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M.A.E./B.A.E. Integrated Degree

Technical Assignment 1 | September 10, 2012
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Renzo Museum of American Art New York, NY

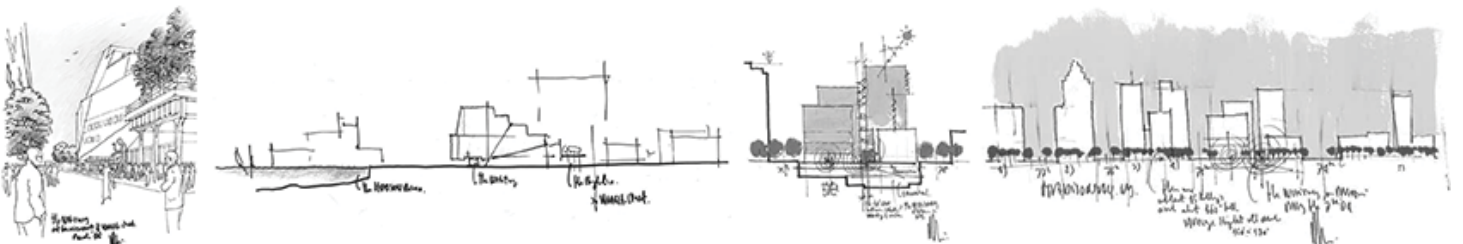


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Executive Summary

This report provides a detailed analysis of the existing lighting design within four spaces of Renzo Museum of American Art located in New York, NY. Analysis is given in four categories for each space, including existing conditions, existing lighting conditions, design consideration and criteria and design evaluation.

For each proposed space, dimensions, material finishes, glazing were analyzed to study the spatial environments. Luminaire schedule and lighting control system, along with qualitative and quantitative design criteria, were examined. Critique and evaluation were then delivered based on the existing spatial and design conditions, lighting and power design criteria, and calculation.

The overall lighting solution for Renzo Museum of American Art offers flexible and consistent design that is in comply with the industrial architecture design of the building. There is great potential for controlled daylighting in many of the spaces. Although the current design provides an adequate solution in most of the spaces, there is opportunity for potential improvements in terms of lighting quality, aesthetics and energy efficiency.

[AGI32 Calculation Files]:
Files are located in Y:\cwl5153\Technical Report 1\AGI Files

[Project Background]

Building Name:	Renzo Museum of American Art
Location and Site:	New York, NY
Building Occupant Name:	Renzo Museum of American Art
Occupancy/function types:	A-3 (Assembly)
Size:	222,952 SF
Number of Stories above Grade:	9, 11 total

[Central lighting control System]

A central Lighting Management Hub is used for lighting control. Lighting Management Hub utilizes Ethernet connectivity to lighting management server. All control station devices, power panels, shades, preset lighting controls, and external inputs are integrated into a single customizable lighting control system with failsafe mechanisms, manual overrides, automatic control, central computer control and monitoring, and integration with Building Management System (BMS) via BACnet.

1 Seminar Room

1.1 Existing Conditions

The Seminar Room is located on the third floor, at the north-west corner of the building. A 4'2" high glazing takes up the majority of the west wall with great daylight potential. A long conference table is located at the center of the room with 32 chairs around. Figure 1- 6 provide detailed spatial information of the room.

The primary tasks in this space are meetings, seminars and workshops.

Dimensions:

Area = 720 ft²

Length = 38 ft.

Width = 19 ft. (avg.)

Ceiling Height = 9 ft.

