
THE MUSEUM OF THE BIBLE

Washington, DC



TECHNICAL REPORT ONE

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L/E Option

Advisor—Richard Mistrick

EXECUTIVE SUMMARY:

The Museum of the Bible (MOTB) was chosen to be the focus of this technical report, assessing the existing conditions of the building design and construction. As mentioned in the Building Statistics Report, MOTB is a non-sectarian museum focusing on the history and impact of the Bible with a core collection compilation of more than 40,000 biblical antiquities and rare biblical texts and artifacts. The museum has several uses which include exhibit space, library resources, meeting spaces for visiting scholars, spaces for certain affiliated museums and their exhibits, and ground floor accessory retail uses, such as a gift shops and cafés or food service establishments.

The following report focuses specifically on the redesign of the spaces listed below:

- » **Performance Hall**
- » **Lobby & Arcade**
- » **Biblical Gardens**
- » **Collections Lab**
- » **“The Boat” - Corridor Space**

The analysis of these spaces and their existing conditions will include reading drawings, specifications, and schedules in order to develop a new set of design criteria. This developed design criteria as well as additional considerations will lead into further analysis of the spaces along with new conceptual design strategies. Throughout the extent of this report, the areas where a potential for improvement was seen include topics of fixture selection, layout design, and lighting power density calculations. While Illuminance criteria and was generally met in the spaces studied, uniformity within those spaces may also be adjusted to better suit the recommendations for the space types and improve task efficiency.

In future technical reports, the study of these spaces will integrate an analysis of a few other disciplines such as architectural additions and structural or mechanical system redesigns. The overall goal for the completion of this thesis project is to understand the complexities of MOTB and its original design to recreate my own design strategies and engineered solutions.

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BUILDING OVERVIEW:

The Museum of the Bible (MOTB) is a non-sectarian museum focusing on the history and impact of the Bible with a core collection compilation of more than 40,000 biblical antiquities and rare biblical texts and artifacts. The Museum has several uses which include exhibit space, library resources, meeting spaces and guest rooms for visiting scholars, space for certain affiliated museums and their exhibits, and ground floor accessory retail uses, such as a gift shop and café or food service establishment. The MOTB will also be a center of study for the Green Scholars Initiative, where established scholars and students will conduct research to pioneer new biblical and classical discoveries on items from the collection.

The Washington Design Center (WDC) originally was an eight-story 241, 073,000 SF brick and concrete building, designed in the Renaissance Revival style, and built for the Terminal Refrigerating and Warehousing Company in 1922. In 1982, the original building was renovated to house the WDC, which included the construction of an addition to the east. The Washington Design Office Center -Phase II (WOC) was later added in 1989 to complete the block.

The new construction of MOTB includes a demolition of the 1982 addition, adding six stories above the original footprint. This addition includes over 430,000,000 square feet of construction, including three stories below grade, to accommodate rotating exhibit gallery collections, storage, and a lower level central plant. The exterior aesthetics honor the historic characteristics of the building, and a curved glass roof will be added to allow daylight exposure as well as beautiful views of central D.C. as well as the capital building.

GENERAL FACTS:

Building Name | Museum of the Bible (MOTB)

Location and Site | Washington, D.C.; property name known as Washington Design Center (WDC)

Building Occupant Name | Museum of the Bible

Occupancy or Function Types (type of building) | Museum

Size (total square feet) | 430,000 SF

Number of Stories | 6 stories above grade; 9 total levels

Primary Project Team | Museum of the Bible - <http://www.museumofthebible.org/>

SmithGroupJJR - <http://www.smithgroupjjr.com/>

Tadger Cohen Edelson Associates Inc. - <http://www.tadgerco.com/>

RK&K - <http://www.rkk.com/>

Michael Vergason - <http://www.vergason.net/>

Fluidity Fountain - <http://www.fluidity-design.com/>

Theatre Consultants Collaborative, Inc. - http://theatrecc.net/non_flash/

Dates of Construction | Feb 2015 – Fall 2017

Actual Cost Information | Contract Value: \$237 million

Project Delivery Method | Design – Bid – Build

PROPOSED AREAS OF STUDY :

SPECIAL PURPOSE SPACE | PERFORMANCE HALL



- EXISTING CONDITIONS -

SUMMARY & DIMENSIONS:

The main entrance to the performance hall is located on the fifth floor of the structure, stretching upward to reach the overall height of the sixth floor. Additional points of entry are located on the sixth floor as well. The space serves as a location for emotionally moving productions and an opportunity to further engage oneself in the cultural aspects of the museum. **It's monumental form and traditional importance of exposing the public to the magic of the arts, express why this space has been selected to have three different schematic design concepts for the third technical report.**

Square Footage: **3,475 sf Bottom Floor; 1,600 sf Mezzanine Level; 2,200 sf Stage Platform**

Approximate Width: **64 ft.**

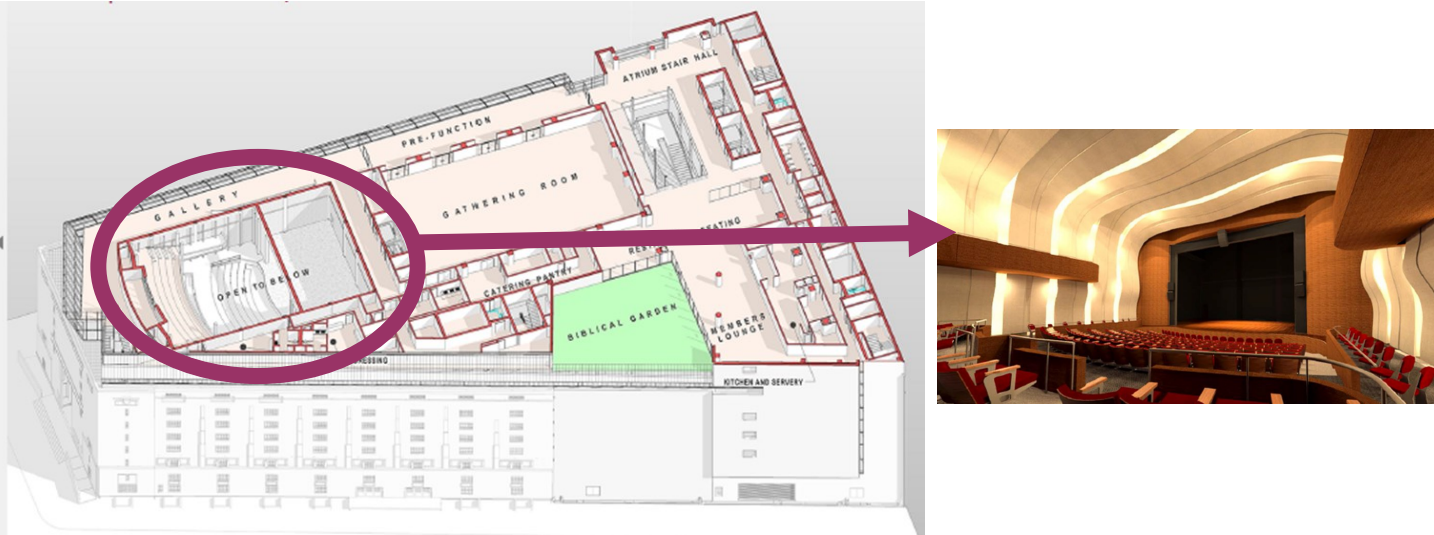
Approximate Length: **95 ft.**

Height: **31.75 ft. Ground Level to Ceiling; 12 ft. Entrance to Ceiling; 15 ft. Mezzanine to Ceiling**

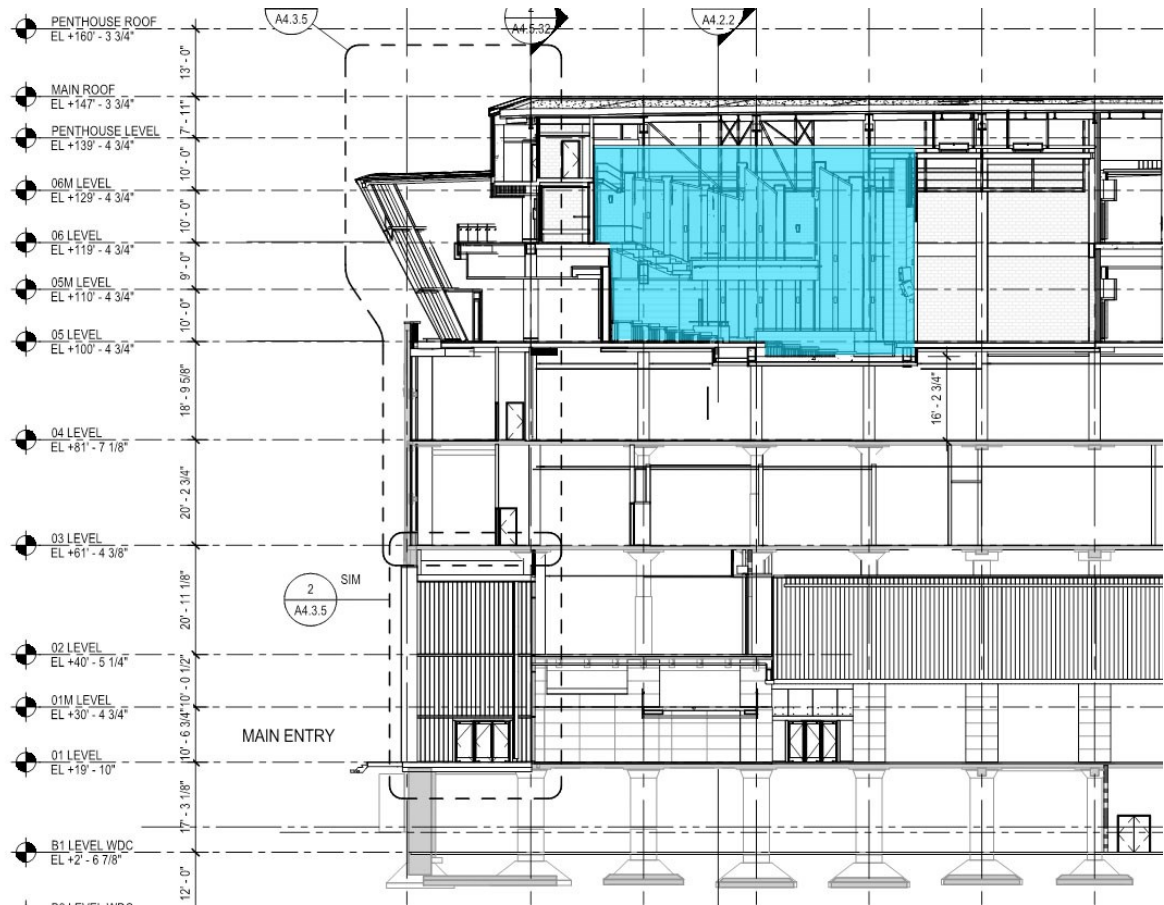
TASKS & ACTIVITIES:

Various performances, lectures, musical productions, assemblies, reading (handouts), emergency circulation.

LOCATION & DRAWINGS:

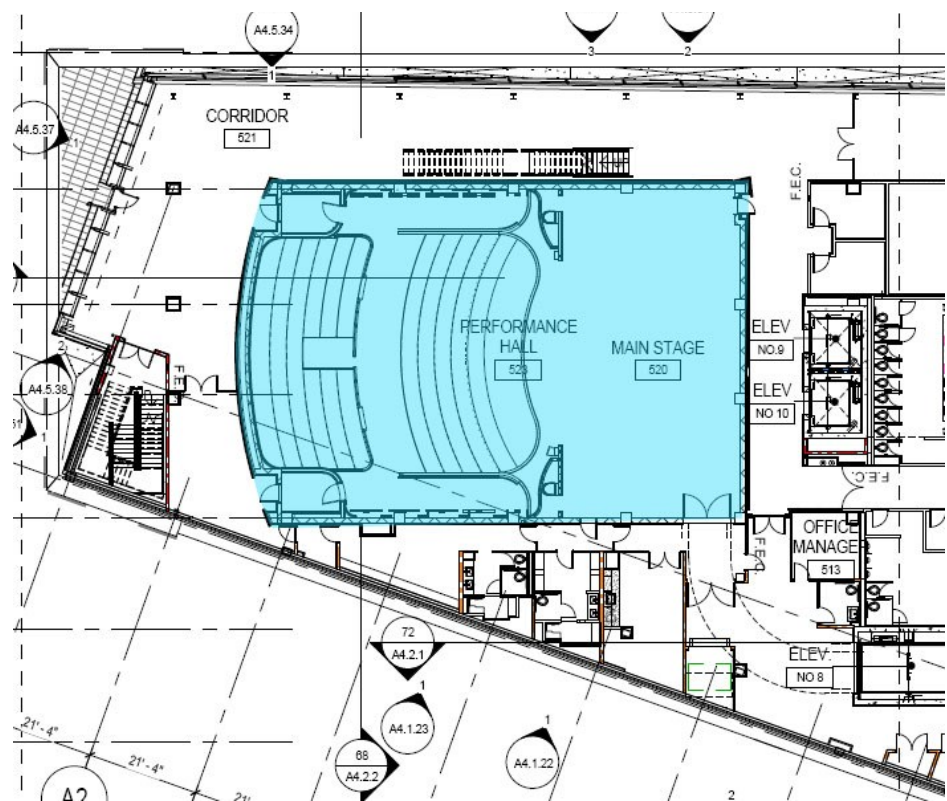


A view from the sixth floor events level (shown above) as well as the building section (shown below) help to communicate the overall depth and vastness of this performance space in context to the entire building. There are two levels of public entry from the gallery space which runs along the Northern and Western edges of the glass façade. Due to the monumental size of this glass structure, this gallery space acts as a great precedent to the entry of the grand hall.

