

THE SALT LAKE CITY PUBLIC LIBRARY

Salt Lake City, UT

COURTNEY YIP

Lighting • Electrical



Technical Report 1: Lighting Existing Conditions + Design Criteria

September 29, 2008

Advisor: Dr. Kevin Houser

existing conditions

+

design criteria

EXECUTIVE SUMMARY

Lighting, both natural and electric, has a substantial role in the Salt Lake City Public Library experience. The existing lighting system is examined in this technical report, with regards to the IESNA design consideration criteria and ASHRAE/IESNA Standard 90.1. Major lighting hardware, drawings, furnishings, and materials are provided along with a computer analysis of the large workspace (the open office) and the circulation space (the Urban Room). These calculations show that the lighting systems are overall successful by staying consistent with the architecture and aesthetics of the building.

The workspace did not meet recommended illuminance values according to calculations. However, it is likely that some outside information may have been omitted in the documented design.

There is still room for improvement in the lighting design, including more integration of daylight and electric light and connecting the separate building through lighting design.

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THE SALT LAKE CITY PUBLIC LIBRARY



The Salt Lake City Public Library is designed to house a new central library and to create a major place of community in the central downtown area. The building form is composed of three main elements: the triangle, the crescent wall, and the bar building.

The central triangle component, which holds the library collections and service desks, is adjacent to the five-story, back-of-the-house administrative bar building. The triangle is partially encircled by a six-story crescent-shaped wall that ties the site and outdoor plaza to the building core. The crescent wall provides commercial spaces and an auditorium at the base, with reading galleries above. The wall increases in height, while leaning inward, allowing visitors to ascend a public walkway from the plaza to a roof garden above the triangle.

The Urban Room, located between the triangle and the crescent wall is designed as an extension of the plaza and as an all-season public space. Two five-story curved glass walls form a lens on one side of the triangle, intended for climate control during the summer and winter months. The building also features a sunken garden, amphitheater, and reflecting pool that connect the Children's Library at the base of the lens to the outdoor plaza. Dedicated parking is provided by a two-story underground parking structure.

The central design element for the building is the idea of transparency. This is seen in the generous use of glass throughout, allowing an abundance of daylight and maximum views inside and outside the building.

OPEN OFFICE [Large Workspace]

EXISTING CONDITIONS

Space Description:

The 1,520 sq. ft. open office is located on the northwest end of the rectangular-shaped “bar” building. The bar building is five-stories, comprising mostly of administrative offices. It is attached to the main library by a bridge running through an open void called the “canyon”. Furniture and spatial characteristics are typical for the open office on the second, third, and fourth floors. Half-height partitioned workstations positioned in the middle of the space form a circulation route from the office entrance to the kitchen area and to a conference room and two enclosed offices. A glass wall on the east side of the space separates the path adjacent to the “canyon,” while exterior windows on the west side of the open office allow views to the outside. The ceiling is a continuation of the architectural barrel vaults in the main library of the triangle building. One barrel vault spans the width of the space.

Surface Materials:

Figure A.1: Open office surface materials

Surface	Material Description	Properties
Floor	Grey carpet tiles	$\rho=0.20$
Ceiling	White-painted cast-in-place barrel vault	$\rho=0.85$
Walls	White-painted gypsum wallboard	$\rho=0.60$
	1” insulated clear butt-glazed window	$\tau=0.84$ U-value=0.48 Shading Coefficient=0.94
	1” insulated and tempered clear exterior window	$\tau=0.79$ U-value=0.48 Shading Coefficient=0.81
Furnishings	Open office partitions – medium-light colored fabric	$\rho=0.45$
	Worksurfaces – medium-light laminate	$\rho=0.45$
	Chairs	$\rho=0.30$

Furnishings:

The open office is furnished with twelve half-height partitioned workstations with chairs.

Lighting Hardware:

Linear two-lamp, 54-watt T5HO fluorescent indirect extruded aluminum pendants in four foot sections illuminate the architectural vaulted ceiling (Type L2). Two rows consisting of end-to-end fixtures provide uplight at the middle and east end of the vault. A third row of interrupted luminaires in the conference room and private offices provide uplight the west end of the ceiling vault. The luminaire was custom designed to have a symmetric “batwing” photometric distribution.

Figure A.2: Open office luminaire equipment schedule

Fixture Type	Description	Fixture (Manufacturer and Model)	Lamp	Fixture Input W	Mounting	Notes
L2	Linear pendant one lamp T5HO fluorescent indirect extruded aluminum uplight; electronic ballast; fused	Litecontrol custom 00-0236-01B-CXX-403-1/54T5HO-LP/ELB custom end sections	(1) FP54/835/HO	58 per 4'	Pendant	Main lighting fixture in "bar" offices.

Figure A.4: Open office architectural plan

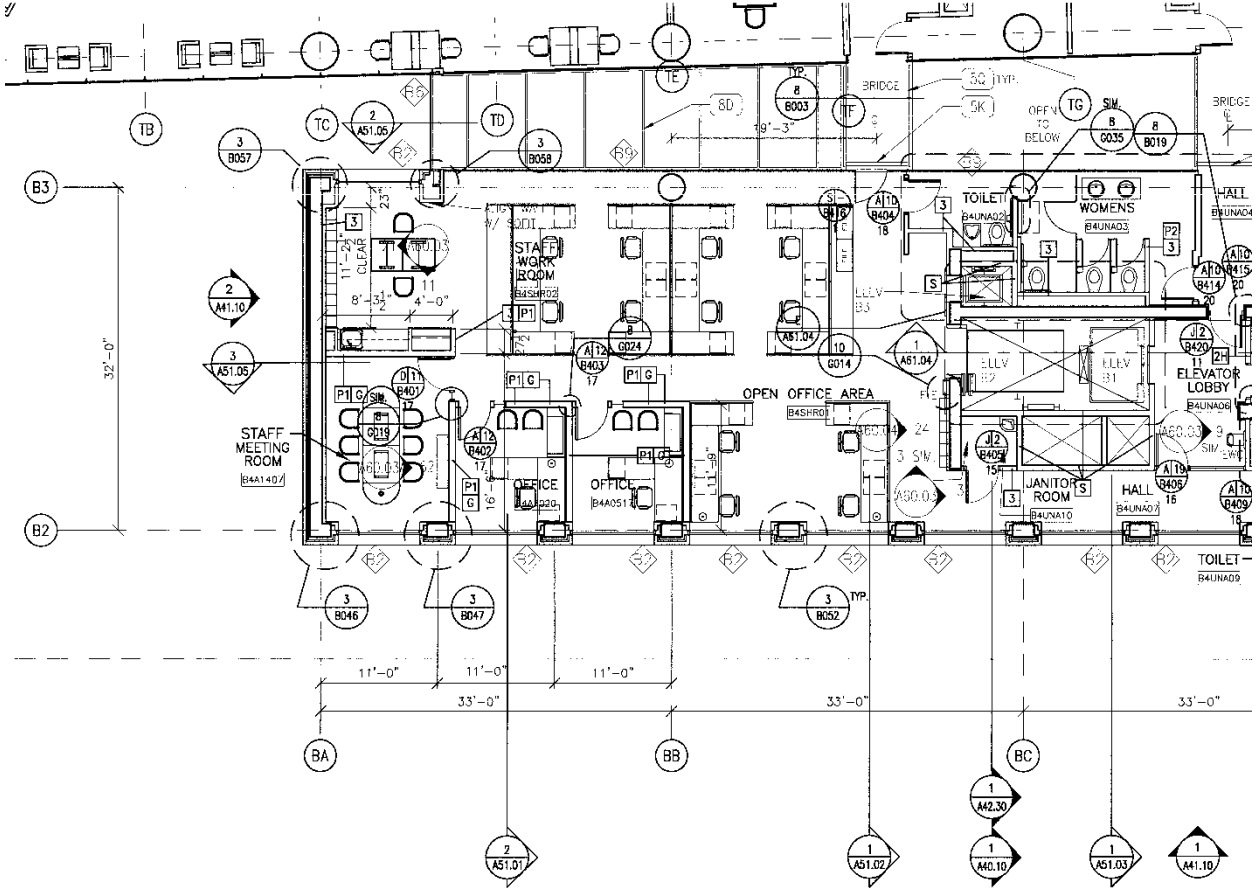
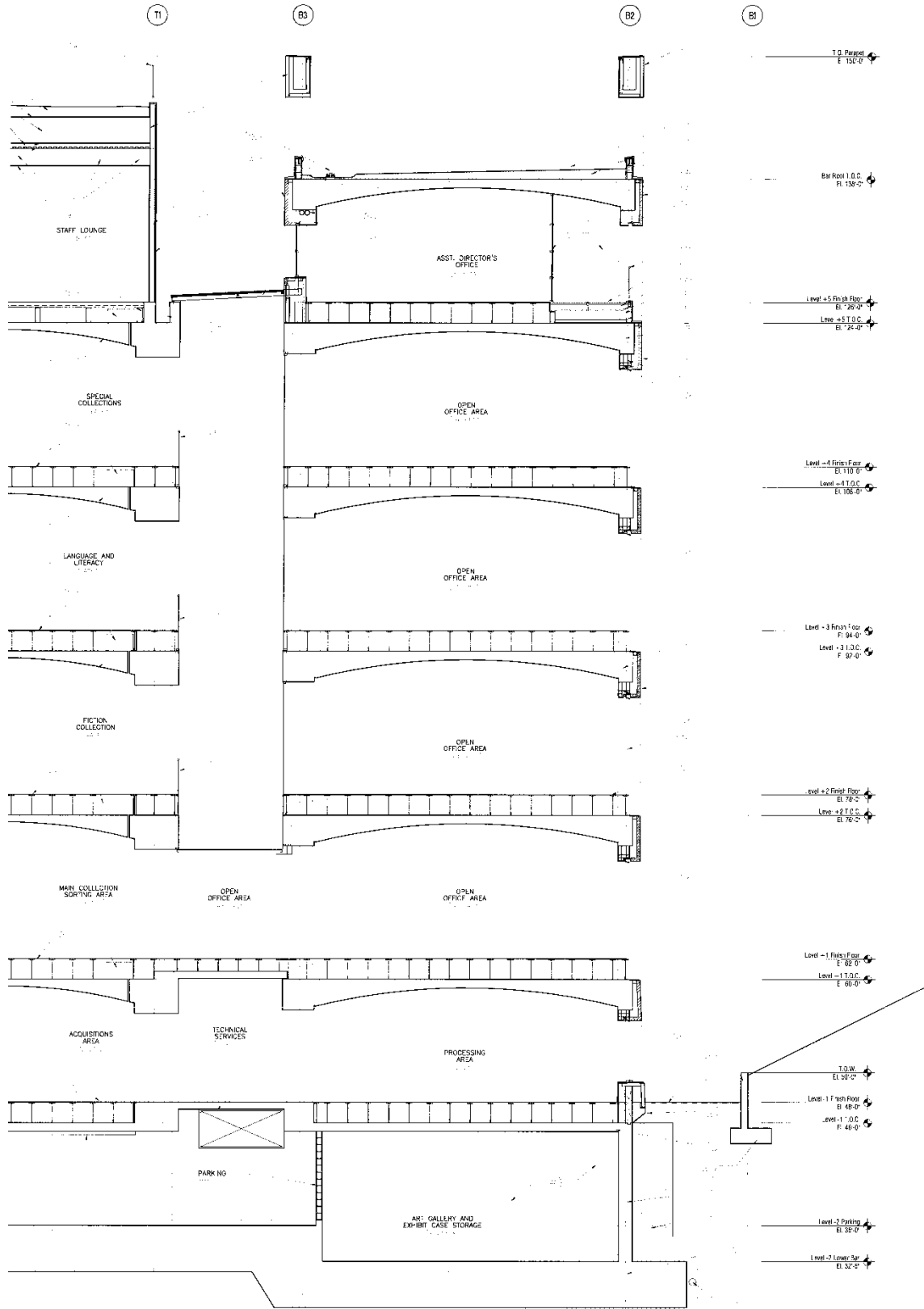


Figure A.5: Open office section



2 Wall Section @ Canyon
Scale 1/4"=1'-0"

DESIGN CONSIDERATIONS

General lighting concept:

Open offices are working environments, allowing people to perform various tasks and communicate with each other. These tasks may include reading, writing, VDT use, phone use, and face-to-face communication. The lighting design should provide a comfortable environment, positively affecting the mood of occupants. It should also allow for visual clarity in order for these tasks to be performed efficiently. Uniform lighting with a regular luminaire layout should create a pattern of light that supports the architecture and provides a sufficient quantity of light for tasks, particularly in the horizontal workplane.