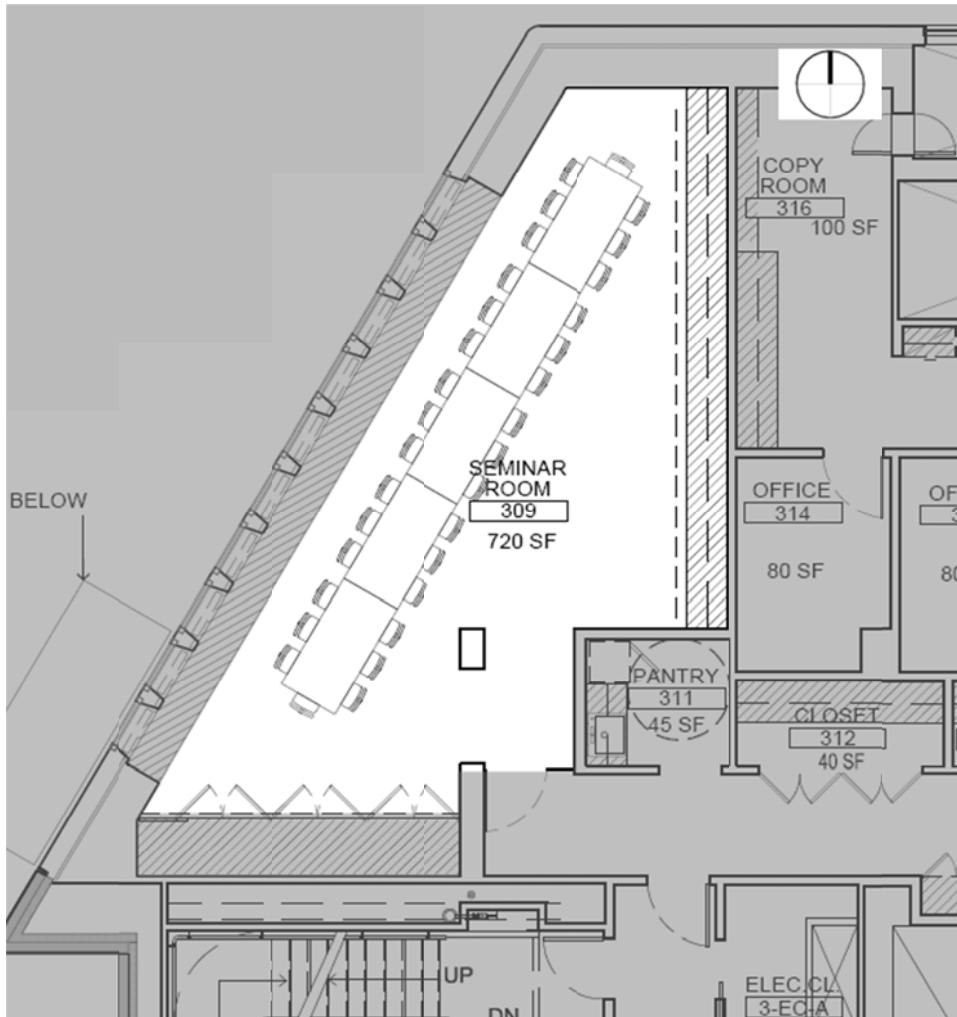


Figure 1 Seminar Room Floor Plan

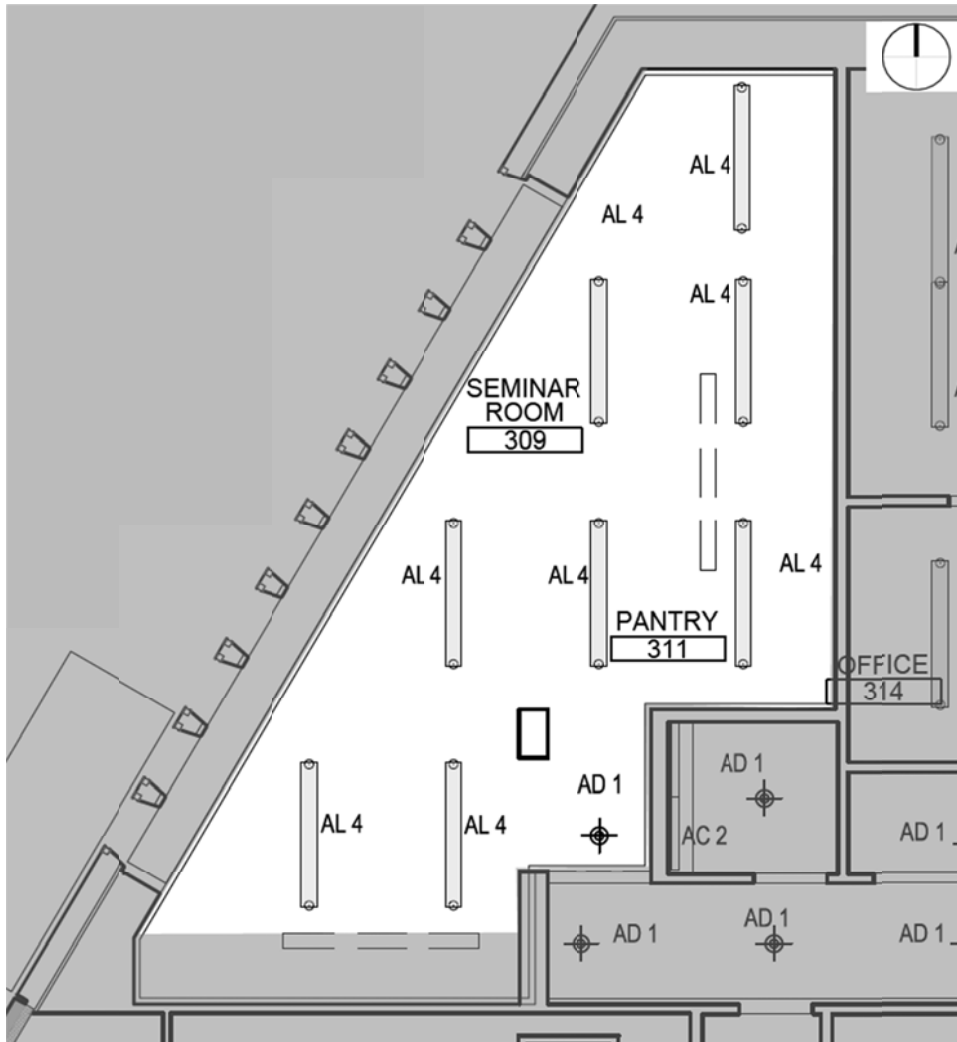


Figure 2 Seminar Room RCP

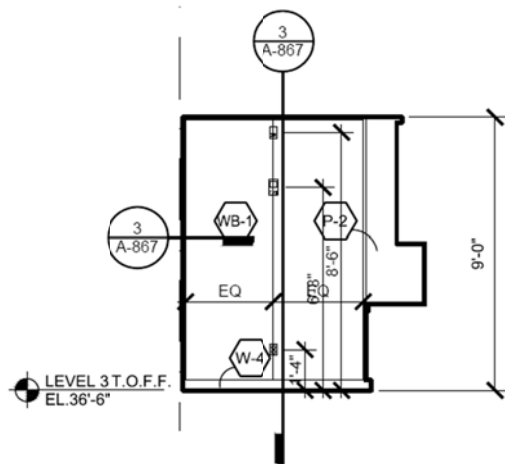


Figure 3 Seminar Room Elevation - Looking North

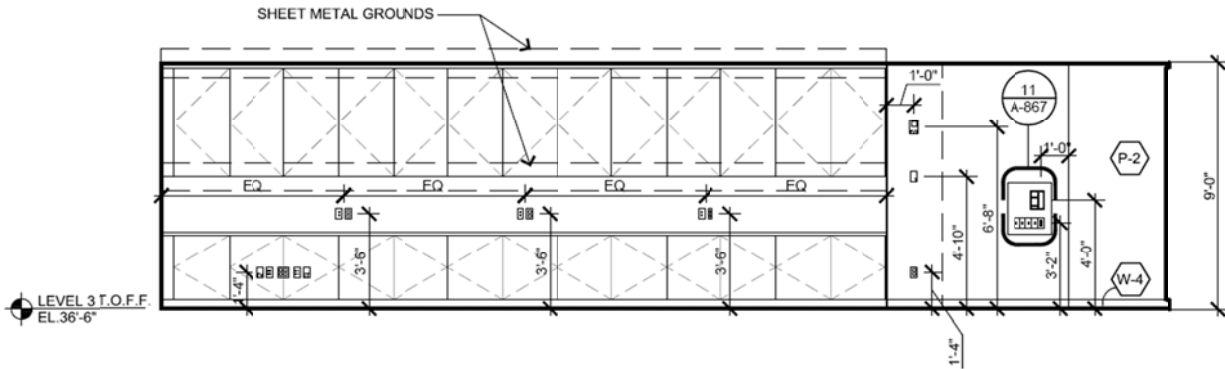


Figure 4 Seminar Room Elevation - Looking East

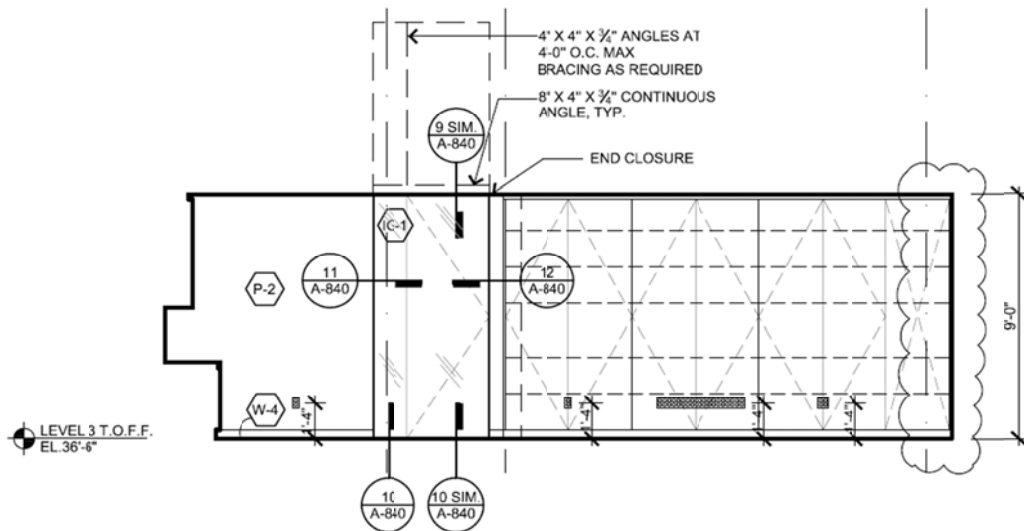


Figure 5 Seminar Room Elevation - Looking South

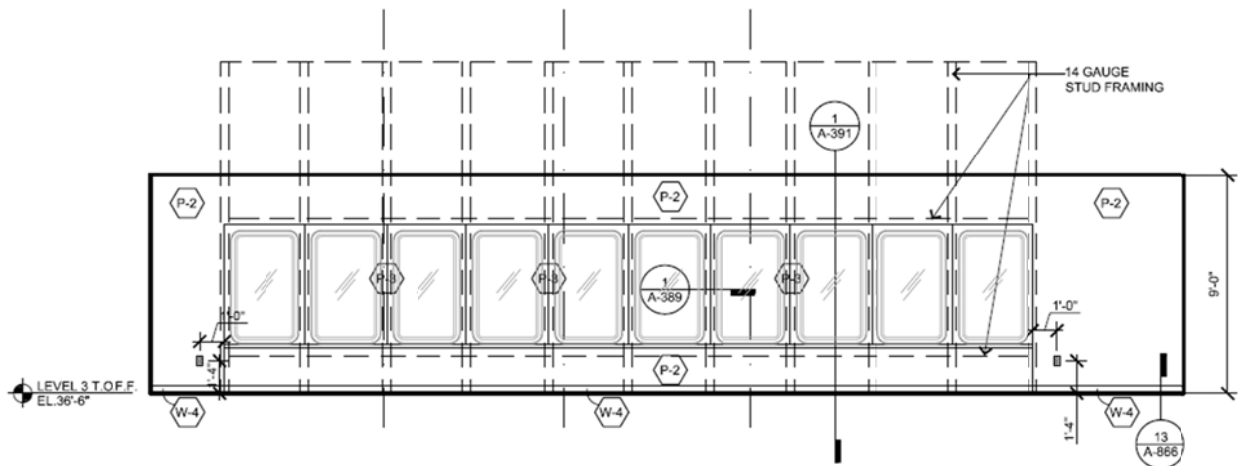


Figure 6 Seminar Room Elevation - Looking West

Finishes:

Table 1 Seminar room finish schedule

Surface	Name	Description	Reflectance
Floor	CA-1	High grade nylon carpet	0.3
Wall	P-2	Gypsum wall board, painted	0.6
	P-3	Glass fiber reinforced gypsum board, painted	0.6
	WB-1	Wood-backed porcelain over steel whiteboard	0.7
Ceiling	CL-9	2' x 2' ceiling type	0.75
	CL-1	Gypsum board	0.7

Glazing:

WDW-1 windows integrated with WT-2 system, consists of a 10 mm low iron outer lite, 12 mm argon filled cavity, and 10 mm laminated inner lite (5 mm low iron/1.5 mm clear PVB interlayer/ 5 mm low iron) with neutral appearance high performance low-e coating on the #2 surface, and laminated outer lite for acoustical performance.

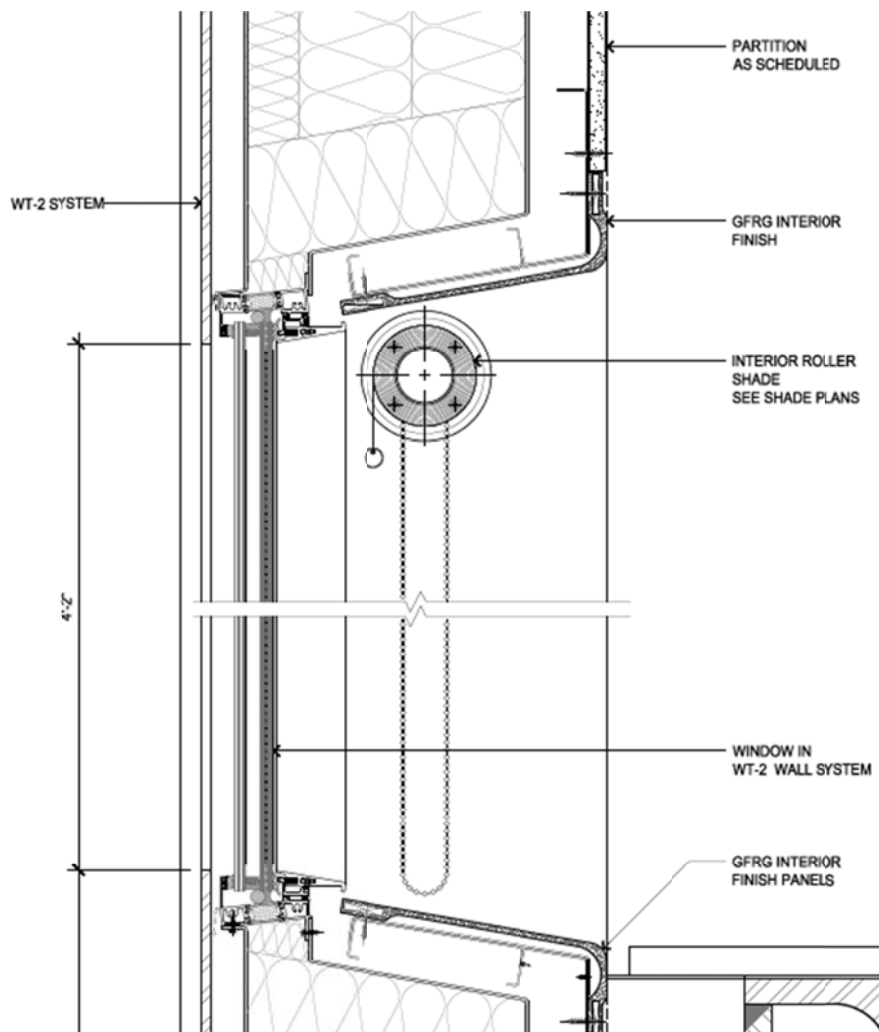


Figure 7 Seminar Room Glazing Detail

1.2 Existing Lighting Conditions

The seminar room utilizes (8) pendant linear fluorescent for general illumination, and (1) LED downlight for accenting the entrance. Detailed luminaire description is listed in the Table1 below; refer to figure 2 for exact luminaire locations. The power for (8) linear fluorescent are on two circuits, one circuit for uplighting and one for downlighting.

Table 2 Seminar room luminaire schedule

Type	Description	Manufacturer	Model	Lamp	Input Watts	Voltage
AL4	Pendant direct-indirect linear luminaire, made of an extruded aluminum profile	Sisternalux	#3500-12-HO-1C-NA-120-01-1EM	(2) T5 54W 3000K	107	120
AD1	Recessed accent LED downlight luminaire with die cast aluminum trim, white finish	USAI	3020-8-10-LRLD4-30H-80	LED 20W 3000K	33	120

Table 3 Seminar room lighting control schedule

Room	Dimmed (Y/N)	Timeclock Control	Daylight Sensor	Occupancy Sensor	In room light control interface	Interface Type	Control Type
Seminar Room	Y	N	N	Y	Y	4B+R/L+OFF	Centrally Controlled

1.3 Design Considerations and Criteria

Qualitative Criteria:

The appropriate lighting for the Seminar Room is dependent on the function and formality of the setting. Clear facial rendering is very important for a meeting space, requiring high standard vertical illuminance and uniformity criteria at faces and background wall surfaces. Daylight integration of the space can help create a more pleasant, and energy efficient space. Additionally, user friendly preset control station should be easy to access.

Quantitative Criteria:

Illuminance Recommendation [IES Lighting Handbook 10th Edition (22.2)]:

Space Type	E _h	E _v	Avg:Min
Meeting	300 lux @ 2ft 6in AFF	75 lux @ 4ft AFF	2:01

Energy Allowance [ASHRAE standard 90.1]:

Space Type	Power Density (W/sqf)
Conference/Meeting	1.3 W/ft ²

1.4 Design Evaluation

AGI model was constructed based on AutoCAD drawings. Simplified material with assumed reflectance was assigned to each surface. Light loss factor was assumed to be 0.8 for fluorescent as no lamp information is given. Based on the calculation, power density of 1.2 W/ft² is achieved, which is less than the ASHRAE standard of 1.3 W/ft². The current lighting design provides adequate illumination that meets the IES recommendations.

As the room has great potential for controlled daylight integration, a daylight sensor should be implemented and incorporated to the lighting control system. Additionally, the irregular shaped room calls for a more sensible and flexible lighting design and higher greater uniformity ratio.