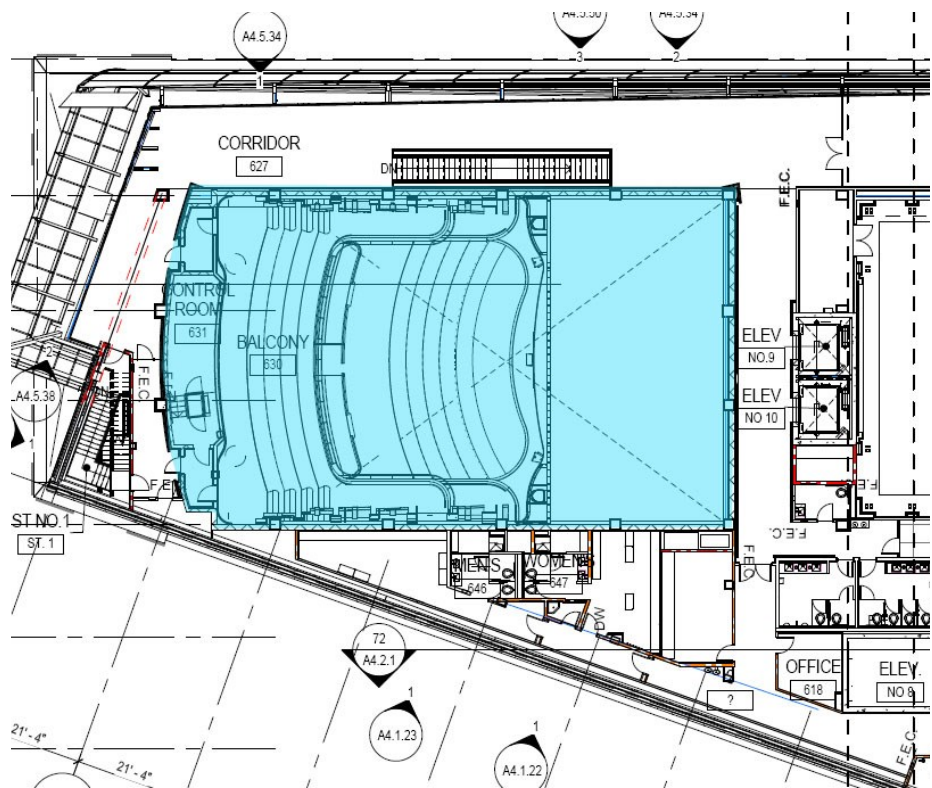


Building Section - Performance Hall

PLANS:

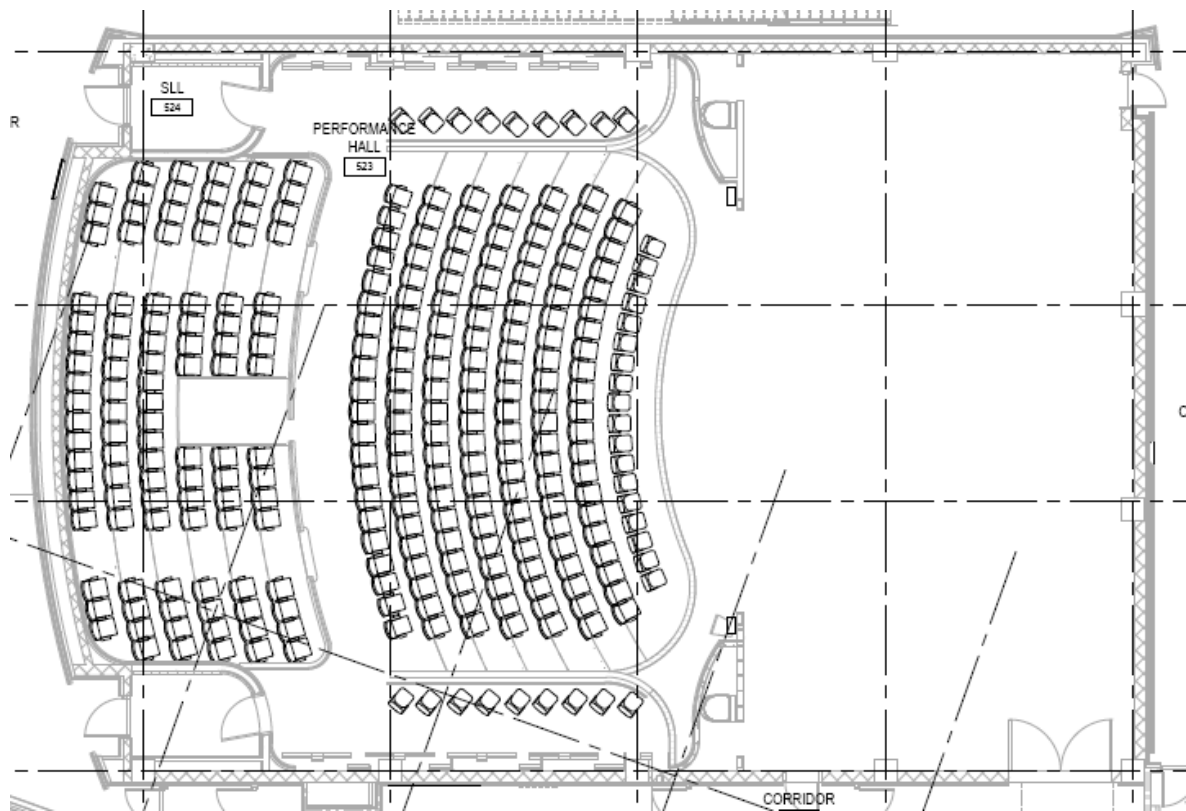


Fifth Floor Plan - Performance Hall

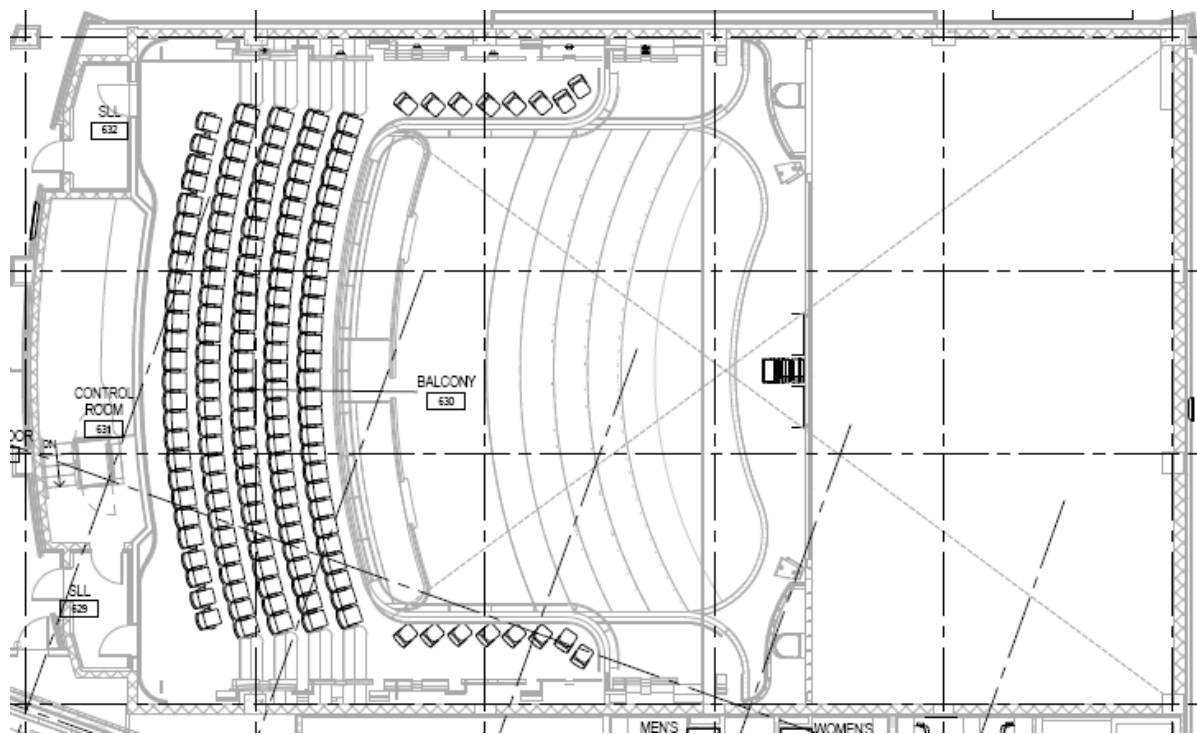


Sixth Floor Plan - Performance Hall

FURNITURE PLANS:



Fifth Floor Furniture Plan - Performance Hall





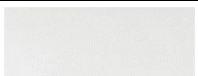




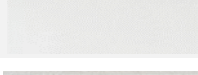
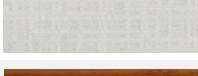

Sixth Floor Furniture Plan - Performance Hall

SECTION - REAR ORCHESTRA AND BALCONY
SCALE: 1/8" = 1'-0"

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MATERIALS:

The most notable material in the Performance Hall is the suspended fabric wrapped acoustical panels which hang along the walls and ceilings, adding drama and elegance to the space. These draping fabrics are designed to have custom color qualities and act as both an aesthetic design aspect as well as an engineered solution for adequate acoustics. Walnut colored wood paneling on the walls help to add a classic appearance while the dark carpet eliminates the need for frequent maintenance. Refer to the table below for further detail on all materials used within the space

Material Specifications - Performance Hall					
Surface Type	Description	Manufacturer	Color	Image	Reflectance
Floor	Broadloom Carpet	Tandus	Brown / Taupe		0.1
	Anti-Static Sealed Concrete	United States Control Products	Translucent White		0.6
Walls	Wall Fabric Panel	Novawall	Novaspun Custom Color		0.8
	Wall Fabric Panel	Luna Textiles	HIFIFHI-5181 Starlight		0.6
	Acoustical Wood Panels	ACGI	Walnut		0.15
	Custom Acoustical Wood Panels	ACGI	Walnut		0.15
Ceiling	Spring Iso Ceiling	VMC Group	Dark Grey		0.1
	Wall Fabric Panels	Novawall	Novaspun Custom Color		0.8
	Wall Fabric Panel	Luna Textiles	HIFIFHI-5181 Starlight		0.6
	Acoustical Wood Panels	ACGI	Walnut		0.15

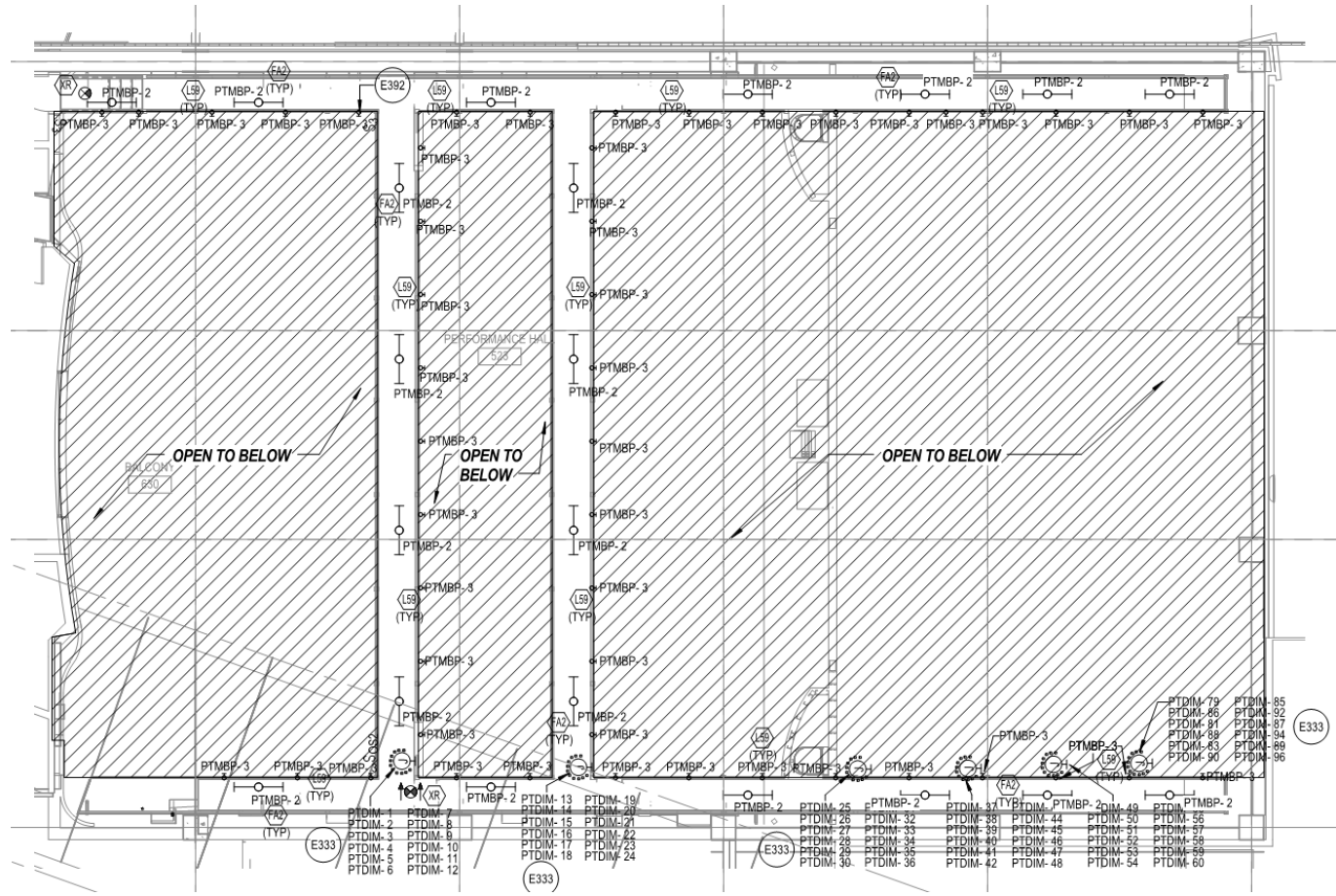
EXISTING LIGHTING:

The unique materiality of this space calls for integrated lighting solutions that include both surface mounted and recessed luminaires. LED cove fixtures are strategically aligned behind the fabric wrapped acoustical panels to create an indirect ambiance within the space. Adjustable LED downlights illuminate the seating areas, including the areas atop the mezzanine level. Emergency exits signs and chair mounted egress lights provide safety precautions for the space in the case of loss of power while 4' fluorescent lights in the ceiling provide functional task lighting in the work spaces above the stage. Overall the lighting truly emphasizes the architectural forms that make up the space and creates an intimate atmosphere for performances.

This detailed architectural floor plan illustrates the layout of the Performance Hall. The central feature is the 'PERFORMANCE HALL' (S23), which is flanked by seating areas on both sides. The stage area is located on the right side of the plan, labeled 'MAIN STAGE' (S20). Various equipment locations are marked with codes and symbols, including PTMBS (e.g., PTMBS-10, PTMBS-11, PTMBS-12, PTMBS-13, PTMBS-14, PTMBS-15, PTMBS-16), PTELS (e.g., PTELS-5, PTELS-6, PTELS-9, PTELS-10), and PTDIM (e.g., PTDIM-70, PTDIM-71, PTDIM-72, PTDIM-73, PTDIM-74, PTDIM-75, PTDIM-76, PTDIM-77, PTDIM-78, PTDIM-79, PTDIM-80, PTDIM-81, PTDIM-82, PTDIM-83, PTDIM-84, PTDIM-85, PTDIM-86, PTDIM-87, PTDIM-88, PTDIM-89). The plan also shows various other equipment like E334, E392, E394, and E395, and symbols for lighting (L10, L12, L13, L14, L15, L16, L17, L18, L19, L20, L21, L22, L23, L24, L25, L26, L27, L28, L29, L30, L31, L32, L33, L34, L35, L36, L37, L38, L39, L40, L41, L42, L43, L44, L45, L46, L47, L48, L49, L50, L51, L52, L53, L54, L55, L56, L57, L58, L59, L60, L61, L62, L63, L64, L65, L66, L67, L68, L69, L70, L71, L72, L73, L74, L75, L76, L77, L78, L79, L80, L81, L82, L83, L84, L85, L86, L87, L88, L89, L90, L91, L92, L93, L94, L95, L96, L97, L98, L99, L100, L101, L102, L103, L104, L105, L106, L107, L108, L109, L110, L111, L112, L113, L114, L115, L116, L117, L118, L119, L120, L121, L122, L123, L124, L125, L126, L127, L128, L129, L130, L131, L132, L133, L134, L135, L136, L137, L138, L139, L140, L141, L142, L143, L144, L145, L146, L147, L148, L149, L150, L151, L152, L153, L154, L155, L156, L157, L158, L159, L160, L161, L162, L163, L164, L165, L166, L167, L168, L169, L170, L171, L172, L173, L174, L175, L176, L177, L178, L179, L180, L181, L182, L183, L184, L185, L186, L187, L188, L189, L190, L191, L192, L193, L194, L195, L196, L197, L198, L199, L200, L201, L202, L203, L204, L205, L206, L207, L208, L209, L210, L211, L212, L213, L214, L215, L216, L217, L218, L219, L220, L221, L222, L223, L224, L225, L226, L227, L228, L229, L230, L231, L232, L233, L234, L235, L236, L237, L238, L239, L240, L241, L242, L243, L244, L245, L246, L247, L248, L249, L250, L251, L252, L253, L254, L255, L256, L257, L258, L259, L260, L261, L262, L263, L264, L265, L266, L267, L268, L269, L270, L271, L272, L273, L274, L275, L276, L277, L278, L279, L280, L281, L282, L283, L284, L285, L286, L287, L288, L289, L290, L291, L292, L293, L294, L295, L296, L297, L298, L299, L300, L301, L302, L303, L304, L305, L306, L307, L308, L309, L310, L311, L312, L313, L314, L315, L316, L317, L318, L319, L320, L321, L322, L323, L324, L325, L326, L327, L328, L329, L330, L331, L332, L333, L334, L335, L336, L337, L338, L339, L340, L341, L342, L343, L344, L345, L346, L347, L348, L349, L350, L351, L352, L353, L354, L355, L356, L357, L358, L359, L360, L361, L362, L363, L364, L365, L366, L367, L368, L369, L370, L371, L372, L373, L374, L375, L376, L377, L378, L379, L380, L381, L382, L383, L384, L385, L386, L387, L388, L389, L390, L391, L392, L393, L394, L395, L396, L397, L398, L399, L400, L401, L402, L403, L404, L405, L406, L407, L408, L409, L410, L411, L412, L413, L414, L415, L416, L417, L418, L419, L420, L421, L422, L423, L424, L425, L426, L427, L428, L429, L430, L431, L432, L433, L434, L435, L436, L437, L438, L439, L440, L441, L442, L443, L444, L445, L446, L447, L448, L449, L450, L451, L452, L453, L454, L455, L456, L457, L458, L459, L460, L461, L462, L463, L464, L465, L466, L467, L468, L469, L470, L471, L472, L473, L474, L475, L476, L477, L478, L479, L480, L481, L482, L483, L484, L485, L486, L487, L488, L489, L490, L491, L492, L493, L494, L495, L496, L497, L498, L499, L500, L501, L502, L503, L504, L505, L506, L507, L508, L509, L510, L511, L512, L513, L514, L515, L516, L517, L518, L519, L520, L521, L522, L523, L524, L525, L526, L527, L528, L529, L530, L531, L532, L533, L534, L535, L536, L537, L538, L539, L540, L541, L542, L543, L544, L545, L546, L547, L548, L549, L550, L551, L552, L553, L554, L555, L556, L557, L558, L559, L560, L561, L562, L563, L564, L565, L566, L567, L568, L569, L570, L571, L572, L573, L574, L575, L576, L577, L578, L579, L580, L581, L582, L583, L584, L585, L586, L587, L588, L589, L590, L591, L592, L593, L594, L595, L596, L597, L598, L599, L600, L601, L602, L603, L604, L605, L606, L607, L608, L609, L610, L611, L612, L613, L614, L615, L616, L617, L618, L619, L620, L621, L622, L623, L624, L625, L626, L627, L628, L629, L630, L631, L632, L633, L634, L635, L636, L637, L638, L639, L640, L641, L642, L643, L644, L645, L646, L647, L648, L649, L650, L651, L652, L653, L654, L655, L656, L657, L658, L659, L660, L661, L662, L663, L664, L665, L666, L667, L668, L669, L670, L671, L672, L673, L674, L675, L676, L677, L678, L679, L680, L681, L682, L683, L684, L685, L686, L687, L688, L689, L690, L691, L692, L693, L694, L695, L696, L697, L698, L699, L700, L701, L702, L703, L704, L705, L706, L707, L708, L709, L710, L711, L712, L713, L714, L715, L716, L717, L718, L719, L720, L721, L722, L723, L724, L725, L726, L727, L728, L729, L730, L731, L732, L733, L734, L735, L736, L737, L738, L739, L740, L741, L742, L743, L744, L745, L746, L747, L748, L749, L750, L751, L752, L753, L754, L755, L756, L757, L758, L759, L760, L761, L762, L763, L764, L765, L766, L767, L768, L769, L770, L771, L772, L773, L774,

