ARCHITECTURE LIGHTING DESIGN

EARTH-BOUND POTTER MUSEUM

TASK IA – DAYLIGHTING DESIGN

1. LIGHTING REQUIREMENTS FOR EACH SPACE

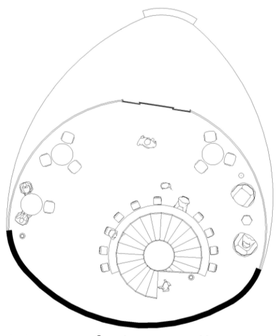
Space	Daylighting priority (1-5 stars)	Artificial lighting priority (1-5 stars)	Recommended Lighting Levels (lux)	Reference (standards, guidelines)
Reception Area	4	3	200-300	https://www.archtoolbox.com/materials-systems/electrical/recommended-lighting-levels-in-buildings.html
Cafeteria	4	4	300-500	
Rooftop Cafeteria	5	3	200-400	
Function Room	3	5	300-500	
Toilet	1	4	100-300	
Prayer Room	1	4	100-300	
Permanent Gallery	4	4	300-500	
Temporary Gallery	5	3	200-400	
Workshop	3	5	300-750	
Administration Office	2	5	300-500	
Storage	1	2	50-200	

2. INTENDED LIGHITNG DESIGN QUALITY OF EACH SPACE

Space	Intended overall lighting quality (argument)
Reception Area	Would like to have more natural lighting to diffuse into the space to illuminates the entire space
Cafeteria	Prefer moderate natural lighting with uniform and soft artificial lighting
Rooftop Cafeteria	Would allow natural lighting to diffuse into the space while still provide moderate artificial lighting
Function Room	Would like to provide high-contrast environment with moderate natural lighting
Toilet	Prefer direct artificial lighting over natural lighting
Prayer Room	Prefer direct artificial lighting over natural lighting
Permanent Gallery	Would like to have combination of moderate natural and direct artificial light so can create strong contrast on the exposed object
Temporary Gallery	Natural lighting as the main while still having artificial lighting to highlight and make the exhibits visible
Workshop	Would like to have natural lighting with good visibility while still provide diffuse artificial lighting to reduced shadow or reflections
Administration Office	Would like to have moderate natural lighting while still providing diffuse artificial lighting to reduce shadows or reflections
Storage	Artificial lighting as the main light source as natural lighting is not critical for this space

3. The space that I've chosen is Rooftop Cafeteria

A. Floor Plan

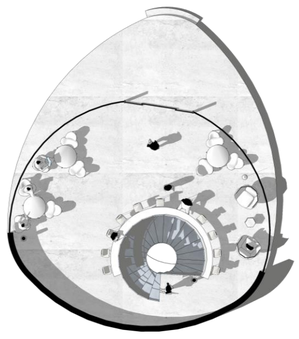


Most of the walls are using glazing window to allow maximum natural light into the space.

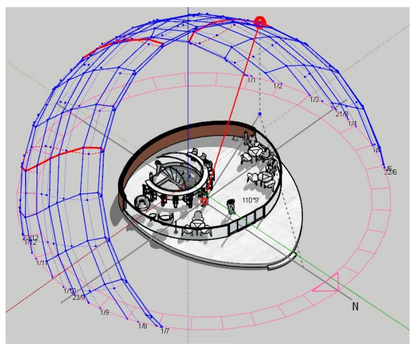
Section

Most of the wall are using glazing window to allow maximum natural light into the space.