Appearance of Space and Luminaires – Important

Lighting systems with a corporate look will help maintain a professional working atmosphere. Use clean, simple luminaire styles. A regular arrangement of luminaires must not physically and visually conflict with the architectural barrel vault ceiling and will help avoid visual clutter

Color Appearance (and color contrast) – Important

Use neutral or cooler CCT for an efficient working atmosphere and to better match daylight. Relatively high CRI (≥ 70) should be chosen for the pleasant appearance of skin tones, displays, food in the kitchen area, etc. Avoid varying CCT of sources. Differences will appear to be amplified by the space's many white surfaces.

Daylight integration and control – Very Important (deviates from IESNA Handbook)

Dimming of perimeter luminaires to save energy and utilize the ample daylight from the exterior and skylighted 'canyon'. Consider photoelectric controls since occupants will unlikely manually dim the ambient lighting system. Provide manual control for task lighting. Use blinds or shading devices on windows to the exterior to control glare and avoid thermal discomfort from daylight.

Direct Glare – Very Important

Use shading devices to control direct glare from sunlight. Choose luminaires that limit glare at normal viewing angles. Consider luminaires that provide an upright component to illuminate the ceiling and control luminance contrast. Avoid a direct view to the light source for task lighting

Flicker (and Strobe) – Important

Use electronic ballast for fluorescent sources; avoid using magnetic ballasts.

Light Distribution on Surfaces – Important

Use diffused light to avoid hot spots and shadows, except for accent lighting on walls. Provide a regular pattern of luminaires on ceiling and walls to complement the structure and architecture. Maintain an appropriate balance with ceiling and wall brightness with a luminance ratio of 3:1.

Light Distribution on Task Plane (Uniformity) – Important

Uniformly illuminate desk tops (task plane) with a regular pattern of light for consistent working conditions and to avoid visual fatigue. Choose luminaires with wide distributions for effective ambient lighting and to evenly illuminate the vaulted ceiling. Task lighting can help increase illuminance on task plane.

Luminances of Room Surfaces – Very Important

Non-glass walls should be illuminated to balance the brightness of the glass walls during the day. Uniform illuminances achieve visual comfort.

Modeling of Faces and Objects – Important

Provide vertical illuminance with interreflected lighting and multi-directional lighting for better facial modeling.

Points of Interest

Any artwork or plaques should be accented to create visual interest.

Reflected Glare – Very Important

Fixtures should not be aimed toward specular surfaces, windows, or VDT screens. Provide light from the sides of the tables to avoid reflected glare from glossy materials or computer screens.

Shadows – Important

Reduce inhibiting shadows with multiple sources from differing angles. Use linear sources or sources with a wide distribution to diffuse shadows. Avoid point sources from a single direction on task plane. Provide local task lighting to minimize shadows on desk tops.

Source/Task/Eye Geometry – Important

Sources should not be aimed onto glossy surfaces or computer screens at high angles which can create glare.

Sparkle/Desirable Reflected Highlights – Not Important

Small, bright sources are not essential for this space.

Surface Characteristics – Important

Space materials are of high reflectance and allow for many inter-reflections.

System Control and Flexibility

Separate, localized control should be employed for task lighting. Ambient lighting should be on a separate control, preferably with dimming.

Nighttime Lighting

Ensure that the maximum candela value of luminaires is contained within the building to prevent light trespass. Task lighting is unnecessary when space is unoccupied. Illumination of the vaulted ceiling can be seen from the exterior.

Maintenance

Not of major concern since ceiling mounted luminaires can easily be reached with a ladder.

Illuminance (Horizontal)

Open office with intermittent VDT use: Category E, 50 fc

Illuminance (Vertical)

Open office with intermittent VDT use: Category B, 5 fc

ASHRAE/IESNA 90.1:

The lighting power density allowed for an open plan office is 1.1 W/ft² according to Table 9.6.1. There are no control requirements for this space.

EVALUATION OF EXISTING LIGHTING

Light Loss Factors:

Figure A.6: Open office light loss factor summary

Type	LLD	LDD	RSDD	BF	Total LLF
L2	0.95	0.91	0.98	0.95	0.80

Figure A.7: Open office AGI32 side view rendering

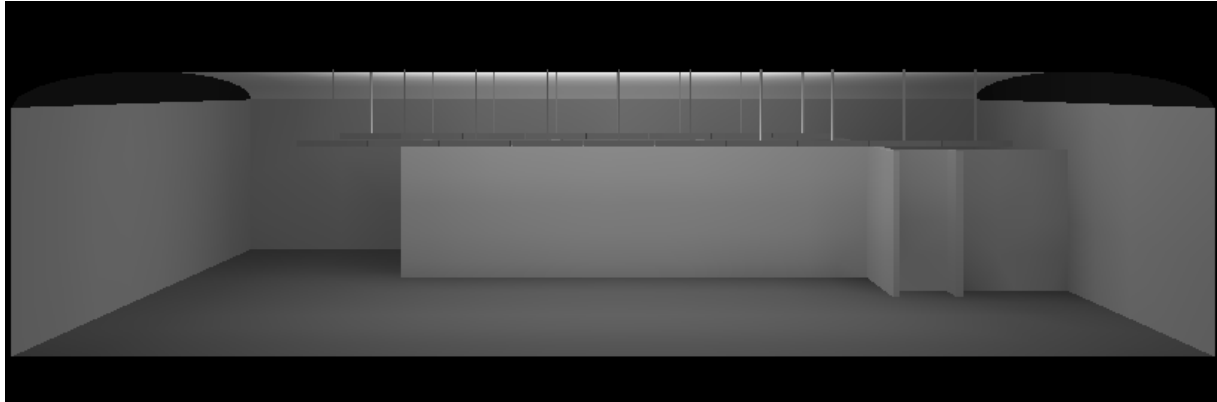


Figure A.8: Open office AGI32 top view rendering

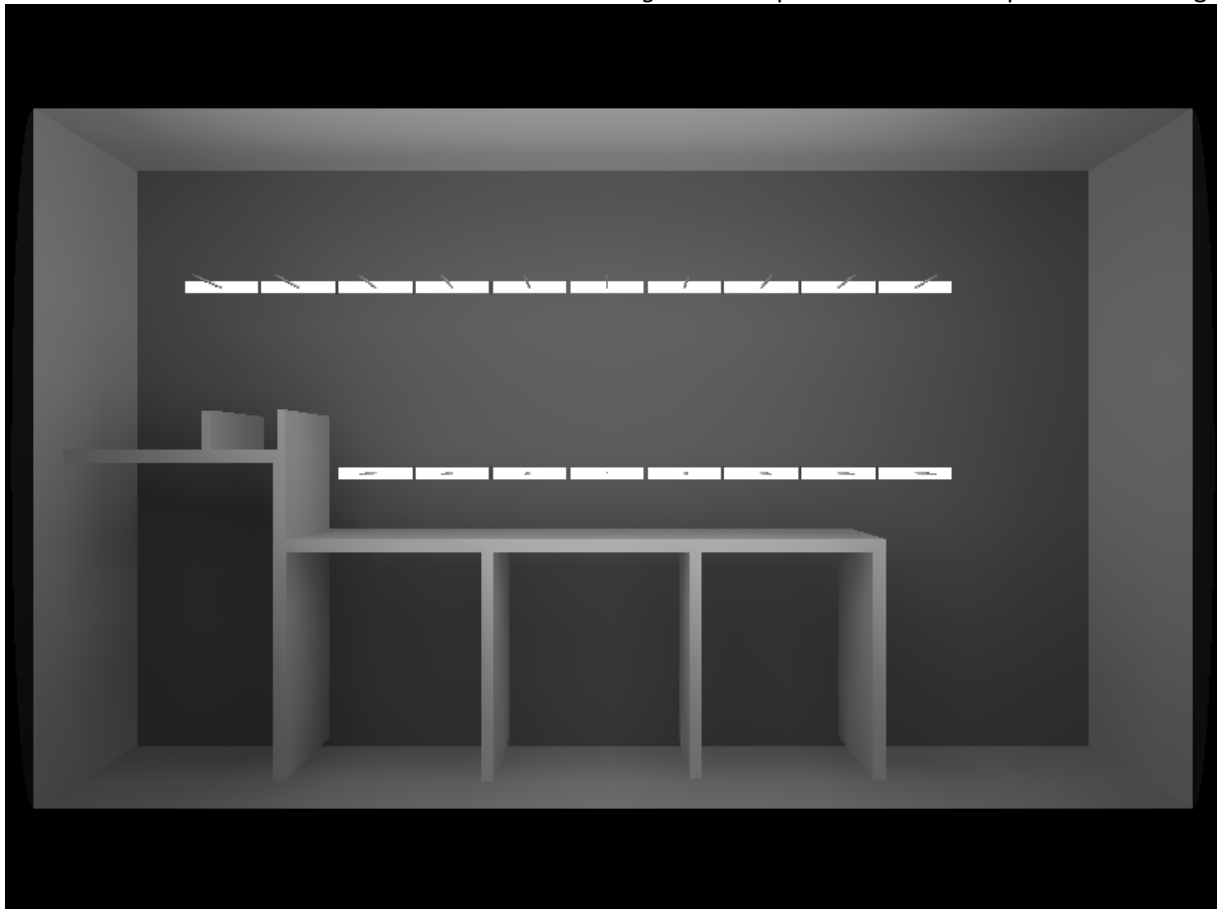


Figure A.9: Open office AGI32 false color perspective

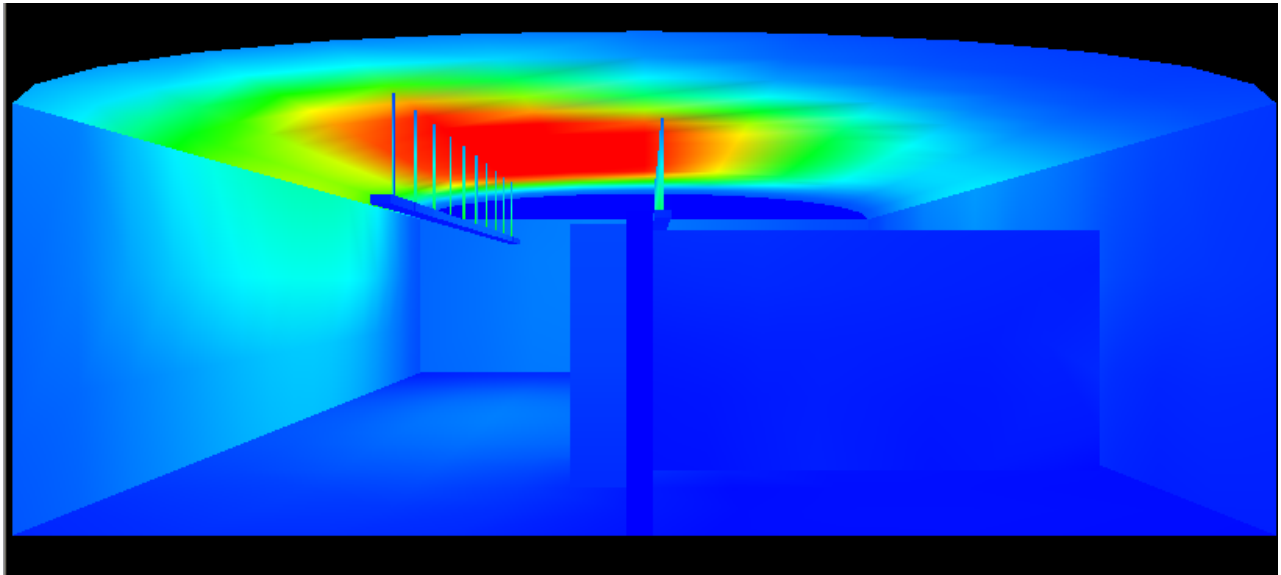
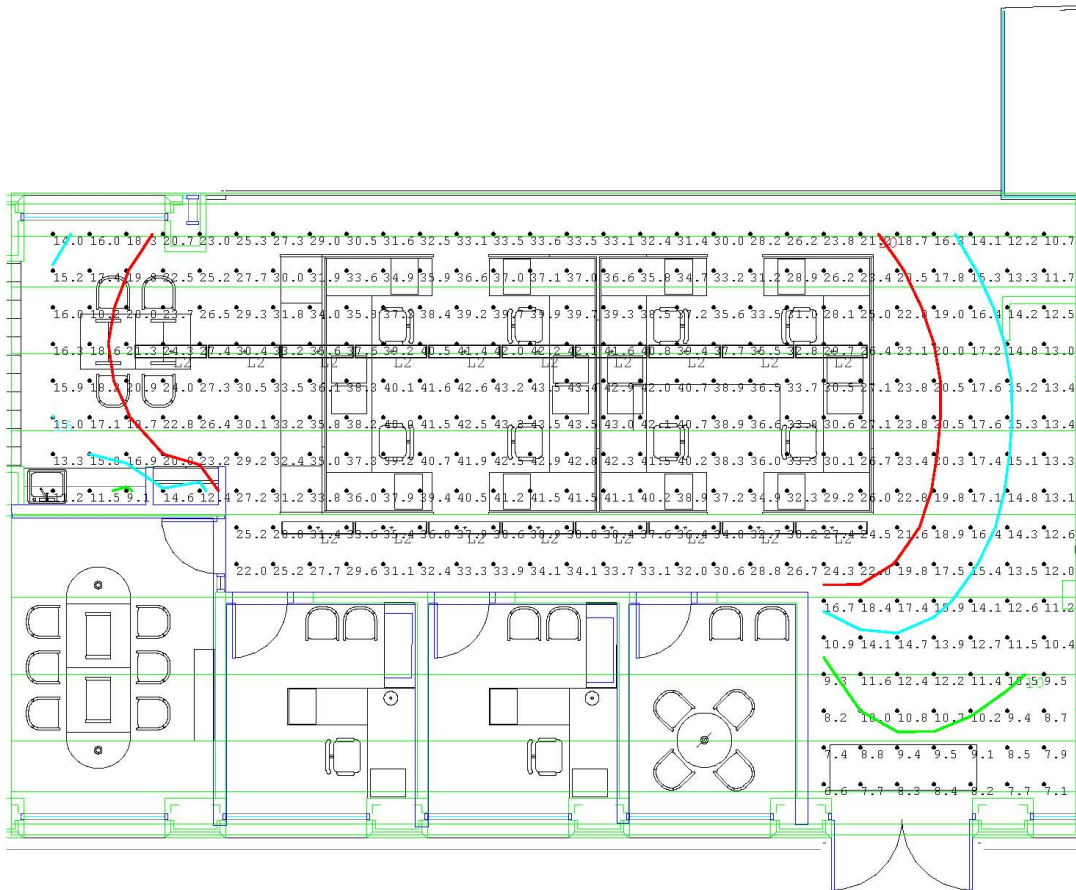


Figure A.10: Open office AGI32 illuminance calculation



Luminaire Schedule					
Symbol	Qty	Label	Lumens	LLF	Description
	18	L2	5000	0.800	P-I-5414T5HO-LP

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
CalcPts	Illuminanc	Fc	26.67	43.5	6.6	4.04	6.59

Discussion:

The existing design for the open office employs an indirect pendant as the only source of lighting. The end-to-end pendants work well in providing uniform, diffuse light to the office space. Glare is minimized and the ceiling is kept clear of visual clutter.

While the pendants succeed in relating to the architectural barrel vaulted ceiling, they do not provide localized lighting for the workstations. As a result, the AGI32 calculations show an average of 26.67 fc, far below the IESNA recommended level. This custom pendant is also used throughout the main library of the triangle, however a two-lamp version. One possibility for this discrepancy is that portable task lighting is used and is not part of the lighting designer's scope.

The consideration for daylight integration and control was not a priority in the lighting design. Exterior windows coupled with light from the 'canyon' skylight can help provide sufficient illuminance for working conditions. Photosensors can help dim or switch the electric lighting to save energy.

AUDITORIUM [Multipurpose space]

EXISTING CONDITIONS

Space Description:

The 319-seat stadium-style auditorium is located on the northeast corner of the library block. It is approximately 4,042 sq. ft. and is accessible from the lowest level and the ground level of the Urban Room. The -1 lower level has 170 seats and +1 ground level has 149 seats. The lower level also consists of equipment storage, a coat check, two main corridors along the exterior walls, and the auditorium stage. The upper level of the auditorium has a projection room in addition to the seating. The acoustical ceiling undulates and curves with slices cut into it for lighting and fire protection. A crinkled gypsum wall surrounds the space with an additional section of gypsum wall over the columns that extend from the crease.

Surface Materials:

Figure B.1: Auditorium surface material summary

Surface	Material Description	Properties
Floor	Forest green tiles	$\rho=0.18$
Ceiling	Suspended white metal acoustical panels	$\rho=0.75$
Walls	Gold acoustical wood baffles	$\rho=0.38$
	¼" gypsum wall board	$\rho=0.60$
	Beech wood trim	$\rho=0.45$
	Metal railing	$\rho=0.55$
	White acoustical fabric	$\rho=0.75$
Furnishings	Royal blue upholstered seating	$\rho=0.20$

Furnishings:

An array of built-in upholstered seats is shown on the drawings.

Lighting Hardware:

Two lighting systems are employed in the auditorium: the house lighting and the stage lighting. General downlighting is provided by PAR 38 6" cylinder fixtures (Type S9) suspended in the ceiling slots. Recessed non-adjustable MR 16 downlights (Type R8) illuminate the covered perimeter of the lower level. Two lamp T8 fluorescent side mounted strip luminaires (Type L23) light the wall cavities behind the wood slats.

The stage lighting consists of MR 16 adjustable pinhole downlights (Type R14) recessed in the acoustical cloud over the stage. Additional lighting is provided by two circuit track with PAR38 incandescent track heads (Type TB/T2).

Figure B.2: Auditorium luminaire equipment schedule

Fixture Type	Description	Fixture (Manufacturer and Model)	Lamp	Fixture Input W	Mounting	Notes
L23A	Two lamp T8 fluorescent side mount strip, dimming (120v)	Cooper Metalux MDSM 2	(2) FO32/830	64 W	Surface	Auditorium. Two and three foot fixtures per details.
L23B	One lamp T8 fluorescent side mount strip, dimming (120v)	Cooper Metalux MDSM 1	(1) FO32/830	32 W	Surface	Auditorium. Two and three foot fixtures per details.
R8	Recessed MR16 pinhole downlight non-adjustable, 277/120 volt transformer	Kurt Versen K7701-277	(1) 50MR16/XP/NF L/25	55 W	Recessed	
R14	Recessed MR16 adjustable pinhole downlight, 45 degree center beam angle	Cooper Iris N3/MR AA pin	(1) 50MR16/XP/NF L/25	55 W	Recessed	Auditorium in acoustical cloud over stage
S9	PAR 38 cylinder 6" black exterior	Cooper Portfolio H8600T MB 3600C	(1) 100PAR/CAP/ R/FL40	100 W	Pendant	Auditorium downlight. Suspended in ceiling slots.
TB	Pendant two circuit track with separate neutrals.	LSI 32XXX series track with pendant hangers	N/A	N/A	Pendant	Auditorium 120v
T2	PAR 38 incandescent track. Provide all necessary power feeds, connectors and mounting hardware.	LSI 297-00-HOOD C	(1) 250PAR/CAP/ L30	250 W	Track	Auditorium on TB track.

Drawings:

Figure B.3: Auditorium schematic plan

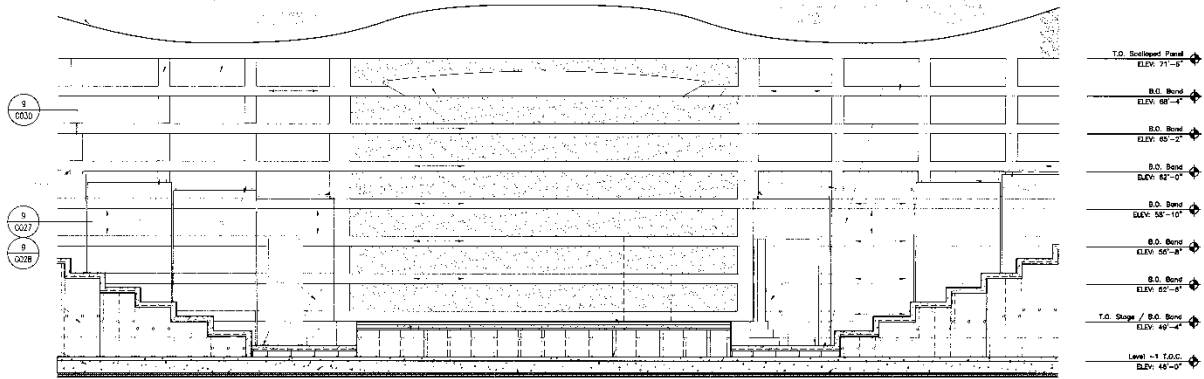


SALT LAKE CITY PUBLIC LIBRARY
-1 level plan

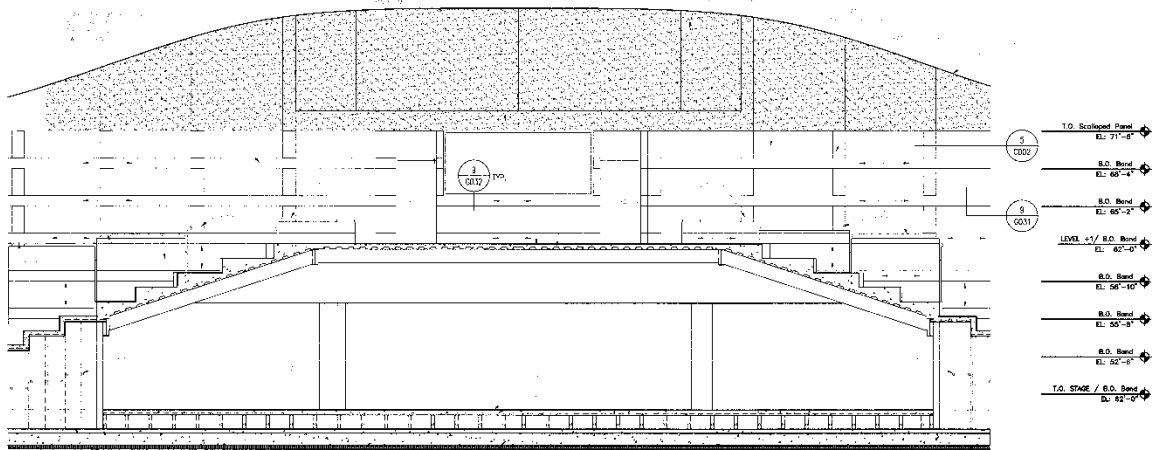
Moshe Safdie & Associates
VCBO Architecture