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LIGHTING PLANS:



Enlarged Performance Catwalk Lighting Plan

LIGHTING SCHEDULE:

Lighting Fixture Schedule - Performance Hall						
<i>Type</i>	<i>Description</i>	<i>Manufacturer</i>	<i>Mounting</i>	<i>Lamp</i>	<i>Ballast</i>	<i>Voltage</i>
L12	2" X 2" Linear LED Fixture With 4 Channel RGBW, Surface Mount Cove Light System	Traxon	Surface	LED; 6W /ft; 100LM/ft; Tri-Color and 4000K RGBW	DMX 512 Control	120
L51	3.94" Diameter Adjustable LED, 27 Degree Beam, 0% Dimming	ETC	Recessed	LED; 16W; 1280 LM; 3000K	DMX 512 Control	120
L56	3.94" Diameter Adjustable LED, 40 Degree Beam, 0% Dimming	ETC	Recessed	LED; 16W; 1280 LM; 3000K	DMX 512 Control	120
L58	6.2" Diameter Yoke Mounted LED, 24 Degree Beam, Continuous 0% Dimming	ETC	Recessed	LED; 16W; 1280 LM; 3000K	DMX 512 Control	120
L59	2.6" Blue Omni-Directional, Dimmable, Frosted Lensed Baffle Dome	Global Design Solutions	Surface	LED; Blue; Low Voltage	DMX 512 Control	120
L63	Custom Chair Mounted Step Light	Ducharme	Surface	LED; Low Voltage	N/A	120
L64	Regressed LED Step Light, 2.75" X 2.56" Wide Brushed Stainless Steel Sealed Linear Spread Lens	Lucifer	Recessed	LED; 2W/ft; 33 LM; 2700K	N/A	120
FA2	Suspended 4' Linear Fluorescent Strip Light With Symmetric Aperture Reflector & Wireguard	Prudential	Wall	(2) 32W T8	Electronic	120
XR	Surface Mounted Edge-Lit LED Exit Sign With White Aluminum Housing	Philips Chloride	Recessed	LED	N/A	277

EXISTING CONTROLS:

Since there is no daylight in this space and it is a special purpose space with important functions, basic control systems are not laid out in the electrical plans. However, there is a control room located directly behind the Performance Hall which I will assume handles all of the dimming and other control systems related to this space.

- DESIGN CRITERIA & CONSIDERATIONS -

The design criteria laid out in the next portion of this report relates to the functionality of the space in terms of quantitative measures as well as the aesthetic appeal related to qualitative measures. These criteria are meant to ensure comfort for the occupants as well as ensure their ability to accomplish tasks related to the spaces. The guidelines for this list of criteria can be found in the Illuminating Engineering Society Lighting Handbook, tenth edition and ASHRE 90.1. Listed below are the specific criteria which were developed for the Performance Hall.

ILLUMINANCE & UNIFORMITY REQUIREMENTS :

The values held within the table are important for the design of the space because they suggest that by meeting the quantitative values required for the space, the spaces with function as desired. In some cases, these values are also provided for safety reasons and therefore should not be overlooked. The table suggests both vertical and horizontal illuminance levels for the expected tasks within the space. For those spaces which hold multiple functions, all task criteria should be taken into consideration. The uniformity recommendations are also listed below and are meant to minimize visual distraction and encourage better functionality within a space.

Illuminance Criteria				
<i>Space</i>	<i>Task</i>	<i>E horizontal (lux)</i>	<i>E vertical (lux)</i>	<i>E h (avg) : E h (min)</i>
Theatre Seating	Performance House During Show	2	10	3:1
Theatre Seating	Performance House Pre/Post Show	75	50	3:1
Theatre Seating	Reading & Writing	300	75	1.5:1
Stage	Set Up / Tear Down	400	200	2:1
Catwalk	Back of House Transitional Independent Passageway	50	30	2:1

LIGHTING POWER DENSITY:

The lighting power density values listed below were determined using the ASHRAE 90.1 requirements. The numerical allowances relate to watts/square foot and may not be surpassed in order to meet electrical code. Below is the break down of this space's lighting power density considering the space by space method. Some assumptions had to be made regarding building space types when the ones required were not provided.

LPD Criteria		
<i>Space</i>	<i>Description of Space</i>	<i>Allowance (W/sf)</i>
Theatre Seating	Audience/Seating Area Performing Arts Theatre Convention Center Exhibit	2.43
Stage	Space	1.45
Catwalk	Active Storage	0.35

MAINTENANCE:

Given the two story height of this massive theatrical space, accessibility to fixtures is critical for re-lamping and adjustment purposes. The hope for this space is that it will function for a long period of time with little maintenance requirements.

GLARE:

Glare from overhead fixtures in the seating areas is of great concern given the output and beam spread needed to illuminate from some of the lower ceilings within the space. Several sources will be dimmed during production, therefore the entering and exiting of the performance space as well as reading and writing scenarios are of greatest concern.

CIRCULATION:

Circulation within the performance hall is imperative in order to guide individuals to exits during the shows, however given that a majority of the movement and way-finding in the space will only take place before and after a production, circulation is not overly critical for the lighting design of the space.

PSYCHOLOGICAL IMPRESSION:

Psychological considerations in this space are important given the atmosphere that the performance hall wishes to create. Even with its massive architectural forms and towering ceilings, the space still seeks to create a relaxing environment for its audience. According to the John Flynn impressions, in order to make this space feel more enclosed and personal, the focus of the light should be in the center of the room rather than along the outskirts of the walls. This space is a great opportunity to play with darkness and centralized light to create drama and enhance the overall experience.

CONTROLS:

Luminaire control is crucial in this space because of the vastly different lighting settings required for production versus circulation and way-finding. Many of the fixtures will have to be turned off during performance times, while others will need to be dimmed for emergency egress. When choosing fixture types for this space, the dimming potential of their control system must be considered.

- EVALUATION -

The lighting in the Performance Hall is meant to be hidden behind the acrylic panels which surround the room. A model of the space was constructed using a computer program called 3DS Max Design and a light loss factor of 0.85 was assumed for this analysis. Due to spacing, the luminaires create undesired scallops on the architectural forms. The seating area closest to the stage is lit very uniformly and achieves an illuminance around 200 lux. On the contrary, the seating beneath the mezzanine area is lit non-uniformly and several hot spots can be seen. The top mezzanine space is also lit relatively uniformly with a bit of excess light along the edges. The calculated illuminance values are high compared to the recommendations for a performance space, however considering the multi-purpose use of the room the levels calculated in the model are slightly lower than expected. I think that dimming controls should allow for the space to be over-illuminated when activities require reading and writing and dimmed to a lower setting during performance days. Overall, the space does achieve its goal of highlighting the shape and form of the architectural elements, creating a soft, non-uniform perimeter illuminance which is perfect for this particular space.

The lighting power density of the existing spaces includes the following values:

Theatre Seating : 5752 W / 5075 sf = **1.13 W / sf**

Stage : 768 W / 2200 sf = **0.35 W / sf**

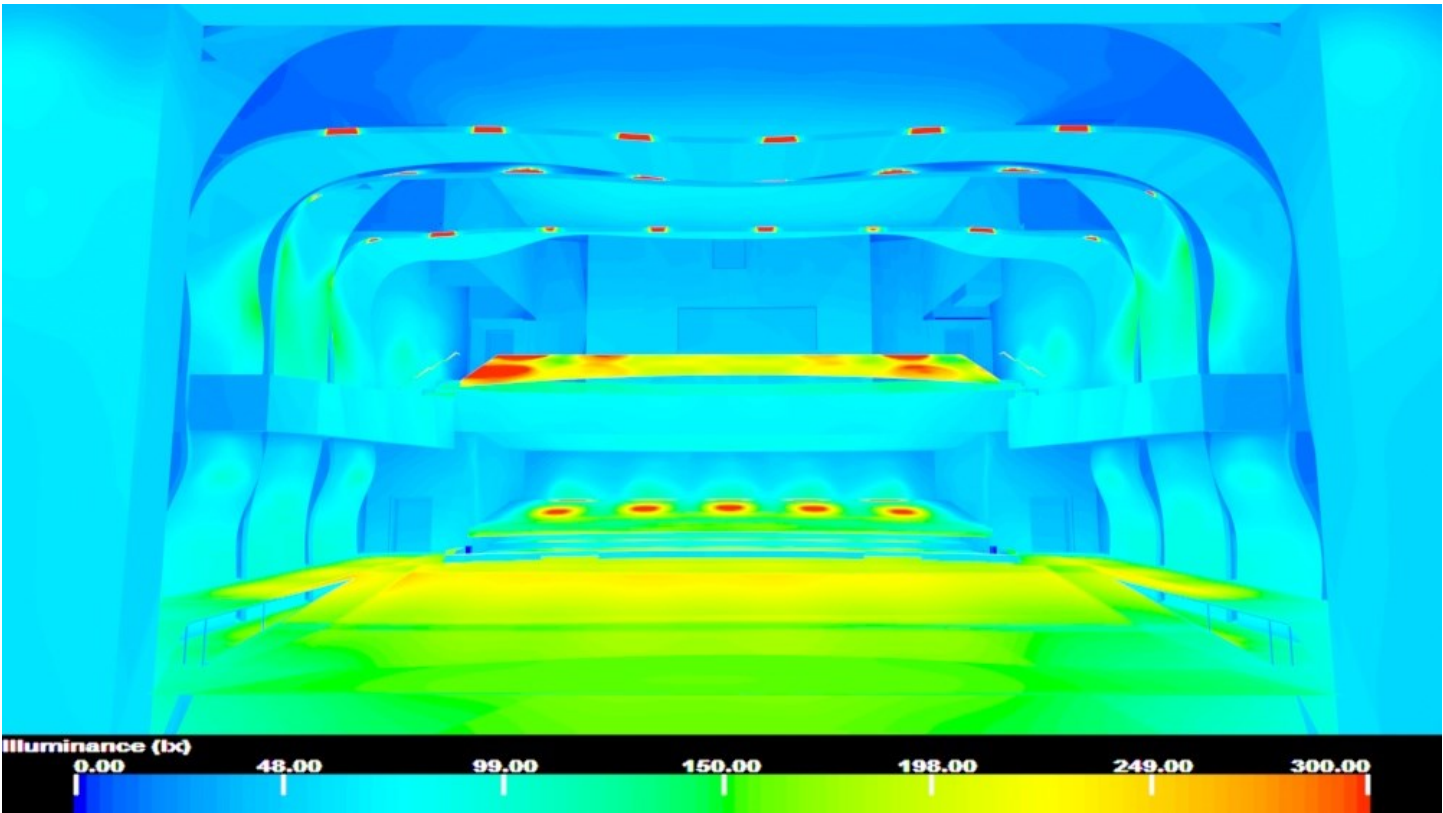
Catwalk : 672 W / 765 sf = **0.88 W / sf**

Therefore in terms of lighting power density calculations, the theatre seating area and the stage values were compliant with the electrical code. There are however areas for improvement with the catwalk space, given the assumptions made above for its space type and corresponding allowance.