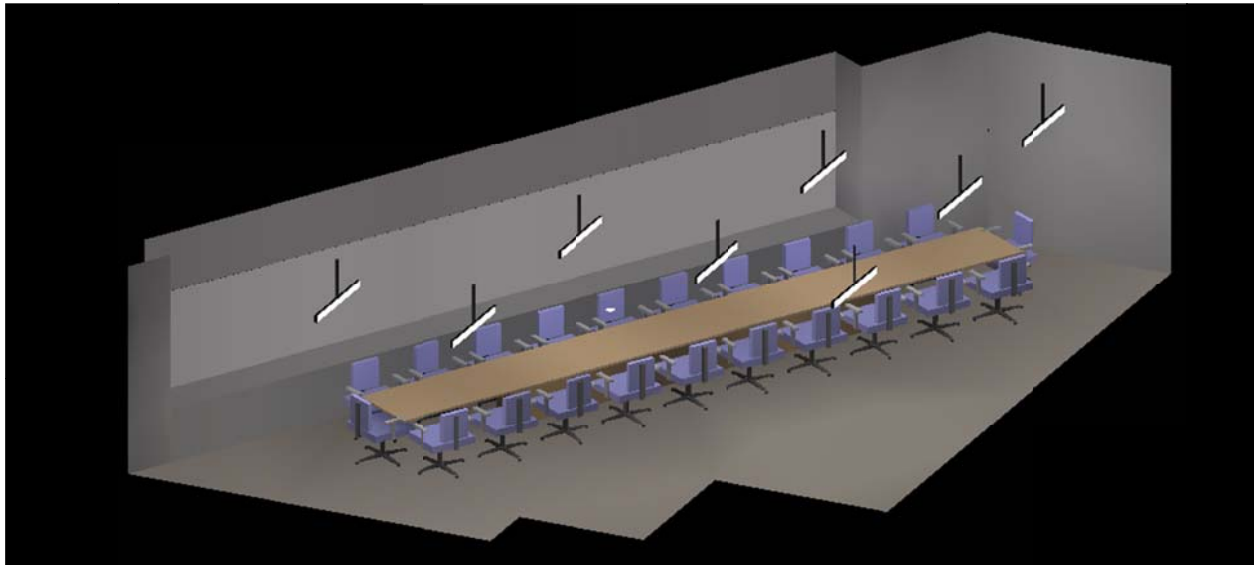


Figure 8 Seminar Room RGB Rendering – Perspective

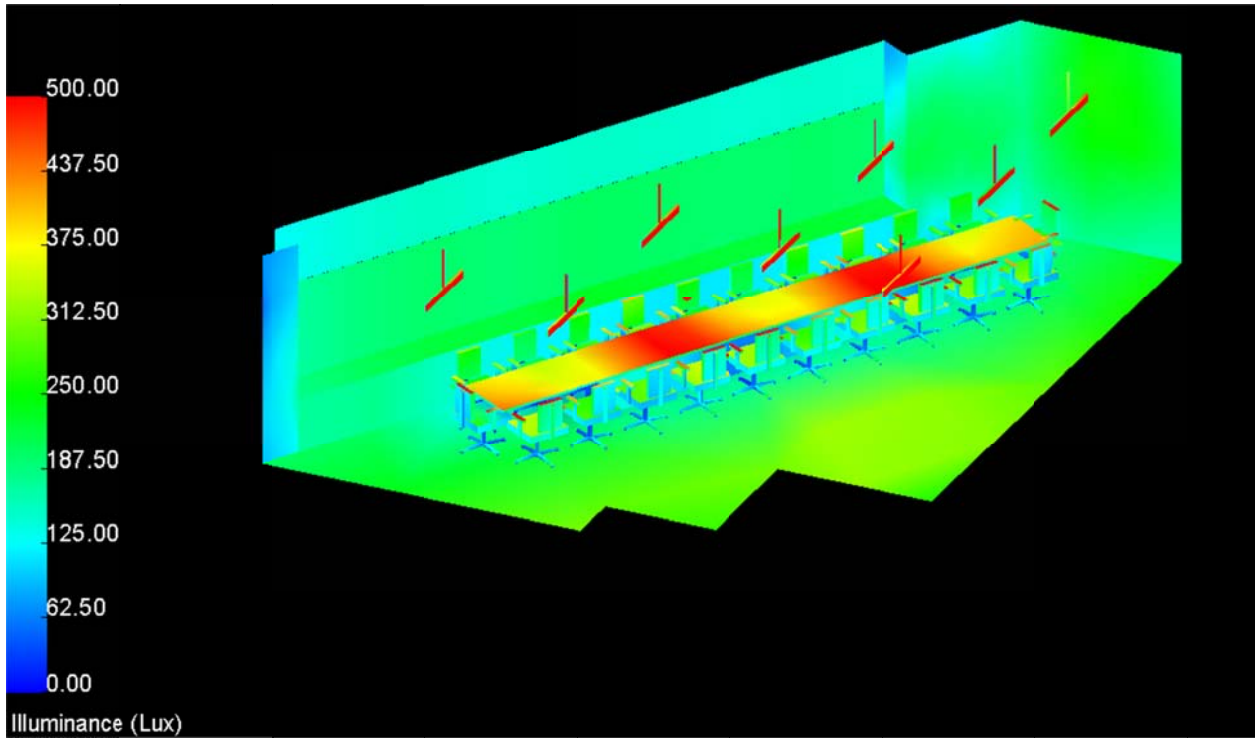


Figure 9 Seminar Room Pseudo Rendering - Perspective

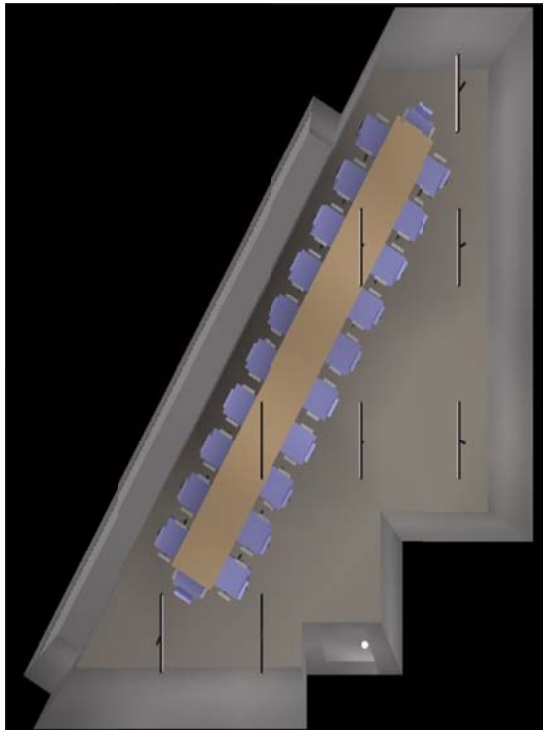


Figure 10 Seminar Room RGB Rendering - Plan

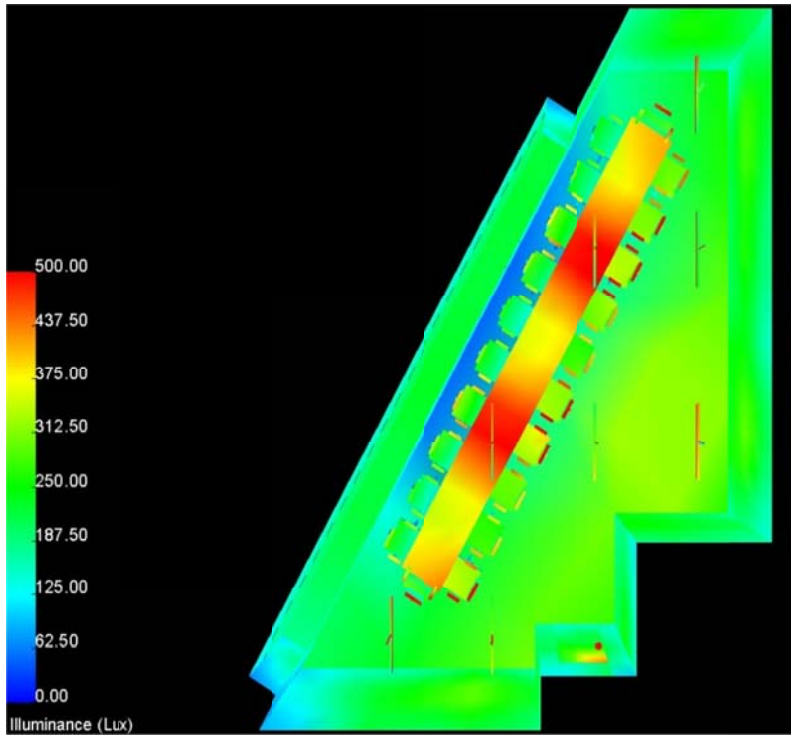


Figure 11 Seminar Room Pseudo Rendering - Plan

2 Main Lobby

2.1 Existing Conditions

The main lobby of Renzo Museum of American Art consists of a 1000-sqf gallery, free of charge and open to public. Sculptures and outdoor installations will be exhibited, along with a membership booth located in the center of the lobby and a ticketing booth on the south-east corner. The main lobby has two different ceiling heights. From the center of the membership booth to the east, ceiling height is 14ft, and from the center of the membership booth to the west, ceiling height is 17ft. Figure 12-19 shows the spatial information of the main lobby through floor plan, reflected ceiling plan and interior elevations.

The primary tasks in this space are circulation, socialization and exhibition.

Dimensions:

Area = 6070 ft²

Length = approx. 142 ft.

Width = approx. 43 ft.

Ceiling Height = west portion 14 ft.
east portion 17 ft.