Figure B.3: Auditorium north section

Figure B.4: Auditorium south section



1
Auditorium Section - North (Flattened For Clarity)
Scale: 1/4" = 1'-0"



2
Auditorium Section - South (Flattened For Clarity)
Scale: 1/4" = 1'-0"

Yip [20]
Figure B.5: Auditorium section

Figure B.6: Auditorium wall section

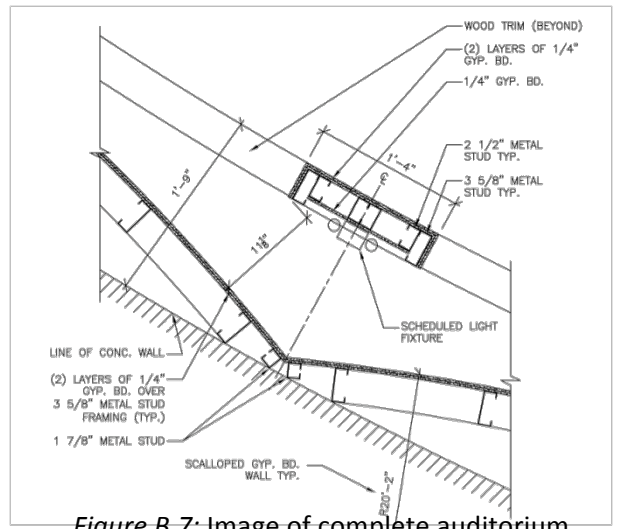


Figure B.7: Image of complete auditorium



DESIGN CONSIDERATIONS

General lighting concept:

The auditorium is used by the public, though managed by the library. It primarily serves as a performance space and a cinema. It is essential for the audience to be able to clearly see the occurrences at the front of the room. Occupants should feel relaxed and comfortable in the space. This can be done with peripheral lighting and non-uniform lighting throughout the space.

Appearance of Space and Luminaires – Somewhat Important

Concealed, high quality luminaires will not interfere with the undulating ceiling and defined architectural forms. It will also add to an integrated, higher-end feel of the space. A regular arrangement of luminaires will help avoid visual clutter. The lighting should be organized to delineate circulation paths and direct attention toward the stage.

Color Appearance (and color contrast) – Important

Choose a warmer CCT for to enhance the color of the wood and create a more intimate and comfortable feel. Choose a high CRI for the pleasant appearance of skin tones.

Daylight integration and control – Important

Daylight should not be introduced to the space because it is variable and can disrupt the programmed lighting for performances.

Direct Glare – Important

Avoid intense visible sources at normal viewing angles that may cause discomfort and inhibit visibility.

Flicker (and Strobe) – Important

Avoid using magnetic ballasts. If using HID sources, use a three-phase electrical system to minimize the stroboscopic effect.

Light Distribution on Surfaces

Provide a regular pattern of luminaires on ceiling and walls to complement the architecture. Aisles should be evenly lit to provide way-finding.

Light Distribution on Task Plane (Uniformity)

The task plane mostly remains on the floor throughout the space. Walkways should be safely illuminated with uniform lighting.

Luminaire Noise

Electromagnetic ballasts should be avoided to minimize distracting noises. Dimmers and air-handling luminaires for incandescent lamps that generate sound should also not be used.

Luminances of Room Surfaces – Important

Luminaires should light the walls of the space without creating dark areas. Direct and diffuse lighting will increase occupant comfort and will reduce shadows and overhead glare.

Modeling of Faces and Objects – Important

Use multi-directional sources for better facial and object modeling on stage. Use downlighting with wide distributions and use interreflected light to contribute to higher vertical illuminance.

Points of Interest

The stage at the front of the room is most important and should appear brighter to attract attention. Secondary points of interest include the entrances and exits. These should be illuminated to a safe level.

Reflected Glare

Illumination from the periphery will help avoid reflected glare. Light should not be aimed toward specular surfaces to maintain visual clarity.

Shadows

Reduce strong inhibiting shadows with area sources for general lighting. Provide task lighting at podium reduce shadows from other lighting in the space. Point sources on stage can cause some beneficial shadowing by enhancing people or object's three-dimensionality.

Source/Task/Eye Geometry

The geometry between the viewer, the task, and the luminaire should be analyzed to ensure that direct and reflected glare is not an issue and will not reduce task visibility.

Sparkle/Desirable Reflected Highlights

Small, bright sources may be used to provide sparkle and enhance the interest of the space.

Surface Characteristics

Surfaces should have high reflectance to increase interreflections, reduce sharp contrast, and decrease the wattage or number of luminaires necessary. Non-specular surfaces will help avoid reflected glare.

System Control and Flexibility – Very Important

Lighting control scenes are essential for the multi-functions of the space:

- Presentation with projection: low light levels sufficient for way-finding, some peripheral lighting, and some stage lighting
- Stage: varying levels of light (low, medium, bright)
- Movie: way-finding and some peripheral lighting
- Cleaning: some general downlighting, stage lighting
- All off

Both dimming and switching should be employed for more flexibility.

Maintenance Issues

Luminaires should be located in areas that can be accessible with a lift or ladder for re-lamping or cleaning.

Special Considerations

Downlight can minimize the loss of visibility with spill light during projections. Contrast between the screen and the background can be reduced by increasing the background luminance to lessen eye strain.

Illuminance (Horizontal)

Auditoriums (Assembly): Category C, 10 fc

Auditoriums (Motion Picture Theatre): 5 fc minimum for circulation during intermissions, 0.1 fc to 0.2 fc during the picture

Illuminance (Vertical)

Stage lighting for performances: 50-100 fc

Vertical illuminance on the peripheral walls can aid in a pleasant impression and better facial rendering (5-10 fc)

ASHRAE/IESNA 90.1:

The lighting power density required by ASHRAE/IESNA 90.1 is 1.3 W/ft² for multipurpose spaces. There are no requirements for lighting control.

EVALUATION OF EXISTING LIGHTING

Light Loss Factors

Figure B.8: Auditorium light loss factor summary

Type	LLD	LDD	RSDD	BF	Total LLF
L23A	0.85	0.91	0.98	0.85	0.64
L23B	0.85	0.91	0.98	0.85	0.64
R8	0.95	0.91	0.98	1.00	0.85
R14	0.95	0.91	0.98	1.00	0.85
S9	0.95	0.91	0.98	1.00	0.85
T2	0.95	0.91	0.98	1.00	0.85