3DS MAX RENDERINGS:



Performance Hall Perspective Rendering



Performance Hall Perspective Pseudo Color Rendering

CIRCULATION SPACE | LOBBY / ARCADE

SUMMARY & DIMENSIONS:



- EXISTING CONDITIONS -

SUMMARY & DIMENSIONS:

This lobby space is located at the main entrance and therefore serves as a transition area between the many exhibits and performance rooms within the building. Ease of way finding is a very important aspect of this space's design strategy, as well as the overall aesthetic impression it leaves on the visitors upon entrance. **Due to the high expectations of this space to create an emotional response from visitors, this space was chosen to be researched in terms of an appropriate psychological impression.**

Square Footage: **10,040 sf**

Approximate Width: **57.5 ft. (at largest width)**

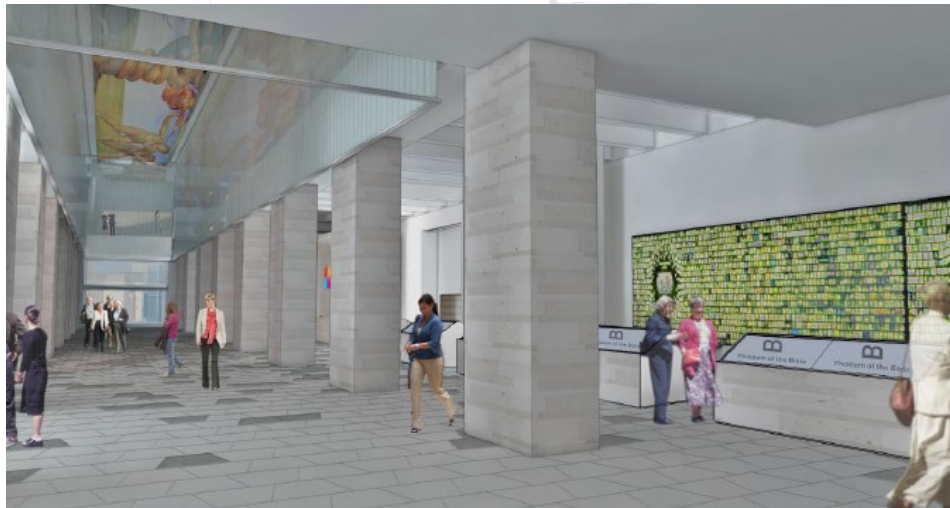
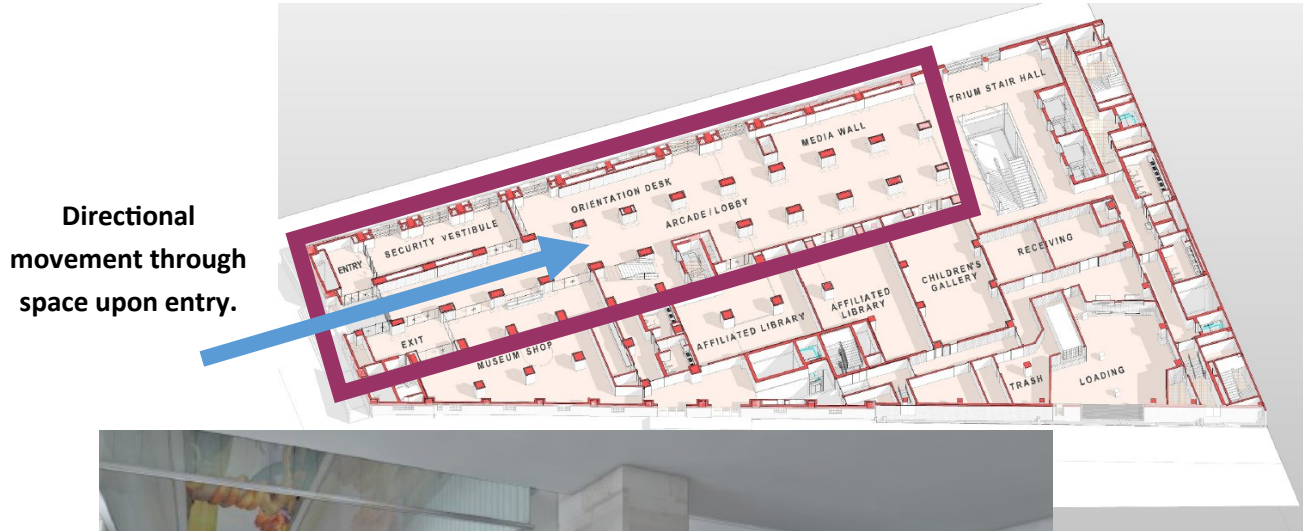
Approximate Length: **194 ft.**

Height: **41.25 ft.**

TASKS & ACTIVITIES:

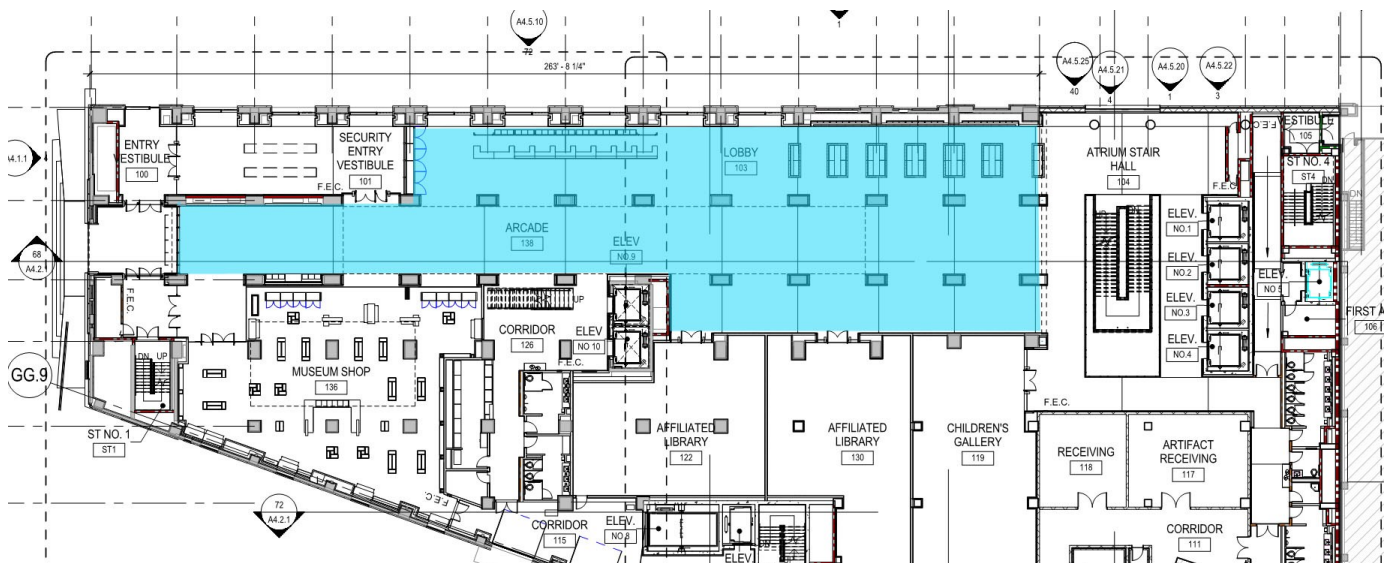
Transition and circulation, way-finding, desk services, reading (pamphlets/maps)

LOCATION & DRAWINGS:



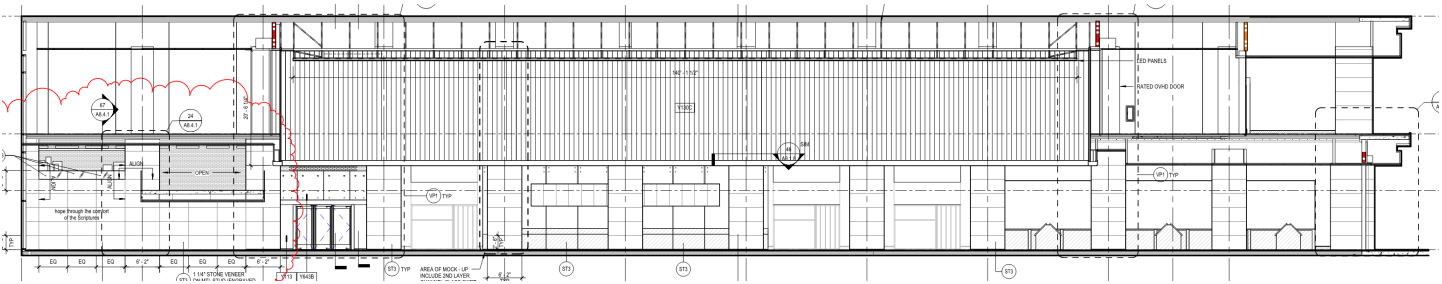
Public view of arcade upon entry.

Located on the first floor of the museum, this lobby/arcade acts as the starting point to a journey of discovery. It's large open design creates an environment that leaves its visitors in awe. Transition straight through the space directs a person to the central stair atrium, providing connections to the entire museum.

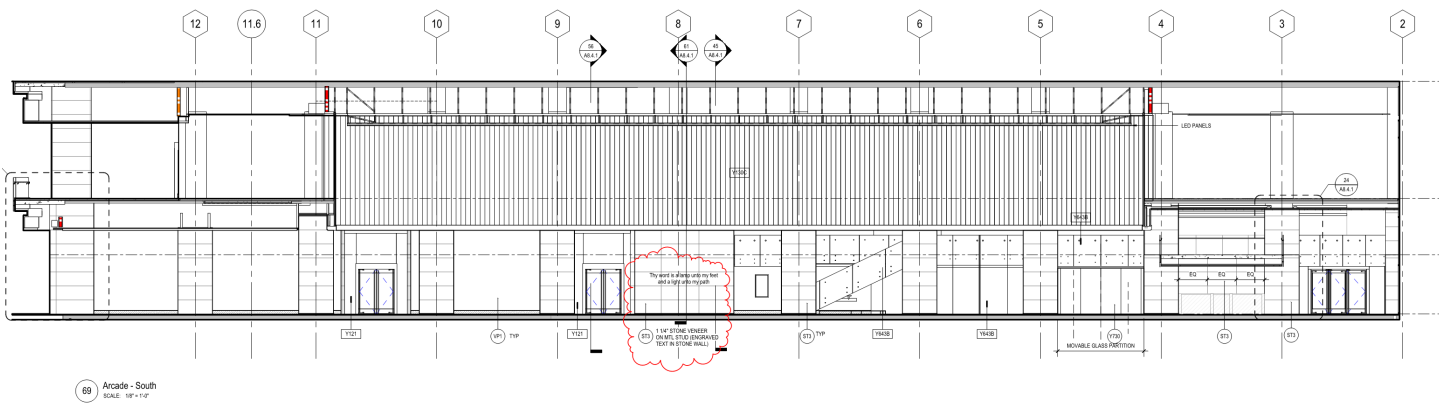


First Floor Plan - Lobby / Arcade

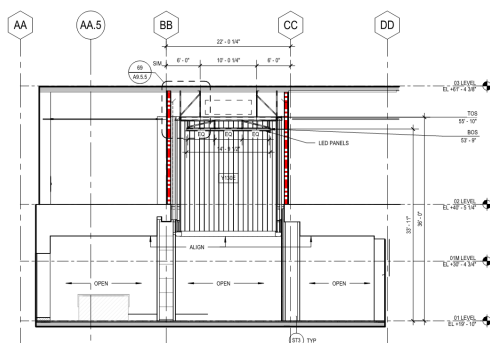
INTERIOR SECTIONS:



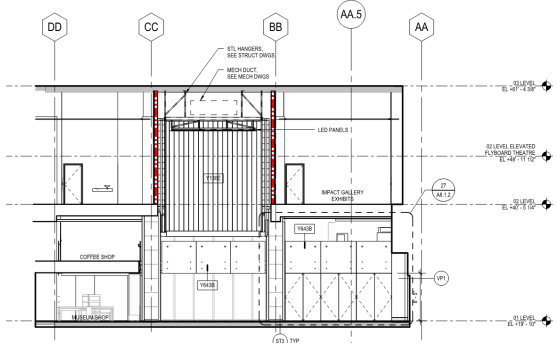
Arcade North Interior Section



Arcade South Interior Section




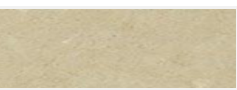


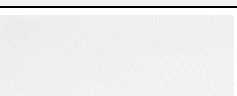
Arcade East Interior Section



Arcade West Interior Section

MATERIALS:

The Lobby / Arcade space is designed with exquisite materials meant to give visitors an awe-struck first impression. The combination of beautiful Venetian and Jerusalem stones speak to the historical aspect of the Bible itself and create a wonderfully decorated space. The high reaching ceilings only emphasize this notion of vastness and everlasting expansion. Because of the unique properties of the materials in this space, certain lighting consideration will need to be made regarding the reflective components of the stone.

Material Specifications - Lobby					
Surface Type	Description	Manufacturer	Color	Image	Reflectance
Floor	Limestone	Daltile	Lagos Blue L983		0.12
	Limestone	Stone Source	Courtaud Polished Limestone		0.2
Walls	Veneer Plaster	Evergreene	Lime-Based Venetian Plaster		0.6
	Limestone	Stone Source	Ramon Cream		0.45
Ceiling	Acoustical Plaster	Baswaphon	Chantilly Lace		0.79

EXISTING LIGHTING:

The existing lighting in the lobby space speaks to the idea of light rising up to the skies. The light fixtures outline the perimeter of the space nicely, softly accenting the architectural forms. The lighting certainly helps to accentuate the idea of an elegant arcade. The lighting doesn't have a basic layout of fixtures, but rather several linear strips of LEDs, numerous coves, and edge lit acrylic panels. Slot lighting and track heads also help to draw attention to some of the art and historical aspects of the space located around the perimeter.

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LIGHTING SCHEDULE:

Lighting Fixture Schedule - Lobby / Arcade						
Type	Description	Manufacturer	Mounting	Lamp	Ballast	Voltage
L1	0.75" X 0.75" Linear LED Fixture With Asymmetrical 90 Degree Distribution, Remote Dimming Driver	iO Lighting	Surface	LED; 11 W/ft; 400 LM/ft; 3000K	N/A	277
L8	5/16" Edge Lit LED Panel With Acrylic and Laser Cut Etching	DLC	Surface	LED; 2.5 W/sf; 875 LM/ft; 3500 K	Remote 0-10 V Dimming Driver	277
L9	5/8" X 3/8" Continuous Linear LED Tape With Aluminum	LED Linear	Surface	LED; 1.8 W/sf; 875 LM/ft; 3500 K	Remote 0-10 V Dimming Driver	277
L16	33" X 8" X 0.75" Multi-Lamp Adjustable Pendant With 10 Degree Narrow Beam Distribution	RSA	Suspended	(3) LED; 18 W; 1000 LM; 3000K	0 - 10 V Dimming	277
L18A	Linear LED Cove With Frosted Lens	Lumenpulse	Surface	LED; 6W/ft; 400 LM/ft; 3500 K	N/A	277
L24	11" X 5" X 6" Trimless Dual-Head Adjustable LED With 25 Degree Beam Distribution	RSA	Recessed	(2) LED; 18W; 1000 LM; 3000 K	0-10 V Dimming	277
L24B	Same as L24 Except 4 Heads	RSA	Recessed	(4) LED; 18W; 1000 LM; 3000 K	0-10 V Dimming	277
L24C	Same as L24 Except 4 Heads and Spot Distribution With Solite Lens	RSA	Recessed	(4) LED; 18W; 1000 LM; 3000 K	0-10 V Dimming	277
L71	4.5" Wide Continuous Recessed Modular Slot System With Spot Lighting Fixtures	Litelab	Recessed	N/A	N/A	120
L71A	2.5" Diameter LED Spot Light With 360 Degree Rotation	Litelab	Track/Busway	LED; 24W; 1300 LM; 3000 K; 90 CRI	N/A	120
XR	Surface Mounted Edge-Lit LED Exit Sign With White Aluminum	Philips Chloride	Recessed	LED	N/A	277

EXISTING CONTROLS:

The existing lobby space utilizes passive infrared /ultrasonic occupancy sensors to control its lighting.

- DESIGN CRITERIA & CONSIDERATIONS -

The design criteria laid out in the next portion of this report relates to the functionality of the space in terms of quantitative measures as well as the aesthetic appeal related to qualitative measures. These criteria are meant to ensure comfort for the occupants as well as ensure their ability to accomplish tasks related to the spaces. The guidelines for this list of criteria can be found in the Illuminating Engineering Society Lighting Handbook, tenth edition and ASHRE 90.1. Listed below are the specific criteria which were developed for the Lobby Space.

ILLUMINANCE & UNIFORMITY REQUIREMENTS :

The values held within the table are important for the design of the space because they suggest that by meeting the quantitative values required for the space, the spaces with function as desired. In some cases, these values are also provided for safety reasons and therefore should not be overlooked. The table suggests both vertical and horizontal illuminance levels for the expected tasks within the space. For those spaces which hold multiple functions, all task criteria should be taken into consideration. The uniformity recommendations are also listed below and are meant to minimize visual distraction and encourage better functionality within a space.

Illuminance Criteria				
<i>Space</i>	<i>Task</i>	<i>E horizontal (lux)</i>	<i>E vertical (lux)</i>	<i>E h (avg) : E h (min)</i>
Lobby	General: Day	100	30	4:1
Lobby	General: Night	50	20	4:1

LIGHTING POWER DENSITY:

The lighting power density values listed below were determined using the ASHRAE 90.1 requirements. The numerical allowances relate to watts/square foot and may not be surpassed in order to meet electrical code. Below is the break down of this space's lighting power density considering the space by space method. Some assumptions had to be made regarding building space types when the ones required were not provided.

LPD Criteria		
<i>Space</i>	<i>Description of Space</i>	<i>Allowance (W/sf)</i>
Lobby	Lobby: Transitional Building	0.9

MAINTENANCE:

Given the multi-story height of this massive lobby space, accessibility to fixtures is critical for re-lamping and adjustment purposes. The hope for this space is that it will function for a long period of time with little maintenance requirements.