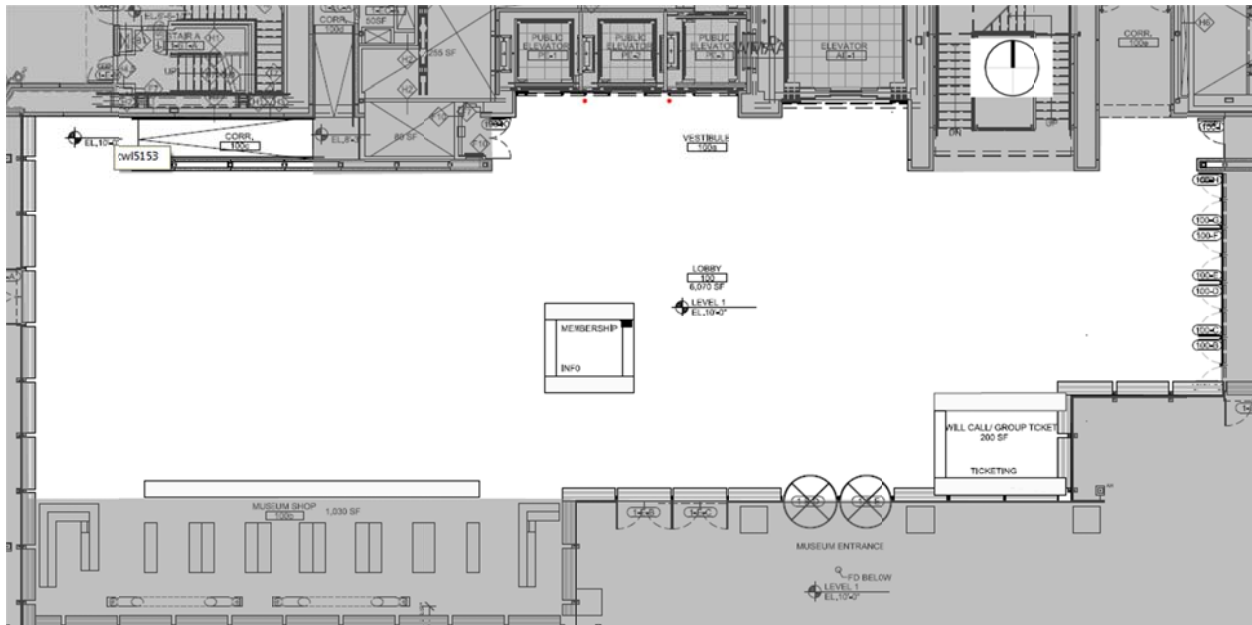


Figure 12 Lobby Floor Plan

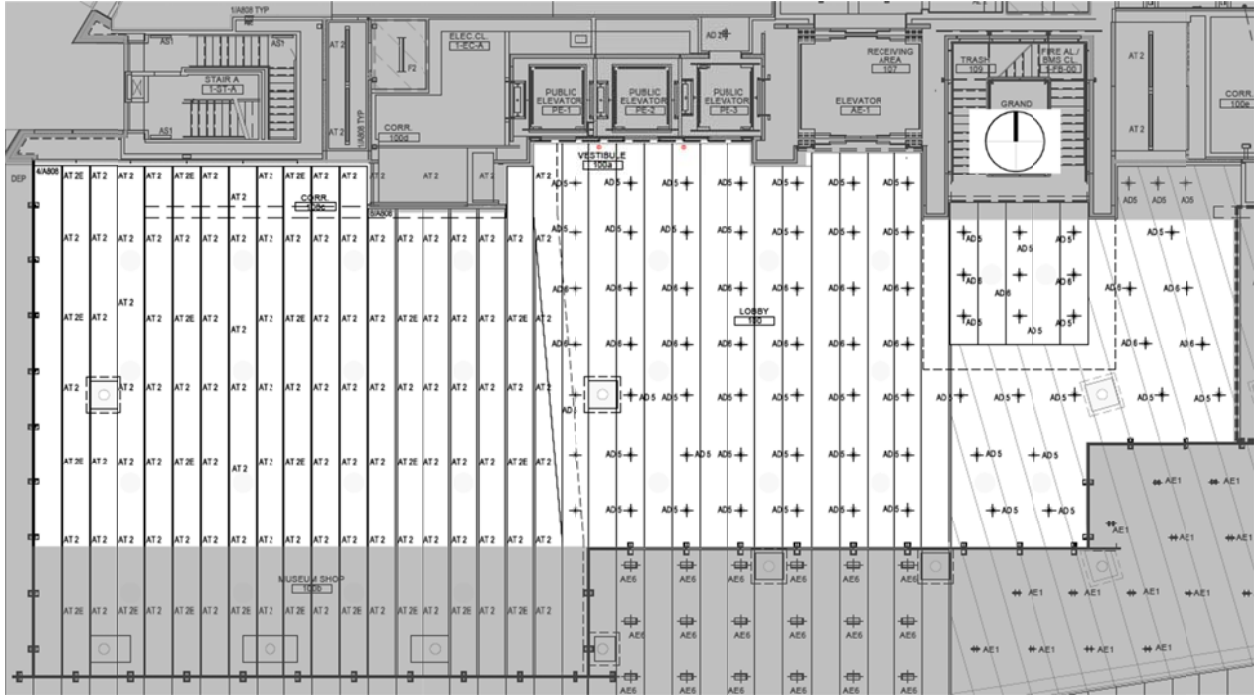


Figure 13 Lobby RCP

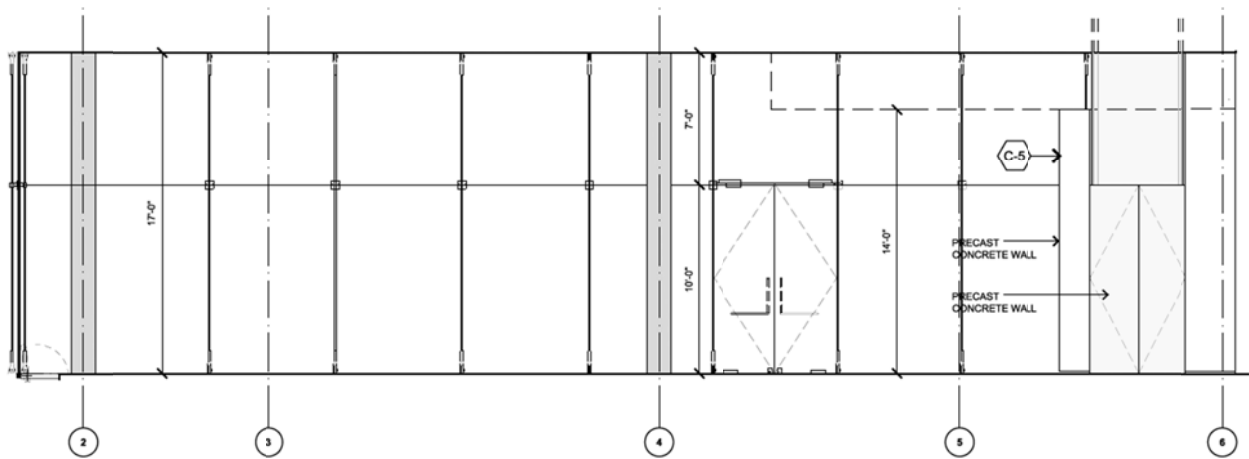


Figure 14 Lobby Elevation - Looking West

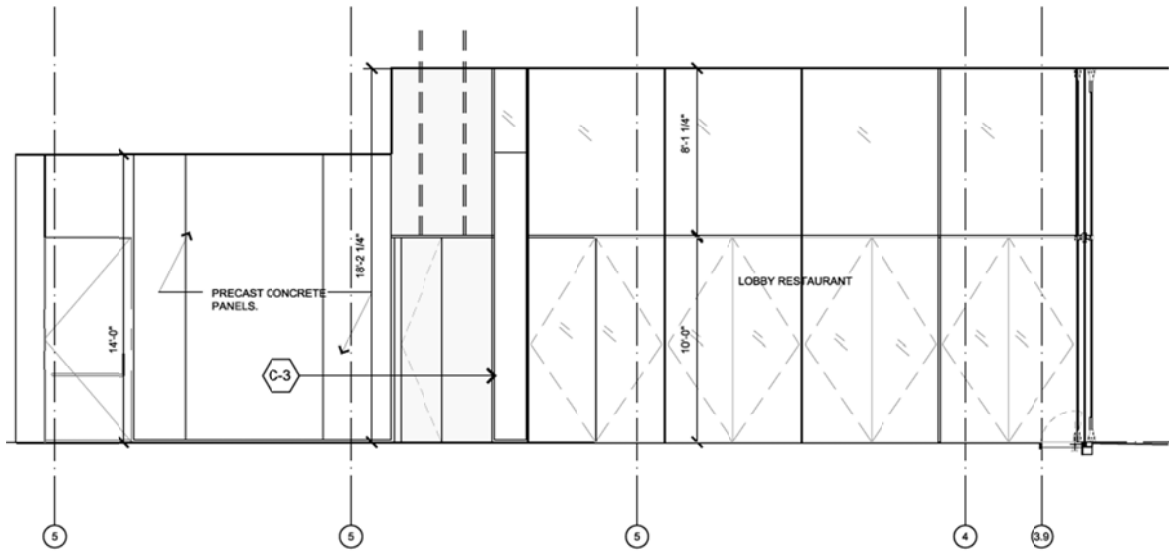


Figure 15 Lobby Elevation - Looking East

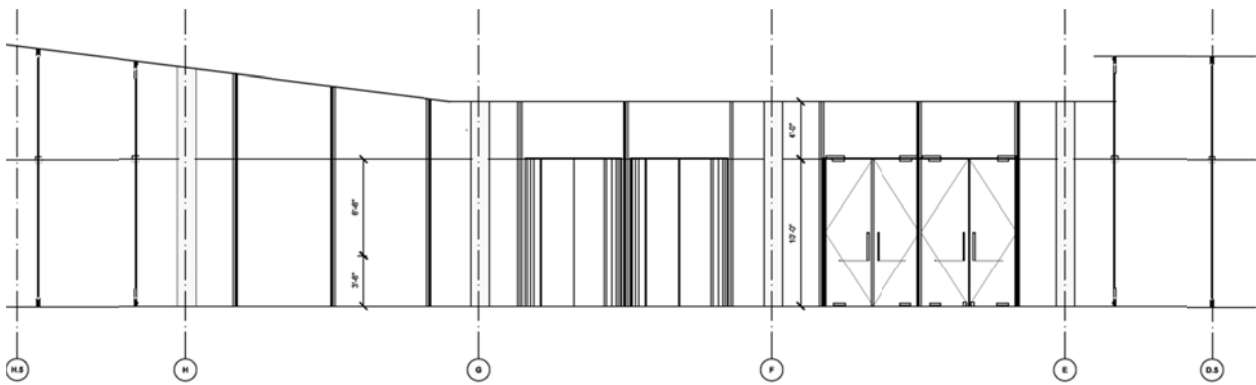


Figure 16 Lobby Elevation - Looking South 1

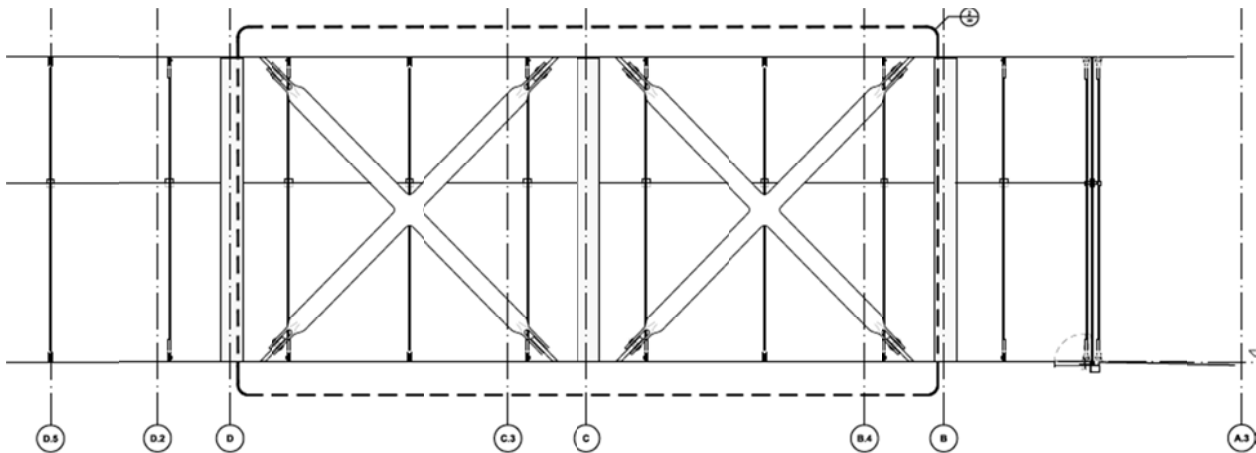


Figure 17 Lobby Elevation - Looking South 2

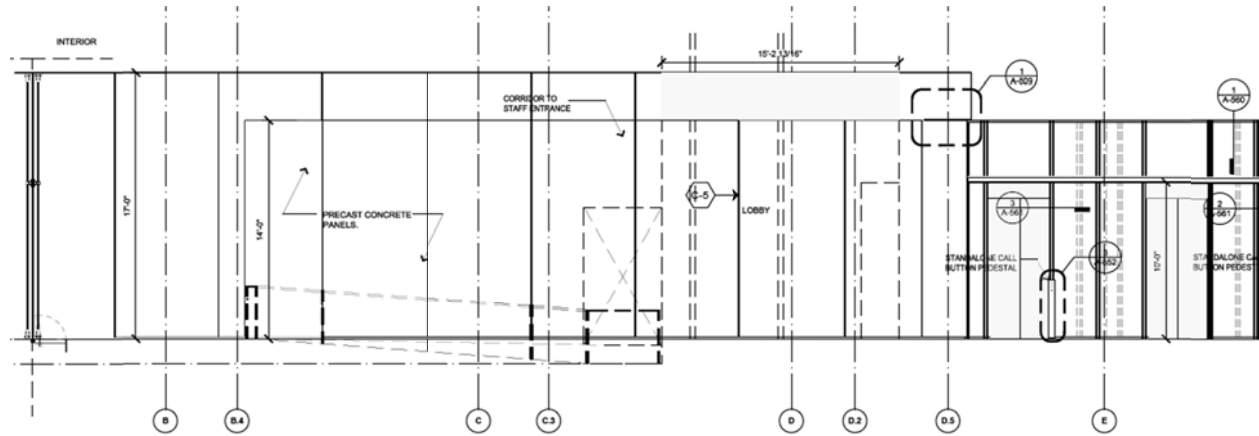


Figure 18 Lobby Elevation - Looking North 1

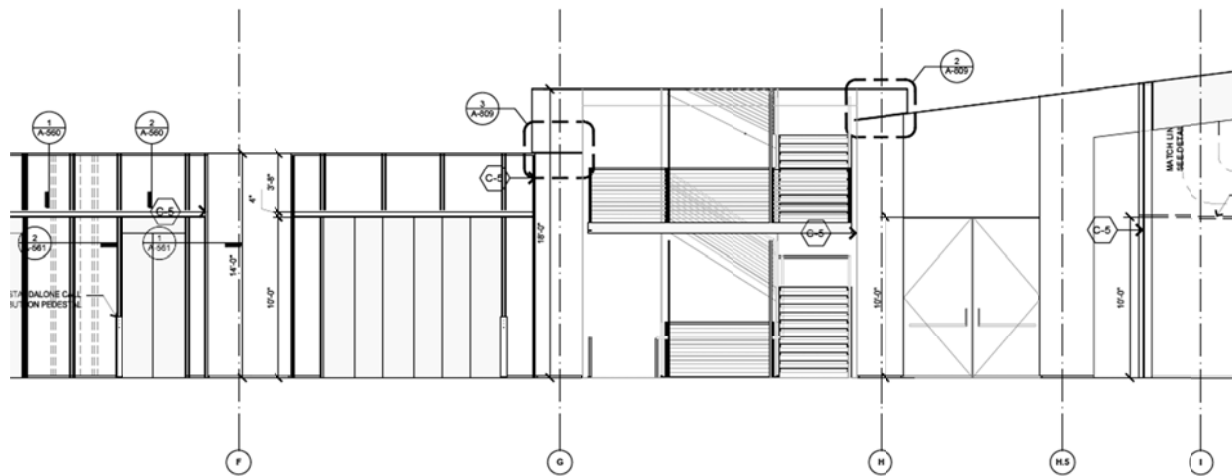


Figure 19 Lobby Elevation - Looking North 2

Finishes:

Table 4 Main lobby finish schedule

Surface	Name	Description	Reflectance
Floor	S-1	3CM stone thermal finish	0.2
Wall	C-5	Pre-cast concrete panel with smooth-as-cast finish, Non fire rated with double seal and weep tubes at vertical joint	0.5
Ceiling	CL-7	Acoustic plaster	0.75

Glazing:

The exterior wall of the main lobby use cable wall system which consists of two 3/4" diameter pre-tensioned stainless steel cables taking lateral and gravity loads, with custom stainless steel patch

2.2 Existing Lighting Conditions

The main lobby utilizes suspended LED pendants. Standard suspended luminaires are used in the portion of the space with 14' ceiling height, while track luminaires of the same series are used with the 17' ceiling height portion of the space. Detailed luminaire description is listed in the table 3. Lobby luminaires are all dimmable and controlled on time clock. In room LCD control stations are also used.