Shadow Casting

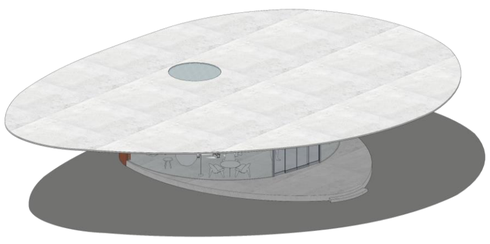


Sun Path



The shadow casting and sun path is on 7 August, 3pm

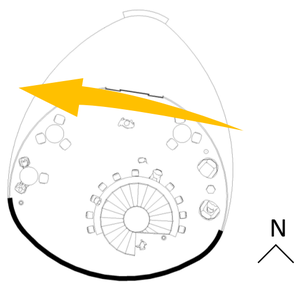
3D



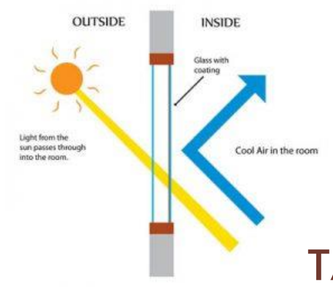
B. Daylighting Design Strategies

1. Skylights
   - A skylight is seen as being beneficial to any space because of its ability to bring in natural light. Having a skylight is that it brings extra daylight into a space.
   - Because of this increase in natural light from skylights, the use of artificial lighting and electricity can be reduced.
   - This can help prevent strong shadow over the exhibits on the eye level, thus improve the entertaining experience.

2. Curtain Window placement
   - The curtain windows were placed large area compare to the solid wall in this space. The curtain windows are built from floor to ceiling to ensure the most daylight and permitting daylight to diffuse into the space.
   - The higher the window built, the deeper the daylight will penetrate into the interior space.
   - The windows were placed facing the East and West to allow maximum daylight into the space.



3. Glazing Material
   - The space using double glazed window which help to reduce heat and noise gain through the window.
   - It help to control the internal room temperature as it stops heat transferring from one side to another.
   - To ensure the resulting of unwanted heat gain in this tropical country, the skylight used heat-absorbing tint and insulated glazing to reduce these impacts.



C. Daylight Factor (Df)

Daylight factor of Rooftop Cafeteria
Based on the table above, the recommended lighting level for rooftop cafeteria is 200-400 lux
Assume the sky illuminance is intermediate
= 30000-100000
Taking Ei = 300 lux, Eo = 50000 lux

$$\text{Daylight Factor (DF)} = \frac{Ei}{Eo} \times 100\% = \frac{300}{50000} \times 100\% = 0.6\%$$

Average less than 2%, appearance looks gloomy that causes electric lighting needs most of the day.

The workshop's space is in semi-circle shape with a radius of 9.25m

Illuminance level required (lux) (E) = 300 lux

Area at working plane height (A) $= \frac{1}{2} \pi r^2 = \frac{1}{2} \pi (9.25)^2 = 134.4 m^2$

To get the length (L) and width (W) of the semicircle,

Circumference of semicircle = Perimeter of square

$2\pi r + 2r = 2 (L + W)$

$2\pi (9.25) + 2 (9.25) = 2 (L + W)$

$2 (47.56) = 2 (L + W)$

$L + W = 47.56$

F = 3500 lumens

n = 2

$$K = \frac{L \times W}{H (L+W)} = \frac{\frac{1}{2}\pi (9.25)^2}{3[\pi(9.25)+2(9.25)]} = \frac{134.4}{142.68} = 0.94$$

$\frac{\text{Area of Semicircle}}{\frac{1}{2} \text{ Circumference of Semicircle}}$

