Chandler City Hall

Chandler, Arizona

Technical Report 1: Lighting Existing Conditions and Design Criteria
AE481W: Architectural Engineering Senior Thesis

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Executive Summary

Chandler City Hall is structure comprised of a combination of elements. Exhibiting a theme of respecting the past and acknowledging the future, both the architecture and implemented lighting design complement the space representing the building's concepts a whole.

The following analysis evaluates the lighting design for four separate spaces:

- Open Office Space (Work Space)
- Council Chambers (Special Purpose Space)
- Lobby (Circulation Space)
- Building Façade (Outdoor Space)

The IESNA 9th edition Lighting Handbook and ASHRAE/IESNA 90.1 – 2007 are used to analyze technical requirements of the lighting systems within the building. However, with the desired effect that Chandler City Hall is to implement on the City of Chandler, the lighting design considerations involve several details pertaining to aesthetics, perception and experience of the space.

In terms of technical requirements each of the space performed well either meeting or exceeding the illuminance requirements. ASHRAE/IESNA 90.1-2007 lighting power density requirements were met in all evaluated spaces, not including the Council Chamber, however due to the differing control scenarios and space lighting power density trade-offs; it is assumed that the standards are met.

Overall, the lighting design creates an aesthetic enhancing the predominance of Chandler City Hall. However, the potential still exists for improvement in the design of the lighting for Chandler City in terms of both quantitative and qualitative measures. Combined, these can create an essence for the spaces both aesthetically and psychologically.

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Open Office: A Large Work Space

The open office space is owned by the City Clerk and is occupied predominantly by city employees.

Existing Conditions

Description:

Area: 3750 sq. ft.
Length: 150 ft.
Width: 25 ft.
Ceiling Height: 10ft.

Occupying the south side of the 3rd floor of Chandler City Hall, is an open office space. The building is enclosed by a glass curtain wall façade on the south, and private offices plus other miscellaneous spaces on the north side of this open office space. However, the spaces to the north of the open office space are private offices which have a glass front enclosure allowing all spaces to have a view to the exterior with potential daylight penetration.

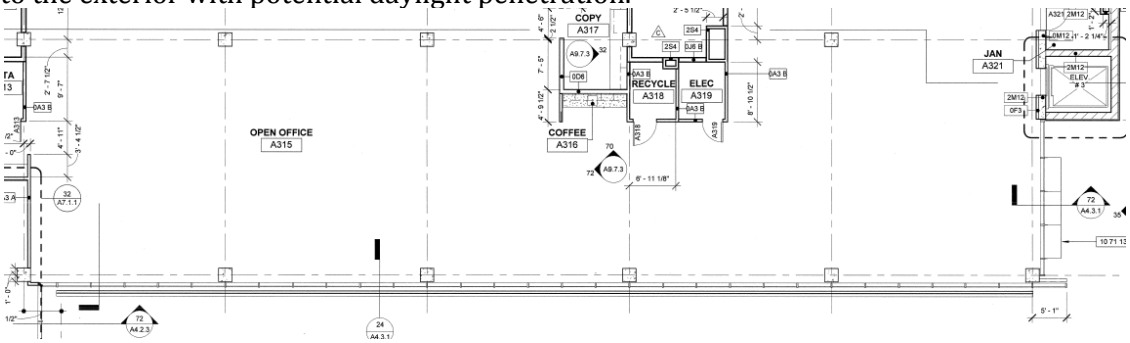

Figure 1: 3rd Floor Open Office Floor Plan

Wall materials are predominantly glass; however, a roller shading system is also used on the south facing glass façade. The carpet in the space is a dark, frisket color lined by a sterling silver colored rubber base. The ceiling is finished with a 2x2 acoustical ceiling tile 10 feet above finished floor.

Open Office Material Finishes

Material	Description	Style/Color	Reflectance
	2x2 ACT; Armstrong Ultima Tegular	White	0.90
CPT-1	Broadloom Carpet	Frisket	0.32
RB-1	Rubber Base	Sterling Silver	0.55
PT-2	Paint	Rockport Gray	0.44

Figure 2.1: 3rd Floor Open Office Material Finishes Table 1

Material	Description	T_S	R_S	A_S	O.F.	S.C.
WT-3	Wall treatment, Roller Shades	16	34	50	3	0.40

Figure 2.2: 3rd Floor Open Office Material Finishes Table 2

Glazing	Description	T_{VIS}	R_{INT}	R_{EXT}	U_W	U_S	SC	SHGC	$R_{L:SG}$
A	Insulating Vision Glass 1"	0.47	0.16	0.32	0.30	0.27	0.35	0.31	1.52
C	Monolithic Spandrel Glass 1/4"	0.14	0.38	0.24	0.8	0.68	0.3	0.25	0.54

Figure 2.3: 3rd Floor Open Office Material Finishes Table 3

Furnishings:

Twenty work stations are arranged throughout the space. Intermixed among workstations are three separate filing storage units topped with a counter-like work surface, providing space for collaboration. An aisle exists to the north of the workstations which will be the main axis of movement throughout the space. Along it is a stopping point at a coffee bar where employees may potentially stop and linger.

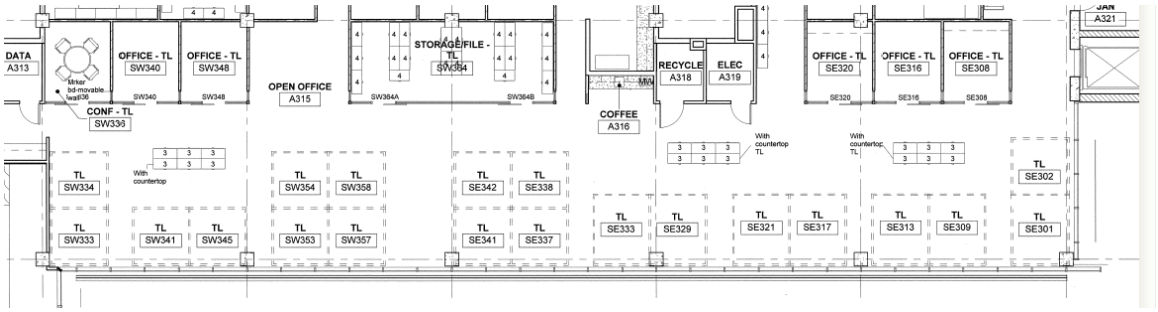

Figure 3: 3rd Floor Open Office Furniture Plan

Tasks:

Desk work involving reading and writing will occur at each of the workstations. Each work station is also equipped with computers which will be used frequently and for extended periods of time throughout the day. The layout is set up for collaboration so conversation and group work is expected to occur frequently. Additionally the north side of the open office space serves as the main axis for movement of people throughout the space.

Existing Lighting:

The 3rd floor open office plan utilizes a task ambient system. Suspended 2 feet from the ceiling, 8' linear fluorescent fixtures exist in continuous runs of 16', spaced15' on center. Refer to the Luminaire Schedule and Lighting Plan below. Both dimming ballasts and occupancy sensors are also provided in the design with the intent to harvest daylight.

Open Office Luminaire Schedule

Type	Description	Ballast	Manufacturer: Series	Voltage	Lamping	Mounting	Notes
P8P	8' pendant mounted semi-indirect linear fluorescent fixture	Universal Electronic Dimming Ballast	LEDALITE: Chopstick	277V	(2) 28 W T5 3500K CCT 82 CRI Min	Pendant	Mount fixture 9'0" A.F.F.

Figure 4: 3rd Floor Open Office Luminaire Schedule

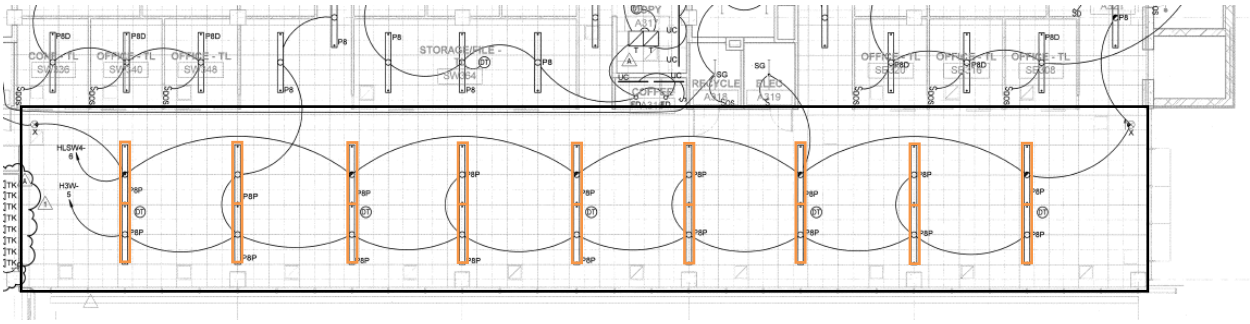

Figure 5: 3rd Floor Open Office Lighting Plan

Design Criteria

Appearance of Space and Luminaires – *Important*
Typically being only accessible by employees, the open office space is not of extreme importance aesthetically. However employees will occupy the space for lengthy periods of time, therefore creating a comfortable environment through careful selections of luminaire and distribution types is an important element of design for this space.

Color Appearance and Color Contrast – *Important*
Contrast is of much importance in an environment as such, because it is essential for performing trouble-free tasks such as VDT usage along with paper tasking including reading and writing. With a south-facing glass façade enclosing the open office space, high color rendering properties and a cooler or higher color temperature closer to that of daylight should be employed , (4100K.) This is important so as to not cause a noticeably contrast between the daylight and electric light being utilized in the space.

Daylighting Integration and Controls – *Important*
The control and integration of a daylighting solution is imperative for the open office space enclosed by a south-facing glass façade. There are many considerations to take into account with a south-facing façade, as direct sunlight becomes a pertinent issue that should be accounted for. Implementation of both shading and dimming controls has the potential to create a comfortable ideal environment for the work space. In addition to controlling the direct sunlight entering the space, glare and thermal comfort can be influenced by the use of a shading system.

Direct Glare – *Very Important*
When VDT usage is frequent as will be in this office space, minimizing glare can add to employee comfort as well as enhance contrast for VDT, reading, and writing tasks. The façade glazing and direct sunlight should be considered controlling glare. Additionally, luminaire selection and placement is optimal when direct views of the lamp are minimized and veiling reflections are avoided.

Flicker – *Important*
In a work space such as this, concentration is important to the tasks at hand. Distractions caused flicker in this space should be minimized as much as possible by utilizing electronic ballasts for the fluorescent and HID source luminaires used in the space.

Light Distribution on Task Plane – *Important*

Light distribution on the high reflectance ceiling and walls will create a diffuse reflected light which can be more suitable for VDT usage. With implementation of an indirect distribution luminaires light distribution on the ceiling will create

Light Distribution on Task Plane – *Important*
Uniformity is important for illuminance levels on the work plane at a height 2'-6". This can be from overhead lighting only or coupled with task lighting for a task-ambient system. Choosing wider distribution and appropriate spacing for luminaires makes this more easily achievable. The aisle to the north of the work stations' task plane is on the floor will serve as the main axis of movement, which yields different considerations than that of the work plane as walking is the main task.

Luminances of Room Surfaces – *Very Important*
Large differences between room surfaces can be undesirable in the workplace. Similar luminance levels between the ceiling, work surfaces, and walls can reduce contrasts. When coupling daylight integration high reflectance values with high illumination levels can reduce the contrast from surfaces and shading devices at the windows.

Modeling of Faces or Objects – *Important*
An open office environment promotes collaboration. Conversions and consults may become frequent in a space like this one shown. Therefore good color rendition of skin tones and ample vertical illuminance would be important for the open office environment.

Reflected Glare – *Very Important*
The unique situation of the glass partitions between the open office space and private offices offers another aspect where control of glare is necessary. Luminaire placement, distribution, and optics should be considered along with the room surface. By doing so, the veiling reflections can be minimized.

Shadows – *Important*
To maintain ample visibility, the lighting design should minimize shadows as much as possible. When shadows exist, it can affect contrast ratios making it more difficult to complete certain tasks because of higher luminance ratios on a surface and between adjacent surfaces. Shadows on the work plane and in the peripheral can be distracting and inhibit view.

Source Task Eye Geometry –*Very Important*
At the work plane source task eye geometry can help to promote better task visibility. Luminaires should not be located in the offending zone which creates the potential for veiling reflections. On the other hand, the proper source task eye geometry can help visual acuity by

Surface Characteristics – *Important*
Matte materials with high reflectance values can be coupled with illuminance to achieve the desired luminance levels and contrast rations from those of lower reflectance. Additionally, the way light reacts with reflective materials such as the glass wall that separate the private offices from the open office as well as the glazing properties of the glass façade should be considered in design.

Special Considerations – *Important*
Lighting should be flexible to accommodate changes in office furniture. With an open office plan there exists potential for a variety change. This could include movement of furniture and yeidl subtle changing of tasks that are to take place in the space.

Horizontal Illuminance – *Important*

Category D: 300lux (or 30fc)

This value would include the combination of ambient and task lighting at the work plane surface. A portion of this level should reach the work plane at a height of 2'-6" from the ambient light. Other considerations should include that from the task lighting to be introduced and the daylight harvesting system.

Vertical Illuminance – *Important*

Category B: 50lux (or 5fc)

The vertical illuminance levels do not to be as high as the horizontal, but it should be sufficient enough for facial recognition and view of other vertical surfaces. The open office plan is set up for collaboration therefore conversation is an important task that will be taking place making vertical illuminance a necessity.

Evaluation and Discussion

Utilizing only the ambient system, an analysis was conducted using AGI32 to evaluate the performance of the open office space on the 3rd floor of Chandler City Hall.

A work plane height of 2'-6" and the following light loss factors were used for the calculations.

Maintenance Category: VI

Clean Environment: Very Clean	
12 month cleaning cycle assumed	LDD = 0.93
Luminaire Distribution: Semi-Indirect	
Percent Expected Dirt Depreciation: 8	
RCR: 1.32	RSDD = 0.929
Initial Lumens: 2900	
Maintained Lumens: 2660	LLD = 0.92
All other LLF's assumed to be 1.0.	Ballast Factor = 1.0
	Total LLF= 0.795

The following results were obtained from the AGI32 analysis of the existing lighting system.

Open Office Existing Conditions Results		
Illuminance	Average	19.59fc
	Maximum	34.9fc
	Minimum	4.7fc
Uniformity	Max/Min Ratio	7.43
	Coefficient of Variation	0.32
	Uniformity Gradient	3.87

Figure 6: 3rd Floor Open Office Calculation Results Table

In terms of energy density the open office space yielded the following:

Total Watts: 1188W
Total Area: 3125 sq.ft.

ASHRAE/IESNA 90.1 2007	
Allowance	1.1 W/ft^2
Actual	0.38 W/ft^2

Figure 7: Open Office ASHRAE 90.1 Table

When viewing only the above results, the system performance appears to be average in terms of light output. On the other hand, it was well under the ASHRAE90.1 Allowances for this type of space. On would assume that this margin leaves room for light power density requirements to be met even with the inclusion of task lighting, once its actual application is determined. Although the average illuminance values appear low compared to the illuminance levels listed by the IESNA there are other considerations for this space. Note that the task component of the task ambient system is not applied here. This would bring the relative illuminance values up to necessary levels at the location of the task at necessary times. This task lighting implementation for occupant control allows the occupant to use the additional lighting components when they feel appropriate. Recall, this open office space has a south facing glass façade in an Arizona climate allowing for daylight penetration and integration into the space.