Figure B.9: AGI32 overhead false color with illuminance values

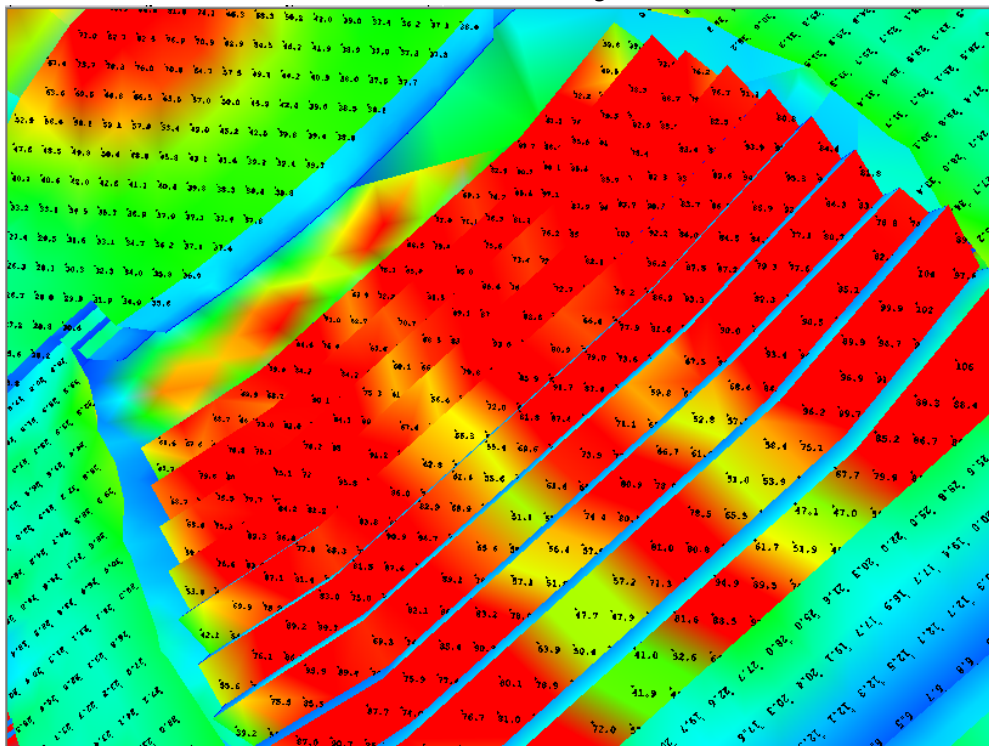


Figure B.10: AGI32 false color perspective

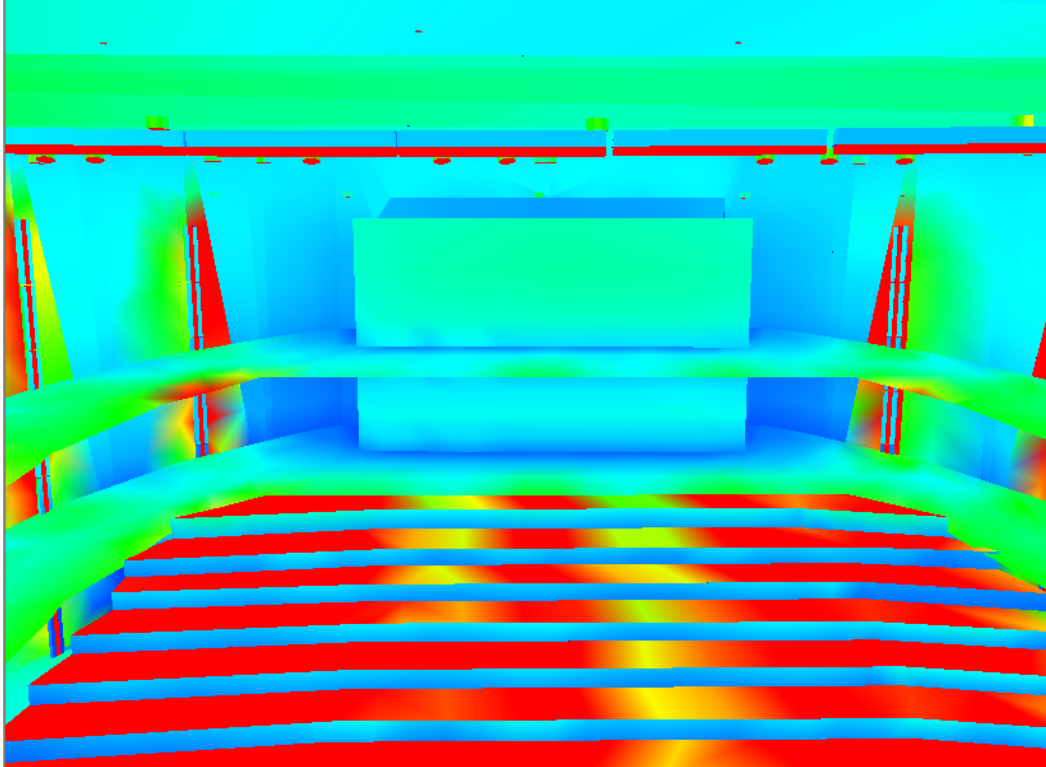


Figure B.11: AGI32 perspective rendering

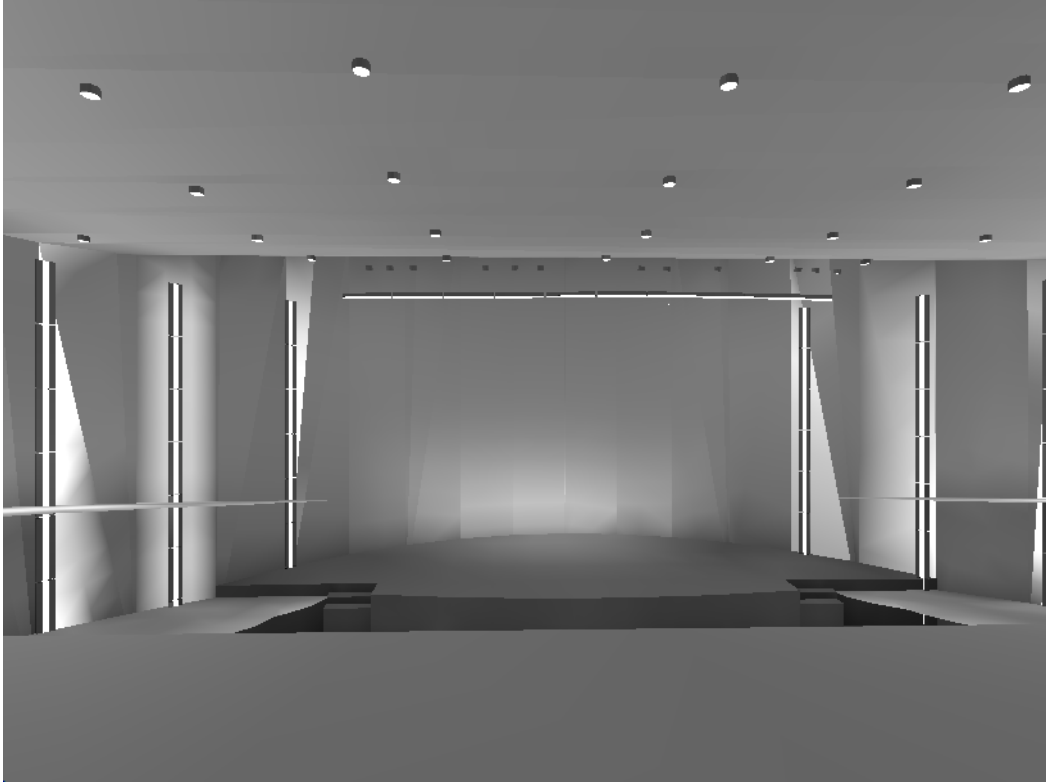


Figure B.11: AGI32 false color perspective toward stage

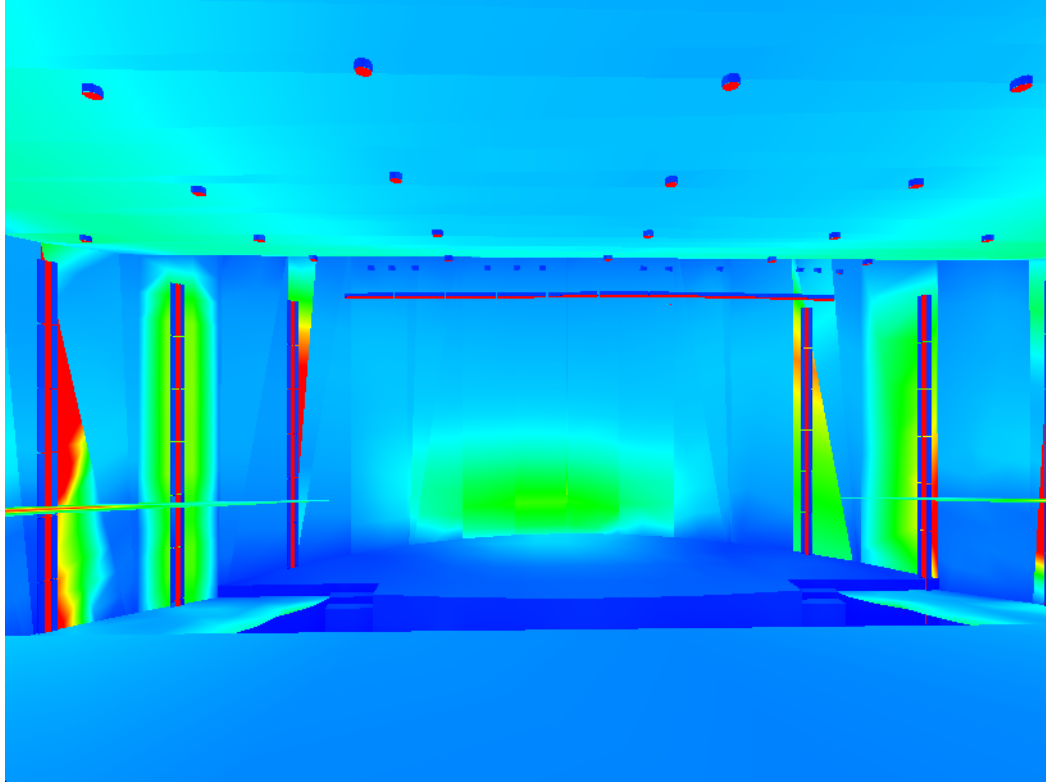


Figure B.12: AGI32 perspective rendering toward the back

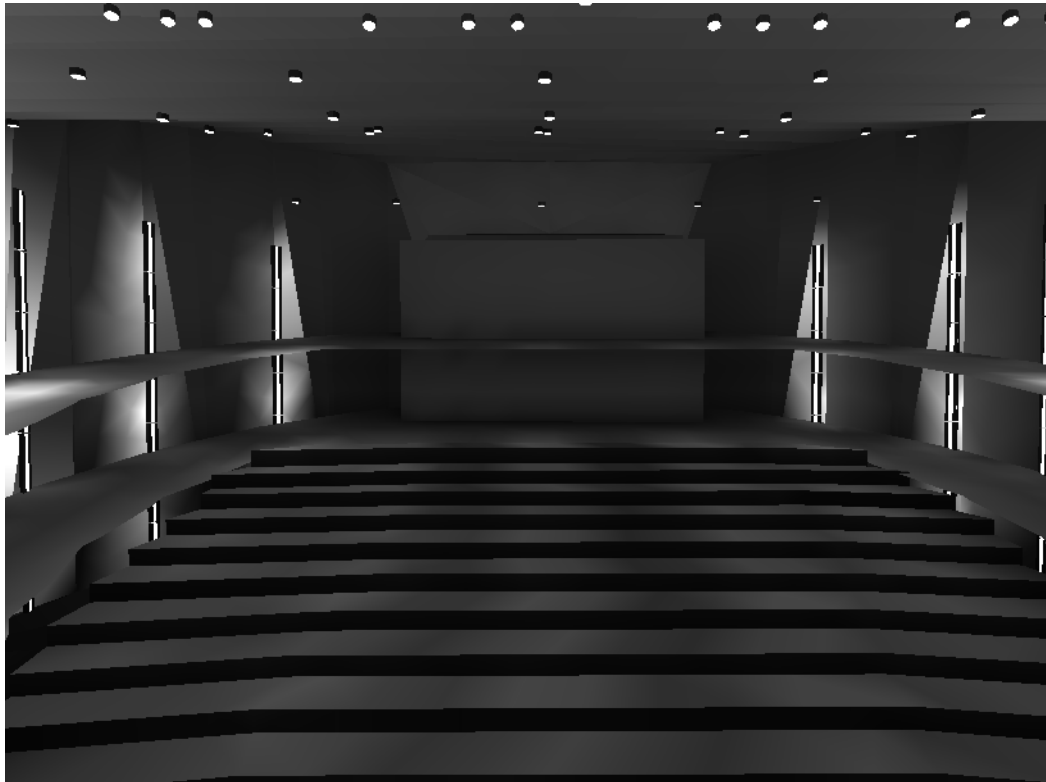


Figure B.13: AGI32 Luminaire and calculation summary

Luminaire Schedule					
Symbol	Qty	Label	Lumens	LLF	Description
	224	L23B	2900	0.640	SN-132
	14	R14	900	0.850	PN3MR-E3PIN
	10	L23A	5800	0.640	edited for 2 lamp SN-132
	36	S9	5000	0.850	edited for incandescent MD7X-7600C
	12	T2	5000	0.850	edited for 250WV MAXIMA 38 0 SP, USING EDISON PRICE 55 DEGREE LENS

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Canopy_1_Upper Level	Illuminance	Fc	41.02	137	0.3	136.73	458.00
Canopy_1_Lower level	Illuminance	Fc	41.02	137	0.3	136.73	458.00
stage_1_Stage	Illuminance	Fc	43.12	85.9	18.8	2.29	4.57
Canopy_1_Lower level_1	Illuminance	Fc	22.32	54.4	0.2	111.60	272.00
seating_1_step 1	Illuminance	Fc	72.02	90.1	39.9	1.81	2.26
seating_3_Step 2	Illuminance	Fc	81.83	101	65.8	1.24	1.54
seating_2_Step 3	Illuminance	Fc	77.76	90.8	59.7	1.30	1.52
seating_4_Step 4	Illuminance	Fc	81.37	103	53.8	1.51	1.91
seating_5_Step 5	Illuminance	Fc	78.14	96.2	42.1	1.86	2.29
seating_6_Step 6	Illuminance	Fc	81.00	95.3	55.4	1.46	1.72
seating_7_Step 7	Illuminance	Fc	74.15	95.9	39.2	1.89	2.45
seating_8_Step 8	Illuminance	Fc	76.31	94.3	51.8	1.47	1.82
seating_9_Step 9	Illuminance	Fc	75.34	104	47.7	1.58	2.18
seating_10_Step 10	Illuminance	Fc	79.10	132	41.0	1.93	3.22

Figure B.14: Auditorium control scenes

	House Lighting Channels									Stage Lighting Channels		
	1 front row downlights	2 general downlights	3 columns - wallwash	4 rear wall cove uplight	5 low voltage aisle steplights	6 uplight behind stage cloud	7 main level entry vestibules	8 lower level entry & walkways	9 spare	1 track circuit #1	2 track circuit #2	3 stage downlights
Panel Dimmer Number	2	1	5+6	51	55	28	53	49		24	25	29
Preset Scenes												
1 full on - stage medium	90	90	100	100	0	100	90	90	-	0	0	60
2 clean-up - energy-efficient	0	20	100	100	0	100	90	90	-	0	0	80
3 presentation with projection	0	0	25	0	0	0	75	75	-	0	40	0
4 movie - dark	0	15	0	0	80	0	75	75	-	0	0	0
5 stage bright - house bright	0	30	40	0	0	0	75	75	-	90	90	90
6 stage bright - house medium	0	15	20	0	0	0	75	75	-	90	90	90
7 stage medium - house dark	0	0	0	0	80	0	75	75	-	80	80	0
8 OFF	0	0	0	0	0	0	0	0	-	0	0	0

Discussion:

Several layers of light were used in the auditorium lighting design, including ambient lighting, peripheral lighting, and various forms of task lighting for the stage. The AGI32 calculation was done with all fixtures at full-output, which provides the maximum illuminance level the auditorium can have. This shows that there is ample lighting and switching and dimming can be employed to suit the space's different functions. The lighting designers provided a control scene schematic for the multipurpose space, which helps provide the necessary illuminance for each function.

The slits cut into the curving architectural ceiling help disguise the lighting and fire protection in the space. Pinhole downlights above the stage also minimize the penetration of the architecture. However, the track lighting highlighting the front stage appears bulky and inconsistent with the other hidden luminaires. A similar slit or drop in the ceiling could have shielding the track fixtures from the audience's view.

The luminous covers along the perimeter of the auditorium were a nice attempt to provide diffuse peripheral lighting to enhance the impression of pleasantness. Unfortunately, the lines of light combined with the horizontal wood strips encircling the space form a checkered look and become distracting and unappealing. A change in direction of either the wood baffles or the luminous covers would complement each other rather than conflict.