When room index = 0.94, from UF table,

Utilisation Factor (UF) = 0.62

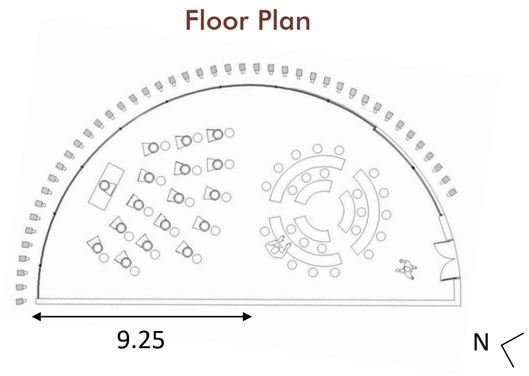
Maintenance Factor (M) = 0.8

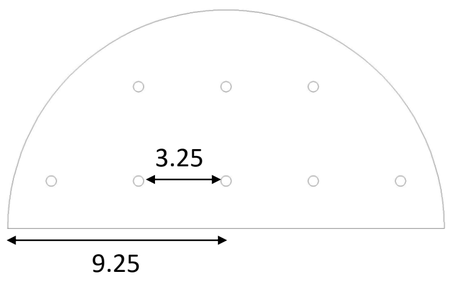
$$N = \frac{E \times A}{F \times n \times UF \times MF} = \frac{300 \times 134.4}{3500 \times 2 \times 0.62 \times 0.8} = 11.61 \text{ nos} = 12 \text{ nos}$$

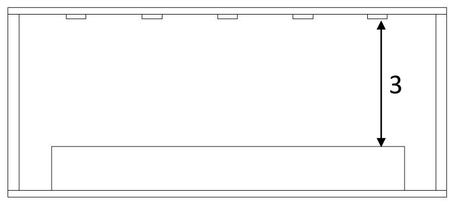
$Smax = 1.5 \times Hm = 1.5 \times 3m = 4.5m \text{ Max}$

Hence, Smax ≤ 4.5m Max

Floor Plan







- The workshop have 8 12 nos of lighting feature where the distance between each other is 3.25m horizontally and 3.55m vertically.
- The height between the lighting fixture and work plan is 3m.

TASK IB – ARTIFICIAL LIGHTING DESIGN

(Workshop)

Natural Light

Artificial Light

REFERENCES

Hasan TariqFollowMaintenance Engineer at Midas SafetyLike171Comment17ShareLinkedInFacebookTwitter0, Follow, & Hasan TariqMaintenance Engineer at Midas SafetyFollow. (n.d.). LIGHTING DESIGN BY LUMEN METHOD(WITH EXAMPLES). Retrieved from https://www.linkedin.com/pulse/lighting-design-lumen-method-examples-hasan-tariq/

Recommended Lighting Levels in Buildings. (n.d.). Retrieved from https://www.archtoolbox.com/materials-systems/electrical/recommended-lighting-levels-in-buildings.html

ARCHITECTURE ACOUSTIC DESIGN

EARTH-BOUND POTTER MUSEUM

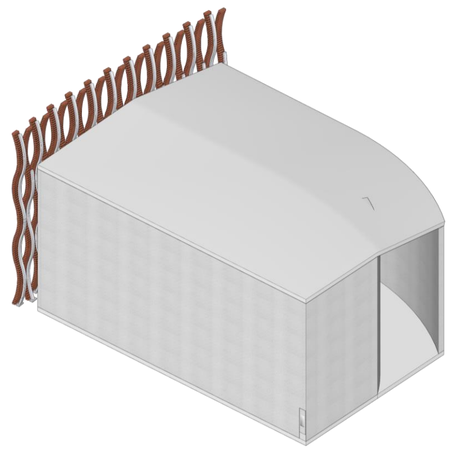
TASK II – ACOUSTIC DESIGN

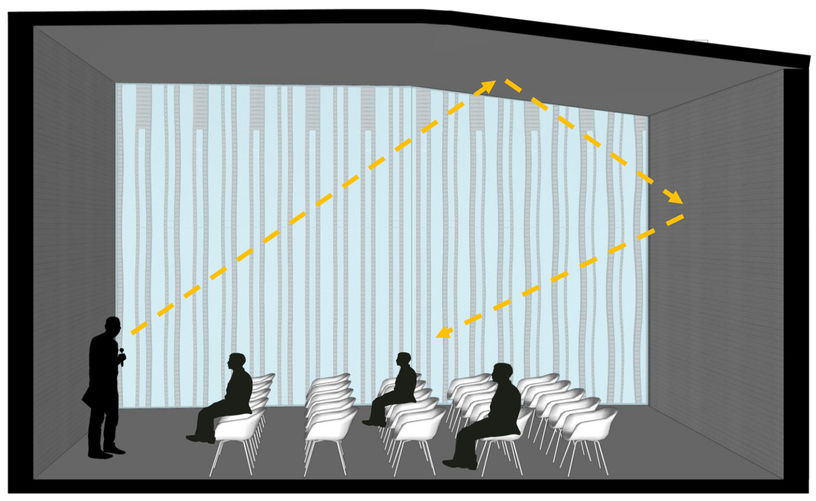
1. ACOUSTICAL REQUIREMENTS FOR EACH SPACE