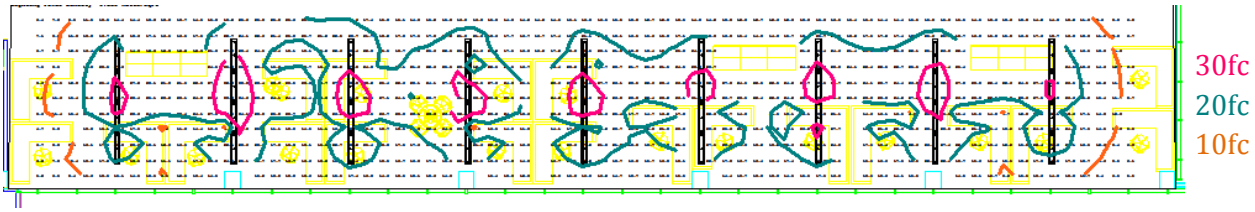

Figure 8: 3rd Floor Open Office Illuminance Contours Plan View

Although not incredibly uniform, somewhat of a pattern is achieved in the illuminance levels due to the shadows created by the 4' high partitions. When viewing the space in a render view it would appear visually uniform across particular objects and surface. The issues arise at the east and west sides of the open office plan. In both the Contours plan above and the Rendered plan below it becomes apparent sufficient light levels are not reaching these areas. Although task lighting is intended for use, the ambient levels should be higher in these areas. No matter how much light reaches this space, comparatively it will appear dark relative to well-lit areas of the open office space.

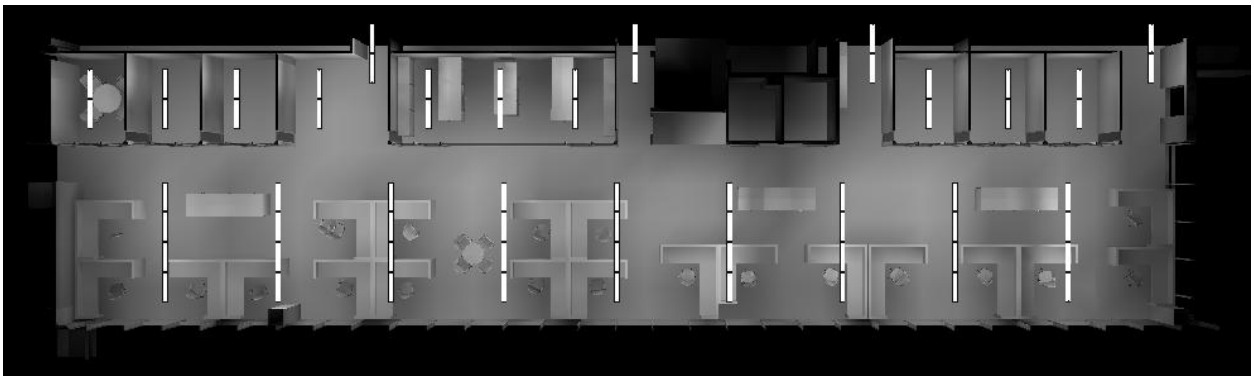

Figure 9: 3rd Floor Open Office Rendered Plan View

A view from the exterior is another important quality where the space should strive for a great design. Because the façade is predominantly glass, the appearance of the inside from an exterior perspective becomes essential. In this area of design, the open office space does very well. A fairly even layer of light is distributed across the ceiling and vertical surfaces. This would help to enhance the view from the exterior when this space is occupied at night.

Figure 10: 3rd Floor Open Office Rendered Exterior View

Below is a perspective view of the space as if entering from the east elevator lobby.

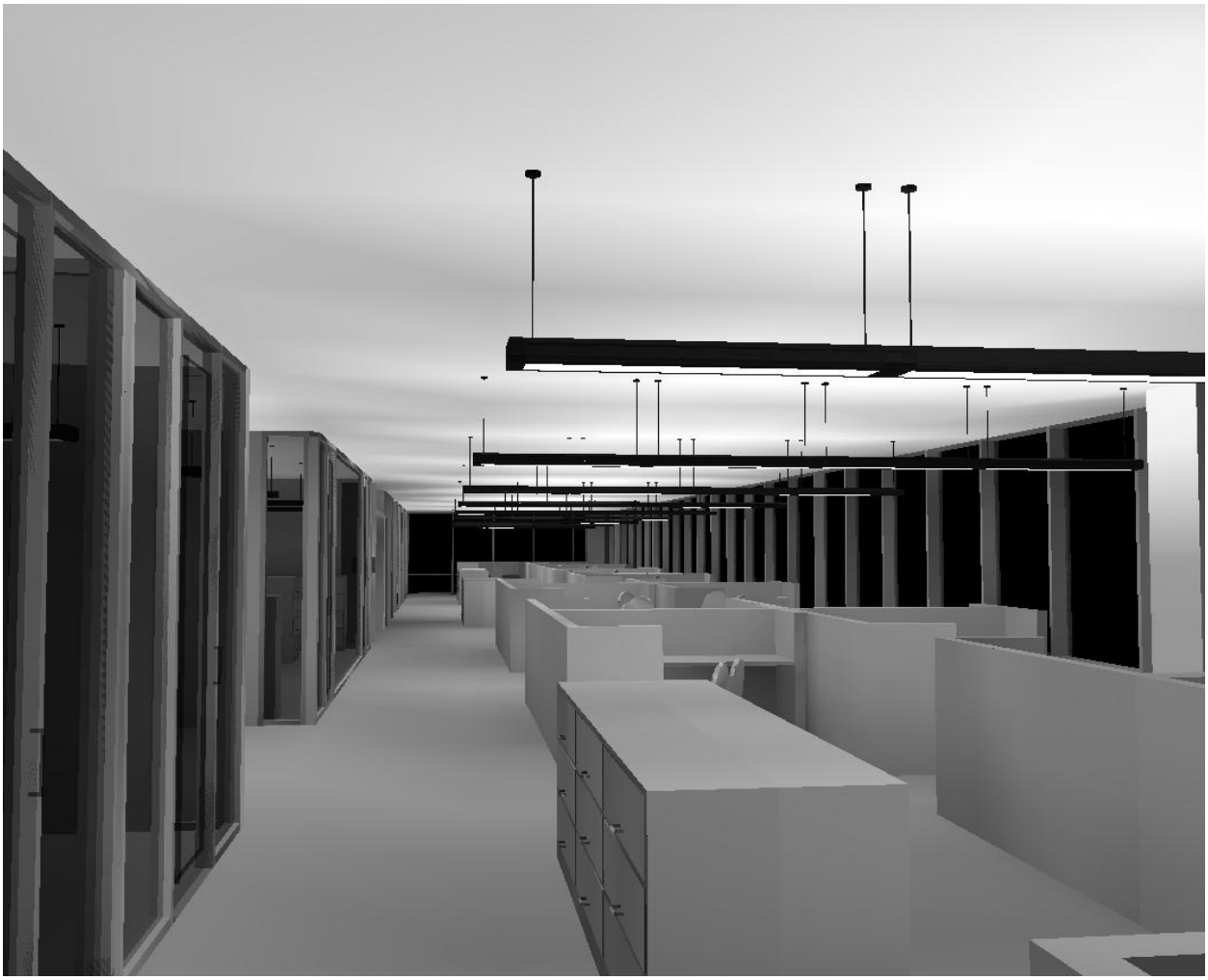

Figure 11: 3rd Floor Open Office Rendered Perspective View

Although the lighting design for the space provides adequate levels based off of the implementation of a task ambient system, the design has room for improvements. The space achieves an acceptable visual quality in which workers would likely accept. Reducing shadows from partitions, as a well as minimizing distracting luminance ratios could be achieved with an altered design.

Council Chambers: A Special Purpose Space

The Council Chambers is a uniquely shaped auditorium space with intended use for council meetings, presentations, academic lectures, and other social venues.

Existing Conditions:

Description:
The Council Chambers exists in the shape of trapezoid with round corners of specified radii. From the Council lobby, people enter the auditorium through a small cove space that serves as a sound lock to reduce sound transmittance into and from the Council Chambers.

Dimensions:
Area= 5187 sq. ft.
Length= 76 ft
Max Width= 80 feet
Minimum Width=46 feet
Floor Slope= 4.7 % (yielding a 1'-4" drop in elevation, back to front)
Ceiling Height= Varies

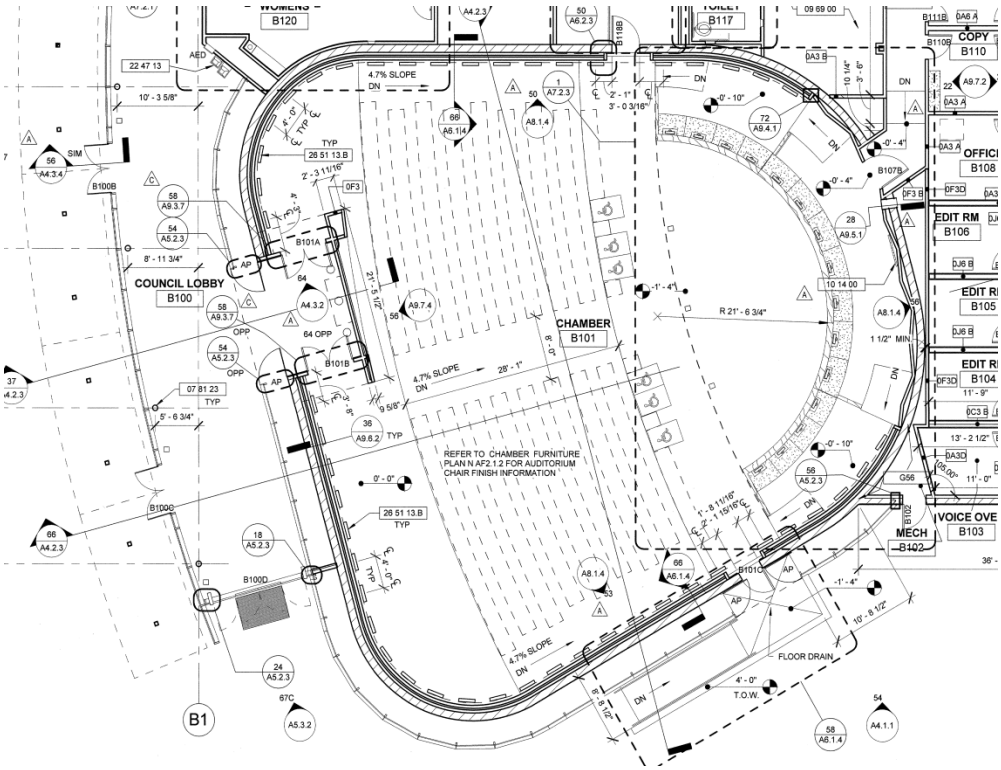

Figure 11: Council Chamber Floor Plan

The floor of the Council chambers is of red carpeting with a wooden base. Surrounding the auditorium space, wooden veneer sloping walls exist, extending from the finished floor to 8'-0" in elevation. Beyond this height, the walls are made of Tectum, a specialty acoustical material. Beyond the council seating at the front of the space vertical grain wooden veneer lines the wall in

an array of positive and negative panels. Upon entering the space, the ceiling is of 2x2 acoustical ceiling tile 10 feet above the finished floor. However, with the slope of the auditorium floor, the ceiling material and height also changes. This ceiling becomes a wooden a series of 1 ft. x 8 ft. pieces arranged in an array of opposite positive and negatives slopes as can be seen in the section view below. For acoustical reasons it is backed with a fleece covering. There are peaks and valleys alternating amongst the array; the peak of the slopes range from 18'-7" to 19'-4" above finished floor and valleys range from 16'-11" to 17'-8" above finished floor, decreasing in height from back to front of the public seating area. Above the chamber seating and presentation area the ceiling drops providing a vertical wood veneer surface for display opportunities and then increases in height above the council seating to the wood veneer at the front wall of the auditorium.

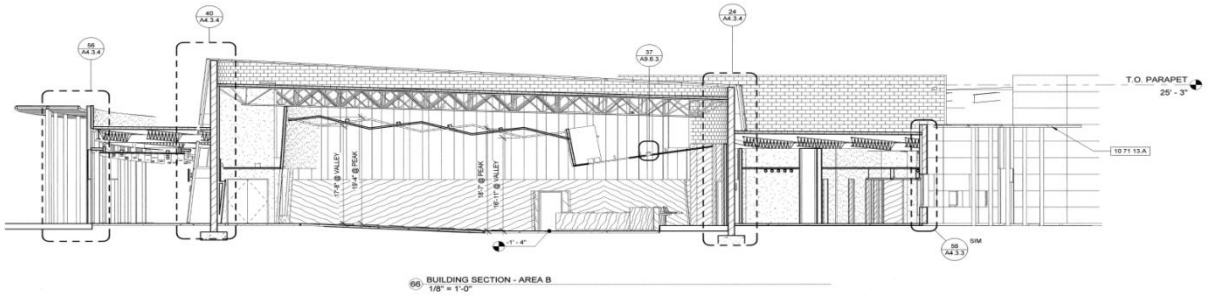

Figure 12: Council Chamber Section North

Council Chamber Material Finishes

Material	Description	Style/Color	Reflectance
CPT-2	Tufted Broadloom Carpet	Kiss;Red	0.25
SPT-2	Specialty wall treatment; Tectum	Natural	0.62
WB-1	Wood Base	To match WV-1	0.56
WV-1	Wood Veneer; Vertical grain	Carmelized, clear finish	0.56
WV-2	Wood Veneer; Vertical grain	Carmelized, stained finish	0.52
	Acoustical Ceiling; Armstrong Woodworks Std. Perf Ceiling;1'x8' panels with fleece backing	Bambo Patina	0.68
	2x2 ACT; Armstrong Ultima Tegular	White	0.90

Figure 13: Council Chamber Finishes Table

Furnishings:
Multiple rows of padded seats are arranged on the sloping floor of the auditorium. There are 250 padded seats in a patterned array of four colors; aurora, clove, coffee and tiger lily. The curved half circle council setting exists at the front of the auditorium space. There are 15 seats with audio visual equipment capability available at each setting for when deemed appropriate for the event. Additionally, a podium and table capable of seating ten resides in the front opening of the space which sits below a vertical face with two VDT screen for use in assembly or presentation events. Refer to the plan and sections views below.