GLARE:

Glare from overhead fixtures in the lobby spaces can be concerning given the output and beam spread needed to illuminate from some of the lower ceilings within the space. However, since this space's main function is circulation and transition, direct light and glare may not be a huge problem. However, consideration of the different glossy materials of the stone will focus to eliminate the appearance of reflections resulting in hidden fixture systems.

CIRCULATION:

Circulation within the lobby is important in order to guide individuals to and from the main spaces of the museum. This transition zone is meant to direct opponents to the rooms located along the length of the arcade as well as move them towards the atrium staircase that gives access to every other floor within the building.

PSYCHOLOGICAL IMPRESSION:

Even though this space is a temporary transition zone to other spaces in the building, it serves as the first impression of the building that visitors get upon arrival. **Due to the high expectations of this space to create an emotional response from visitors, this space was chosen to be researched in terms of an appropriate psychological impression.** Using the Flynn Impressions, different settings can be accessed for the controls of the lighting systems to enhance the architectural form and evoke the sensations of spaciousness. Some of the suggested design strategies for this impression include uniform, peripheral (wall) lighting and brightness as a reinforcing factor, but not a decisive one.

CONTROLS:

Luminaire control is not especially important in this space, however controls would be necessary if different settings for public visitation during the day versus more private events in the evening were to be developed.

- EVALUATION -

The lighting in the lobby space succeeds in creating a visually interesting space. The gradient of light that exists on several of the perimeter surfaces really helps to draw the attention of the viewer upward. The use of backlit panels seems to be a trend in this space and I argue that too much accent lighting on all surfaces of the space can be visually cluttering at times. The gradient of light on the acrylic surface above the columns almost seems to break up the space and make the lobby feel smaller than it is, while the architectural notion of the space was intended to be vast and everlasting in height. I think improvements can be made to the lighting design to make this space feel more spacious.

The lighting power density of the existing space includes the following value:

$$\text{Lobby : } 4586 \text{ W} / 10040 \text{ sf} = \mathbf{0.45 \text{ W} / sf}$$

Therefore in terms of lighting power density calculations, the lobby values were compliant with the electrical code. These calculations leave room for new design strategies because of the vast size of the space and the limited number of existing fixtures.

OUTDOOR SPACE | BIBLICAL GARDENS



- EXISTING CONDITIONS -

SUMMARY & DIMENSIONS:

The Biblical Gardens are located on the 6th floor and act as a breakaway space from the restaurant and other special event rooms on this floor. A staircase is located on the far side of the space, opposite the restaurant connection. It's openness allows for natural ventilation of the kitchen and restaurant spaces as well as a great view of D.C. The steel structure that encloses the outside territory is simply there to maintain the visual consistency of the exterior façade and act as a barrier for safety purposes. Greenery and ivy are expected to grow along this steel structure, as well as on the surrounding walls of the space to offer a natural, relaxing outdoor setting.

Square Footage: **3,052 sf**

Approximate Width: **75 ft.**

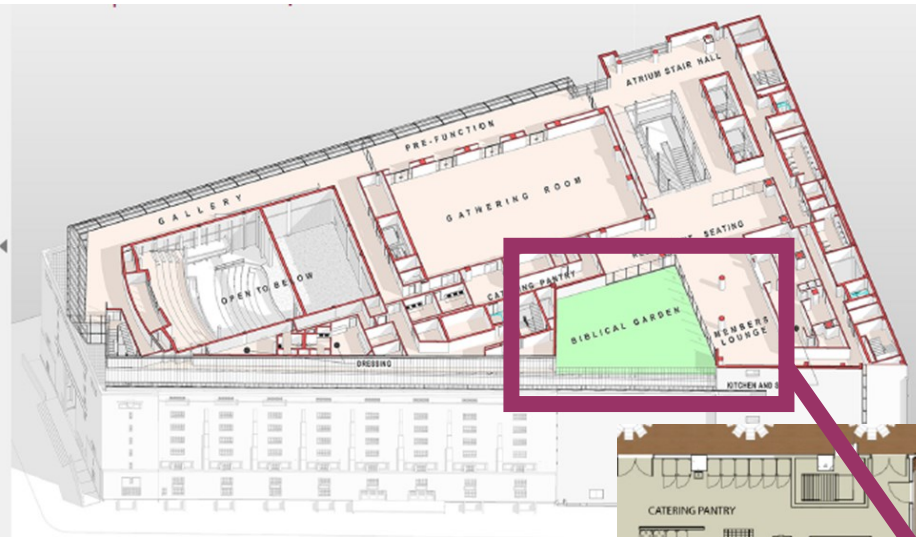
Approximate Length: **55 ft.**

Height: **27 ft.**

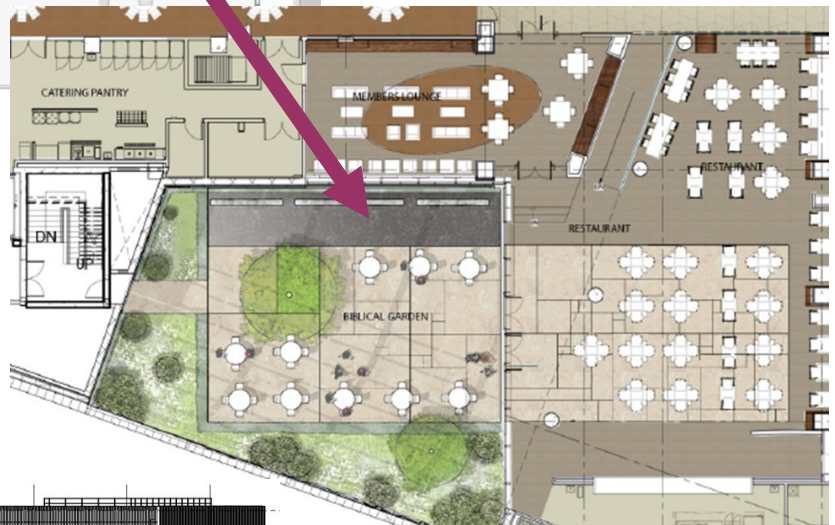
TASKS & ACTIVITIES:

Circulation, eating, reading, study/break out, lounge.

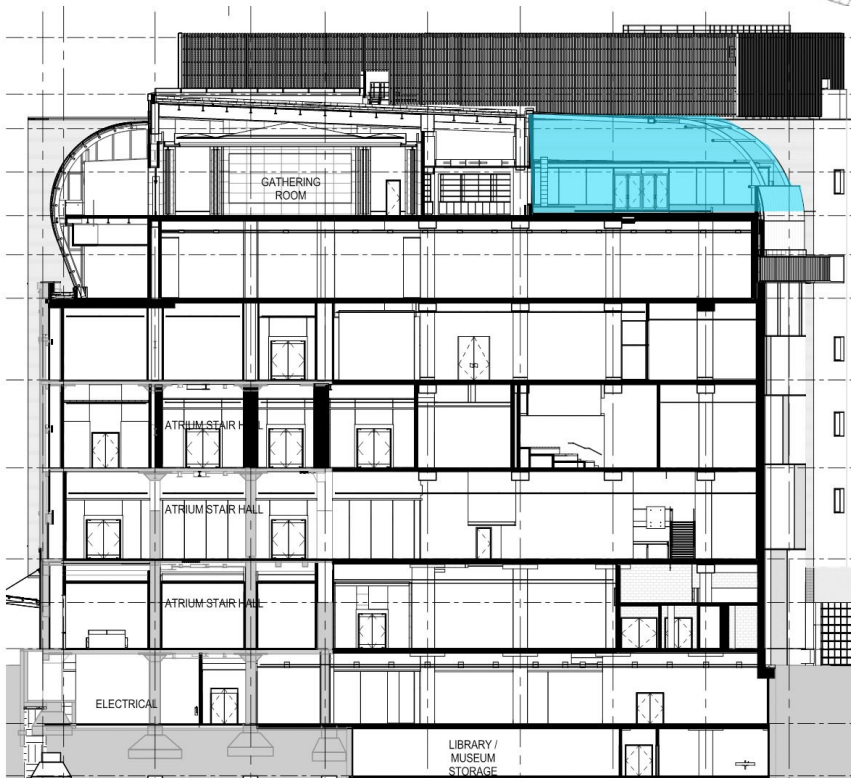
LOCATION & DRAWINGS:



The gardens are located between the restaurant space and a stairwell.

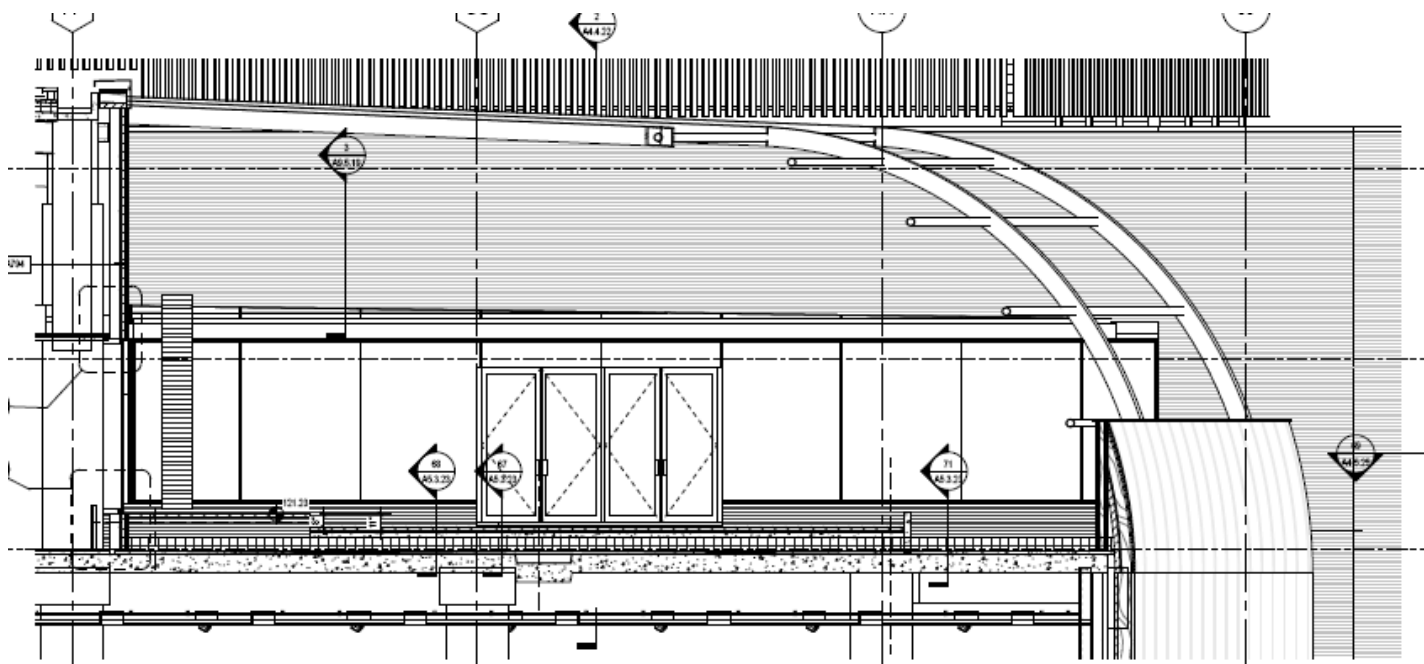


The curved structure on the rooftop is exposed steel.

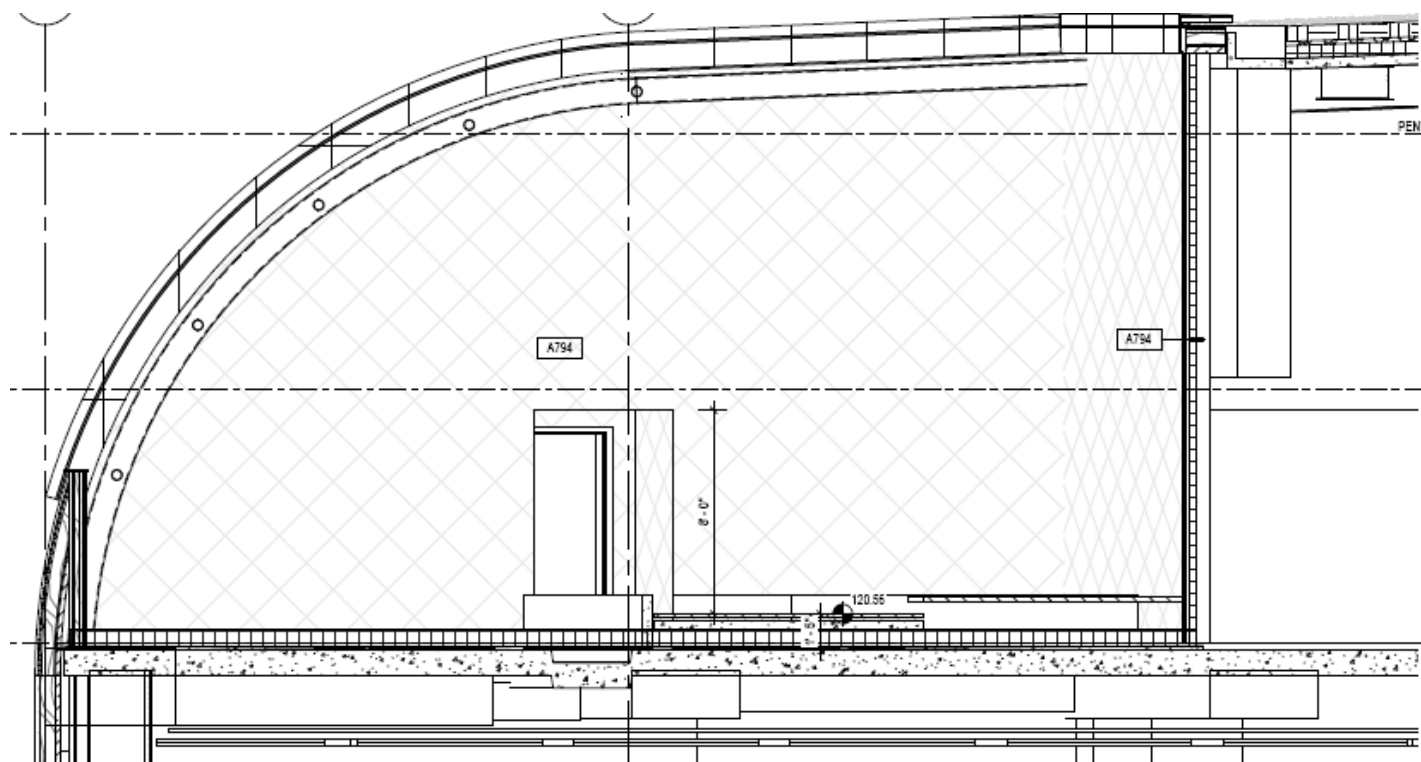


The biblical gardens act as a seating and relaxation space for the public on a rooftop terrace. It's location helps to naturally ventilate the restaurant and kitchen space by offering the opportunity to prop open doors which lead to the gardens. The section (on the left) helps to describe its location in form of the building. Because it is located on the topmost level of the building, nighttime lighting conditions must be taken into account to accommodate the requirements of Washington D.C. building regulations.

SECTIONS & ELEVATIONS:



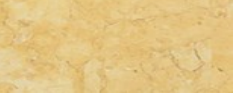

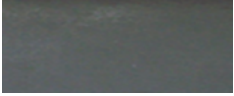
Biblical Garden Section - North / South



Exterior Elevation - Biblical Garden West

MATERIALS:

The Biblical Gardens have a very natural material selection. Most of the walls are covered with green ivy and the floor surface is a simple gold limestone. The space is open to the exterior, surrounded by exposed steel structure that provides safety and support for the rest of the building’s façade.