Space	Acoustical priority (1-5 stars)	Insulation from exterior noise priority (1-5 stars)	Recommended Reverberation time RT (sec)	Reference (standards, guidelines)
Reception Area	2	3	0.3-0.6	GREEN, A. (n.d.). Recommended reverberation times for 7 key spaces. Retrieved from https://blog.knauf.solutions/recommended-reverberation-times-for-7-key-space
Cafeteria	3	3	0.7-1.4	
Rooftop Cafeteria	2	2	0.7-0.8	
Function Room	5	5	0.8-1.2	GREEN, A. (n.d.). Recommended reverberation times for 7 key spaces. Retrieved from https://blog.knauf.solutions/recommended-reverberation-times-for-7-key-space
Toilet	1	1	-	
Prayer Room	1	4	0.1-0.3	
Permanent Gallery	5	5	0.8-1.2	
Temporary Gallery (outdoor)	4	3	2.5 – 4.0	
Workshop	3	4	0.4-0.6	Peek, W. (2020, August 04). Target Reverberation Time. Retrieved from https://commercial-acoustics.com/reverberation-time-graphic/
Administration Office	4	5	0.4-0.7	
Storage	1	1	-	

2. CHOSEN SPACE – FUNCTION ROOM

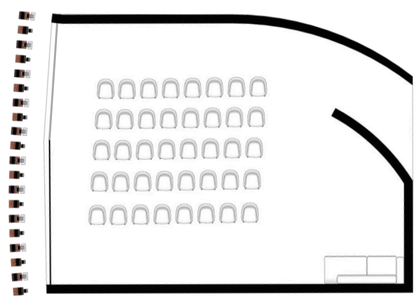
- Type of space
  - The space is an enclosed space where sound can travel directly from the source to the audience.
  - The space has a seating capacity of 54 people and is located beside reception area.
  - It has a shoe-box seating arrangement that hovers over the function room.





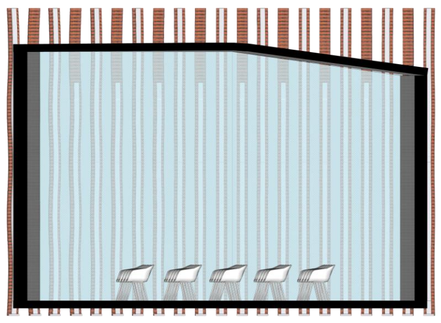
- The function room is in linear shape with angular ceiling above.
- The angular ceiling effectively reflect and propagate sound to the users of the room.

A. Floor Plan



- The Function room is established in a 'shoe box' shape. In a shoe box design.
- To maximize the sight lines and seating capacity
- Able to reduce sense of space and grandeur from the audience's perspective

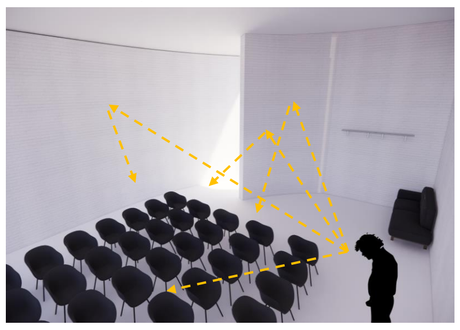
Section



- The reflection of sound follows the law of reflection.
- The hard surface such as brick walls, floorings and tilted ceiling are used to reflect direct sound thus dispersing the sound equally in the function room.