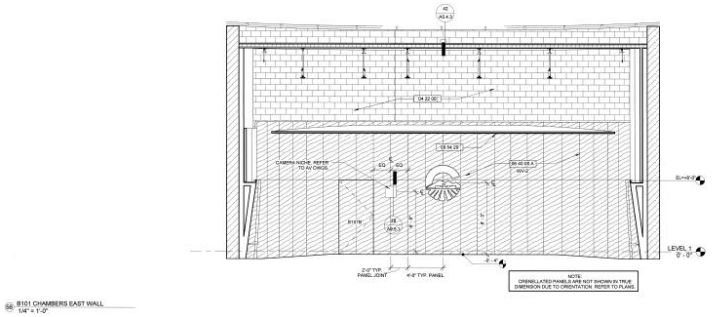

Figure 14: Council Chamber Interior Elevation East (NTS)

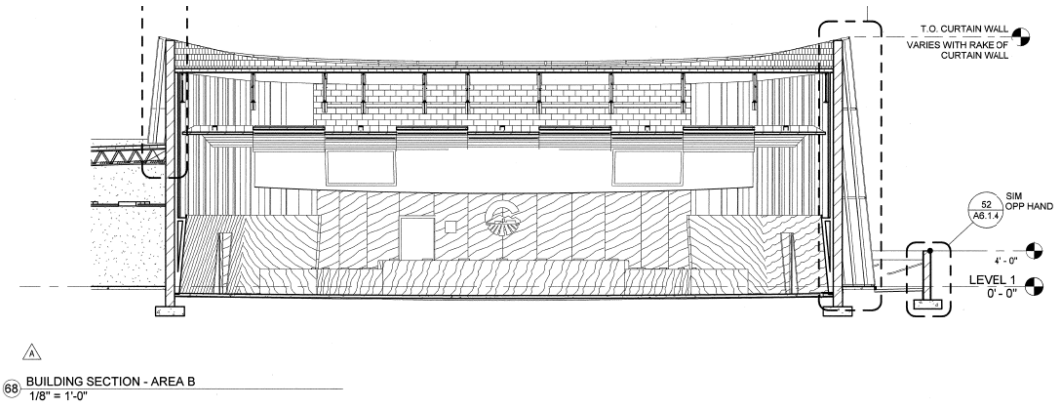

Figure 15: Council Chamber Section West (NTS)

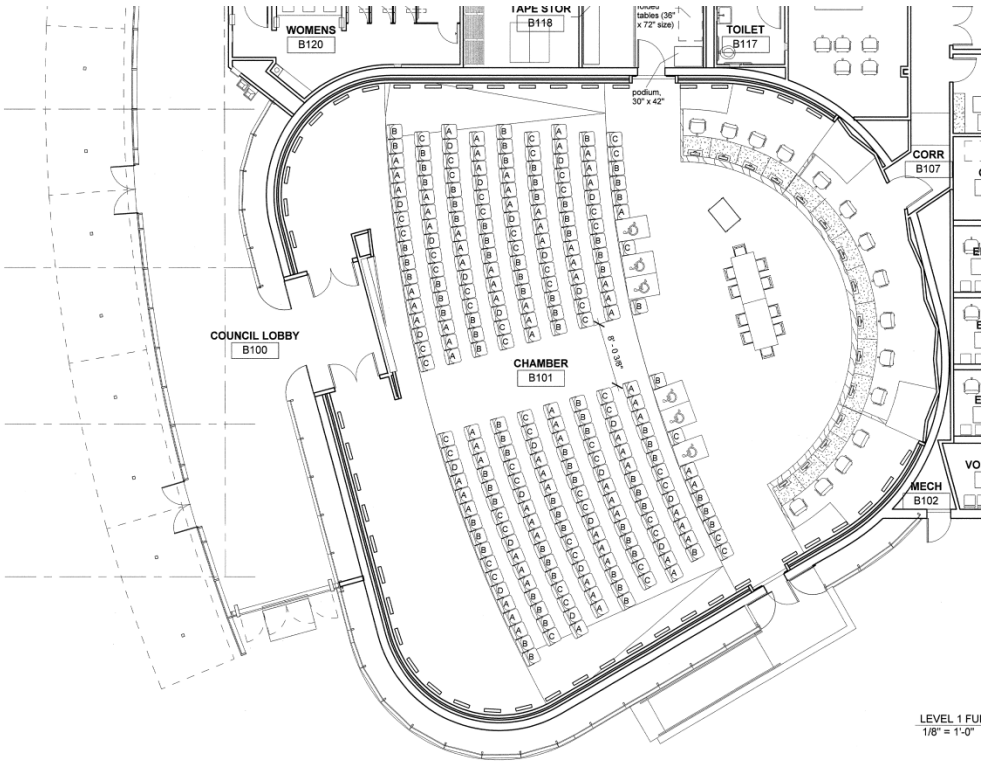

Figure 16: Council Chamber Furniture Plan (NTS)

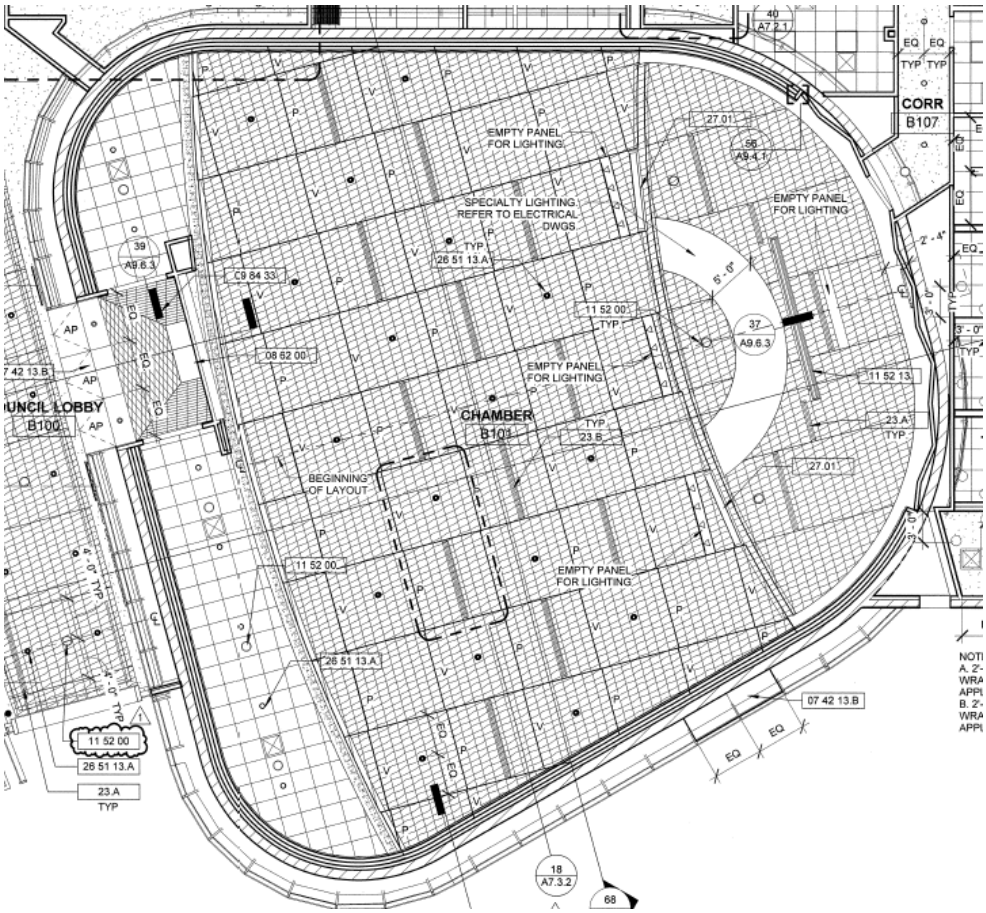

Figure 17: Council Chamber RCP (NTS)

Tasks:
During Council assemblies, the council will incur reading, writing, and potential video conferencing. Discussion is important as well as viewing characteristics from an audience. Other more private presentations will include the task of the presenter presenting at the podium, they may need adequate lighting for reading notes. From the audience perspective, the main objective is viewing the presenter and any display materials.

Existing Lighting:
The current lighting system utilizes several different fixtures. There are down lights that provide some of the general illumination in the space in terms of circulation into and through the auditorium. Additionally there are several other fixtures that are used to provide highlight to the walls and ceiling surfaces within the space giving way to a peripheral focal point. This aims to create an initial impression of the space for its visitors. At the front of the auditorium there exists a plethora of track heads and broadcasting purpose fixtures to provide sufficient levels for Council events that may require video conferencing. Refer to the luminaire schedule and lighting plans below for more details.

Council Chambers Luminaire Schedule							
Type	Description	Ballast	Manufacturer: Series	Voltage	Lamping	Mounting	Notes
ACB	4" adjustable accent light		PRESCOLITE:	120V	(1) 35W MR16	Recessed	
F7	3-3/4" x 5-7/8" profile linear fluorescent assymetric uplight with combination ellipsodial parabolic reflector	Universal Electronic Ballast	ELLIPTIPAR: F306 Series	120V	(1) 54W (or 39W)T5HO 3500K CCT 82 CRI Min	Surface	
F9	25" x 4-5/8" linear fluorescent assymetric ingrade	Universal Electronic Ballast	BEGA: 8642P Series	120V	(1) 24W T5HO 3500K CCT 82 CRI Min	Ingrade	
F10	2' linear fluorescent assymetric cove fixture	Universal Electronic Ballast	FOCAL POINT: Cove 26 Series	120V	(1) 17W T8 3500K CCT 82 CRI Min	Surface	
F14	50" x 11" x 5" fluorescent soft light fixtures for television broadcast studios	Universal Electronic Ballast	KINO FLO: Para Zip 200 Series	120V	(1) 55W TBX 3500K CCT 82 CRI Min	Surface	
F15	Linear flourescent strip fixture	Universal Electronic Ballast	Metalux: SM Series	120V	(1) 54W (39W, 24W)T5HO 3500K CCT 82 CRI Min	Surface	
T2	6" PAR 38 downlight with 5 degree sloped ceiling adapter		EDISON PRICE: DL30/6 Series	120V	(1) 200W PAR38 2900K CCT	Recessed	Mounting height at 14'-7" above Level 1 elevation 0'
T3 T4	PAR track head with monopoint mounting, SP10 distribution		LSI: GR38 Series	120V	(1) 100W PAR38 2900K CCT	Surface	T3 MH 14'-7" T4 MH 13'-3" above Level 1 elevation 0'
T5	PAR track head with single circuit track, NFL25 distribution		LSI: GR38 Series	120V	(1) 100W PAR38 2900K CCT	Track	See drawings for mounting heights.
T6	PAR track head with monopoint mounting, NFL25 distribution		LSI: GR38 Series	120V	(1) 100W PAR38 2900K CCT	Surface	Mounting height at 12'-9" above Level 1 elevation 0'
T7	PAR track head with two circuit track, NFL25 distribution		LSI: GR38 Series	120V	(1) 100W PAR38 2900K CCT	Track	Mounting height at 16'-4" above Level 1 elevation 0'
T7A	PAR track head with two circuit track, FL40 distribution, with diffusing lens		LSI: GR38 Series	120V	(1) 100W PAR38 2900K CCT	Track	Mounting height at 16'-4" above Level 1 elevation 0'

Figure 18: Council Chamber Luminaire Schedule

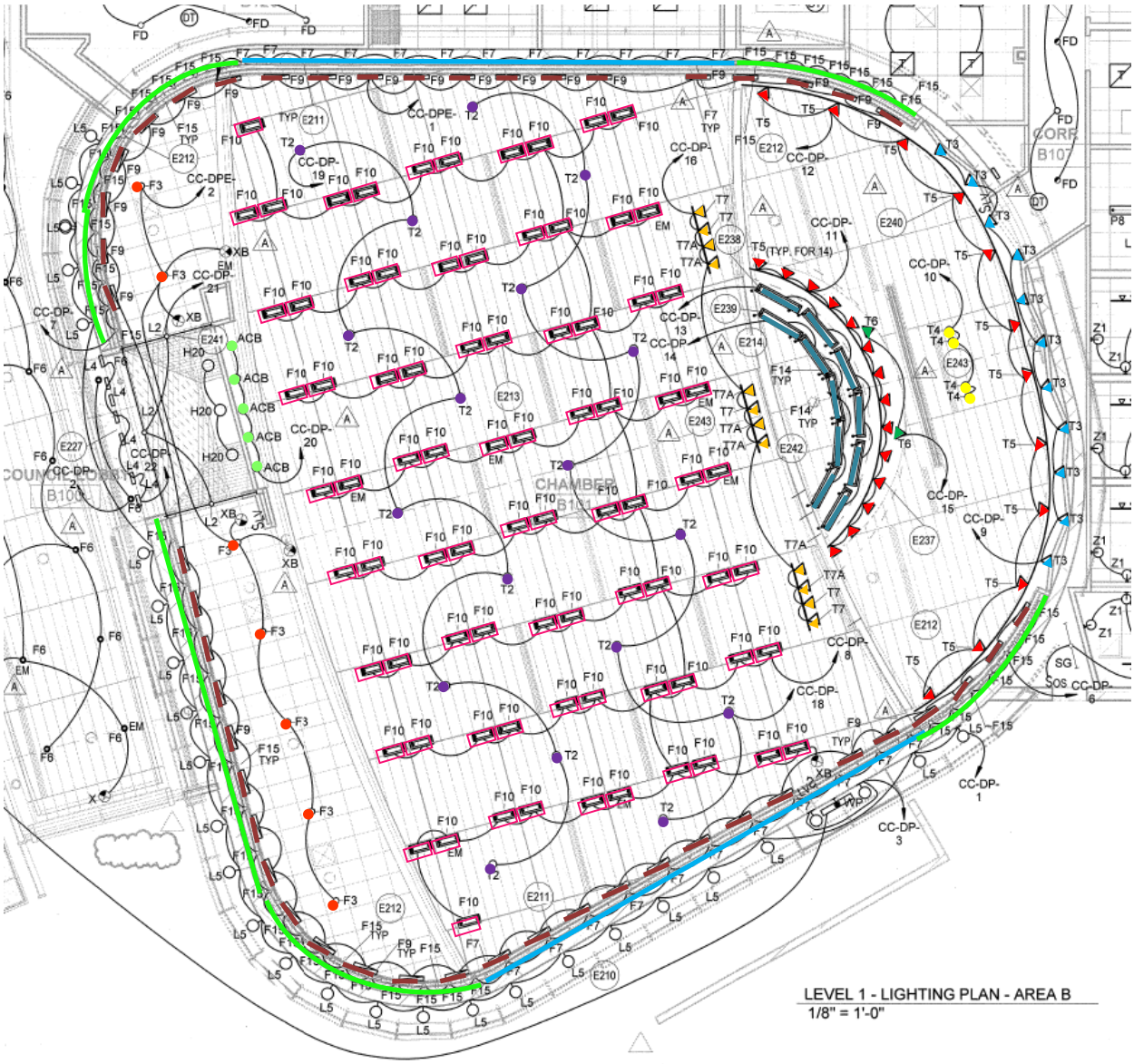

Figure 19: Council Chamber Lighting Plan (NTS)

Design Criteria:

Appearance of Space and Luminaires – Somewhat *Important*

Highly impressionable and frequented by guests and elite city employees, it is important that the Council Chamber present a pleasant appearance. This should be a quality environment, complemented by high class lighting design suitable for the occurring event. The architecture and finishes of this space should be accented by luminaires that seldom exist in the field of view. Those located in direct sight must be of high quality design.

Psychological Impressions – *Important*
Being a prominent feature with unique architecture, the Council Chambers should exhibit a design of the highest quality. The events that will occur in this multifunction space can be categorized as public or private. Lighting considerations can be used to achieve scenarios that match the function. Public events can yield a lighting design with higher more even illumination levels whereas private keeps the focal points in the peripheral, out of the general locale and allows for a hierarchy of light.

Color Appearance and Color Contrast – *Important*

With people being of most importance, color appearance and contrast become essential. The space exhibits the need for good color rendering, with warm color temperature being preferable due to the rich warm tones displayed in the space. Events taking place in the space include but are not limited to presentation, assemblies, and social events. Regardless of the event viewing is one of the most important tasks which adds to the importance of contrast from the audience perspective.

Direct Glare – *Somewhat Important*
In terms of disability glare and discomfort glare, both should be minimized as much as possible. The audience should not be uncomfortable when viewing a presentation. Limit views into luminaires can significantly reduce the glare observed by occupants as well as minimizing the luminance ratios between that of the luminaire and surrounding surfaces. Additionally, although a significant amount of light is needed at the council table for scenarios when video conferencing is in use, the council members should not be put in an unpleasant atmosphere, therefore minimizing veiling reflections from the luminaires becomes imperative.

Flicker – *Somewhat Important*
Distracting and bothersome, flicker in this space should be minimized as much as possible. There is no daylight in this space, and with the only source being electric lighting, it is critical take account for minimizing sources with flicker from luminaires both in the in the direct view and peripheral view of the audience. Flicker can be minimized by choosing quality luminaires and using electronic ballasts for the fluorescent and HID source luminaires used in the space.

Luminances of Room Surfaces – *Somewhat Important*
Although the space does not have any fenestrations to the exterior, a perception of brightness can be achieved when desired based off the luminance of surfaces in the room. When applicable, high reflectance materials can help to achieve the desired luminance levels in the space when coupled with suitable illuminance levels.

Modeling of Faces or Objects – *Somewhat Important (Assembly); Important (Social Activity)*
When council is in session, modeling of faces of the council members is essential. This is potentially one of the most important occurrences that will take place in this environment. Both important discussion and rulings will take place in this space as well as video conferencing. Additionally, when the occasion is more private presentation or lecture the modeling of faces becomes less important over the area as a whole, but more important at the podium and table set up where a speaker would most likely be presenting.