Table 5 Main lobby luminaire schedule

Type	Description	Manufacturer	Model	Lamp	Input Watts	Voltage
AD5	Pendant LED luminaire with steel suspension cables	Sisternalux/iGuzzini	Le Perroquet Medium Small	Xicato LED 32W 3000K 95CRI		120
AD6	Track suspension LED luminaire with steel suspension cables, wide flood	Sisternalux/iGuzzini	Le Perroquet Medium Small	Xicato LED 26W 3000K 95CRI		120

Table 6 Main lobby lighting control schedule

Room	Dimmed (Y/N)	Timeclock Control	Daylight Sensor	Occupancy Sensor	In room light control interface	Interface Type	Control Type
Lobby	Y	Y	N	N	Y	LCD Station	Centrally Controlled

2.3 Design Considerations and Criteria

Qualitative Criteria:

The main lobby serves three main purposes: it is the space adjacent to the entrance for circulation, it invites and gathers the neighborhood, and it is also an exhibition space.

The circulation and general lighting in the lobby should meet the illuminance recommendation for safety reason. Flexible lighting solution should be applied to adapt to the various uses of the lobby space. As the public's primary physical and visual link to the rest of the museum, the lighting solution for the main lobby need to attract the neighborhood and correspond to the exterior changes, such as daylight. High quality color rendering is also important for visitors to truly experience the art installations in the space.

Quantitative Criteria:

Illuminance Recommendation [IES Lighting Handbook 10th Edition (Table21.2)]:

Space Type	E _h	E _v	Avg:Min
Lobby - Day	100 lux @ floor	30 lux @ 5ft AFF	4:1
Lobby - Night	50 lux @ floor	20 lux @ 5ft AFF	4:1

Energy Allowance [ASHRAE standard 90.1]:

Space Type	Power Density (W/sqf)
Lobby	1.3 W/ft ²

2.4 Design Evaluation

The existing lighting design for the lobby is simple and flexible. One type of luminaires with two variations is used. The Le Perroquet suspended LEDs are free to aim at different directions and as a result easy to adapt to various purpose and function of the space. As the east portion of the lobby is adjacent to the ground level restaurant, the lighting should be less dramatic and acts as a buffer area to the rest of the lobby. Thus, it is reasonable to illuminate the east portion of the main lobby with fixed LEDs. The LED track light used to illuminate the west portion of the lobby offer more flexibility and potential for dramatic lighting effect to invites the public.

3 Theater

3.1 Existing Conditions

The theater, located on south east corner of the third floor, houses 170 seats. The space allows for multiple configurations and uses, including performance, film and installation. The focus will be on the architectural or “house” lighting.

Dimensions:

- Area = 2,370 ft²
- Length = 64 ft.
- Width = 37 ft.
- Ceiling Height = 25 ft. 11 in.