THE URBAN ROOM

[Circulation space]

EXISTING CONDITIONS

Space Description:

The 84,000 sq. ft. Urban Room is located on the ground floor of the north side of the building, between the triangle and the arcing crescent wall. It acts as an interior street, with the main entrance connecting to the outdoor plaza. It is designed to be an all-season public space and can be used as a function of the library or separately. Bridges connect the space to the triangle, allowing secure access to the main library. It is lined with leasable retail shops along the base crescent wall and provides some seating areas along the perimeter. The space also allows access to the auditorium.

A 20,000 square foot sloping skylight protects the Urban Room from the weather, while curving in two directions. Upper story reading galleries are separated by glass railings, making them visible on both sides of the Urban Room walls. This space is also highly integrated with interior and exterior views, as well as daylight.

Surface Materials:

Figure C.1: Urban Room surface material summary

Surface	Material Description	Properties
Floor	Yellow limestone pavers	$\rho=0.25$
Ceiling	1" laminated and tempered low-E, insulated glazing	$\tau=0.72$ U-value=0.40
Walls	Light tan colored precast concrete	$\rho=0.50$
	Clear glass-supported guardrail system	$\tau=0.84$ U-value=0.48 Shading Coefficient=0.94
	½" clear glazing for retail spaces	$\tau=0.90$ U-value=0.86 Shading Coefficient=0.81
	Black metal mullions for retail space glazing	$\rho=0.10$
	Metal railing	$\rho=0.55$
Furnishings	Aluminum tables and chairs	$\rho=0.80$

Furnishings:

Movable aluminum tables and chairs provide eating and socializing areas. A couple indoor trees, approximately 30' in height are also located near the seating.

Lighting Hardware:

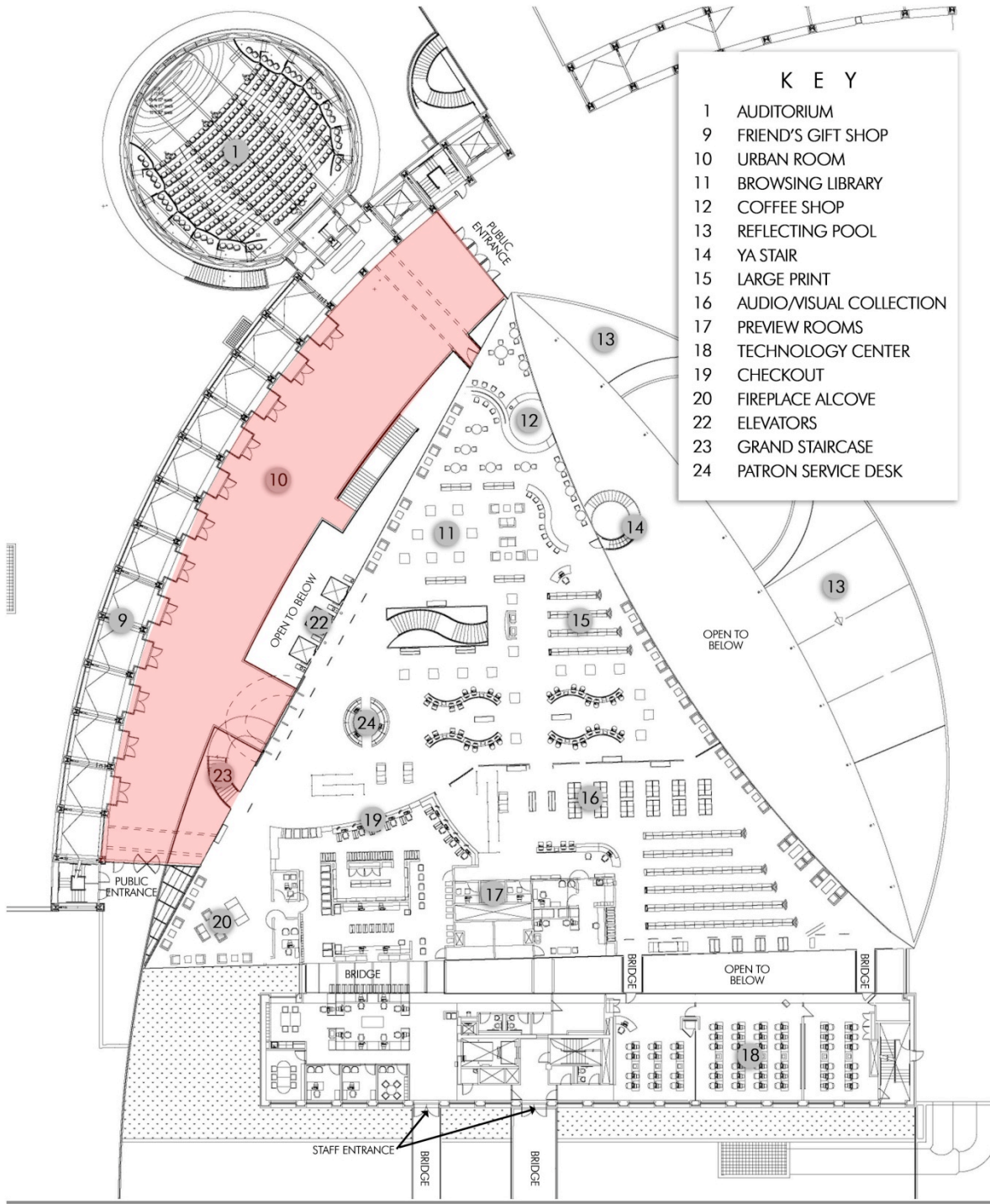
Wall mounted lantern fixtures (Type W1) with 70 watt T6 ceramic metal halides line the crescent wall. This custom luminaire directs light onto a curved aluminum sheet, offering indirect lighting. Recessed single circuit track (Type TF) with 250 watt PAR 38 incandescent adjustable track style downlights (Type S7) provide emergency lighting above the retail spaces. Recessed 32 watt compact fluorescent downlights (Type R1) and wallwashers (Type R2) provide lighting near the entrance of the Urban Room.

Figure C.2: Urban Room luminaire equipment schedule

Fixture Type	Description	Fixture (Manufacturer and Model)	Lamp	Fixture Input W	Mounting	Notes
R1	Recessed 1x32 watt compact fluorescent 6" vertical lamp downlight; white flange	Cooper Portfolio C6032__-6001LI-white flange	(1) CF32DT/E/N/8 30	35 W	Recessed	
R2	Recessed 1x32 watt compact fluorescent 7" lensed wallwasher; white flange	Cooper Portfolio C7932-2E-7191-LI-WF	(1) CF32/DT/E/N/8 30	35 W	Recessed	
S7	Surface mount 250 watt PAR 38 metal halide adjustable track style downlight with glare hood and electronic ballast	LSI M2901-5A-HOOD-CIN	(1) 250 PAR/CAP/FL30	N/A	Surface	Urban Room mounted on custom truss assembly. For emergency lighting only.
TF	Recessed single circuit track	LSI __	N/A	N/A	Recessed	Lower Urban Room along weall near meeting rooms
W1	Custom wall mount lantern	Winona Lighting	(1) CDM70/TC/830	70 W	Wall mount	Along crescent in Urban Room

Drawings:

Figure C.3: Urban Room schematic plan



SALT LAKE CITY PUBLIC LIBRARY
+1 level plan

Moshe Safdie & Associates
Valentiner Crane Brunjes Onyon

Figure C.4: Urban Room and Auditorium section

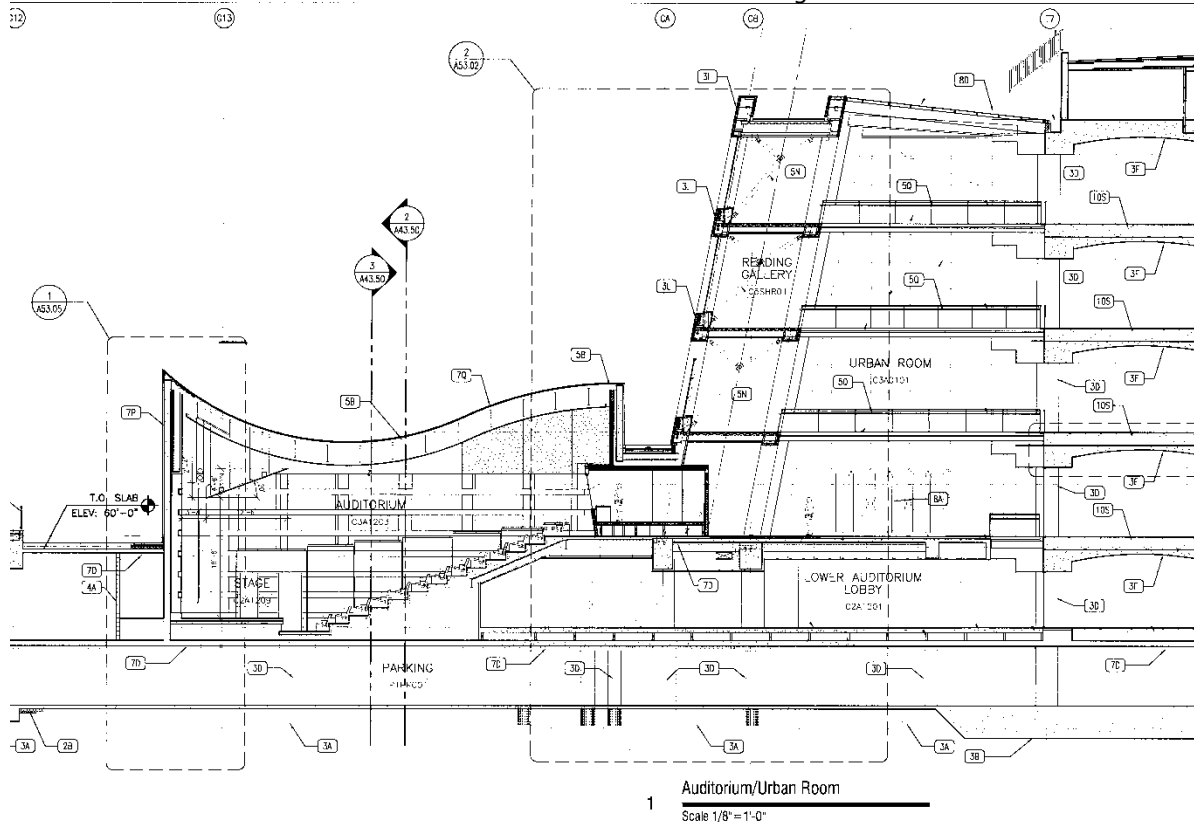


Figure C.5: Urban Room retail storefront

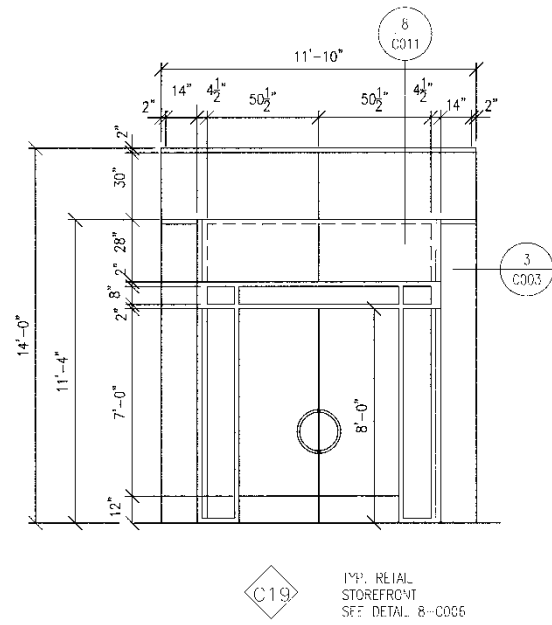


Figure C.6, C.7, and C.8: Urban Room pictures



DESIGN CONSIDERATIONS

General lighting concept:

The Urban Room is multi-functional, serving as a circulation, shopping, eating, and meeting space. It is a public transitioning space from the outdoor plaza to indoors. An abundance of natural light during the day makes the lighting for this space important at night to maintain a dynamic atmosphere. Transparency is key in this space, providing visual orientation within the building through the glazing and openings to the crescent wall and library. An impression of spaciousness and pleasantness can be achieved with peripheral wall emphasis and some non-uniform lighting.