System Control and Flexibility – *Very Important*
Due the mixed use tendencies of this space, system control and flexibility becomes crucial. This flexibility should have the ability to transform the space based on the current event taking place within the space. In addition to having the flexibility to amend the environment, pre-function, and post-function settings should also be easily achievable.

Horizontal Illuminance – *Important (Assembly); Somewhat Important (Social Activity)*
Assembly- Category C: 100lux (or 10fc)
Social Activity- Category B: 50lux (or 5fc)
Video Conferencing- Category E: 500lux (or 50fc)
Horizontal illuminance measures should be taken along all areas that reside in main axes of transportation in the auditorium space and these levels are important for movement through the space. Additionally, the podium where a speaker might present from should have sufficient levels to be able to read notes. The Council Seating at the front should have sufficient light for reading and also video conferencing.

Vertical Illuminance – *Important (Social Activity)*
Category A: 30lux (or 3fc)
Video Conferencing- Category D: 300lux (or 30fc)
Facial recognition is important for both social activities and for the presenter in a presentation or lecture setting. Video conferencing displays an essential need for vertical illuminance. Shadows should be minimal and vertical brightness is important for cameras to pick up detail correctly.

Evaluation and Discussion

AGI32 was used to evaluate the performance of the Chandler City Hall Council Chamber Auditorium.

Compact fluorescent downlighting is used to provide general illumination upon entering the space serving the purpose of ambient light for movement of people as they move into and out of the space. The main task occurring here is walking, therefore, a calculation plane height of 0' and the following light loss factors were used.

Upon entering the auditorium space with an opened area of a higher ceiling height halogen downlighting is used, in combination with cove fixture to accent the ceiling material. In the peripheral along the walls, highlight is provide on the both the sloping wood veneer and acoustical material. This creates a dramatic effect for the space which would be on in the setting of Council meeting and pre-function setting before a presentation or lecture event.

Above the council seating area there are a series of track head fixtures used. These serve the purpose to enhance the illuminance levels at and around where council members will be seated so that they are presented as the focal point during the important meetings. Additionally for the purpose of video conferencing at the dais, broadcasting lighting fixtures have been included in the design.

Fixtures were defined in AGI32 luminaire definitions by their respective .IES files and the following light loss factors were applied to each.

Downlight F3
Maintenance Category: IV
Clean Environment: Very Clean
12 month cleaning cycle assumed LDD = 0.93

Luminaire Distribution: Direct
Percent Expected Dirt Depreciation: 8
RCR: 4.79 RSDD = 0.98
Initial Lumens: 2400
Maintained Lumens: 2040 LLD = 0.85
All other LLF's assumed to be 1.0.
Total LLF= 0.775

Ingrade fixture F9
Maintenance Category: VI
Clean Environment: Very Clean
12 month cleaning cycle assumed LDD = 0.93
Luminaire Distribution: Direct
Percent Expected Dirt Depreciation: 8
Averages used to calculate RCR:
Height: 10ft.
Length: 60ft.
Width: 65ft. RCR=1.60 RSDD = 0.92
Initial Lumens: 2000
Maintained Lumens: 1840 LLD = 0.92
All other LLF's assumed to be 1.0.
Total LLF= 0.787

Uplight fixtures F7, F15
Maintenance Category: VI
Clean Environment: Very Clean
12 month cleaning cycle assumed LDD = 0.93
Luminaire Distribution: Direct
Percent Expected Dirt Depreciation: 8
Averages used to calculate RCR:
Height: 18ft.
Length: 60ft.
Width: 65ft. RCR=2.88 RSDD = 0.92
Initial Lumens: 5000
Maintained Lumens: 4600 LLD = 0.92
All other LLF's assumed to be 1.0.
Total LLF= 0.787

Cove fixtures F10
Maintenance Category: VI
Clean Environment: Very Clean
12 month cleaning cycle assumed LDD = 0.93
Luminaire Distribution: Direct
Percent Expected Dirt Depreciation: 8
RCR=2.88 RSDD = 0.92
Initial Lumens: 1325
Maintained Lumens: 1260 LLD = 0.95
All other LLF's assumed to be 1.0.
Total LLF= 0.812

Broadcasting Fixtures F14

Maintenance Category: IV	
Clean Environment: Very Clean	
12 month cleaning cycle assumed	LDD = 0.93
Luminaire Distribution: Direct	
Percent Expected Dirt Depreciation: 8	
RCR=2.88	RSDD = 0.92
Initial Lumens: 3200	
Maintained Lumens: 2690	LLD = 0.84
All other LLF's assumed to be 1.0.	
	Total LLF= 0.719

Downlight T2

Maintenance Category: IV	
Clean Environment: Very Clean	
12 month cleaning cycle assumed	LDD = 0.93
Luminaire Distribution: Direct	
Percent Expected Dirt Depreciation: 8	
Averages used to calculate RCR:	
RCR=2.88	RSDD = 0.99
Initial Lumens: 1325	
Maintained Lumens: 1260	LLD = 0.95
All other LLF's assumed to be 1.0.	
	Total LLF= 0.875

Track Heads T3, T4, T5, T6, T7

Maintenance Category: IV	
Clean Environment: Very Clean	
12 month cleaning cycle assumed	LDD = 0.93
Luminaire Distribution: Direct	
Percent Expected Dirt Depreciation: 8	
Averages used to calculate RCR:	
RCR=2.88	RSDD = 0.99
Initial Lumens: 1325	
Maintained Lumens: 1260	LLD = 0.95
All other LLF's assumed to be 1.0.	
	Total LLF= 0.875

Track Heads T7A

Maintenance Category: V	
Clean Environment: Very Clean	
12 month cleaning cycle assumed	LDD = 0.93
Luminaire Distribution: Direct	
Percent Expected Dirt Depreciation: 8	
RCR=2.88	RSDD = 0.99
Initial Lumens: 1325	
Maintained Lumens: 1260	LLD = 0.95
All other LLF's assumed to be 1.0.	
	Total LLF= 0.875

Luminaires were placed in the model as their respective .IES file according to the Council Chambers Lighting Plan. Numerical results are listed below, however they are not necessarily true of the existing conditions. This space is intended to be lit via controlled settings. The AGI calculations are analyzed with all luminaires on. This only simulates that the desired light level are possible of being achieved based off of the current layout of fixtures within the space. This includes fixtures whose main purpose is general illumination, others that are purely aesthetic or for one specific setting, and also fixtures exist that serve both purposes.

Council Chambers Existing Conditions Council Desk		
Illuminance	Average	58.3fc
	Maximum	106fc
	Minimum	28.0fc
Uniformity	Max/Min Ratio	3.79
	Coefficient of Variation	0.36
	Uniformity Gradient	1.44
Council Chambers Existing Conditions Circulation		
Illuminance	Average	38.65fc
	Maximum	114fc
	Minimum	18.8fc
Uniformity	Max/Min Ratio	6.05
	Coefficient of Variation	0.34
	Uniformity Gradient	1.56
Council Chambers Existing Conditions Vertical		
Illuminance	Average	33.29fc
	Maximum	68.9fc
	Minimum	20.8fc
Uniformity	Max/Min Ratio	3.30
	Coefficient of Variation	0.33
	Uniformity Gradient	1.57

Figure 20: Council Chamber Illuminance Data Table

*Vertical Illuminance was taken at an overall of 5'-6" from the lowest floor height at the front of the auditorium. This was equivalent to 3'-8"at the Council seating.
*Note: Calculations run with all luminaires on. These numbers only reveal that the desired illuminance levels are achievable; these will not be the same with different setting controls.

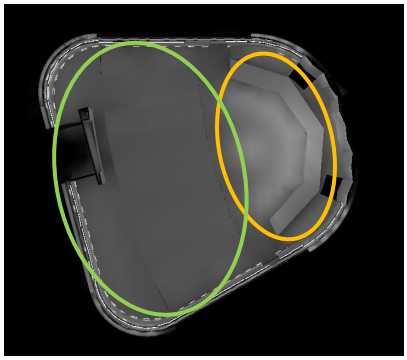

Figure 21: Illustration to Complement Illuminance Data Table

In terms of energy density the open office space yielded the following:

Total Watts: 14585 W
Total Area: 5187 sq.ft.

*Note: In drawings, the council seating area is referred to as the dais, a space used for theatric presentations. Therefore the power allowances were noted as follows.

ASHRAE/IESNA 90.1 2007	
Allowance (Audience/Seating)	0.9 W/ft^2
Allowance (Performing Arts Theater)	2.6 W/ft^2
Actual	2.81 W/ft^2

Figure 22: Lighting Power Density Table

The above data regarding lighting power density is with all luminaires on. This scenario would be unlikely to occur, due to the fact that certain fixtures provide illumination scenarios for different settings or event that will occur within the multi-function auditorium space

The following renderings provide a more detail explanation of the space through visual analysis of where light is being placed.

The plan view rendering shows that the higher light levels in the front of the auditorium can be achieved for Council meetings and conferences. The lights in the front that provide this illumination are adjustable and once determined which function each light will serve, they can then be properly aimed.

These fixtures will have the potential to be dimmed or switched off to make the lighting scenario suitable for the occurring function within the space.

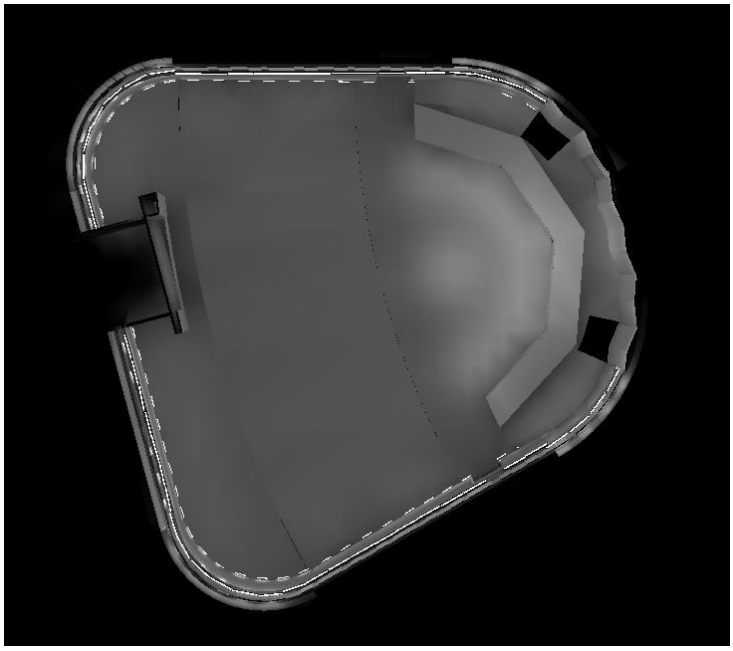

Figure 23: Council Chamber Plan View Rendering

The following images represent an audience perspective of the space the first of which from the front and the following from the back of the auditorium space. The images help to represent the aesthetics the lighting creates for the space.