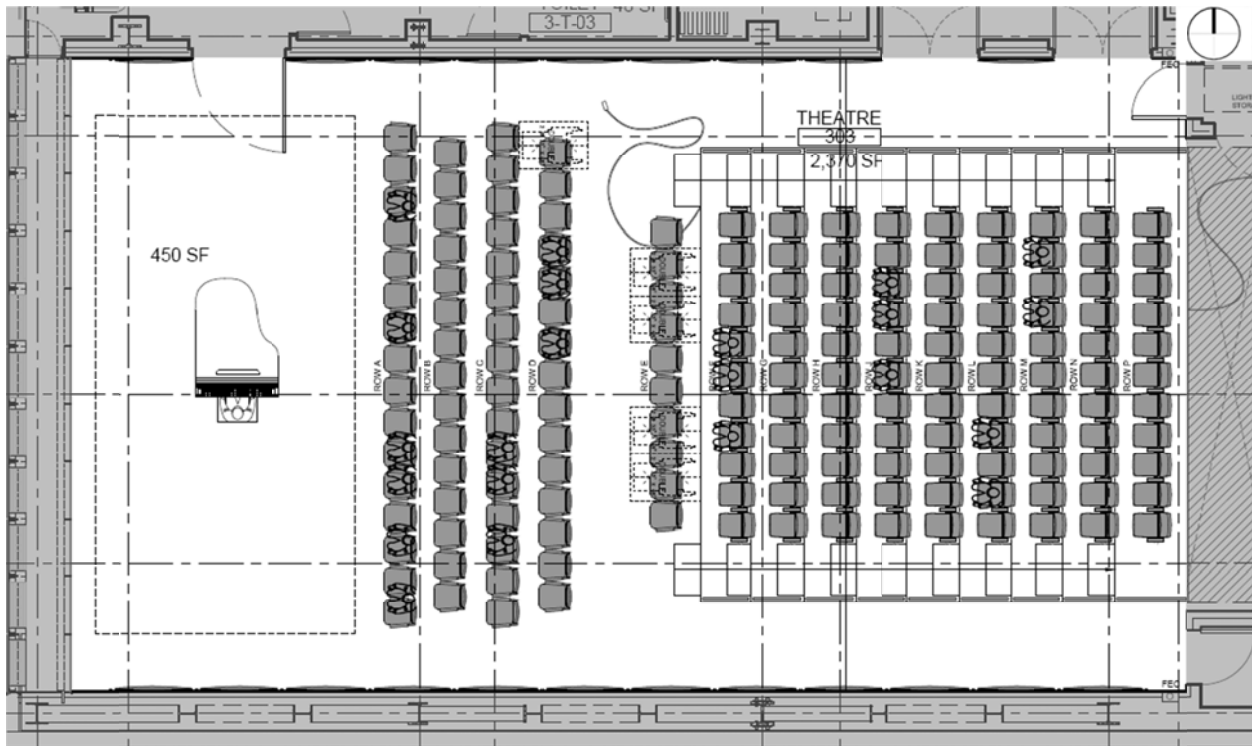


Figure 21 Theater Floor Plan



Figure 22 Theater RCP

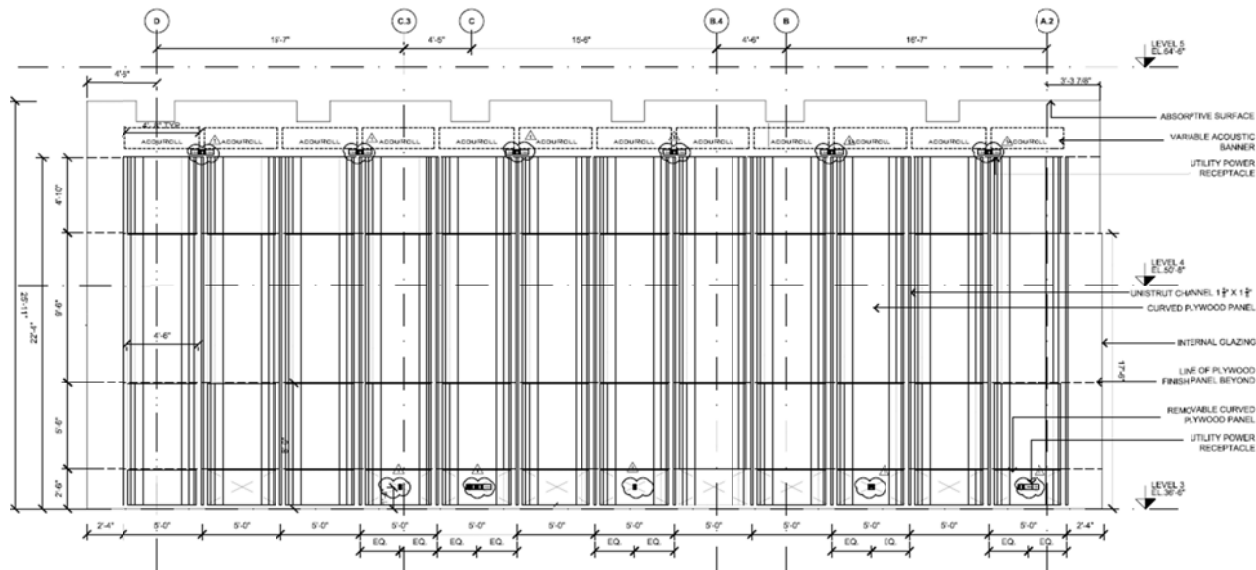


Figure 23 Theater Elevation - Looking South

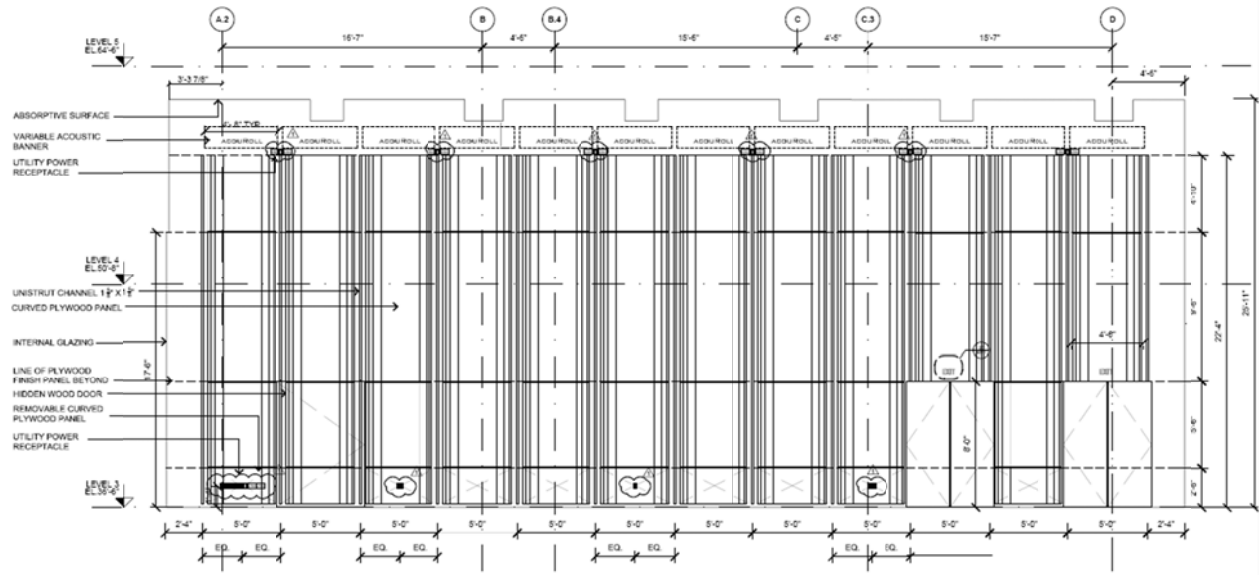


Figure 24 Theater Elevation - Looking North

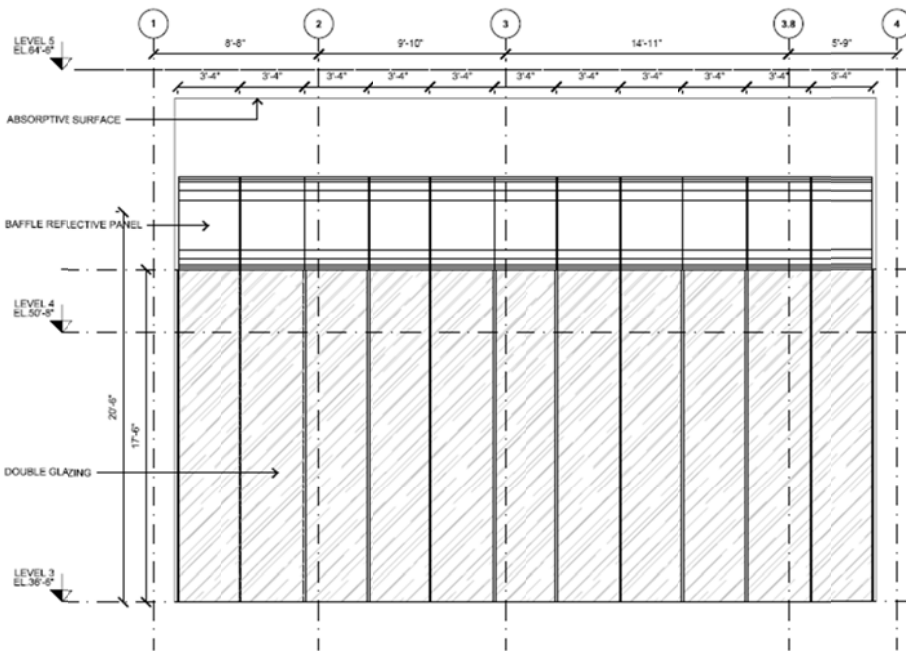


Figure 25 Theater Elevation - Looking West

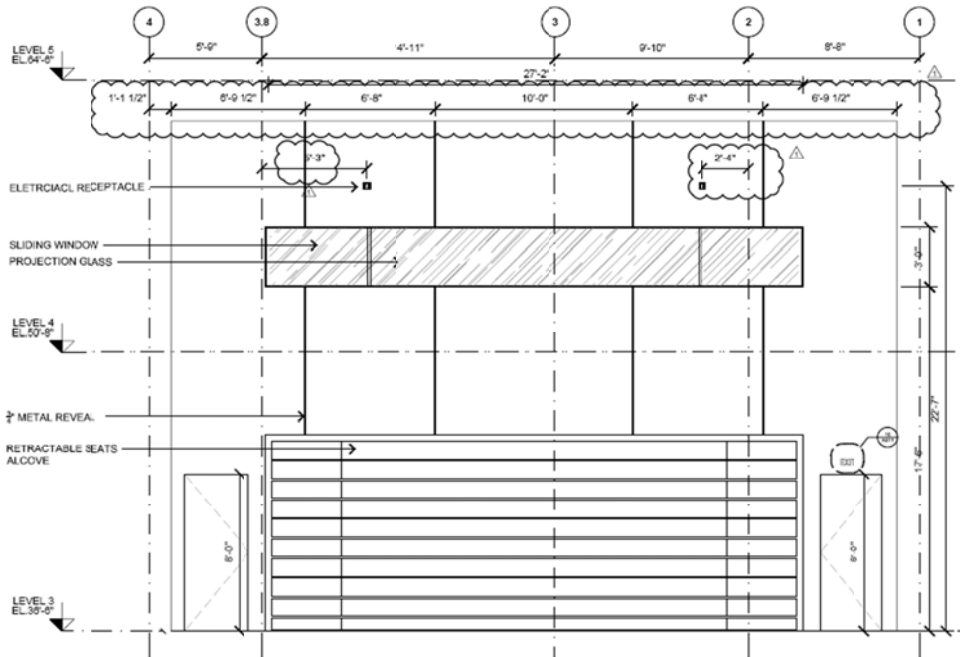


Figure 26 Theater Elevation - Looking East

Finishes:

Table 7 Theater finish schedule

Surface	Name	Description	Reflectance
Floor	W-1	Yellow Pine Flooring 4" Width	0.4
Wall	P-2	Gypsum wall board, painted	0.6
	PLYWO	3/4" thick square edge Plywood Panel	0.5
Ceiling	CL-10	Theater ceiling assembly - reflective	0.7
	CL-11	Theater ceiling assembly - absorptive	0.7

Glazing:

Double glazing system is used. The system consists of 3'-4" wide insulating glass units glazed at vertical edges. Insulating glass units to consist of a 10 mm low iron outer lite, 12 mm argon filled cavity, and 10 mm laminated inner lite (5 mm low iron/1.5 mm clear PVB interlayer/ 5 mm low iron) with neutral appearance high performance low-e coating on the #2 surface. The system also includes an interior laminated low-iron glass wall for acoustic performance.

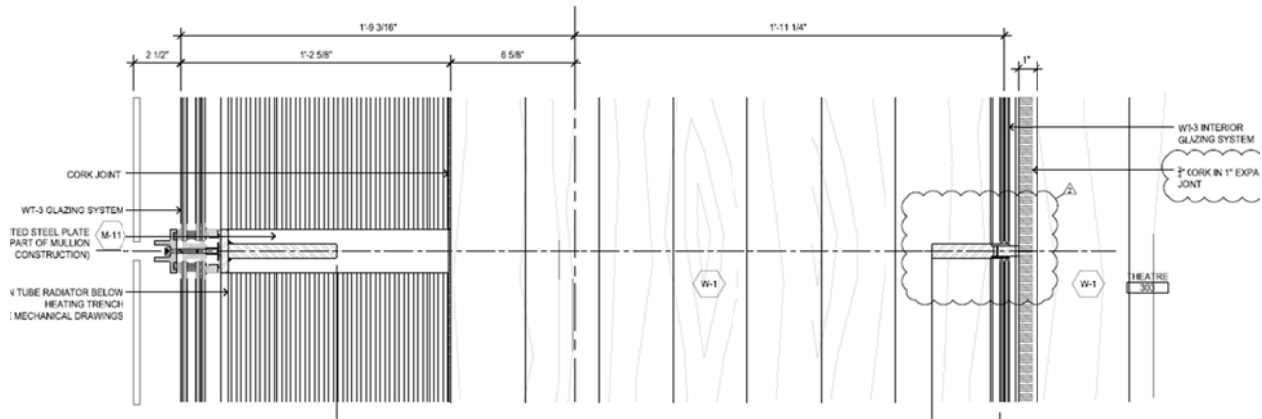


Figure 27 Theater glazing detail

3.2 Existing Lighting Conditions

The primary light source for theater house lighting is custom LED track luminaires with Xicato LEDs (95CRI). Three variations of the same series luminaires are used to fulfill different purpose such as wall washing, emergency lighting and general downlight.

Table 8 Theater architectural luminaire schedule

Type	Description	Manufacturer	Model	Lamp	Input Watts	Voltage
AT3A	LED track light with floodlight distribution. Provide with accessory adaptor and beam softening lens.	Sistimalux/iGu zzini	Le Perroquet Medium Small #1.4872-SPI000443	Xicato LED 26W 3000K	26W	120
AT3B	LED track light with floodlight distribution. Provide with wall wash adaptor and lens	Sistimalux/iGu zzini	Le Perroquet Medium Small #1.4872-SPI000443	Xicato LED 26W 3000K	26W	120
AT3E	LED track light with floodlight distribution. Emergency.	Sistimalux/iGu zzini	Le Perroquet Medium Small #1.4872-SPI000443	Xicato LED 26W 3000K	26W	120

Table 9 Theater architectural lighting control schedule

Room	Dimmed (Y/N)	Timeclock Control	Daylight Sensor	Occupancy Sensor	In room light control interface	Interface Type	Control Type
Theater	Y	N	N	N	Y	by theater consultant	by theater consultant

3.3 Design Considerations and Criteria

Qualitative Criteria:

As the theater architectural lighting serves different functions for film, performance and installation, flexibility of the design is crucial. Some other very important criteria for the space include high color rendering ($CRI \geq 85$) as well as good dimming ability (smooth, excellent dimming range, etc.). Aisle lighting need to meet the requirement for illuminance and uniformity to allow for safe and convenient access into and out of the space at all times. Minimum shadow for aisle lighting is desired.

Quantitative Criteria:

Illuminance Recommendation [IES Lighting Handbook 10th Edition (Table 28.2)]:

Space Type	E_h	E_v	Avg:Min
Audience Seating - During production	2 lux @ floor	1 lux @ 5ft AFF	2 : 1
Audience Seating - pre/post production and during intermissions	100 lux @ floor	30 lux @ 5ft AFF	2 : 1
Circulation - During production	2 lux @ floor	4 lux @ 5ft AFF	5 : 1
Circulation - pre/post production and during intermissions	100 lux @ floor	30 lux @ 5ft AFF	2 : 1

Energy Allowance [ASHRAE standard 90.1]:

Space Type	Power Density (W/sqf)
Audience/Seating Area for Performing Arts Theater	2.6 W/ft ²

3.4 Design Evaluation

The existing architectural lighting for theater offers flexible lighting design using three variations of the Le Perroquet LED track light. The Xicato LED offers smooth dimming to 1%. The warm tone illumination enhances the wooden finishes and texture of the space.

AGI model of the theater was constructed based on provided AutoCAD drawings. Simplified material with assumed reflectance was assigned to each surface. Number of the luminaires is assumed as no information is provided regarding the quantity of the theater house lighting luminaires. 0.7 light loss factor is assumed for LEDs. Based on the AGI calculation, when the overall light level of the space meets the IES illuminance recommendation, the power density will reach 2.9 W/ft² and exceeds the ASHREA standard of 2.6 W/ft². Furthermore, as no exact aiming strategy is provided, all luminaires are aimed down. In reality, some of the track light will wash the wall. Even though the AGI calculation may not be exactly the reality, it provides good insight into the existing theater house lighting. Daylight is not calculated for this model, however, the west façade of the theater is

mainly consists of a double glazing system which offers potentially large amount of indirect daylight. Daylight integration of the space will lower the power density of the theater.