Material Specifications - Biblical Gardens					
Surface Type	Description	Manufacturer	Color	Image	Reflectance
Floor	Limestone	Stone Source	Jerusalem Stone Gold		0.35
Walls	Ivy	N/A	Green		0.2
Ceiling	Exposed Steel Structure	N/A	N/A		0.18

An additional material in this space which is important to note is the glazing located in the middle of the garden space. This glazing separates the two parts of the space with a unique lighting integrated water feature, therefore is important for the analysis of the space. The following glass type is included here:

1-11/16” nominal insulating glass unit with 1/2” clear fully tempered outer lite with low-e coating, 5/8” argon filled cavity and 9/16” laminated inner lite consisting of two 3/16” clear heat strengthened lites bonded to clear PVB interlayer (as described in specifications) approximate transmittance = 0.9

EXISTING LIGHTING:

The existing lighting in the biblical gardens is minimal and strategically spaced throughout to provide minimal task lighting for the tables and accent lighting for the greenery. The landscaping is the main focus in this space because only low level lighting is required in this exterior sanctuary. All of the fixtures are either surface mounted or ground mounted to accommodate the space’s unique architectural design. A submersible fixture is also integrated into a water feature on the North end of the gardens.

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LIGHTING SCHEDULE:

Lighting Fixture Schedule - Biblical Gardens						
<i>Type</i>	<i>Description</i>	<i>Manufacturer</i>	<i>Mounting</i>	<i>Lamp</i>	<i>Ballast</i>	<i>Voltage</i>
L31	1.5" X 2.75" Submersible Linear LED Fixture With Lockable Rotation	Winona	Surface	LED; 6 W/ft; 332 LM/ft; 4000 K	0-10 V Dimming	277
L39	LED Flood Light With 6 Degree Very Narrow Distribution	WE-EF	Surface	LED; 30W; 2000LM; 4000 K	0-10 V Dimming	277
L41	Landscape Accent Fixture On Mounting Stake and Glare Shield	BK Lighting	Surface	LED; 8W; 250LM; 3000 K	Integral Dimming Driver	277
L41A	Same as Type L41 With Linear Spread Lens	BK Lighting	Ground	LED; 8W; 250LM; 3000 K	N/A	277
L42	4.5" Diameter Floodlight With Pure Anodized Aluminum Reflector	Bega	Surface	LED; 7W; 350LM; 3000 K	N/A	277

EXISTING CONTROLS:

No control systems are currently used in this exterior space apart from LED Dimming.

- DESIGN CRITERIA & CONSIDERATIONS -

The design criteria laid out in the next portion of this report relates to the functionality of the space in terms of quantitative measures as well as the aesthetic appeal related to qualitative measures. These criteria are meant to ensure comfort for the occupants as well as ensure their ability to accomplish tasks related to the spaces. The guidelines for this list of criteria can be found in the Illuminating Engineering Society Lighting Handbook, tenth edition and ASHRE 90.1. Listed below are the specific criteria which were developed for the Biblical Gardens.

ILLUMINANCE & UNIFORMITY REQUIREMENTS :

The values held within the table are important for the design of the space because they suggest that by meeting the quantitative values required for the space, the spaces with function as desired. In some cases, these values are also provided for safety reasons and therefore should not be overlooked. The table suggests both vertical and horizontal illuminance levels for the expected tasks within the space. For those spaces which hold multiple functions, all task criteria should be taken into consideration. The uniformity recommendations are also listed below and are meant to minimize visual distraction and encourage better functionality within a space.

Illuminance Criteria				
<i>Space</i>	<i>Task</i>	<i>E horizontal (lux)</i>	<i>E vertical (lux)</i>	<i>E h (avg) : E h (min)</i>
Biblical Gardens	Transition - Plaza	6	2	5:1

LIGHTING POWER DENSITY:

The lighting power density values listed below were determined using the ASHRAE 90.1 requirements. The numerical allowances relate to watts/square foot and may not be surpassed in order to meet electrical code. Below is the break down of this space's lighting power density considering the space by space method. Some assumptions had to be made regarding building space types when the ones required were not provided.

LPD Criteria		
<i>Space</i>	<i>Description of Space</i>	<i>Allowance (W/sf)</i>
Biblical Gardens	Walkways 10 ft wide or greater Plaza areas (Zone 3)	0.16

MAINTENANCE:

Since this is an exterior space, fixtures must be IP Rated so that they do not fail because of water damage or dirt deterioration. Mounting height is not an issue with this space making most fixture placements easily accessible.

GLARE:

Glare is not an overriding issue here, given that the illuminance criteria call for low level illumination. Most fixtures will be surface or pole mounted and minimize uplight for the purpose of eliminating glare.

CIRCULATION:

Circulation in the biblical gardens is pretty straight forward. Access to the gardens come from the restaurant area and the stairwell, respectively. There needs to be high enough levels to lead people safely through the pathways without creating too much illumination and disturbing the exterior environment.

PSYCHOLOGICAL IMPRESSION:

Since this space is located on the top most level and is designed to have low illumination, it will be influenced by the Flynn Impressions denoting privacy and relaxation.

CONTROLS:

Luminaire control is not especially important in this space, however luminaires should all have 0-10V dimming capabilities.

- EVALUATION -

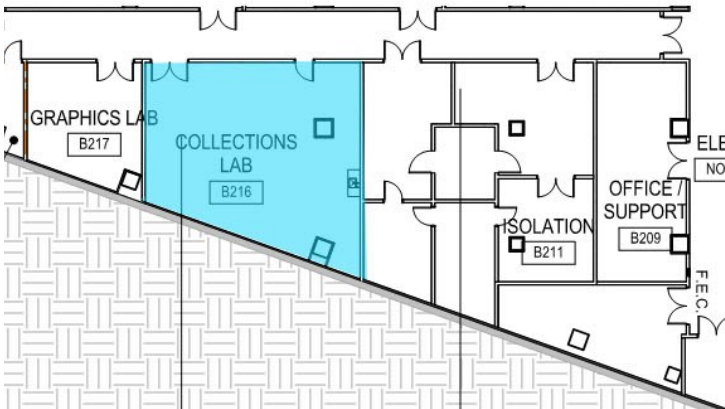
The lighting in the biblical gardens is mainly meant to be low level and accent or highlight the greenery on the patio as well as a unique water feature. The perimeter ground fixtures illuminate the shrubbery around the edges of the space to help it feel relaxed and more private. I think this strategy is well implemented given the limitations of the space however some of the fixtures used were of a very high wattage and therefore fixture selection could improve the overall energy efficiency of the space.

The lighting power density of the existing space includes the following value:

Plaza Area : 588 W / 3052 sf = **0.19 W / sf**

Therefore in terms of lighting power density calculations, the biblical gardens slightly exceeded the allowance they were required to meet for electrical code. This is an area that can be improved within the redesign of the space.

WORK SPACE | COLLECTIONS LAB



- EXISTING CONDITIONS -

SUMMARY & DIMENSIONS:

The collections lab, which is located in the lower level basement, is surrounded by technical support rooms and storage spaces. The room is not excessively finished because of its function for the building, acting as a secure location for artifact retrieval and restoration. Since the room's main purpose is a functional lab, certain criteria will have to be followed to adhere to the protocol for rare artifacts.

Square Footage: **1,019 square feet**

Approximate Width: **35 ft.**

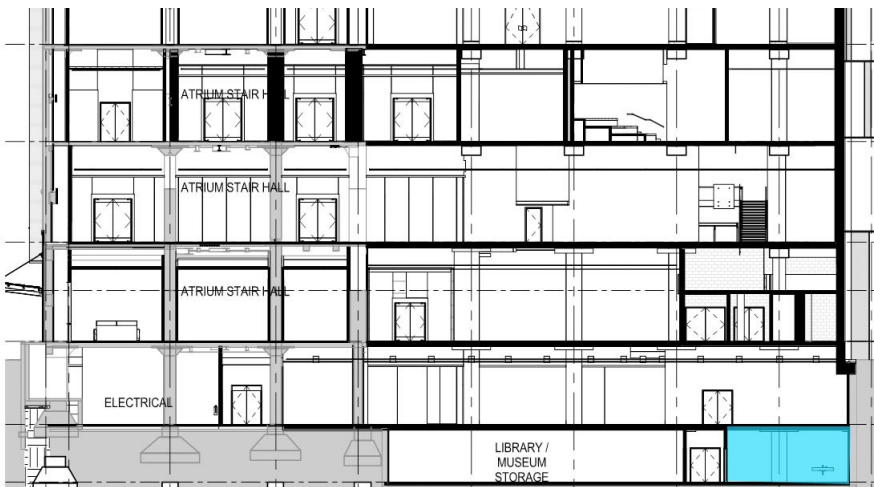
Approximate Length: **30 ft.**

Height: **12 ft.**

TASKS & ACTIVITIES:

Preservation, restoration, researching and documentation.


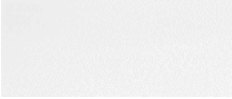

SECTION CUT:



The room is located in the lower of two basement levels below grade.

MATERIALS:

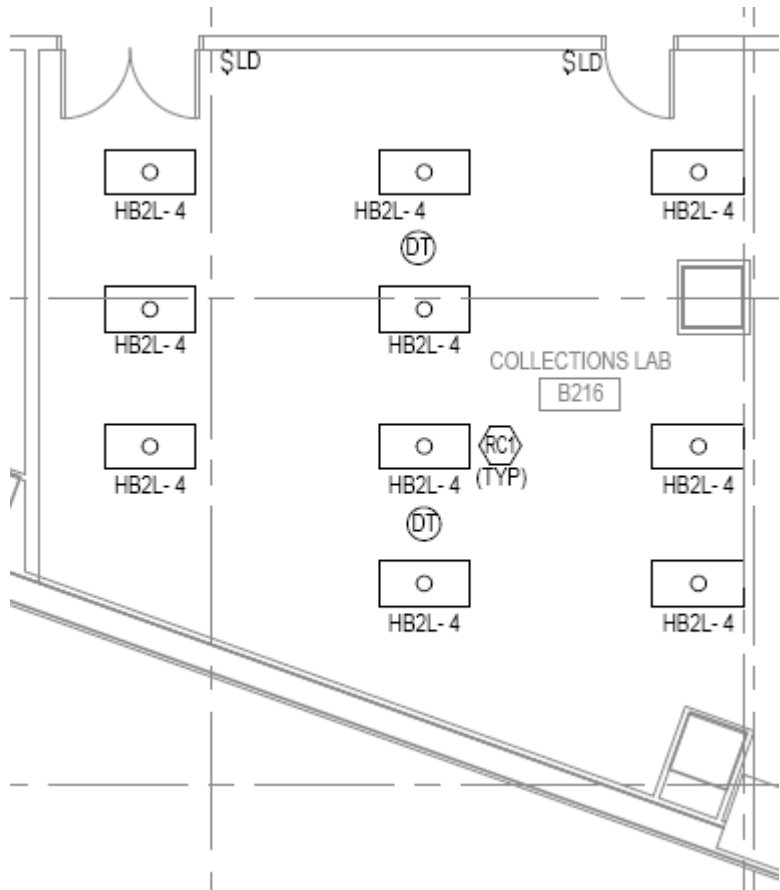
The Collections Lab is a very basic room located in the basement of the museum. The clean white walls and exposed steel structure help to communicate that it is a workplace meant for accuracy and functional use, rather than aesthetic appeal.

Material Specifications - Collections Lab					
Surface Type	Description	Manufacturer	Color	Image	Reflectance
Floor	Vinyl Composite Tile	Shaw Hard Surface	Haze		0.25
Walls	Paint	Benjamin Moore	Chantilly Lace		0.79
Ceiling	Exposed Steel	N/A	N/A		0.18

EXISTING LIGHTING:

The existing lighting in this space is a classic 2’ X 4’ recessed LED fixture layout on an electronic dimming driver. The particular fixture is recessed and provides direct illumination to the space. The spacing of the fixtures is 12’ by 6’ and the wattage of the fixtures is pretty high in comparison to similar LED solutions.

LIGHTING PLAN:



Basement Level 2 Lighting Plan - Collections Lab

LIGHTING SCHEDULE:

Lighting Fixture Schedule - Biblical Gardens						
Type	Description	Manufacturer	Mounting	Lamp	Ballast	Voltage
RC1	2' X 4' Recessed LED Direct Fixture With Micro-Prismatic Lens	Axis	Recessed	LED; 26.65W; 2700LM; 3500 K	Electronic Dimming Driver	277

EXISTING CONTROLS:

This space uses passive infrared / ultrasonic occupancy sensors to control its lighting.

- DESIGN CRITERIA & CONSIDERATIONS -

The design criteria laid out in the next portion of this report relates to the functionality of the space in terms of quantitative measures as well as the aesthetic appeal related to qualitative measures. These criteria are meant to ensure comfort for the occupants as well as ensure their ability to accomplish tasks related to the spaces. The guidelines for this list of criteria can be found in the Illuminating Engineering Society Lighting Handbook, tenth edition and ASHRE 90.1. Listed below are the specific criteria which were developed for the Collections Lab.

ILLUMINANCE & UNIFORMITY REQUIREMENTS :

The values held within the table are important for the design of the space because they suggest that by meeting the quantitative values required for the space, the spaces with function as desired. In some cases, these values are also provided for safety reasons and therefore should not be overlooked. The table suggests both vertical and horizontal illuminance levels for the expected tasks within the space. For those spaces which hold multiple functions, all task criteria should be taken into consideration. The uniformity recommendations are also listed below and are meant to minimize visual distraction and encourage better functionality within a space.

Illuminance Criteria				
<i>Space</i>	<i>Task</i>	<i>E horizontal (lux)</i>	<i>E vertical (lux)</i>	<i>E h (avg) : E h (min)</i>
Collections Lab	Laboratory	500	150	2:1

LIGHTING POWER DENSITY:

The lighting power density values listed below were determined using the ASHRAE 90.1 requirements. The numerical allowances relate to watts/square foot and may not be surpassed in order to meet electrical code. Below is the break down of this space's lighting power density considering the space by space method. Some assumptions had to be made regarding building space types when the ones required were not provided.

LPD Criteria		
<i>Space</i>	<i>Description of Space</i>	<i>Allowance (W/sf)</i>
Collections Lab	Laboratory for Medical/ Industrial/Research	1.81

MAINTENANCE:

Since this space has low ceilings, maintenance is not a primary issue.

GLARE:

Since lab workers will be working with delicate artifacts, the reduction of glare is important to their work. This can easily be achieved with luminaire selection of low glare reflectors.

CONTROLS:

When dealing with ancient artifacts and delicate museum pieces, it is important to minimize exposure to light. Light exposure for extended periods of time can be harmful to the artifact's historical preservation. This can be achieved through use of different occupancy / vacancy sensors.

OTHER CONSIDERATIONS:

Given the importance of the historical artifacts being worked on in this space, fixture selection is especially important regarding the amount of UV light that the luminaire gives off. Ideally, when dealing with such precious artifacts, UV light should never be used in this type of space. Careful selection of product is most important in this scenario.

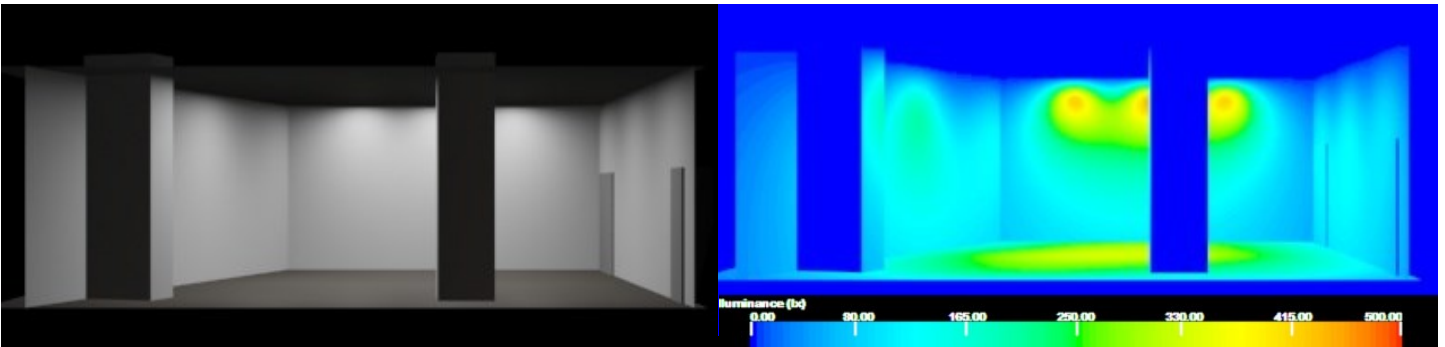
- EVALUATION -

A model of the space was constructed using a computer program called 3DS Max Design and a light loss factor of 0.85 was assumed for this analysis. The lighting in the collections lab was basic and relatively uniform given the restraints of the room and the columns interrupting the lighting layout. In terms of overall illumination, the space was slightly under the recommended values for horizontal surfaces. Since this room's main function requires intricate work on historical artifacts, a recommended furniture layout can be suggested for the central area of the space along with higher output fixtures. Additionally, the layout chosen created some undesired hot spots on the perimeter walls. Uniformity on both the horizontal and vertical surfaces can be improved here.