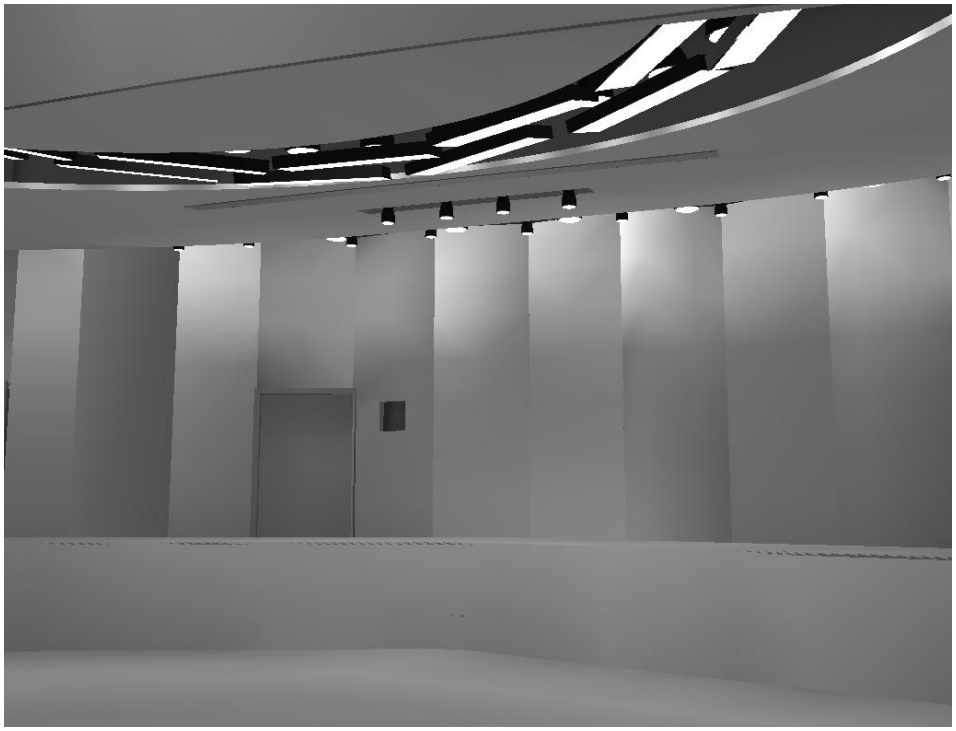

Figure 24: Council Chamber Perspective View at Council Desk Rendering

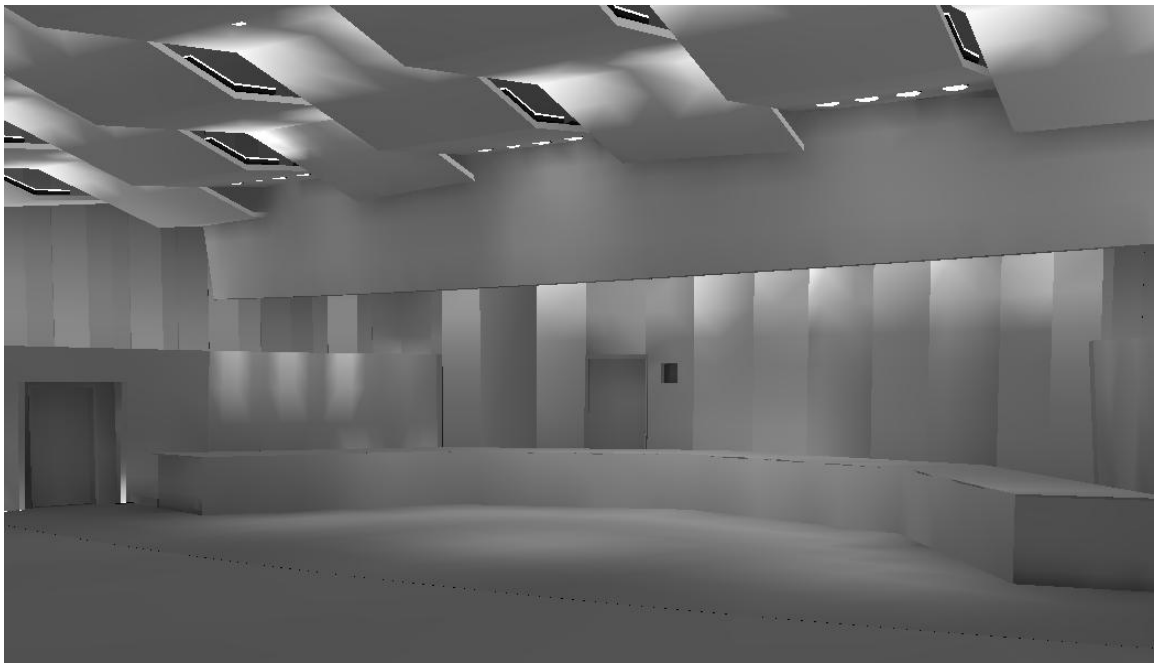

Figure 25: Council Chamber Perspective View From Seating Rendering

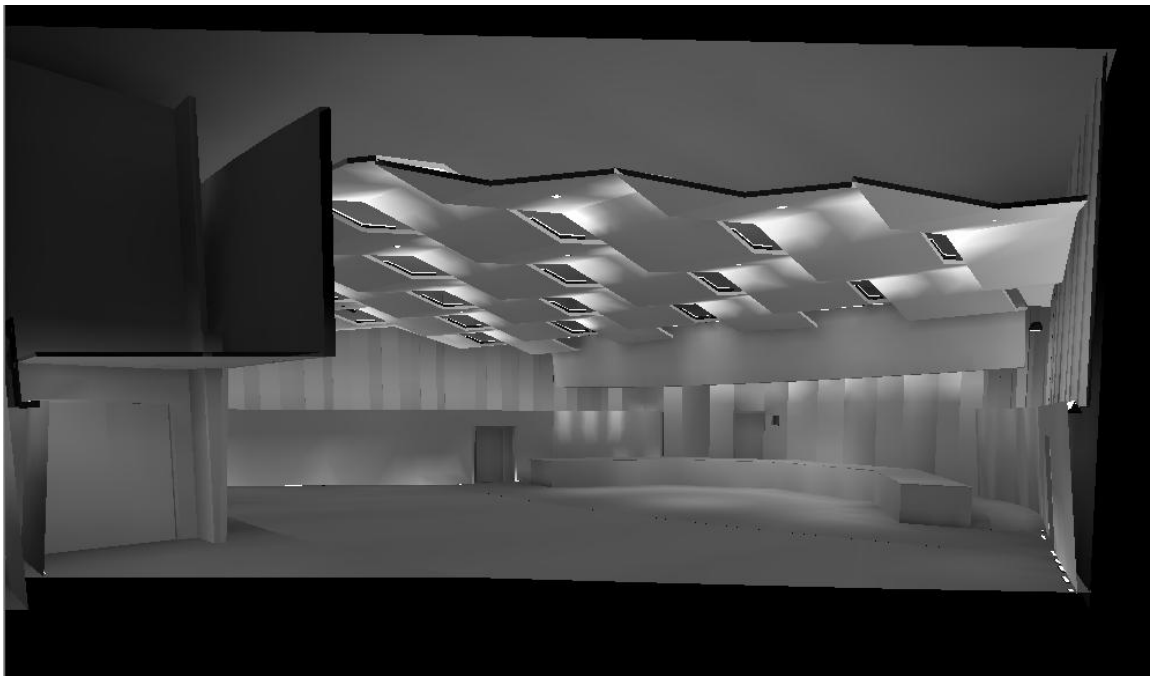

Figure 26: Council Chamber Perspective View Section Cut Rendering

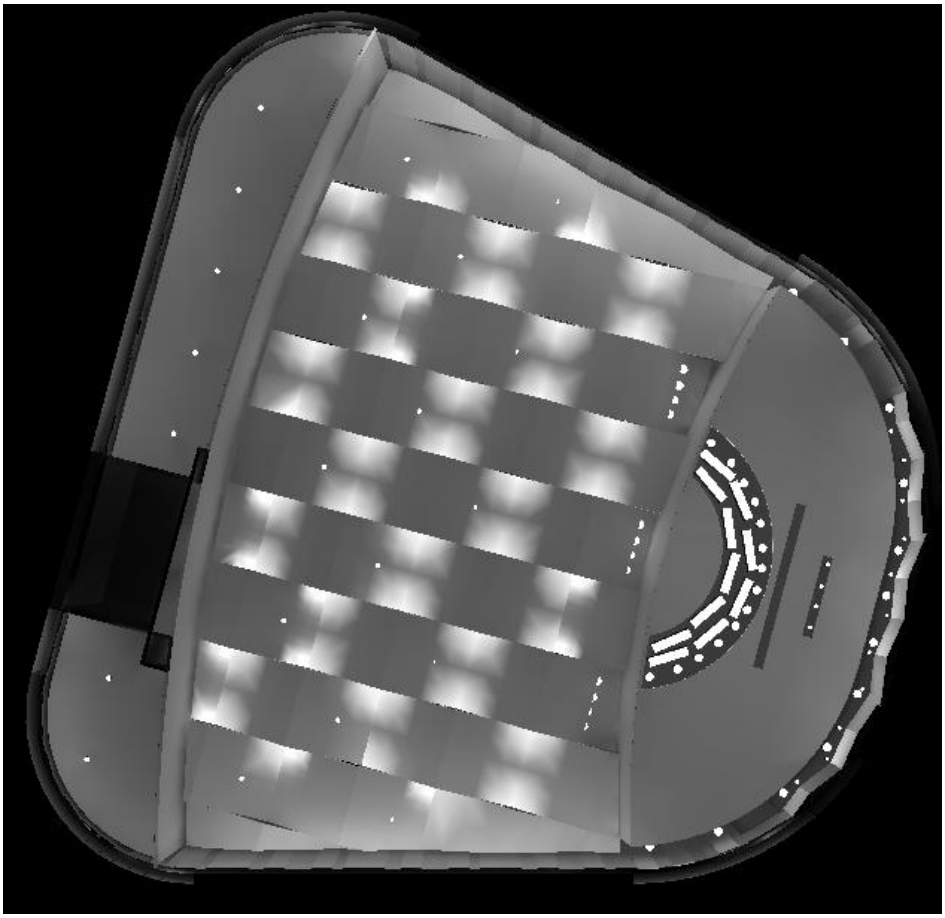

Figure 27: Council Chamber Reflected Ceiling Plan Rendering

All in all, this special purpose space has the potential to perform well in any setting that is desired for the multi-use auditorium space. The track heads and broadcast lighting provide ample lighting that may be desired at the Council desk in terms of both horizontal and vertical illuminance. Vertical Illuminance was taken at an overall of 5'-6" from the lowest floor height at the front of the auditorium. This was equivalent to 3'-8"at the Council seating. This allowed the data to be relevant for either a presenter standing at the front of the space or Council member seated at a chamber meeting.

General illumination was met by downlight fixtures both over the entrance at the back of the auditorium, and over the seating. High levels are not needed, but the low ratios achieved keep the visual tasks from being inhibited.

The spaces psychological impressions yield a lasting on for the visitor. Peripheral light levels at the wall create a dramatic effect that enhances the nature of the space. The lighting also provides a systematic approach to highlight textures and materials. Additionally, by creating a hierarchy of elements within the space different architectural elements are brought to focus.
In general, the auditorium portrays a very high quality lighting design. Room for improvements do exist thought. Although improved through control techniques, in terms of energy standards is a potential for lowering the lighting power density. Certain setting scenarios could utilize the same fixtures as others, with the idea of a fixture to serve a dual purpose, meaning one component for different systems.

Lobby: A Circulation Space

The lobby, intended for circulation is the first area one experiences as they enter the building. It is utilized by both employees and visitors and serves as both a transitional and gathering space which should be impressionable on those who enter and pass through the space.

Existing Conditions

Dimensions:

Area: 2485 sq.ft.
Length: 90 ft.
Width: Varies
Ceiling Height: Varies

The lobby, intended for circulation is the first area one experiences as they enter the building and is utilized by both employees and visitors. Initially the space is 34 feet wide with elevators and stairs to the right and the reception desk forward and to the left. The space then narrows to 19' in width as it extends the 90 length through the building to the exterior plaza.

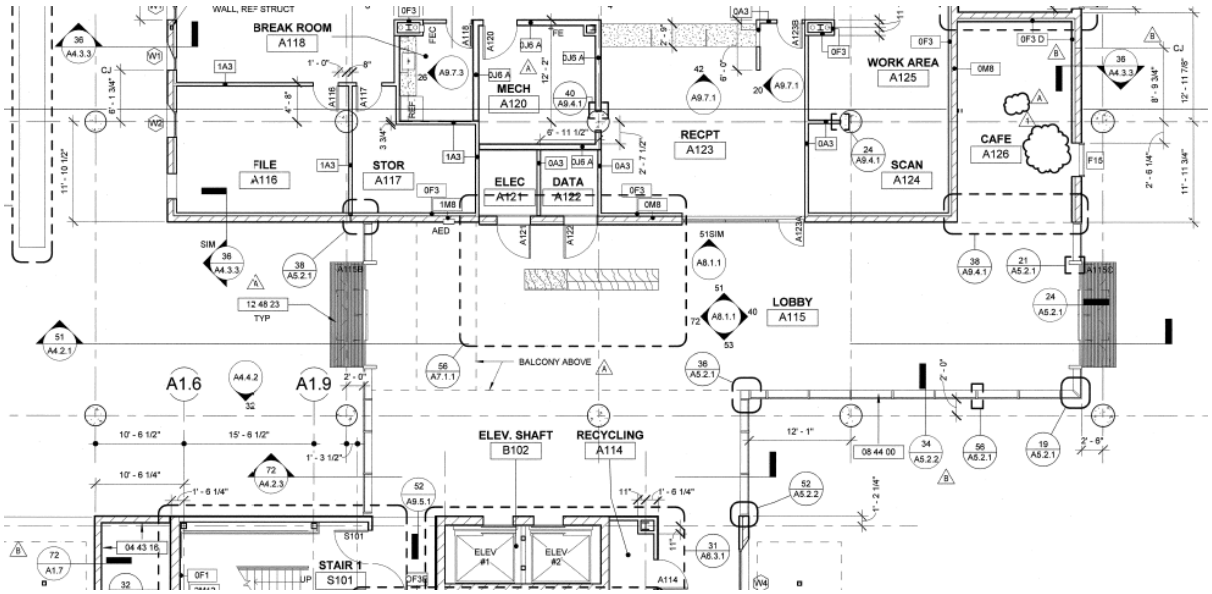

Figure 28: Lobby Floor Plan (NTS)

Lobby Material Finishes

Material	Description	Style/Color	Reflectance
ST-1	Stone Veneer; Quartzite	Golden Gate	0.58
STS-1	Stainless Steel Panel	Stainless Steel	0.28
TRZ-1	Terrazzo (Field)	River Rock; Beige	0.45
TRZ-2	Terrazzo (Accent)	River Rock; Grey	0.30
TRZ-3	Terrazzo (Accent)	River Rock; Red	0.34
WV-2	Wood Veneer; Vertical grain	Carmelized, stained finish	0.52
09 51 00.C	Suspended Drywall Ceiling with wood film	Belbien	0.73
09 72 00.A	Drywall Ceiling with wood film	Belbien	0.73

Figure 29.1: Material Finishes Table

Glazing	Description	T_{VIS}	R_{INT}	R_{EXT}	U_W	U_S	SC	SHGC	$R_{L:SG}$
D	Insulating Vision Glass 1"	0.7	0.12	0.11	0.29	0.26	0.44	0.38	1.84
D_T	Insulating Tempered Glass 1"	0.7	0.12	0.11	0.29	0.26	0.44	0.38	1.84

Figure 29.2: Material Finishes Table

As for the wall materials, the entrance is glass, the walls behind the reception desk are of a wood veneer, stone veneer, and glass, stone veneer exists at the elevator lobby, and again glass to allow view out onto the exterior plaza. Refer to the Interior Elevations of the lobby which are shown below.

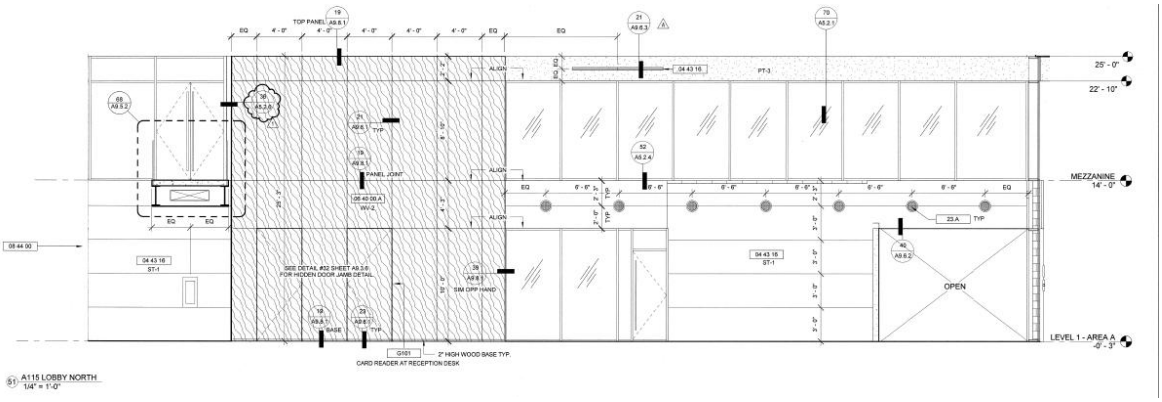

Figure 30: Lobby Interior Elevation North (NTS)

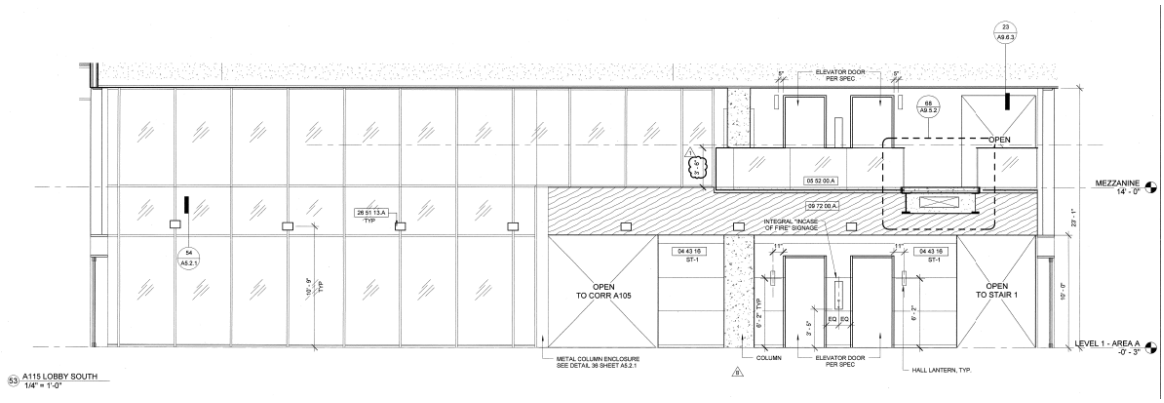

Figure 31: Lobby Interior Elevation South (NTS)

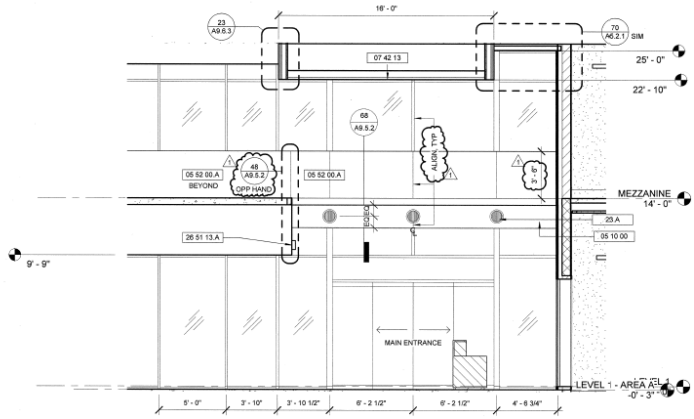

Figure 32: Lobby Interior Elevation West (NTS) – Main Entrance

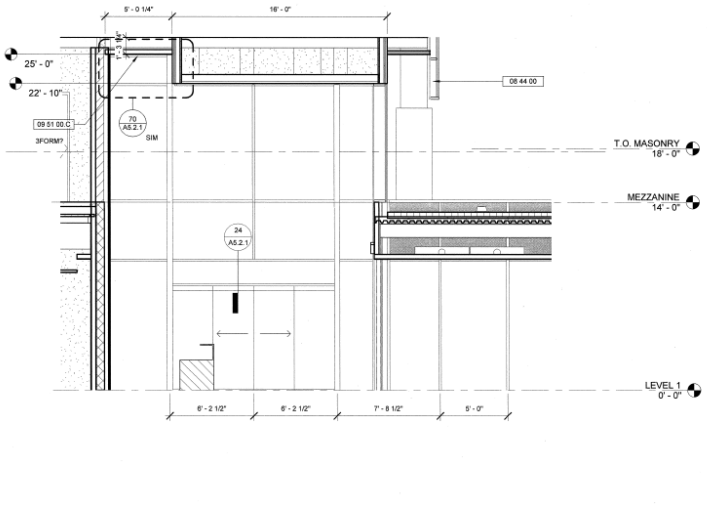

Figure 33: Lobby Interior Elevation East (NTS)

Three types of river rock terrazzo are used in the flooring of the following colors; beige, grey and red. Unique patterning helps to establish areas of gathering versus transitional flow. Refer to the Lobby Finish Plan below. The ceiling however exists at different levels within the lobby. There is a 10 ft. high suspended drywall ceiling above the elevator lobby on the first floor. The remainder of the lobby exists at a double story height that exists at two different elevations. A gypsum board ceiling exists over the elevator lobby of the mezzanine level at height of 25 ft. above finished floor and continues out into the main lobby space at this elevation, framing the steel panel ceiling that has continues indoors from the vertical west facing façade at a height of 22'-10".