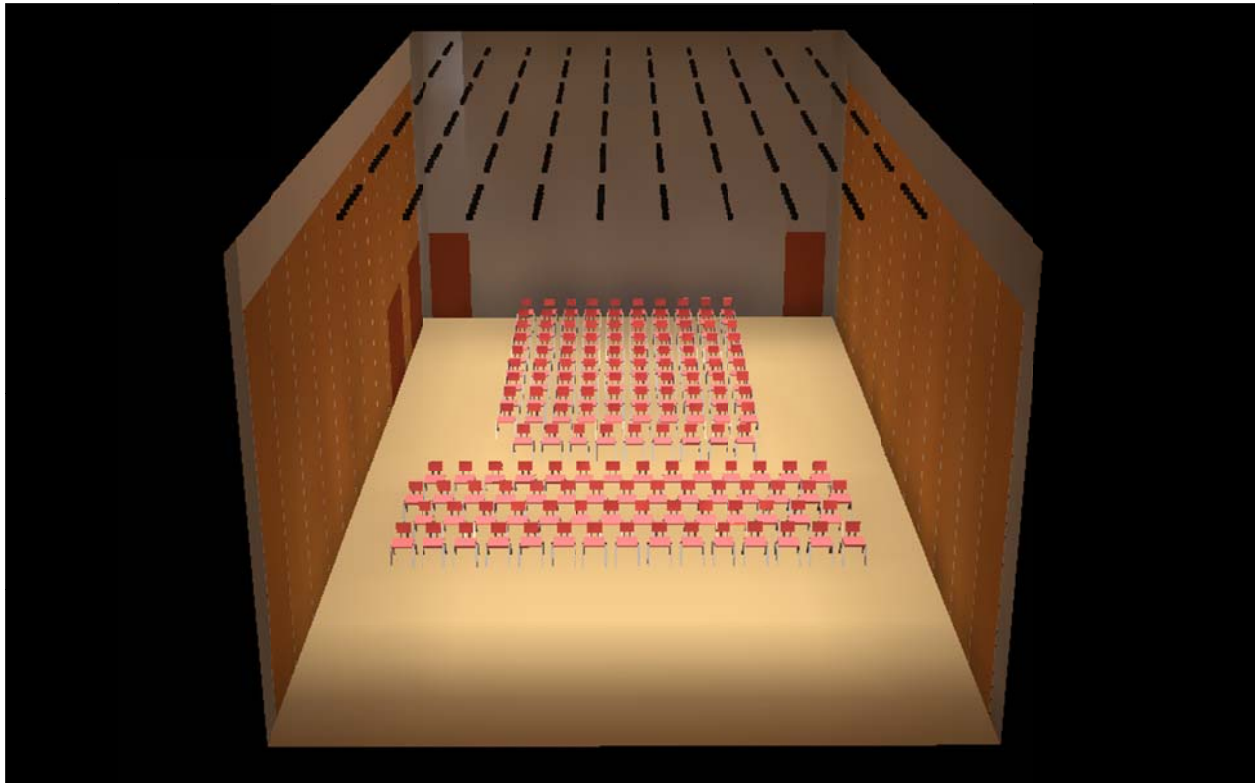


Figure 28 Theater RGB Rendering - Perspective

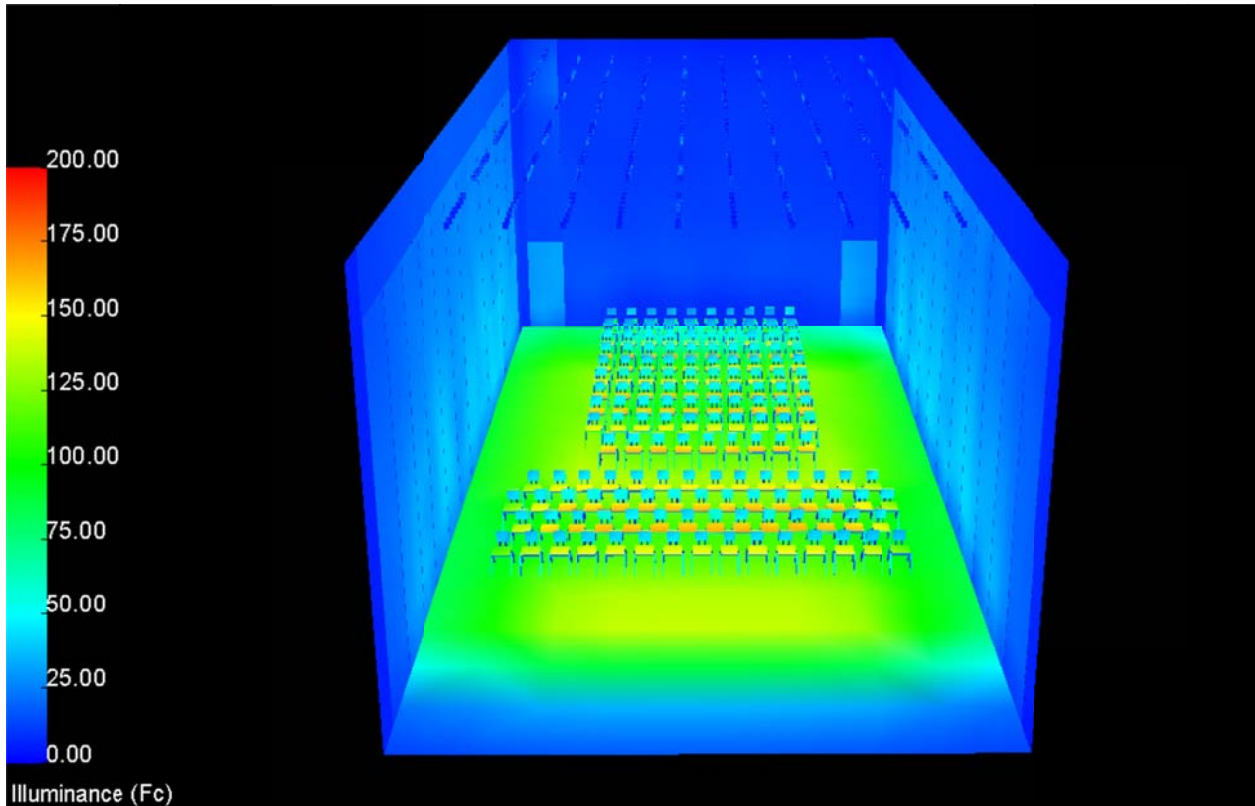


Figure 29 Theater Pseudo Rendering - Perspective

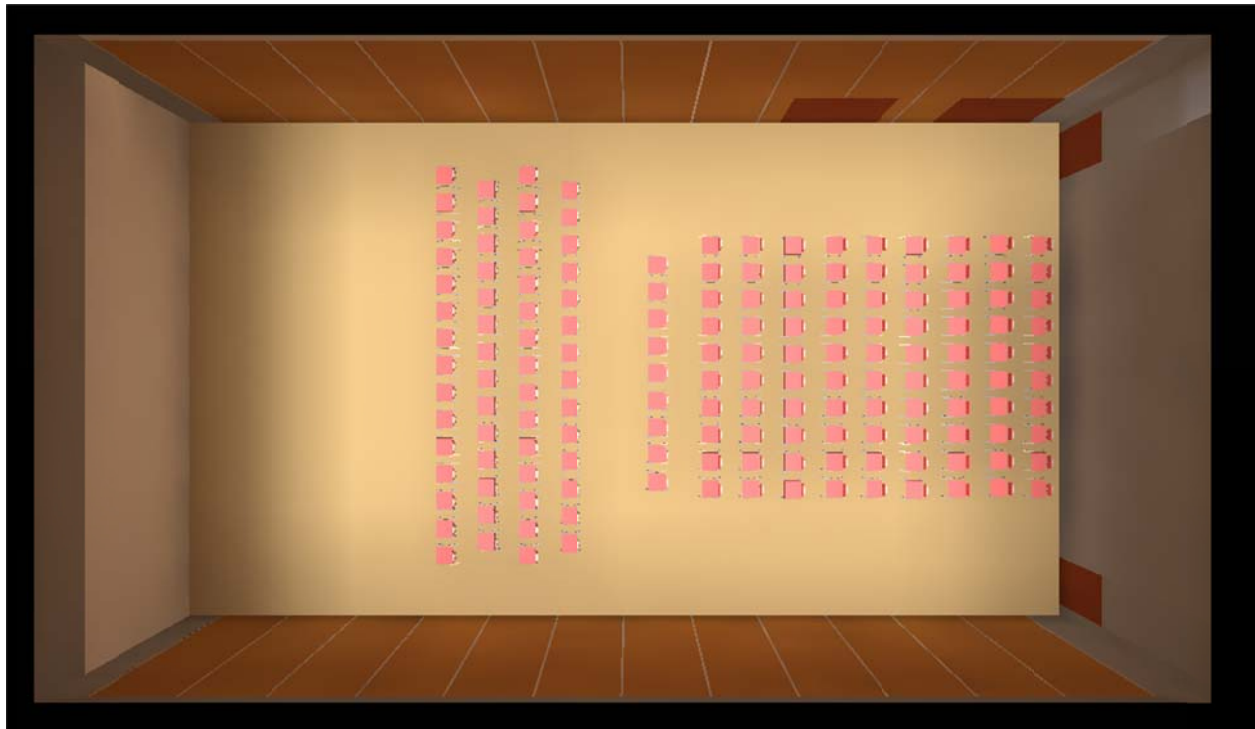


Figure 30 Theater Color Rendering - Plan

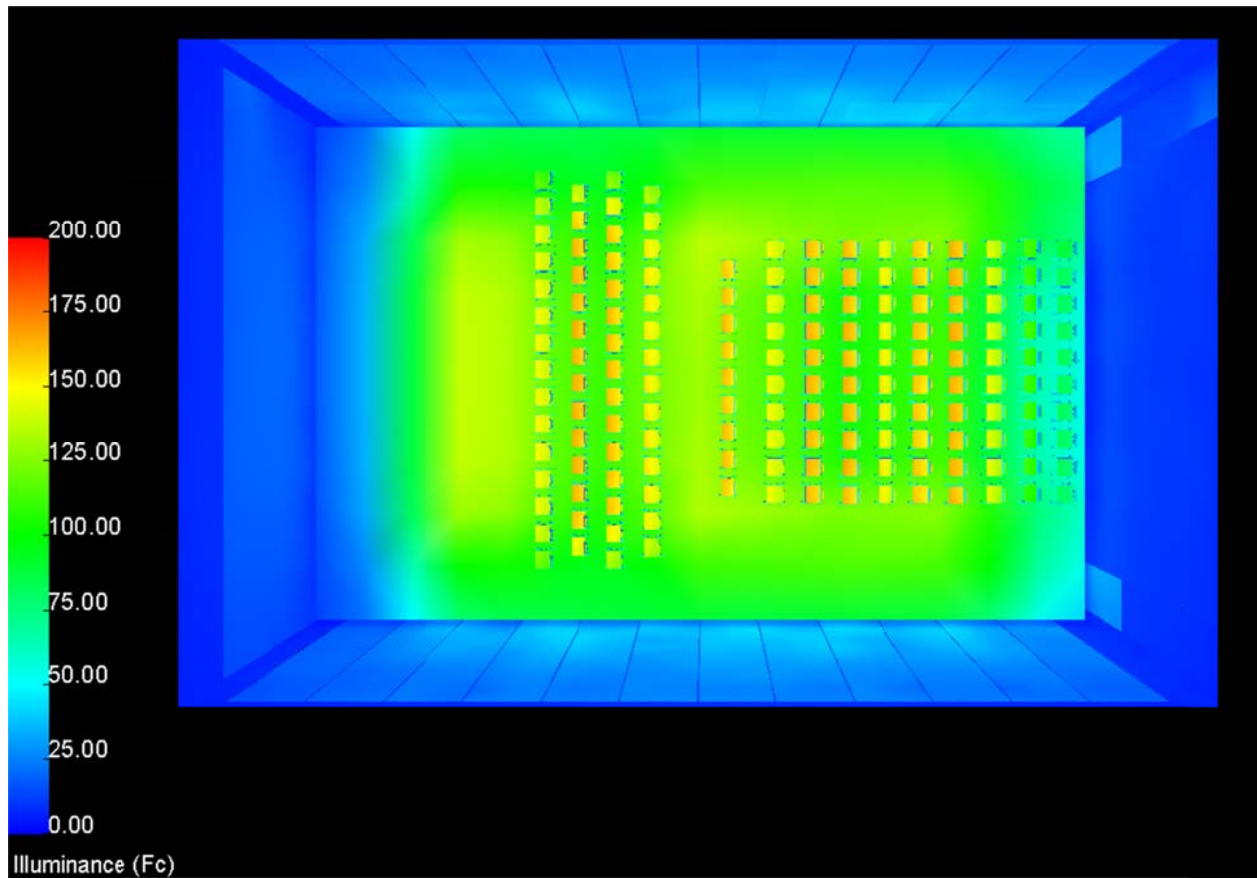


Figure 31 Theater Pseudo Rendering - Plan

4 Exterior Façade and Plaza

4.1 Existing Condition

Designed by Renzo Piano, the Renzo Museum of American Art is located in a former industrial neighborhood of lower Manhattan for vanguard architecture, design, fashion, and restaurants. Responds to the neighborhood industrial character, the overall architectural design has a strong and asymmetrical form. While the bulk of the building volume concentrated on the west side, the east side of the building steps down as the story decreases. Figure 32 shows the building in context of the existing neighborhood, looking east. Figure 33-36 building elevation demonstrates the overall form of the design.

A cantilevered entrance shelters a public plaza, designed to be a gathering space to engage the museum with the bustling community of artist, gallerists, students, educators, entrepreneurs, and residents from the neighborhood. The main task taking place at the exterior plaza is for gathering and socialization.