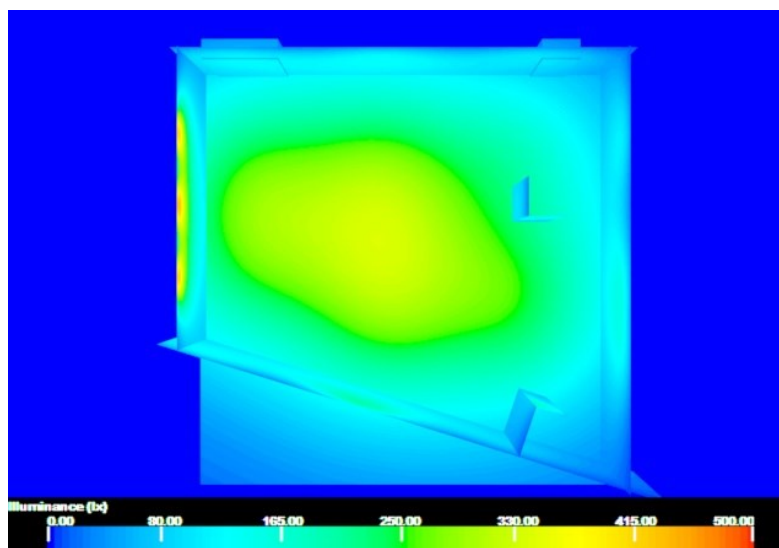
The lighting power density of the existing space includes the following value:

Laboratory : 2665 W / 1019 sf = **2.62 W / sf**

Therefore in terms of lighting power density calculations, the collections lab exceeded the allowance that it was required to meet for electrical code. This is an area that can be improved within the redesign of the space.

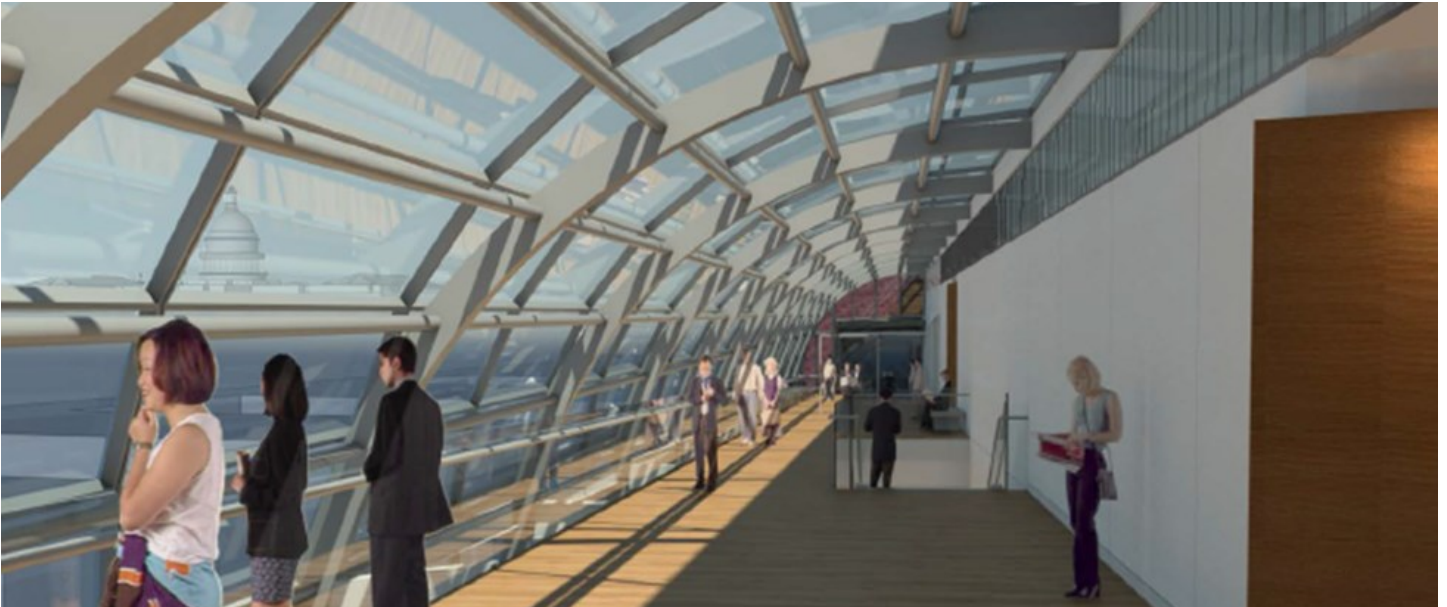


Collections Lab Perspective Rendering and Pseudo Color



Collections Lab Pseudo Color Plan

ADDITIONAL SPACES | THE BOAT



- EXISTING CONDITIONS -

SUMMARY & DIMENSIONS:

The boat is a nickname provided to define the circulation spaces located on both the 5th and 6th floors which are stacked atop one another and run along the length of the building's perimeter. These transition zones provide access to several performing arts spaces and offer visual connection to the outdoors. The orientation of the building allows for ample sun exposure during the daytime condition as well as a great view of the capitol. The corridor's main purpose are to transition occupants around the special events floor in a memorable fashion. **This space will be analyzed in a parametric fashion to determine the best architectural design alterations that can be applied to achieve a multi-objective daylighting solution that integrates illuminance criteria, energy considerations and view for the occupants.**

Space Dimensions: **10,360 total sf. (over 2 floors)**

Approximate Width: **7.5 ft.**

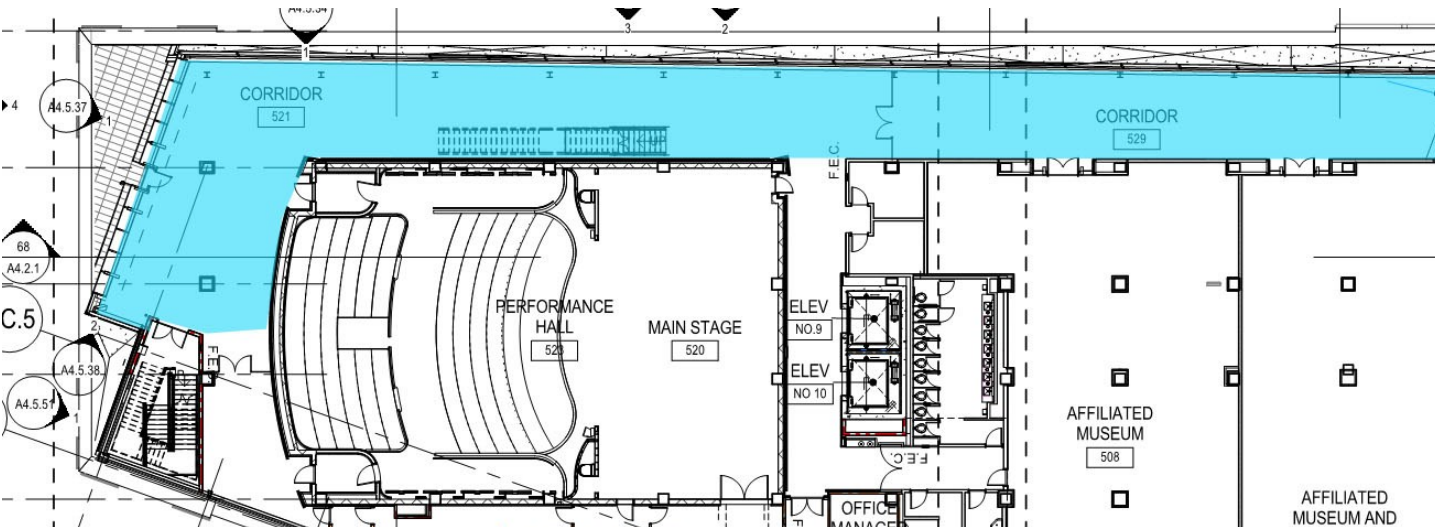
Approximate Length: **130 ft.**

Height: **44 ft. (over two floors)**

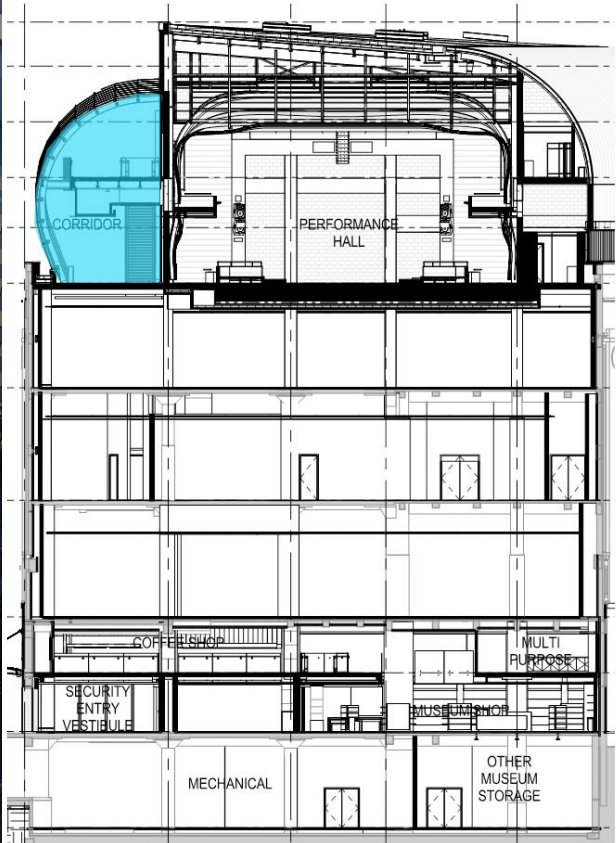
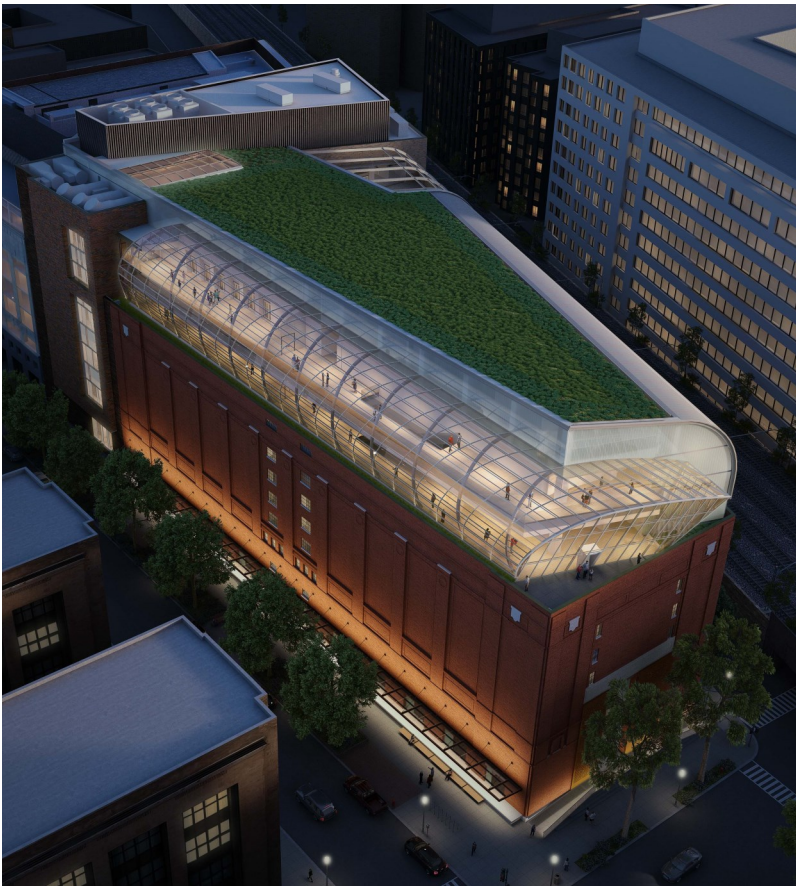
TASKS & ACTIVITIES:

Transition, wayfinding, site - seeing.

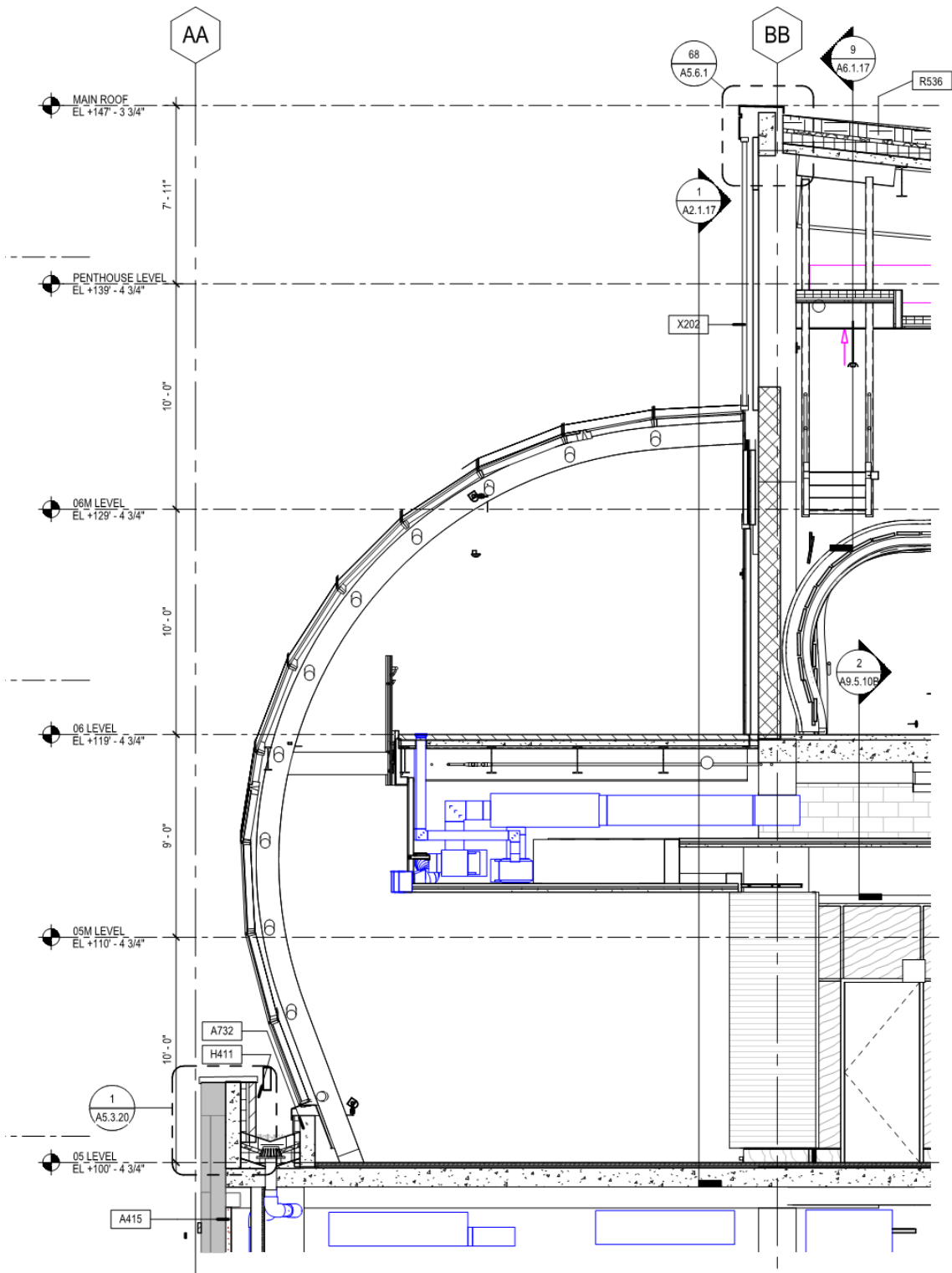
LOCATION & DRAWINGS:



The floor plan on each of the 5th and 6th floors has a simple layout as shown above. These corridors lead to several different museum and performances spaces on the highest point of the structure. This monumental glass façade faces in the North and North-Western direction, toward a great view of central D.C. and the Capitol Building. It's building structure and orientation make it a great daylighting analysis design space.