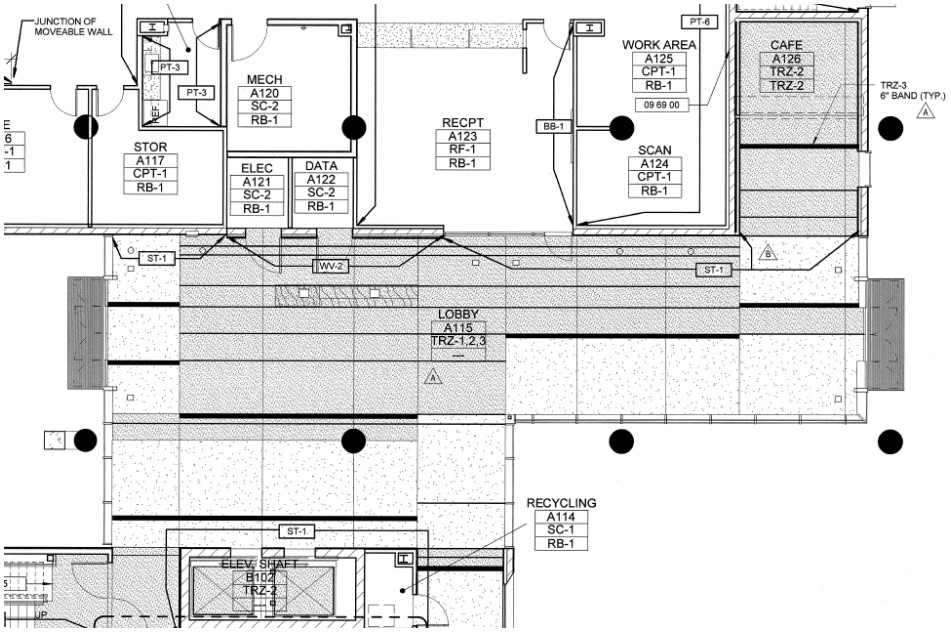

Figure 34: Lobby Finish Plan (NTS)

Furnishings:

Serving the dual purpose of reception and security, there is a front desk upon entering the space. In addition to this, on the west side of the space, is a seating area where others may sit to relax or wait for another. Refer to the Lobby Furniture Plan below.

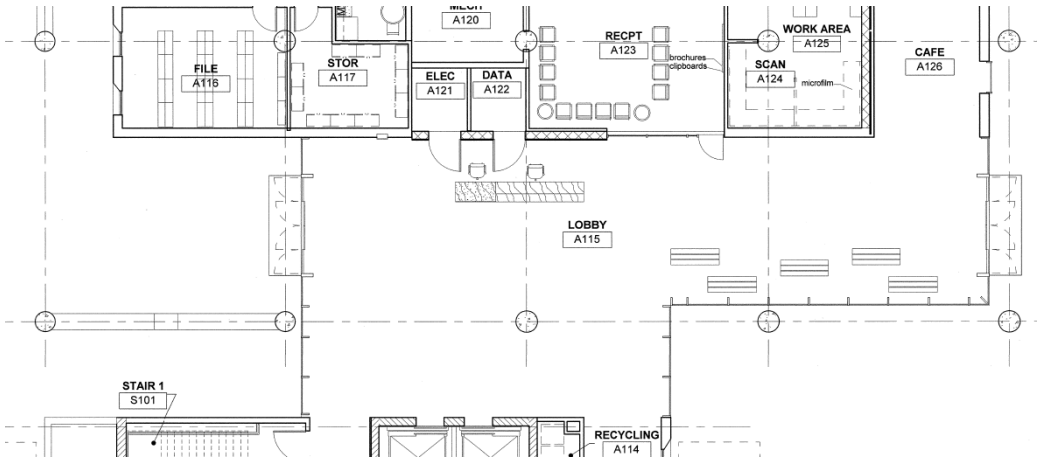

Figure 35: Lobby Furniture Plan (NTS)

Tasks:
The lobby exists for the purpose of welcoming both guest and employees. It will serve as a transitional space as well as a gathering space. A seating area exists where people could sit to read or converse with others.

Existing Lighting:

The existing lighting in the space utilizes a number of different fixture types and sources. Along the north side of the lobby there are four metal halide ingrade fixtures wall. Along the opposite wall are wall mounted metal halide flood distribution fixtures. To provide general lighting, the space in front of the elevator lobby is lit by an array of fluorescent downlight fixtures. At the mezzanine level there are addition metal halide downlighting fixtures as well as linear led fixture in the steel panel ceiling. Refer to the following luminaire schedule and lighting plans for more details.

Lobby Luminaire Schedule

Type	Description	Manufacturer: Series		Lamping	Mounting	Notes
F2	6" square recessed open downlight	KURT VERSEN: H8632 Series	277V	(1) 32W TRT 3500K CCT 82 CRI Min	Recessed	
F5	6"diameter recessed downlight with vertical lamping	GOTHAM: AFV Series	277V	(1) 32W TRT 3500K CCT 82 CRI Min	Recessed	
H1	10" diameter metal halide ingrade fixture with wall wash distribution and cool lens	HYDREL: PDX Series	277V	(1) 35 W T6 3000K CCT	Recessed Ingrade	
H4	6" diameter recessed adjustable downlight with flood distribution	AMERLUX: RA Series	277V	(1) 39 W T6 3000K CCT	Recessed	
H18	Low profile flood fixture with spread lens and glare louver	EXTERIEUR: Nano Series	277V	(1) 39 W T6 3000K CCT	Surface	
H19	Metal halide track head with spot distribution and monopoint mount canopy	AMERLUX: IMZ Series	277V	(1) 39 W T6 3000K CCT	Surface	
L1	1.81" x 0.65" profile wet listed linear LED luminous accent fixture	iLIGHT: T24 Series	277V	12W/L.F.	Surface	

Figure 36: Lobby Luminaire Schedule

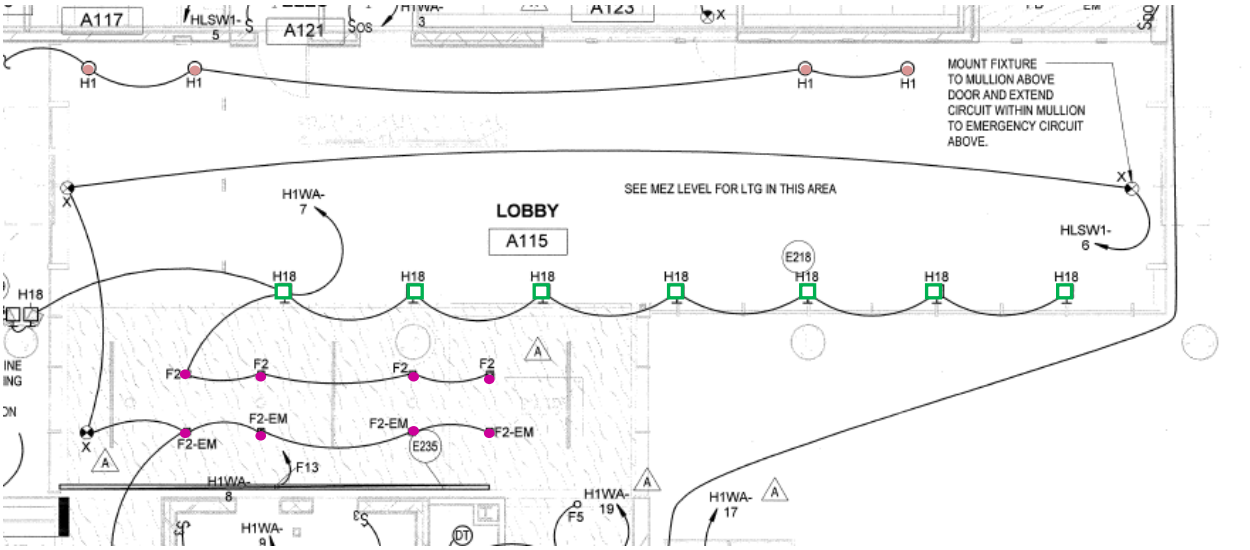

Figure 37: Lobby Lighting Plan Level 1 (NTS)

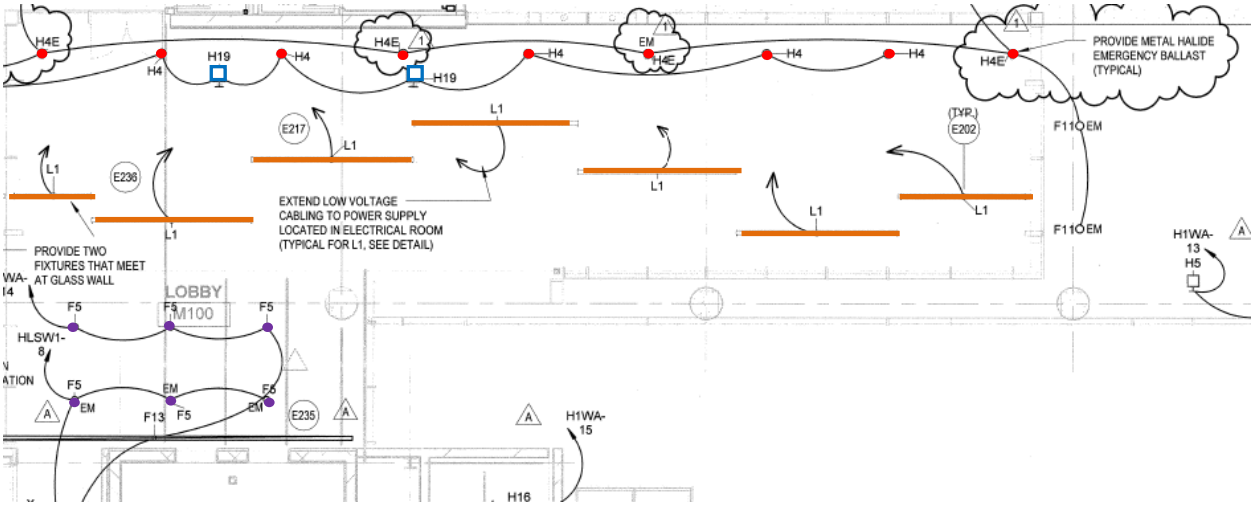

Figure 38: Lobby Lighting Plan Mezzanine Level (NTS)

Design Criteria

Appearance of Space and Luminaires – *Very Important*
Very impressionable are lobby and entrance spaces of buildings. There is nothing different about this one. The appearance of the space shall be welcoming and pleasant. Those who enter the space should leave having been positively impacted by the space. If possible luminaires should be limited from view. However, luminaires existing in the field of view shall be of high quality a potentially of a decorative nature to enhance one's experience of the space.

Color Appearance and Color Contrast – *Important*
In Chandler City Hall the lobby serves as both a transitional space and a one where someone may stop to relax, sit or visit with another. Color appearance is of the space is important for both rendering of people and the environment to be sure that the experience is pleasant and enjoyable. In terms of color contrast as it can help to add to the visual interest of the space.

Daylighting Integration and Controls – *Somewhat Important*
With glass facades lining several of the walls ample daylight reaches this space. In the lobby, the daylight reaching the space could help to achieve potential energy savings by reducing the need for electric lighting during certain hours of the day. A control system with photosensors could be utilized to achieve necessary light levels.

Direct Glare – *Important*
Controlling direct glare from sources in the space is essential. Choosing luminaire with minimal view of the lamps and sufficient optics can reduce glare. Also, were applicable luminaires should be placed out of the direct field of view in order to reduce any potential discomfort due to glare.

Flicker – *Somewhat Important*
In a space with specular and semi-specular finishes, when flicker occurs it can become more apparent bothersome due to the reflections off the material finishes. In order to reduce glare, electronic ballasts should be specified.

Light Distribution on Surfaces – *Important*
It is not necessary for the light distribution on surface to be uniform. A non-uniform approach is usually better for a lobby space. Light should be placed on the peripheral elements creating a focal point and allowing the general local of the space to feel more comfortable.

Luminances of Room Surfaces – *Important*
Contrast ratios between surface luminances in a lobby may be desired to create focal points and create flow within the space. Higher luminances can be created by providing washing or grazing techniques to peripheral surfaces. For a non-peripheral object, a spot lighting or directional technique may be more appropriate.

Modeling of Faces or Objects – *Important*
Especially in the front desk and gathering space, modeling of faces and objects is important. A sufficient vertical illuminance should exist from luminaire with color rendering properties good at rendering skin tones. Additionally, by modeling of objects in the space, it will help to create a focal point or a destination spot within the transition space.

Reflected Glare – *Somewhat Important*
Specular and semi-specular materials are commonly used in lobby spaces. The control and application of both electric light and daylight should be considered. By doing so, veiling reflectances off of certain materials can be minimized.

Shadows – *Somewhat Important*
Minimizing shadows on walls and in corners is especially in the double height portions of the lobby space. By placing light on peripheral surfaces, it can enhance the quality of the space while also reducing shadows. Developing proper spacing for luminaires can be important to also create the desired effect.

Surface Characteristics – *Important*
In addition to wide use of glass in this space, the lobby also utilizes specular and semi-specular finishes on some of the materials. Other materials include wood and stone veneer. The light can be correctly employed to these materials to bring out texture and sheen without causing glare or uncomfortable reflections.

Horizontal Illuminance – *Important*
Category C: 100lux (or 10fc)
Important for circulation, the horizontal light levels should be sufficient for people movement throughout the space. Although 10fc is recommended for a space like this, some adjustments many be made within Chandler City Hall's lobby. A hierarchy of areas within the space can encourage movement in transitional areas while also defining where a gathering space might exist.

Vertical Illuminance – *Important*
Category A: 30lux (or 3fc)
Vertically there are some very nice textures in the space at the peripheral walls. These areas should have higher vertical illuminance levels due to the

Evaluation and Discussion

*Note no images are available of the final lighting design solution as the project is currently under construction.

The lighting design in the lobby space offers unique characteristics that enhance the space as a whole. Providing highlight to the stone veneer through use of ingrade fixtures helps to accent its texture and bring out the subtle sparkle in the stone. Additionally the wide usage of glass façade walls within the space helps to bring in daylight adding brightness and giving way to views to the exterior. This would help to promote circulation through the space for those entering the building intending to proceed toward the council chambers and other public spaces within the building.