Figure 32 Contextual Site Plan

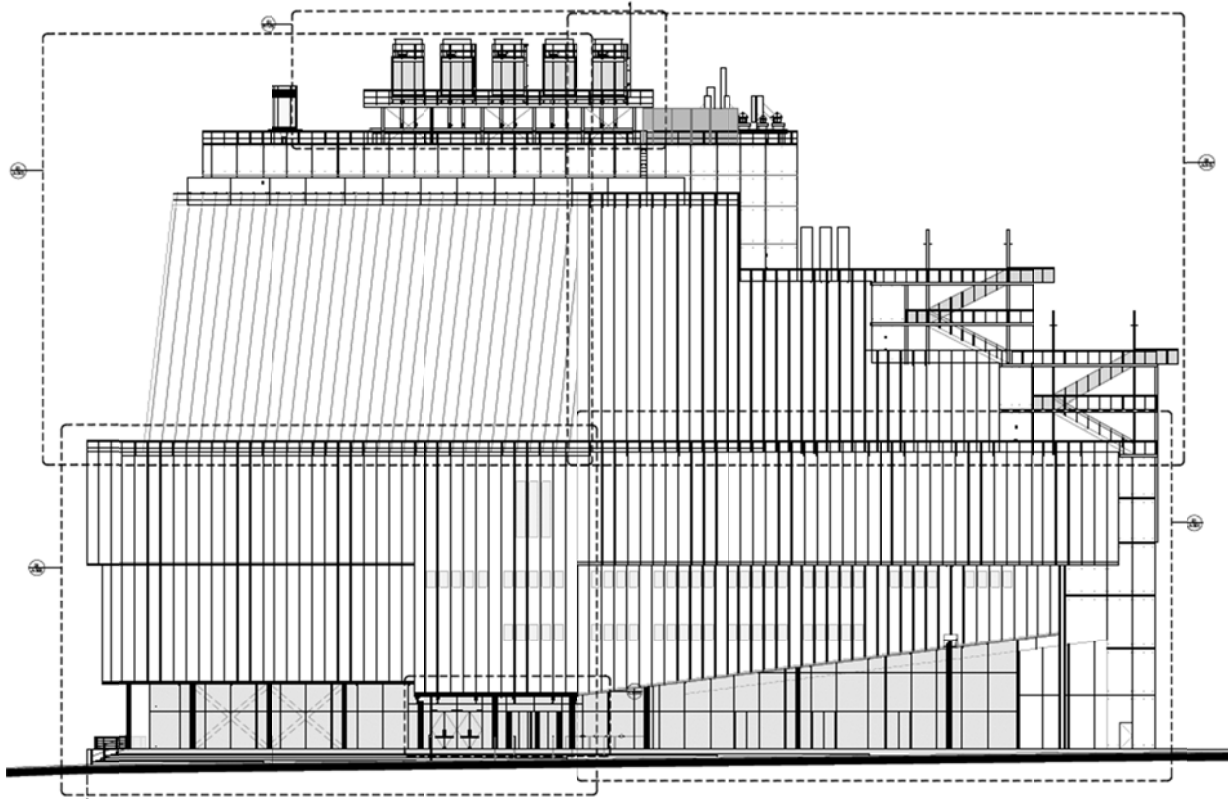


Figure 33 Building Facade South Elevation

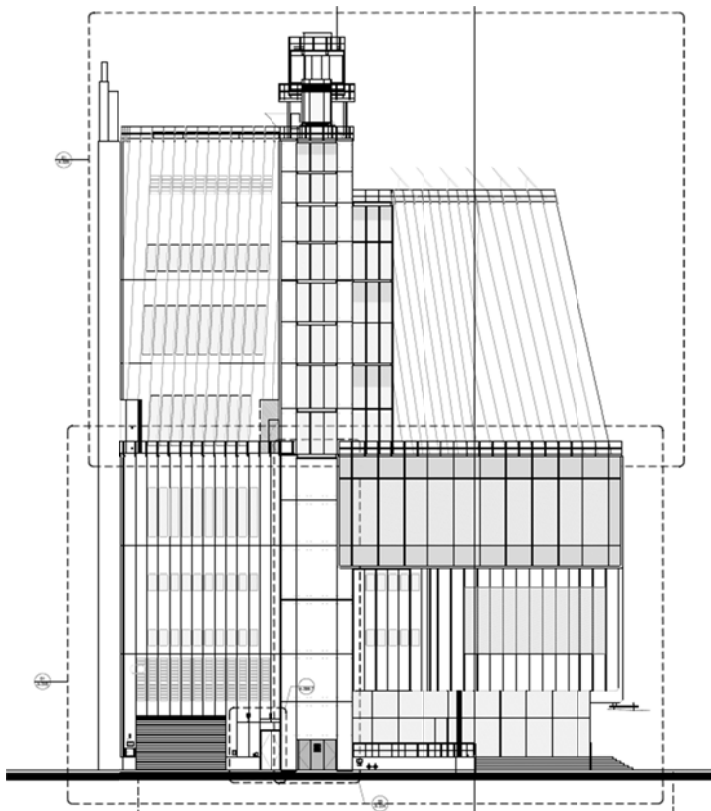


Figure 34 Building Facade West Elevation

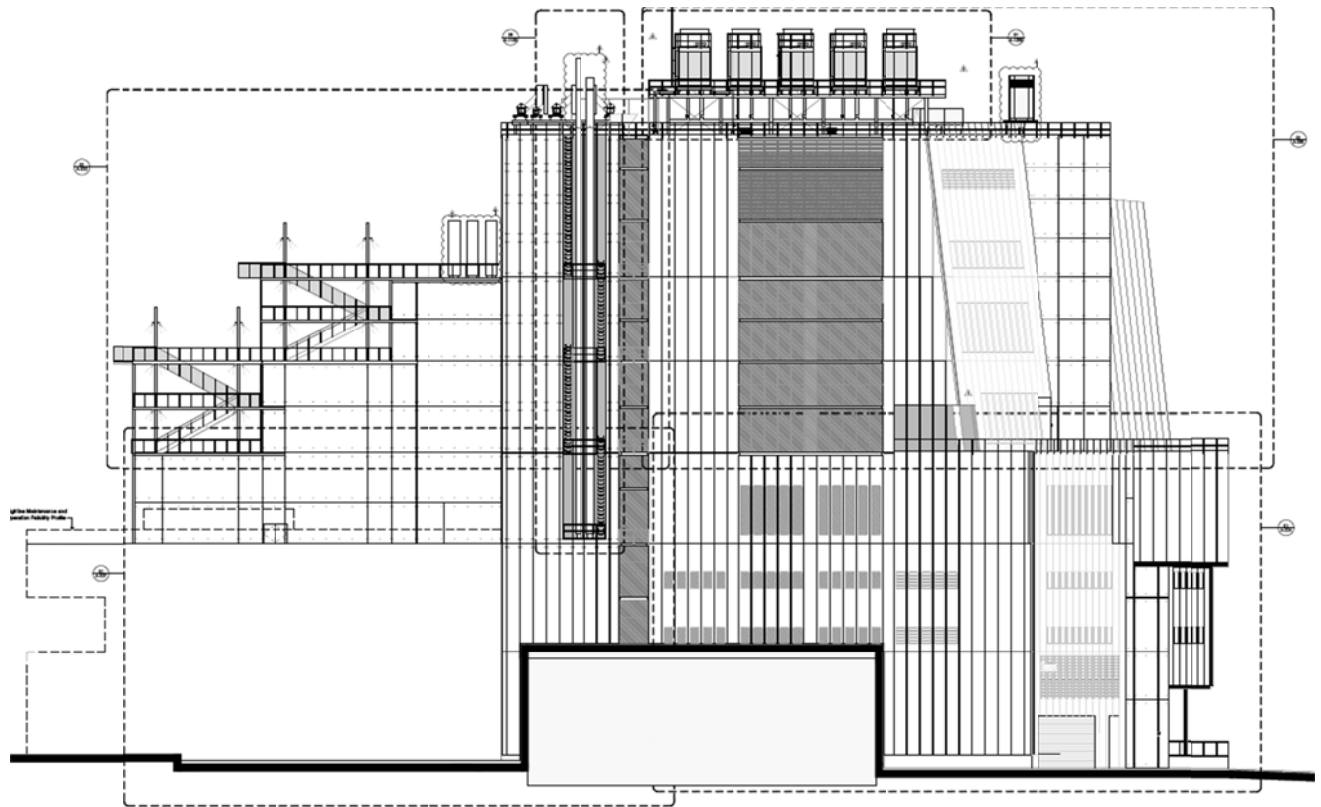


Figure 35 Building Facade North Elevation

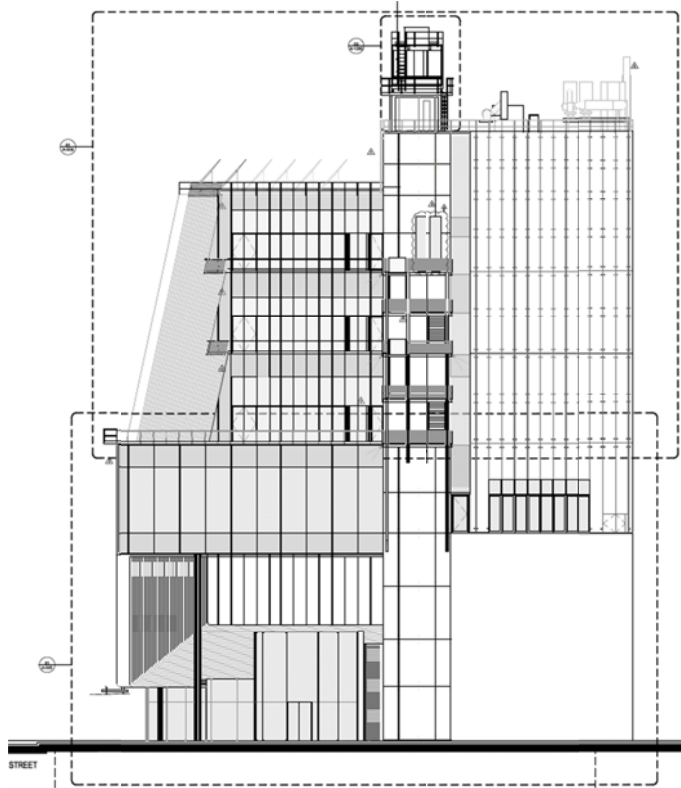


Figure 36 Building Facade East Elevation

Finishes:

The building façade is composed of Steel Plate Rainscreen Cladding System. The system consists of 5/16" thick light gray enamel steel panels cladding with stainless steel mounting hardware and exposed stainless steel fasteners. Other materials utilized are precast concrete, and cable wall.

Table 10 Exterior facade finish schedule

Surface	Name	Description	Reflectance
Façade	C-4	Pre-cast concrete panel with smooth-as-cast finish, 2-hr fire rated with double seal and weep tubes at vertical joint	0.5
	M-1	Carbon Steel. Custom color metallic feve	0.6
	WT-2	Steel plate rainscreen cladding system	0.7
	WT-6	Cable Wall glazing	



Figure 37 Building Facade Rendering – Looking South



Figure 38 Building Facade Rendering – Looking North West



Figure 39 Building Facade Rendering - Looking North East

4.2 Existing Lighting Conditions

The author wasn't able to obtain design drawings for exterior façade lighting and landscape lighting at the time this report is written. Figure 39 shows a night-time rendering of the south west building façade.



Figure 40 Night-time Rendering - Looking North East



Figure 41 Night-time Rendering – Site

4.3 Design Considerations and Criteria

Qualitative Criteria:

The exterior façade of Renzo Museum of American Art plays a prominent role in composing its identity. The unique asymmetrical façade calls for a complementary lighting solution. The owner's vision for the museum is for it to embrace and reciprocate the energy of the neighborhood and provide a stimulating and immersive space in which to experience art. As a design that really responds to the site and its neighborhood, a well designed lighting solution should be established to enhance the building's dynamic presence and echoes the neighborhood's vibrant energy. The exterior plaza under the cantilevered entrance offers a pleasant space to engage the neighborhood. A cohesive exterior lighting design should not only showcase the vitality of the space, but at the same time provide a safe and pleasant gathering space and cultural harbor. At the same time, light pollution and trespass should be taken into consideration during design.

Quantitative Criteria:

Illuminance Recommendation [IES Lighting Handbook 10th Edition (Table 26.2, 26.4, 22.4)]:

Space Type	E_v
Building Façade	Lighter-toned façade materials (Reflectance ≥ 0.5), 200 lux ; Darker-toned façade materials (Reflectance < 0.5), 400 lux

Note: High activity, LZ-3

Energy Allowance [ASHRAE standard 90.1]:

Space Type	Power Density (W/sqf)	Note
Building Façade	0.2 W/ft ² for each illuminated wall or surface or 5.0 W/linear foot for each illuminated wall or surface length	Tradable
Building Grounds	1.0 W/linear foot for walkways less than 10 ft wide. 0.2 W/ft ² for walkway 10 ft wide or greater, plaza areas, and special feature areas	Nontradable
Canopies	1.25 W/ft ²	Tradable

4.4 Design Evaluation

No façade or exterior landscape lighting drawings are available at the time of this report was written. Evaluation is solely based on the exterior night-time renderings.

The exterior architecture is highlighted through uplighting the sloped cladding system at level 6. Overall, the simple lighting design offers an elegant presence for the museum. There is potential for more sophisticated design and improvement to establish the building as an architectural landmark and an engaging nighttime identity.

References

ASHRAE Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings. 2007th ed.

DiLaura DL, Houser KW, Mistrick RG, Steff GR. Illuminating Engineering Society The Lighting Handbook. 10th ed.