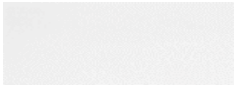
BUILDING SECTION:



North Section of Glass Facade

MATERIALS:

This corridor space, which is surrounded by glass, is made from very natural materials. All of the floor and wall finishes incorporate wood into their design, conceptually connecting individuals to the exterior environment similar to how the glass acts as a viewing portal to the outside.

Material Specifications - Corridor Space					
Surface Type	Description	Manufacturer	Color	Image	Reflectance
Floor	Solid Wood Planks	LV Wood	White Oak Flatsawn Matte		0.32
Walls	Veneer Plaster	Evergreene	Lime-Based Vene-tian Plaster		0.6
	Acoustical Wood Panels	ACGI	Walnut		0.15
	Custom Acoustical Wood Panels	ACGI	Walnut		0.15
Ceiling	Acoustical Plaster	Baswaphon	Chantilly Lace		0.79

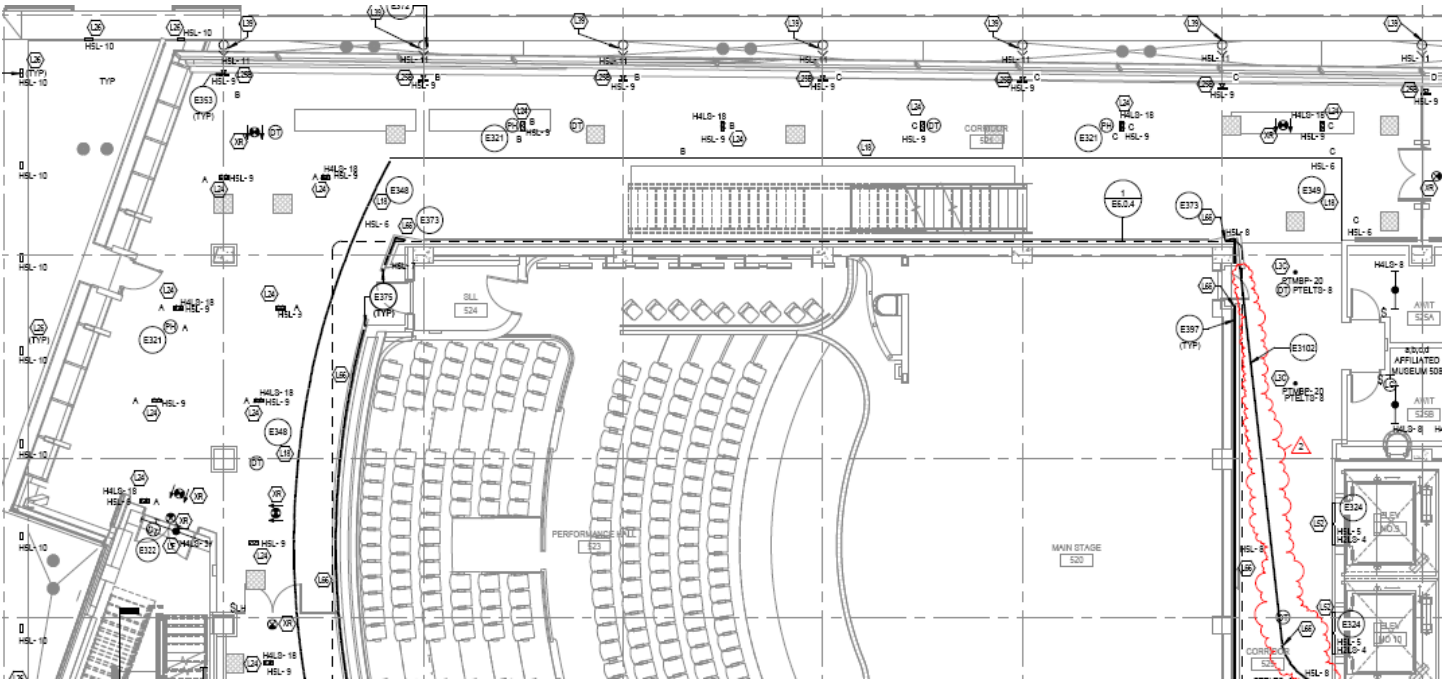
An additional material in this space which is important to note is the exterior glazing along the North and West edges of the corridor space. This glazing spans the entire wall, therefore is important for the analysis of the space. The following glass types are included in the curtain wall design of the structure:

- 1-7/16" nominal insulating glass unit with 3/8" clear fully tempered outer lite with low-e coating, 5/8" argon filled cavity and 7/16" laminated inner lite consisting of two 3/16" clear heat strengthened lites bonded to clear PVB interlayer (as described in specifications) approximate transmittance = 0.9
- 1-7/16" nominal insulating glass unit with 3/8" clear fully tempered outer lite with low-e coating and 20% coverage standard white dot pattern ceramic frit, argon filled cavity and a 7/16" laminated inner lite consisting of two 3/16" clear heat strengthened lites bonded to clear PVB interlayer (as described in specifications) approximate transmittance = 0.72
- Same as type B. with 40% coverage white dot pattern ceramic frit (as described in specifications) approximate transmittance = 0.54
- Same as type B. with 40% coverage white dot pattern ceramic frit (as described in specifications) approximate transmittance = 0.36

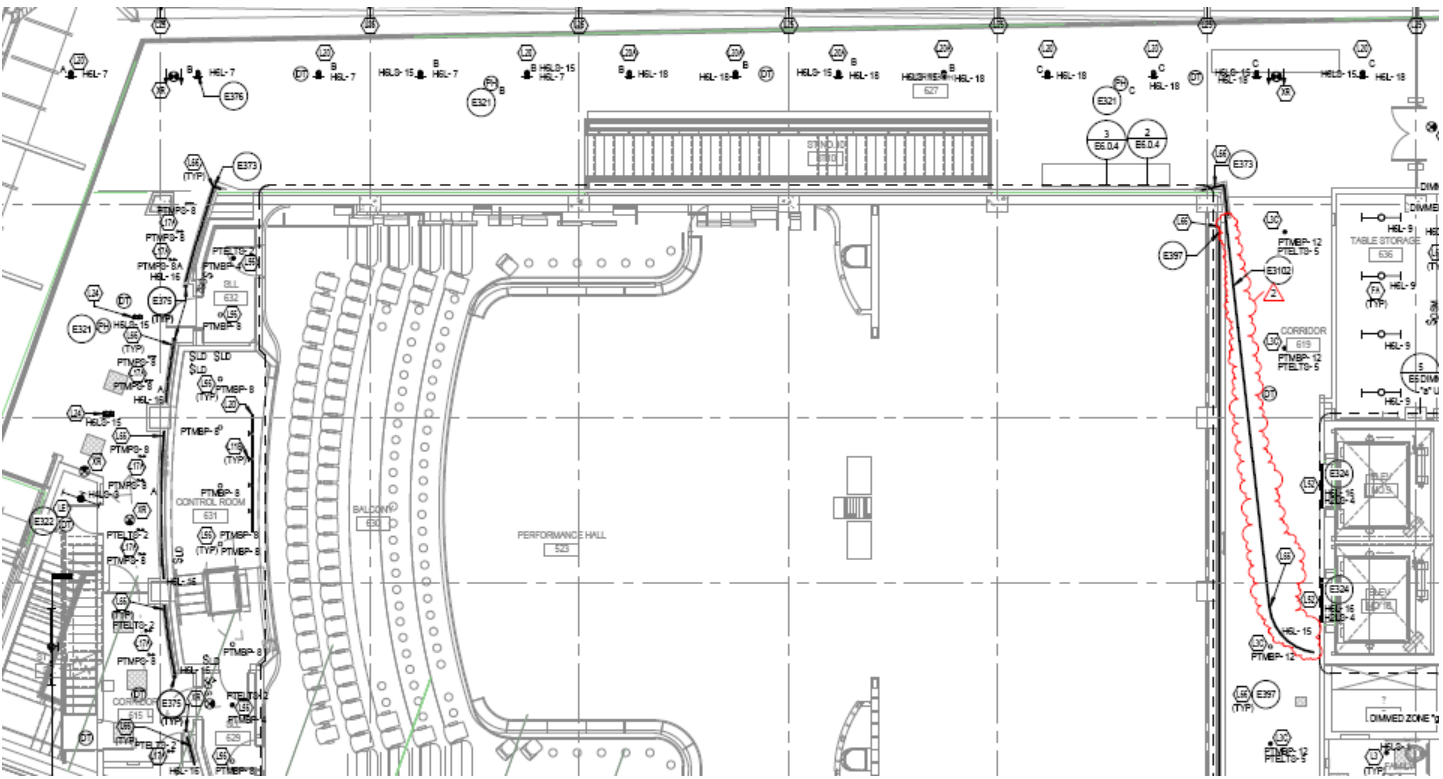
EXISTING LIGHTING:

The lighting in this transition space uses a variety of different fixture types. Surface mounted, recessed and track type fixtures provide both ambient lighting and accent lighting. Transition in this space is important along with uniformity, therefore regular lighting layouts exist throughout the spans of the hallway spaces. Daylighting is also a huge component of the lighting in this space, therefore many of the light fixtures are on control systems to accommodate this. Additionally, cove fixtures accent the curved wall on the West side of the hallway.

LIGHTING PLANS:



Fifth Level Lighting Plan - Corridor



Sixth Level Lighting Plan - Corridor

LIGHTING SCHEDULE:

Lighting Fixture Schedule - Corridor Space						
<i>Type</i>	<i>Description</i>	<i>Manufacturer</i>	<i>Mounting</i>	<i>Lamp</i>	<i>Ballast</i>	<i>Voltage</i>
L17A	3.7" Diameter Lensed Wall Wash Downlight With Trimless Aperture	Lucifer	Recessed	LED; 20W; 1300LM; 3000K	N/A	120
L18	1.5" Cove Fixture With 120 Degree Wide Distribution	Ecosense	Surface	LED; 5 W/ft; 264 LM/ft; 3500 K	0-10 V Dimming	277
L20	2-5/8" Diameter Cylindrical Track Fixture	LSI	Surface	LED; 14W; 1300LM; 3000 K	N/A	277
L20A	Same As L20 Except Spot Distribution	LSI	Surface	LED; 14W; 1300LM; 3000 K	N/A	277
L24	11" X 5" X 6" Trimless Dual-Head Adjustable LED With 25 Degree Beam Distribution	RSA	Recessed	(2) LED; 18W; 1000 LM; 3000 K	0-10 V Dimming	277
L25B	2.5" Diameter X 5" Museum Collection Track Fixture	Litelab	Track	Soraa Vivid 2' LED MR16; 7.5W; 3000K	ELV Dimming	277
L66	1.5" Diameter Linear Cove Fixture With 120 Degree Wide Distribution	Lumenpulse	Surface	LED; 3W/ft; 196 LM/ft; 2700 K	N/A	277
XR	Surface Mounted Edge-Lit LED Exit Sign With White Aluminum Housing	Philips Chloride	Recessed	LED	N/A	277

EXISTING CONTROLS:

This corridor space uses several control systems to eliminate excess energy consumption throughout the day. Some of the sensor systems integrated here include dimming photocells and passive infrared/ultrasonic occupancy sensors. These control systems can be found in both the 5th and 6th floor corridor spaces.

- DESIGN CRITERIA & CONSIDERATIONS -

The design criteria laid out in the next portion of this report relates to the functionality of the space in terms of quantitative measures as well as the aesthetic appeal related to qualitative measures. These criteria are meant to ensure comfort for the occupants as well as ensure their ability to accomplish tasks related to the spaces. The guidelines for this list of criteria can be found in the Illuminating Engineering Society Lighting Handbook, tenth edition and ASHRE 90.1. Listed below are the specific criteria which were developed for The Boat.

ILLUMINANCE & UNIFORMITY REQUIREMENTS :

The values held within the table are important for the design of the space because they suggest that by meeting the quantitative values required for the space, the spaces with function as desired. In some cases, these values are also provided for safety reasons and therefore should not be overlooked. The table suggests both vertical and horizontal illuminance levels for the expected tasks within the space. For those spaces which hold multiple functions, all task criteria should be taken into consideration. The uniformity recommendations are also listed below and are meant to minimize visual distraction and encourage better functionality within a space.

Illuminance Criteria				
<i>Space</i>	<i>Task</i>	<i>E horizontal (lux)</i>	<i>E vertical (lux)</i>	<i>E h (avg) : E h (min)</i>
Corridor	Lobby Circulation Distant From Entries	100	30	4:1

LIGHTING POWER DENSITY:

The lighting power density values listed below were determined using the ASHRAE 90.1 requirements. The numerical allowances relate to watts/square foot and may not be surpassed in order to meet electrical code. Below is the break down of this space's lighting power density considering the space by space method. Some assumptions had to be made regarding building space types when the ones required were not provided.

LPD Criteria		
<i>Space</i>	<i>Description of Space</i>	<i>Allowance (W/sf)</i>
Corridor	Corridor / Transition	0.66

GLARE:

The main cause of glare within this space is daylight. The large glass façade allows for an ample amount of light to enter the corridor, which can be overwhelming for people doing more than just passing through. While the electric lighting is important, my hope is to analyze this space for daylighting.

CONTROLS:

With a large amount of daylight entering the space, sensors should be used within the corridors to eliminate unnecessary electric light during the daytime. This can be done with daylight sensors.

- EVALUATION -

The lighting in this space is simple and serves its purpose to provide ambient light for transition. While a few accent lighting techniques exist, there seems to be a lack in illumination to highlight the curved glass façade during the nighttime environment. One of the more important aspects of this space is the influence of daylight. A further analysis will look into the alteration of this space's architectural form to decrease glare, unnecessary heat, and energy consumption throughout the day.

The lighting power density of the existing space includes the following value:

$$\text{Corridor} : 1158 \text{ W} / 10360 \text{ sf} = \mathbf{0.12 \text{ W} / \text{sf}}$$

Therefore in terms of lighting power density calculations, the corridor space meets the electrical code requirements and there is room for significant alteration in design of the space.

CONCLUSION:

The Museum of the Bible is a exquisite museum that honors both the history and impact of the Bible. The building offers a variety of different functions, encouraging education and inspiring the masses. Originally constructed for the Terminal Refrigerating and Warehousing Company, the new construction of this landmark building includes over 430,000,000 square feet of additions. The exterior aesthetics of MOTB truly honor the historic characteristics of the building, while also communicating its significance through new architectural design elements.

Throughout the course of my thesis design project I will study a select variety of interior and exterior spaces and their existing designs, with the intent of creating new design strategies of my own. The spaces considered for the lighting portion of this project include the performance hall, the lobby, the biblical gardens, and the collections lab. A large transition space labeled as “the boat” will also be considered for additional daylighting analysis. The study of these spaces will integrate analysis of a few other disciplines such as architectural additions and structural or mechanical system redesigns. Select spaces will be designed to accommodate multiple lighting implementations and others will focus on in depth physiological impressions related to the research of John Flynn. The overall goal of this thesis project is to understand the complexities of MOTB and use knowledge of the existing architectural engineering systems to recreate my own design strategies.

REFERENCES:

The following references were used throughout the extent of this report:

All professional renderings and additional information was provided courtesy of SmithGroupJJR.

ASHRAE Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings. 2010th ed. ASHRAE, Print.

DiLaura, David, Kevin Houser, Richard Mistrick, and Gary Steffy. Illuminating Engineering Society The Lighting Handbook. 10th ed. IESNA, Print.