Appearance of Space and Luminaires – Important

Lighting systems with a casual look will complement the informal feel of this public space. A regular arrangement of luminaires located along the perimeter will help avoid visual clutter and delineate circulation routes and areas of special interest. Luminaires should be aesthetically pleasing and of high quality to enhance the appearance of the space.

Color Appearance (and color contrast) – Important

Neutral or cooler CCT of light sources will better match daylight and help promote movement, as compared to warmer sources. Relatively high CRI (≥ 80) should be chosen for the pleasant appearance of skin tones, merchandise, and food.

Daylight integration and control – Very Important (deviates from IESNA Handbook)

Daylight from the glass skylight and walls is the primary source of light in this space during the daytime. Switching of luminaires on a time of day control can save energy. Preventing direct glare from sunlight with shades or blinds is not critical. People will be continually moving through the space and already adjusted to ample daylight. Shades and blinds will obstruct views and destroy the transparency concept.

Direct Glare – Not important

Choose luminaires that limit glare and visible sources at normal viewing angles to avoid discomfort and disability glare. Direct glare from windows and skylights are more tolerable because of the visual information provided.

Flicker (and Strobe) – Not important

Use electronic ballast for fluorescent sources; avoid using magnetic ballasts.

Light Distribution on Surfaces – Important

Provide a regular pattern of luminaires to complement the regular arrangement of the structure and architecture and to prevent confusion. Light should be provided on the perimeter and should not have very different brightness levels.

Light Distribution on Task Plane (Uniformity) – Somewhat Important

A uniform level of light is necessary for safety and to avoid distractions.

Luminances of Room Surfaces – Important

Wall surfaces should have a relatively high reflectance to increase the luminance and help reduce a brightness difference with the glazing.

Modeling of Faces and Objects – Important

A combination between direct and diffuse light can help with facial and object modeling. Provide vertical illuminance with interreflected and multi-directional lighting.

Points of Interest – Important

Retail store fronts should be accented to direct attention and create visual interest. The entrance should also be accentuated, particularly at night for way-finding.

Reflected Glare – Very Important

Fixtures should not be aimed toward specular surfaces or to windows. Lighting for the glass enclosed retail spaces should be at a shallow angle to prevent reflect glare.

Shadows – Somewhat Important

Shadows may add to the dynamics of the space. Localized lighting, as compared to the daylight from the skylight and windows, can help minimize shadows at the storefronts and seating areas.

Source/Task/Eye Geometry – Not Important

Sources should not be aimed onto glossy or specular surfaces at high angles that can create glare.

Sparkle/Desirable Reflected Highlights – Important

Sparkle from small, bright sources and reflected highlights can enhance the visual interest of the space.

Surface Characteristics – Important

Space materials are of high reflectance and allow for many inter-reflections.

System Control and Flexibility – Important (deviates from IESNA Handbook recommendations)

The space does not particularly require different lighting scenes for its functions. Lighting can be switched on or off with a programmed time-of-day control, since luminaires will rarely be on during the daytime.

Nighttime Lighting – Important

This space will be occupied at night. The lighting should be able to be seen from the exterior to draw visitors into the building.

Maintenance – Important

Durable luminaires of high quality can help reduce maintenance costs. Luminaires must be in accessible locations for re-lamping and cleaning.

Special Considerations

Peripheral lighting is also provided by the adjacent library and reading rooms in the crescent wall and will contribute to the overall space impression. Lighting levels for cleaning (10-20 fc) should be maintained during normal hours.

Illuminance (Horizontal)

Hotel (lobby) and merchandising spaces (circulation): Category C (10 fc).

Illuminance (Vertical)

N/A

ASHRAE/IESNA 90.1:

The lighting power density required by ASHRAE/IESNA 90.1 is 0.6 W/ft² for the first three floors and 0.2 W/ft² for each additional floor, totaling 1.0 W/ft² for five floors. Automatic lighting shutoff is required for this space using a scheduled time-of-day operated control device, an occupant sensor that will turn lighting off within 30 minutes of an occupant leaving a space, or a signal from another control or alarm system that indicates the area is unoccupied.

EVALUATION OF EXISTING LIGHTING

Light Loss Factors

Figure C.9: Urban room light loss factor summary

Type	LLD	LDD	RSDD	BF	Total LLF
R1	0.85	0.91	0.98	1.00	0.76
R2	0.85	0.91	0.98	1.00	0.76
S7	0.83	0.91	0.98	1.00	0.74
W1	0.83	0.91	0.98	1.00	0.74

Discussion:

Electric lighting was kept to a minimum in the Urban Room for good reason. The space has abundant daylight, which makes for a dynamic public space. Shadows and highlights from the structure of the glass mullions and crescent wall reading rooms add to the movement of this “indoor street.” Shading was appropriately omitted in this space. A window or skylight treatment would destroy any views, and thus the transparency of the space, a major unifying concept for the whole building.

Downlights and wallwashers were added to the partially covered entrance of the Urban Room. This helps transition visitors from the exterior to the interior. Crescent wall reading rooms and library spaces above are illuminated at night, adding peripheral lighting. The custom wall mounted luminaires line the retail storefronts along the crescent wall. This successfully draws attention to the shops with diffuse, indirect lighting. One concern for the lighting would be if there is sufficient comfortable lighting for the seating areas at night. Highlighting the trees could help with this and add to the aesthetics of the space.

OUTDOOR PLAZA [Outdoor space]

EXISTING CONDITIONS

Space Description:

The outdoor plaza, approximately 50,000 sq. ft. is located in the front of the main façade and is open for civic festivities. It serves as the heart of the 10 acre central city park. The plaza is comprised of a reflecting pool, fountain, and gardens. The reflecting pool, separated by the lowered seating and play area, offers a view of the building inside and outside. A metal guardrail surrounds the pool. The water flows over the play area walls, creating a cascading waterfall. The plaza also offers outstanding views to the mountains beyond and allows access to the crescent wall that ascends to the rooftop garden. The library floors inside can be seen through the glass “lens” façade, as well as a reflection of the extending crescent wall.

Surface Materials:

Figure D.1: Outdoor plaza light loss factor

Surface	Material Description	Properties
Ground	2" yellow limestone pavers	$\rho=0.25$
	2" concrete paver at children's garden and amphitheater	$\rho=0.25$
	Fine granite crusher for paths	$\rho=0.10$
	Plants	$\rho=0.15$
Walls	Jerusalem Red Hebron stonewalls	$\rho=0.35$
Amphitheater stairs	Light tan precast concrete	$\rho=0.50$
Pool	Ceramic tile flooring	$\rho=0.60$
	Precast concrete water wall panels	$\rho=0.50$
	Stainless steel water trough	$\rho=0.60$
	Water	$\rho=0.08, \tau=0.50$

Furnishings:

Movable tables and chairs may be present in the sunken children's play area and on the main plaza level.

Lighting Hardware:

In ground 9" compact fluorescent luminaires wallwash the walls and waterfall surrounding the children's play area. Step lights (Type N16) provide light from the children's garden to the amphitheater, as well as the steps of the amphitheater (Type N19). Indirect metal halide post-top fixtures (Types G1 and G11) line the plaza garden for general and path illumination. In ground PAR 38 metal halide well lights (Type G4) illuminate the trees in the plaza garden.

Figure D.2: Outdoor plaza luminaire equipment schedule

Fixture Type	Description	Fixture (Manufacturer and Model)	Lamp	Fixture Input W	Mounting	Notes
G1	Post-top indirect metal halide area light on 12' pole	Bega 8200MH with 12' pole	(1) CDM70/T6/830	70 W	Pole	
G2	Ground recessed round 100 watt PAR 38 metal halide adjustable well light with directional grill, electronic ballast	Lithonia/Hydrel 9300D B MH100__PFL(PAR38)___	(1) CDM100/PAR3 8/FL/3K	100 W	Recessed	Tree uplight in plaza
G4	In ground 9" compact fluorescent wallwasher with internal mini louver	Lithonia/Hydrel M9410 RD SNG 32TRT ASY FLC5 34SNPT	(1) CF32DT/E/IN/8 30	32 W	Recessed	Wallwasher for site walls
G11	Post-top indirect metal halide luminaire with full specular, floodlighting optical system with flush, clear tempered glass shield	Bega 8200MH	(1) 70W T6 G12 MH	70 W	Pole	
N16	Recessed step light with die-cast aluminum faceplate and clear tempered glass with translucent white ceramic coating	Bega 2289P	(1) CF9 twin-2p	9 W	Recessed	
N19	Recessed stainless steel step light with clear tempered glass and 30 degree micro-louver behind single window	Bega 2217P	(1) CF13 twin- 2p	13 W	Recessed	

Drawings:

Figure D.3: Outdoor plaza site plan

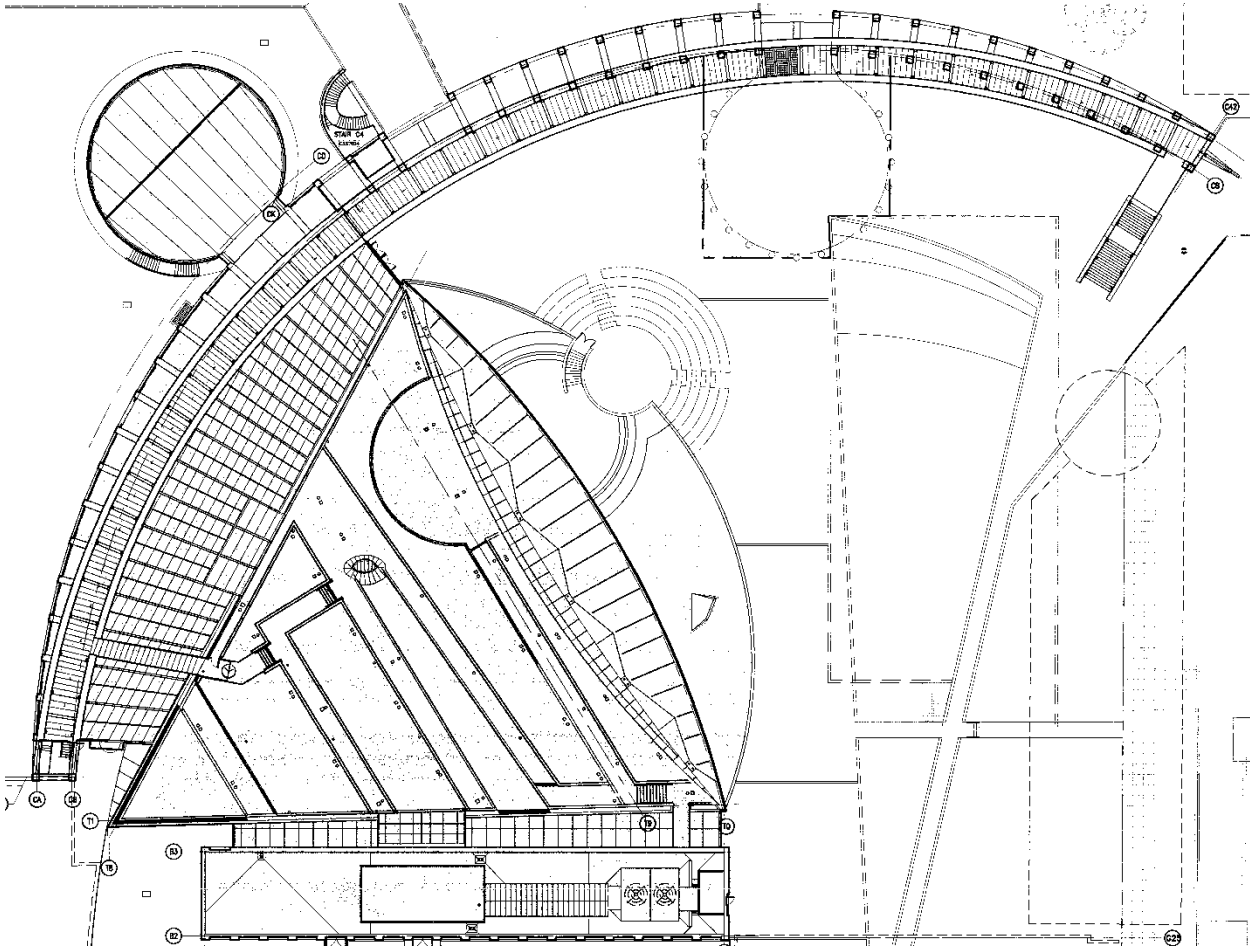


Figure D.4: Amphitheater plans and sections

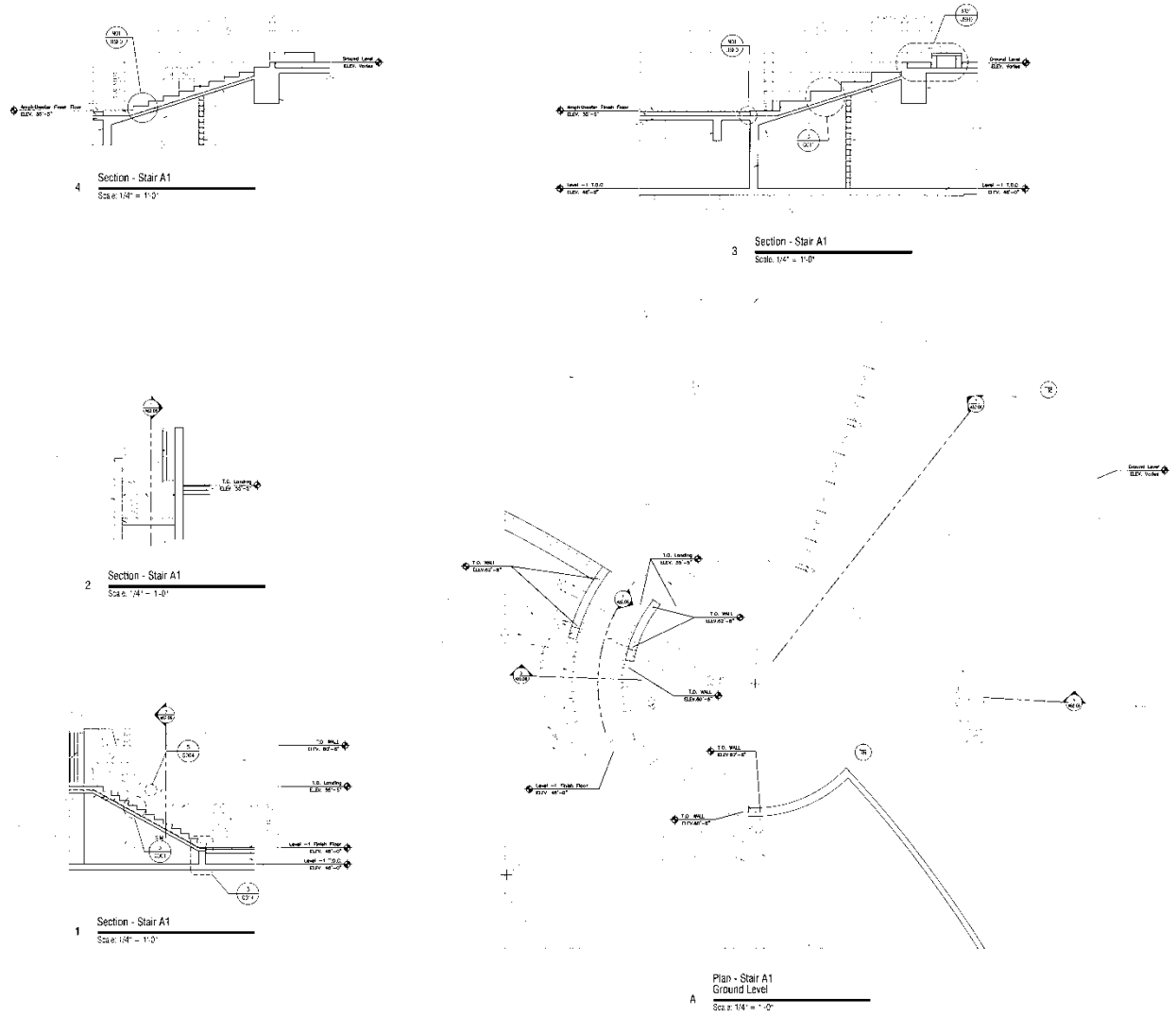


Figure D.5 and D.6: Outdoor plaza images



DESIGN CONSIDERATIONS

General lighting concept:

The outdoor plaza should draw attention to the building at night and create an inviting setting. Walkways and prominent architectural features should be highlighted for safety, orientation, and visual interest.

Appearance of Space and Luminaires – Important

Lighting systems with a casual and aesthetically pleasing look will complement the informal feel of this public space and contribute to the inviting appearance of the space. Luminaires should be chosen to correspond with the lighting systems in the Urban Room. A regular arrangement of luminaires will help avoid visual clutter and delineate circulation routes and areas of special interest.

Color Appearance (and color contrast) – Important

Sources should have similar CCT for uniformity and aesthetics. CRI should be adequate for the pleasant appearance of skin tones and for safety.

Daylight integration and control –

Electric lighting is not necessary during the day. Luminaires should be on a time switch and/or a photosensor to turn lights on when daylight is insufficient.

Direct Glare – Very Important

Fixtures should have cutoff optics or semi-cutoff optics to control glare. Avoid visible lamps that can cause disability glare.

Flicker (and Strobe) – Important

Use electronic ballast for fluorescent sources; avoid using magnetic ballasts.

Light Distribution on Surfaces – Important

A regular pattern of exterior fixtures should correspond with the architecture and landscaping and create visual interest. Pathway lighting and areas of congregation should have adequate lighting for safety.

Light Distribution on Task Plane (Uniformity) – Not Important

The task plane is the ground. Patterns on the task plane can aid in way-finding and highlight congregation areas.

Light Pollution/Trespass – Very Important

Avoid using luminaires that direct light upward (above 90 degrees) to the sky or reflected from surfaces that interferes with seeing the night sky. Contain light within the property line by appropriately locating luminaires or providing cutoffs.

Luminances of Room Surfaces – Not Important

Direct and diffuse light will increase comfort and satisfaction. Diffuse lighting can be achieved with indirect fixtures for general lighting.

Modeling of Faces and Objects – Very Important

Facial and object modeling is important for safety. Multi-directional and interreflected light will increase vertical illuminance and can enhance nonverbal communication.

Peripheral Detection - Important

Occupants should be able to see movement in the periphery for safety.

Points of Interest

Architectural features, including the waterfall, amphitheater, and gardens should be highlighted to attract attention. Pathways should also be illuminated for way-finding.

Reflected Glare –Important

Luminaires should not be aimed toward the glass façade so as to not detract from the nighttime lighting effect for the building and to prevent discomfort and disability glare.

Shadows – Very Important

Shadows that interfere with task visibility should be avoided. Occupied areas should not be kept in shadow for safety reasons. Reflectors or lenses can help diffuse strong shadows.

Source/Task/Eye Geometry – Important

Sources should not be aimed at high angles onto the glass façade or the reflecting pond to avoid glare.

Sparkle/Desirable Reflected Highlights – Not Important

Small sources of high luminance are not essential for this space.

Surface Characteristics – Important

Surfaces are all matte and will help avoid reflected glare.

System Control and Flexibility

The space does not require different lighting scenes for its functions. Luminaires can be controlled with a programmed time-of-day control, electric lighting is unnecessary during the daytime.

Nighttime Lighting

This space should have a favorable nighttime presence and attract visitor to the building. Lighting should provide sufficient illuminance for outdoor activities may take place at night.

Maintenance

Durable luminaires of high quality and suitable for wet locations should be used for this outdoor space. Luminaires must be in accessible locations for re-lamping and cleaning.

Special Considerations

Lighting should be consistent with the Urban Room since it is a continuation of the plaza. Lighting for the reflecting pond and waterfall must be water submersible luminaires.

Illuminance (Horizontal)

Plazas: Category B (5 fc)

Water and rock features (fountains, waterfalls): Category A (3 fc)

Water and rock features (decorative pools): Category B (5 fc)

Illuminance (Vertical)

Plazas: Category A (3 fc)

Water and rock features (fountains, waterfalls): Category B (5 fc)

Water and rock features (decorative pools): Category A (3 fc)

ASHRAE/IESNA 90.1:

The lighting power density required by ASHRAE/IESNA 90.1 is 0.2 W/ft² for plaza areas and special feature areas. An additional unrestricted 5% of the sum of the power densities is allowed for this tradable space. All exterior building grounds luminaires supplied by the building that operate greater than 100 watts must contain lamps having a minimum efficacy of 60lm/W unless controlled by a motion

sensor. Exterior lighting controls that do not have a designated dusk-to-dawn operation must be controlled by a combination of a photosensor and a time switch or an astronomical time switch.

EVALUATION OF EXISTING LIGHTING

Light Loss Factors

Figure D.7: Outdoor plaza light loss factor summary

Type	LLD	LDD	RSDD	BF	Total LLF
G1	0.83	0.82	0.90	1.00	0.61
G2	0.83	0.82	0.90	1.00	0.61
G4	0.85	0.82	0.90	1.00	0.63
G11	0.83	0.82	0.90	1.00	0.61
N16	0.85	0.82	0.90	1.00	0.63
N19	0.85	0.82	0.90	1.00	0.63

Discussion:

The lighting design for the outdoor plaza was effective in creating a nighttime presence and a favorable impression for the building. The steplights around the amphitheater help define the structure and create a safe condition for way-finding. Exterior lighting is minimal enough so as to not detract from the library façade. The water features are gently highlighted, subtly enhancing the space and allowing the reflection of the building façade to be seen. In addition, continuous post-top fixtures delineate the path to and from the building with attractive, cut-off fixtures.

Although the steplights are effective, the fixture chosen has potential to cause glare. A diffusing lens helps shield the source, but may not shield it enough. A fixture with louvers instead may help reduce glare.

GENERAL BUILDING CRITIQUE

The overall lighting design for the building is successful and generally stays true to the complex architecture. The custom indirect pendants in the triangle and bar building effectively illuminate the vaulted ceiling, which can be seen from the exterior. The main concept for transparency is carried through with the lighting design. The glass façade enables visitors and passersby’s to see into the structure, giving it more depth and visual interest.

Although the lighting design was successful, there is still room for improvement. The Urban Room as an extension of the outdoor plaza is expressed with the curving crescent wall, but the lighting does not necessarily do the same. Illuminating the voids of the outdoor crescent wall will help direct attention along the wall and transition into the illuminated reading rooms.

When the building was being designed, energy conservation was not a very important issue. As a result, the integration of daylight with electric lighting was not used to its fullest. Photosensor control for

switching or dimming can significantly reduce energy costs in essentially all of the library spaces.

RELEVANT COMPUTER FILES USED FOR ANALYSIS

Lighting calculations:

T:\Calculations\Auditorium.AGI

T:\Calculation\Open office.AGI

T:\Calculations\ies files

Reference Drawings:

T:\Drawings\2003-07-31 SLCPL Volume #1 RECORD DRAWINGS - Architectural