Other wall mounted fixtures in the space highlight voluminous nature of the space as it utilizes a wide flood distribution uplighting technique. This helps to enhance the lobby space as it adds to an initial impression.

The elevator lobby uses a practical design of fluorescent downlights. This provides the general illumination for the space; however both wood veneer and stone veneer finishes exist near the elevators. It is understandable to create focal points out of some of the material features, within the space, where guests and visitors will be circulating. However, even though the elevator lobby is primarily for employee usage, the lower ceiling height and veneer finishes may lower the perceived brightness in this area.

The overall design creates an impression for visitors from an aesthetic view point and in terms of energy density the open office space yielded the following:

Total Watts: 2451 W
Total Area: 2485 sq.ft.

ASHRAE/IESNA 90.1 2007	
Allowance	1.3 W/ft^2
Actual	0.986 W/ft^2

Figure 39: ASHRAE/IESNA 90.1 Lighting Power Density Table

Building Façade: An Outdoor Space

The combination of exterior façade components is wide, but it is this combination which gives Chandler City Hall the new 'urban edge' it wishes to impose on the City of Chandler. It serves as landmark on the City of Chandler representing its concept entirely by respecting the past and acknowledging future.

Existing Conditions

Stone veneer lines the lower single story portions of Chandler City Hall, creating a character and natural scale for the building. The tower portion however stands tall and transparent, encompassed by a glass curtain wall. It is enclosed though by towering stone veneer portions that hold the stairways and elevator shafts which give the building a prominent stance. Linearly, on the west façade the height of the building is expressed by stainless steel panels running down the building, then turning inward serving as a canopy ceiling before extending into the lobby as a ceiling element. Displaying the Vision Gallery and transitional spaces, glass curtain walls line the public spaces within the building. Unlike the other glass portions of the façade, the Council Chamber's exterior provides a more translucent aesthetic. Additionally, shading devices line the façades where people will walk through the plaza and along the streetscape of the building.

Practical, yet artistic, the west façade of the tower boasts a Ned Kahn art scrim. An array of perforated pieces of stainless steel set out from the façade overlay the glass curtain wall serving as both shading and artistic purposes. With the wind, these panels sway in creating a wavelike movement across the scrim.

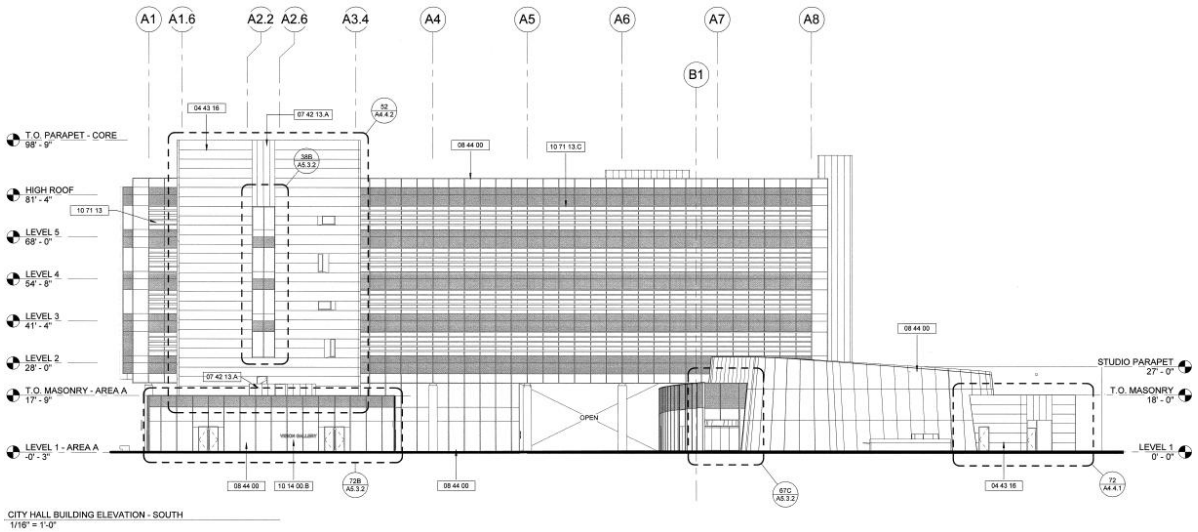

Figure 40: Lobby North Elevation (NTS)

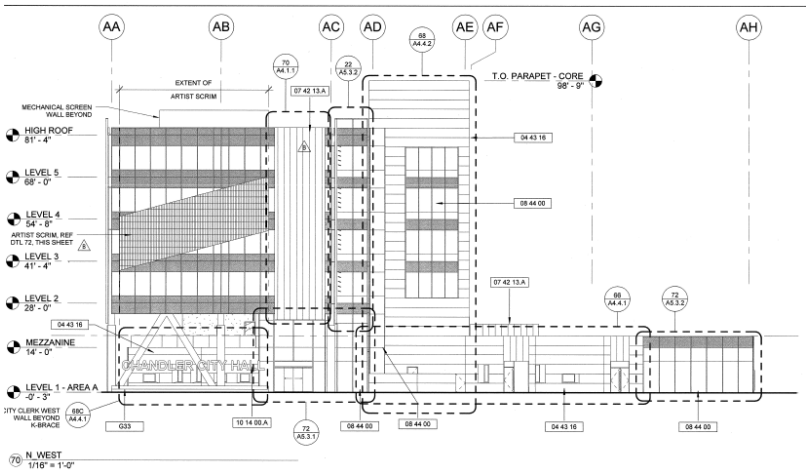

Figure 41: Lobby East Elevation (NTS)

The materials as discussed above are listed in more detail in the following tables.

Material	Description	Style/Color	Reflectance
ST-1	Stone Veneer; Quartzite	Golden Gate	0.58
STS-1	Stainless Steel Panel	Stainless Steel	0.28

Figure 42.1: Exterior Material Finishes

Glazing	Description	T_{VIS}	R_{INT}	R_{EXT}	U_W	U_S	SC	SHGC	$R_{L:SG}$
A	Insulating Vision Glass 1"	0.47	0.16	0.32	0.30	0.27	0.35	0.31	1.52
C	Monolithic Spandrel Glass 1/4"	0.14	0.38	0.24	0.8	0.68	0.3	0.25	0.54
D	Insulating Vision Glass 1"	0.7	0.12	0.11	0.29	0.26	0.44	0.38	1.84
E	Insulating Tempered Glass 1"	0.7	0.12	0.11	0.29	0.26	0.44	0.38	1.84

Figure 42.2: Exterior Material Finishes: Glazing

Existing Lighting:
The exterior façade lighting uses a variety of fixtures and sources, many of which have controlled optics and defined distributions in order to adhere to the dark sky concerns in the area. Refer to the following luminaire schedule and lighting plans for more details.

Exterior Facade Luminaire Schedule

Type	Description	Manufacturer: Series	Voltage	Lamping	Mounting	Notes
F12	4' linear fluorescent exterior rated fixture with wall wash distribution	LSI: LF Series	277V	(1) 32 W T8 3500K CCT 82CRI MIN	Surface	
H1	10" diameter metal halide ingrade with wall wash distribution and cool lens	HYDREL: PDX Series	277V	(1) 39 W T6 3000K CCT	Recessed Ingrade	
H2	Exterior rated surface mounted cylinder with up and downlight controlled separately	BEGA: 6623 Series	277V	(2) 39 W T6 3000K CCT	Surface	
H5	Wet listed asymmetric uplight with wet listed integral ballast and visor	ELLIPTIPAR: M452 Series	277V	(1) 70 W T6 3000K CCT	Surface	
H5A	Wet listed asymmetric uplight with wet listed integral ballast and visor and custom arm length TBA	ELLIPTIPAR: M452 Series	277V	(1) 70 W T6 3000K CCT	Surface	
H16	Exterior rated flood lighting with medium flood distribution	INVUE: VFS Series	277V	(1) 150 W ED17 base MH 3000K CCT	Surface	Barn doors
H16A	Exterior rated flood lighting with medium flood distribution	INVUE: VFS Series	277V	(1) 150 W ED17 base MH 3000K CCT	Surface	Wall mount bracket, Barn doors
H17	Exterior rated flood lighting with vertical flood distribution	INVUE: VFS Series	277V	(1) 150 W ED17 base MH 3000K CCT	Surface	
H17A	Exterior rated flood lighting with vertical flood distribution	INVUE: VFS Series	277V	(1) 150 W ED17 base MH 3000K CCT	Surface	
H18	Low profile flood fixture with spread lens and glare louver	EXTERIEUR: Nano Series	277V	(1) 39 W T6 3000K CCT	Surface	
L1	1.81" x 0.65" profile wet listed linear LED luminous accent fixture	iLIGHT: T24 Series	277V	12W/L.F.	Surface	
L4	2.1" x 2.8" x 1' linear exterior rated line voltage LED with 10x60 distribution	COLOR KINETICS: 523 Series	277V	WHITE LED 4200 K CCT	Surface	
L5	12.5" x 7.1" x 4.9" exterior rated LED floodlight with 10 degree distribution, line voltage, 28,929 center beam candlepower	COLOR KINETICS: 523 Series	277V	WHITE LED 4200 K CCT	Surface	Dimming
L6	12.5" x 7.1" x 4.9" exterior rated LED floodlight with 8 degree distribution, line voltage, with static color LED	COLOR KINETICS: EB Blast 12 Series	277V	BLUE LED	Surface	
L6A	12.5" x 7.1" x 4.9" exterior rated LED floodlight with 8 degree distribution, line voltage, with static color LED	COLOR KINETICS: EB Blast 12 Series	277V	AMBER LED	Surface	

Figure 42: Exterior Façade Luminaire Schedule

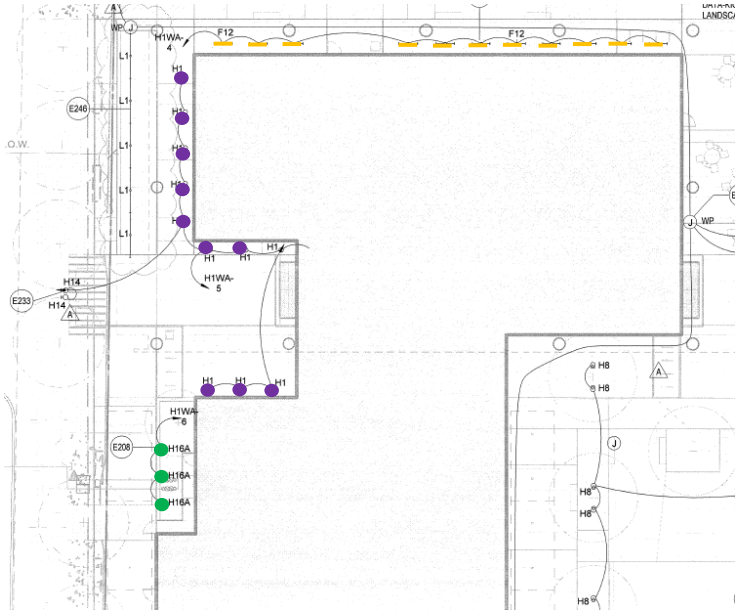

Figure 43: Site Lighting Plan Area A (NTS)

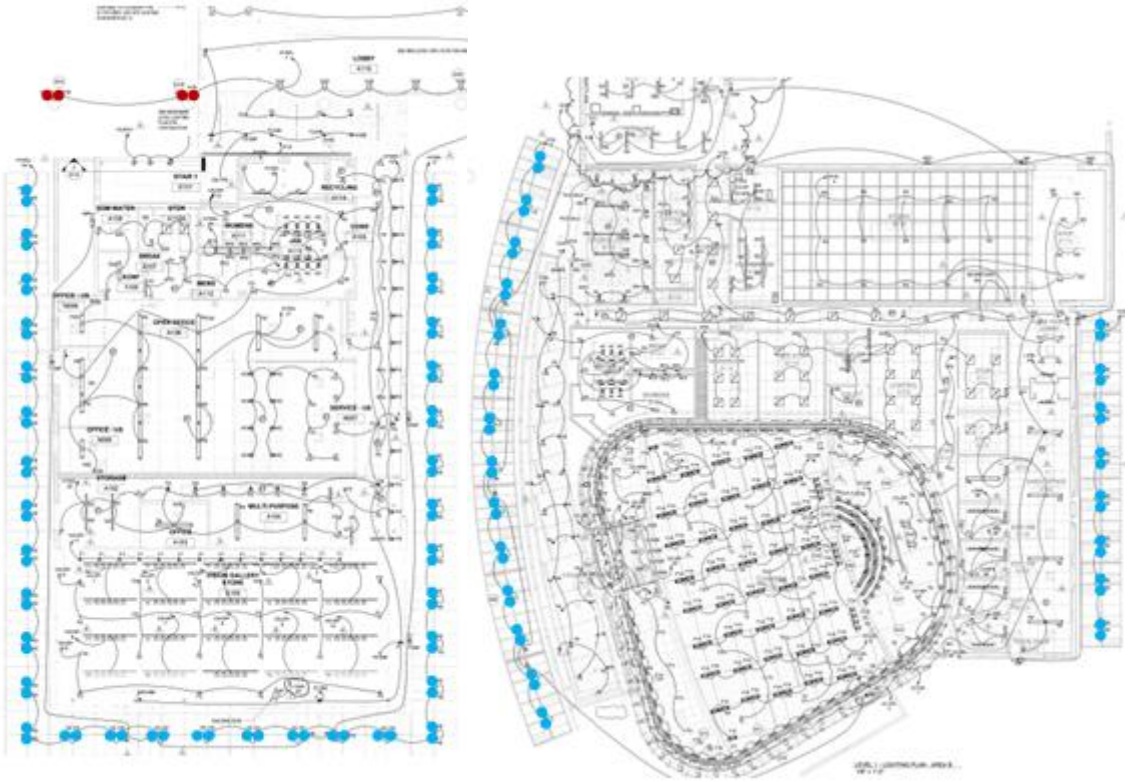

Figure 44: Level 1 Lighting Plan: Pedestrian Walkway Shade Canopy Lighting (NTS)

