an urban area. Therefore under Title 24, all outdoor lighting shall comply with that established for Zone 3:

Using Table 147-A

Consumed Watts:	1660
<b>W/sf:</b>	<b>0.28</b>
<b>Allowed W/sf:</b>	<b>0.17 (Zone 3)</b>
Area:	5840 sf
Allowed watts:	992.8 W

Therefore, the exterior lighting arrangement in the NE plaza exceeds that allowed by Title 24.