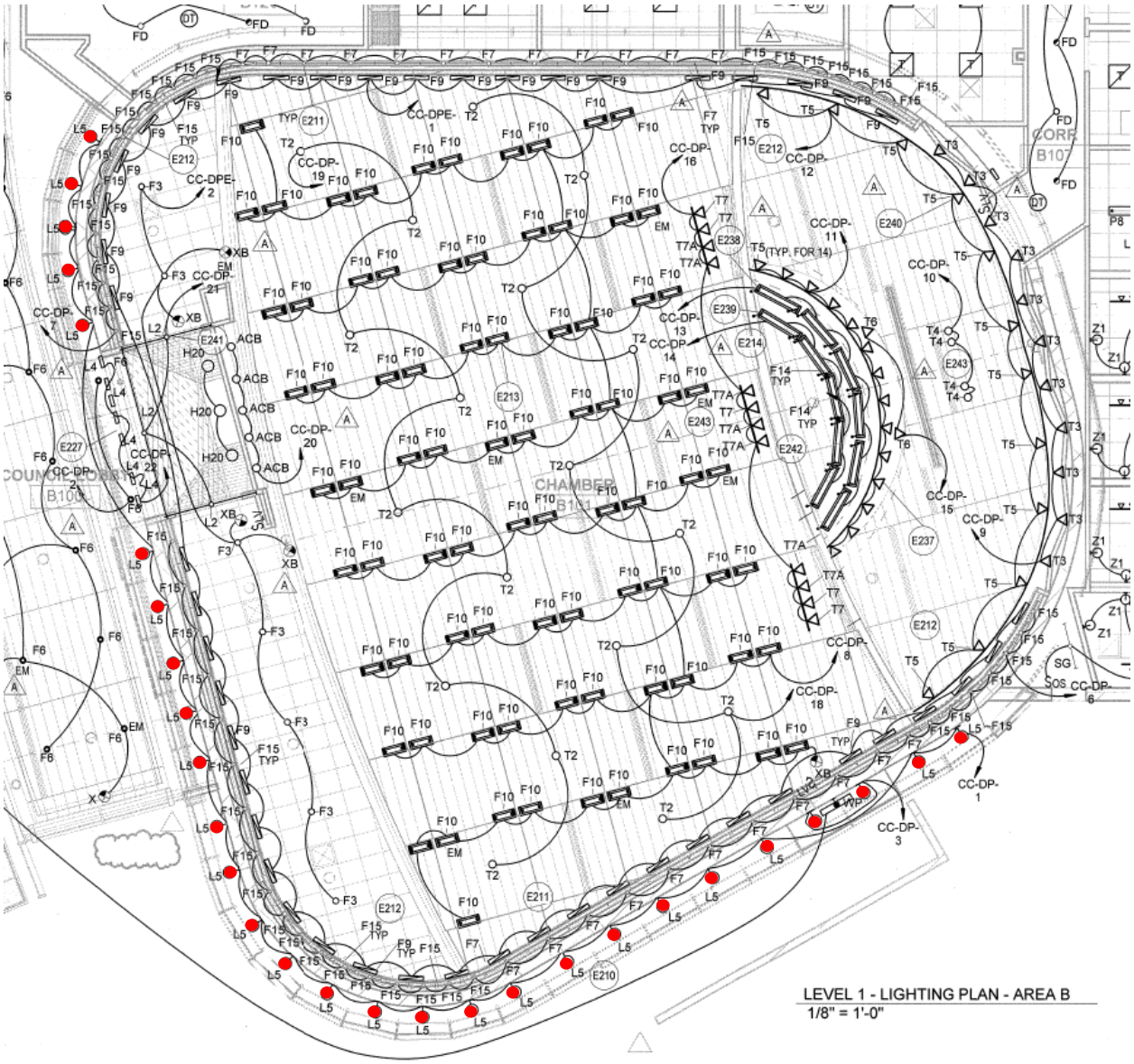

Figure 45: Level 1 Lighting Plan: Backlit Translucent Glass at the Council Chamber (NTS)

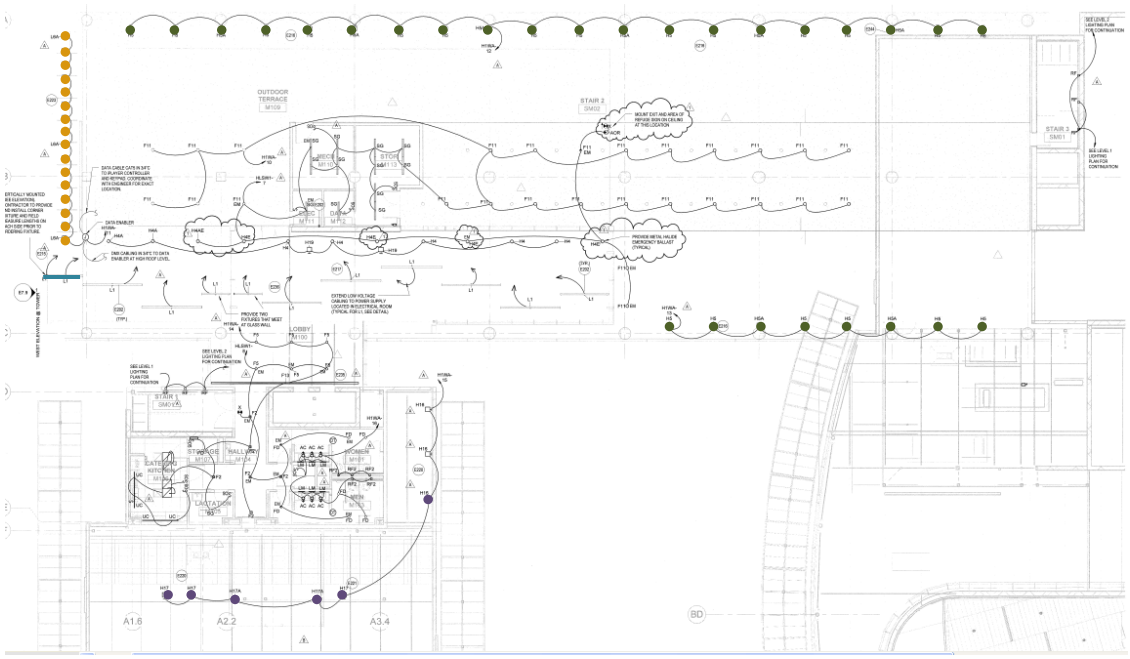

Figure 46: Low Roof and Mezzanine Area A Lighting Plan (NTS)

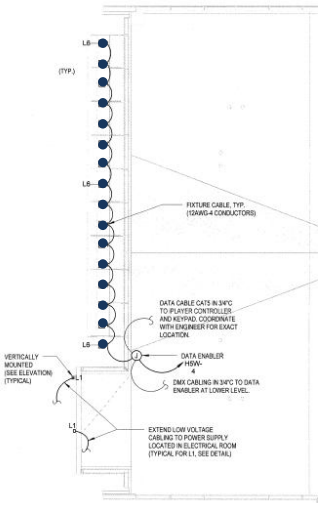

Figure 47: High Roof Area A Lighting Plan (NTS)

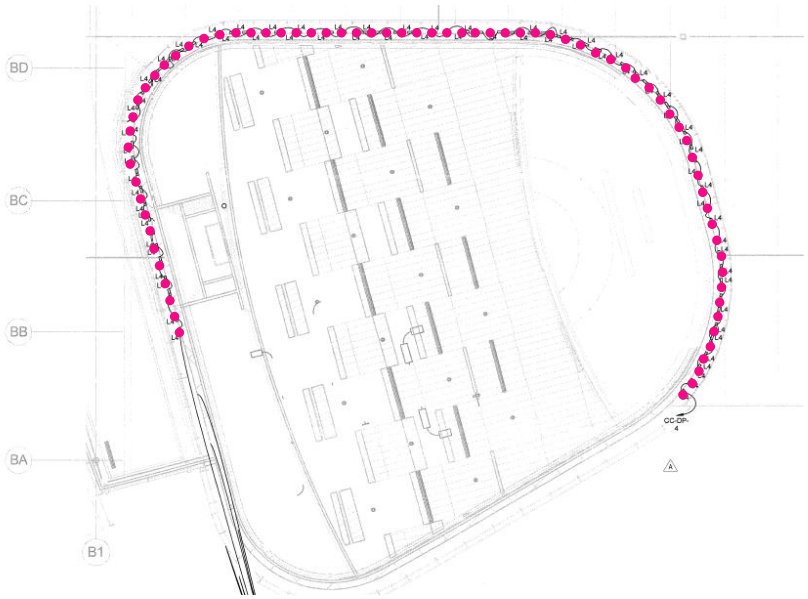

Figure 48: Low Roof Area B Lighting Plan (NTS)

Design Criteria

Building Exterior: Active Entrance, Predominant Structure; IESNA Lighting Handbook, 9th Edition

Appearance of Space and Luminaires – *Very Important*
Standing taller than most of the surrounding buildings, Chandler Hall serves as a landmark for the city. Its appearance should make an impression relative to its theme of creating an urban edge for the city. Luminaires should be of high quality when not concealed and the appearance of the façade should be prominent and sleek.
Color Appearance and Contrast – *Very Important (Active Entrance); Important (Predominant Structure)*
A blended palette of warms tones is the quartzite stone veneer used for the elevator tower and single story portions of the building. Warm color temperature and tones will enhance this feature. Additionally color rendition is important, because the building is to be a landmark for the city; it should appear just as nice at night as during the daylight hours. Color contrast can enhance the features by making certain element stand out in highlight.

Direct Glare – *Very Important (Entrance); Important (Predominant Structure)*
Direct glare is a concern that pedestrian traffic is not affected by glare from fixtures. The building lines the main street which is main axis of transportation for pedestrians and vehicles alike. Minimize glare can be achieved by choosing fixtures with proper cut offs and optics.

Light Distribution on Surfaces – *Important (Active Entrance); Very Important (Predominant Structure)*
Placement of light can create focal points and also draw people through or to a particular area. Distributing highlight to predominant structures will help enhance the building's presence. Additionally by distributing light with higher brightness near entrances, it draws people to where they are supposed to go.

Light Pollution/Trespass– *Very Important*
Light Pollution and trespass are particularly important in the setting of this project. Light pollution will be measure in terms of upward sky glow (%) while light trespass will be measured in terms of vertical illuminance at a setback from the specified site. Located in Chandler, Arizona, this project has a special dark sky concern minimizing sky glow as priority for the exterior lighting. The following table has been produced by the ILE, International Lighting Engineers defining a set of recommendations for dealing with light pollution.

Table 1 – Obtrusive Light Limitations for Exterior Lighting Installations

Environmental Zone	Sky Glow ULR [Max %] (1)	Light Trespass (into Windows) Ev [Lux] (2)		Source Intensity I [kcd] (3)		Building Luminance Pre-curfew (4)
		Pre- curfew	Post- curfew	Pre- curfew	Post- curfew	Average, L [cd/m2]
E1	0	2	1*	2.5	0	0
E2	2.5	5	1	7.5	0.5	5
E3	5.0	10	2	10	1.0	10
E4	15.0	25	5	25	2.5	25

Figure 49: Obtrusive Lighting Limitations Table (ILE, International Lighting Engineers)

Chandler City Hall resides within environmental zone 3, referring to medium district brightness centers such as small town centers, or urban locations. These concerns can be handled and a design implemented in a variety of ways. This can include having a curfew in which the majority of exterior lighting will be shut off, or different lighting scenarios can be developed appropriate for a particular event at City Hall, in the town, or time of year.

Modeling of Faces or Objects – *Very Important (Active Entrance); Important (Predominant Structure)*
At entrance points and predominant structures, modeling of faces, objects and obstructions is important along an exterior façade. Providing vertical and horizontal illuminance alike can help to achieve adequate modeling of these objects. This can also be a safety issue so that one knows whether it is a stranger or a friend who may be approaching.

Peripheral Detection – *Very Important (Active Entrance); Somewhat Important (Predominant Structure)*
Important in the night hours, people, objects and obstructions become more difficult to see. To enhance visual acuity, both horizontal and vertical illuminance levels shall be provided without high contrasts between dark and lit spaces.

Points of Interest – *Very Important*
Depending on the event that may be occurring, the lighting scheme could be used to help create focal points of those of interest. Different settings will be provided in which a general lighting scheme highlighting the structure of the building is developed, another where the Council Chamber is the focal point, and a final which would provide an artistic flare putting an added focus on the art scrim feature on the west façade.

Reflected Glare – *Very Important*
With glass a major component of the façade, reflected glare becomes a concern. Set along the main axis of transportation reflected glare should not inhibit either pedestrians or traveling vehicles. Choosing fixtures with proper optics and specifying appropriate aiming angles can reduce any potential negative effects.

Shadows – *Very Important*
Safety is of highest importance in an exterior environment at night. By minimizing the contrast between lit and shadowed areas, the eye can adjust more easily and be able to see in the shadows. In areas that should be lit, dark shadows can be a detriment to the appearance of the space or object.

Source Task Eye Geometry –*Very Important*
In terms of luminaire placement, direct views of the lamp should be minimal from both pedestrian and vehicular traffic. This can be achieved by specifying luminaires with proper cut off angles and optical control.

Sparkle/Desirable Reflected Highlight – *Important (Active Entrance); Somewhat Important (Predominant Structure)*
Having incorporated glass, stainless steel and quartzite into the façade materials, these material have the potential enhance the appearance of the exterior of the building by bringing out the sheen and sparkle within these materials through careful incorporation of light. Other considerations when trying to achieve this desired effect include
Surface Characteristics – *Very Important*

Horizontal Illuminance – *Very Important (Active Entrance); Important (Predominant Structure)*
Category B: 50lux (or 5fc)
Horizontal illuminance is important in terms of safety and circulation. These levels should be met to ensure safety at entrances and pedestrian walkways. This includes under the shaded canopies that exist along the building's perimeter that serve as main axes for circulation.
Vertical Illuminance – *Very Important*
Category A: 30lux (or 3fc)
For facial recognition, object obtrusions, and highlighting of predominant feature, vertical illuminance measures should meet adequate levels. The illuminance values can be altered to create a hierarchy of elements to create focal points as well as promote attractions and features that may be occurring.

Evaluation and Discussion

Chandler City Hall provides an ample amount of exterior façade lighting with good reasoning at that the building is design as a new landmark in the city of Chandler. The lighting design exhibits high quality in presenting Chandler City Hall as a prominent structure on the site.

Quartizite stone veneer is washed effectively using metal halide fixtures, bringing out and emphasizing both the scale and texture of the building. On the north side of the building, linear fluorescents with a wall washing distribution provide highlight to the natural scaled single story stone veneer. This enhances the idea of bring the building to personal scale while respecting the nature and colors natural Arizona habitat.

Integrated into the exterior architecture, lighting components hidden in the shading canopy surrounds the building using both uplight and downlight separately controlled distributions. This provides the sufficient horizontal illuminance for circulation about the site at night to provide visual comfort and safety.

Being a prominent structure on the site, the Council Chamber exhibits a glowing nature from the backlit glass façade surrounding its unique shape. This enhances the building's theme of acknowledging the future amongst other features that respect the past.

Enhancing the appearance of the floating glass box that encapsulates the office floors, the underside is lit from a low roof terrace. This creates a glow from beneath allowing for the appearance of a floating structure.

At the west, the main entrance exhibits a continuation of the exterior into the building both in terms of architecture and the linear LED accent fixtures that run along the steel panels. The entry ways are also lit with uplight metal halide fixture that create a focal point and promote circulation to a potential destination point.

Artistic and prominence are qualities that the City of Chandler hopes to instill on the new Chandler City Hall. This is enhanced by the lighting techniques used to illuminate that Ned Kahn Wind structure that is featured on the west façade. Standing tall and creating art by nature of wind, the stainless steel panels are illuminated at night by use of color LED fixtures. From above and below the art scrim, the opportunity exists to create different patterns of light depending on the wind at any particular time.

Respecting the concepts that Chandler City Hall represent, the lighting design provides emphasis to the particular features. It creates an initial impression of prominence and stance on the surrounding the City of Chandler, however with the dark-sky concerns that exist in Arizona, improvements can be made to the design to limit the amount of light emitted upward from the site. Other areas design could include specific settings based on the event occurring by provide a focal point of the destination of a particular event.

General Evaluation of Lighting Systems in Chandler City Hall

The lighting systems within Chandler City Hall present the building in an aesthetically appropriate way while meeting technical requirements laid forth by the IESNA and ASHRAE recommendations. A hierarchy of light within each space create focal points, highlights features, and also promotes flow and circulation where desired.

Luminaire choices and placement help to achieve the desired results from a quantitative illuminance standpoint. Although in terms of ASHRAE lighting power density standards, the Council Chamber does not meet the requirements based off of a space-by-space analysis, the energy efficient solutions employed by the remainder of the space would allow the building to meet ASHRAE standards when calculated by the entire building method.

Where the majority of sources in the interior environment utilize 3500K CCT, the exterior environment uses different color temperatures along blue and amber LED sources to provide the desired effect. The exterior environment uses the different color properties of light to effectively render the range of materials compile to create the building façade.

Controls within the lighting design of spaces are used to achieve the desired effect within spaces while also creating an energy efficient design. Where controls are coupled with a daylight harvesting system, the design's efficiency even further improves.

Chandler City Hall's lighting system overall creates an energy efficient design while also focusing on and creating visually appealing aesthetic. Although, a high quality design has be implemented, room for adjustments and redesign still exists to improve the overall quality of the lighting for Chandler City Hall.

AGI Files used in this report can be found under the following folder on the Y: drive.
Y:\smr5094\TechnicalReport1\AGI