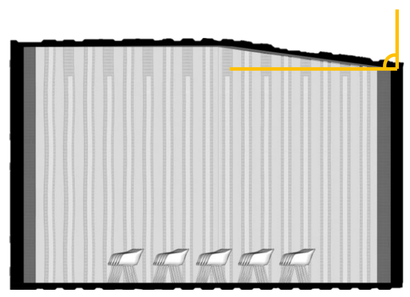
B. Acoustic Design Strategies

1. Concave Entrance
   - The concave wall entrance is built to block the sound from the outside while still reflect the sound in the space.
   - Thus, producing higher reverberation time and enhance the performance.

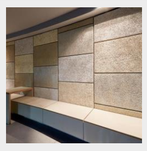
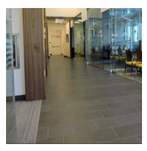


2. The use of absorbent materials
   - This type of absorbent characteristics are the most vital factors in designing a function room for speech.
   - The space is using acoustic ceiling panel like gypsum panel to absorb sound wave produced by the speech and movement of people.

3. Angular Flat ceiling
   - A flat surface with a certain angle can effectively distribute reflected sound.
   - Because of the limited size of the space, the tilt ceiling is place toward the speaker and project the sound energy toward the audiences.



C. Proposed Building Materials

Building Components	Proposed Building Materials	Photo
Wall	<u>Acoustic Fabric</u> Fiberglass Panel Absorber reduce echo and reverberation in function room, improving the intelligibility of sound within the space.	
Floor	<u>Vinyl Tile</u> It is installed with a sound-insulating underlayment, is a great resilient flooring option used for sound treatment. It is selected by many facilities due to its design versatility, durability and relatively low maintenance costs.	
Ceiling	<u>Gypsum Board Ceiling</u> It is built with smooth surfaces help in sound reflection and provide for acoustical intimacy, atmosphere, and strengthens the overall sound quality.	

D. Reverberation Time (RT)

Materials	Area (m^2)	Absorption Coefficient (Sabins) (500Hz)	Absorption Surface
Acoustic Fabric	50.5	0.40	20.2
Vinyl Tile	73.5	0.04	2.94
Gypsum Board	73.5	0.80	58.8
People	24	0.44	10.56
		Total	**92.5**

Height of the function room = 5000mm
Total area of the floor = 73.5m^2
Total volume of the space = 5 x 73.5
= 367.5m^3

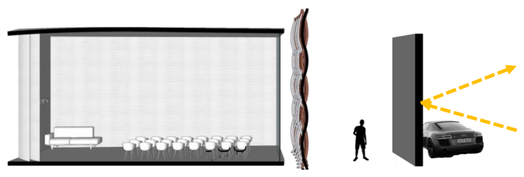
RT = Reverberation time (s)
V = Volume of the space
AT = Total absorption of room surfaces

$$RT = \frac{0.16V}{A}$$
$$= \frac{0.16\ (367.5)}{92.5}$$
$$= 0.64 \text{ seconds}$$

The reverberation time of the function room is 0.64 seconds where the amount of time for the sound to die off is in moderate pace. Therefore, the function room have a good acoustic level.

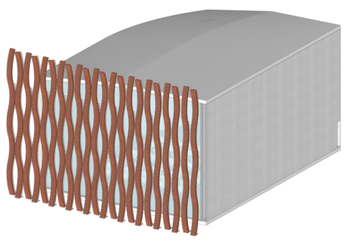
E. Architectural & Urban Measures

1. Barrier wall
   - Using solid structure wall on the exterior wall can stop direct sound path from the traffic.
   - The wall has an advantage of low cost, and it will achieve noise reduction and preserve the acoustic quality of the internal space.



2. Water feature place at the external of the space
   - Creating 'white noise' using the soothing sound of water to cover unwanted noises from the traffic outside.
   - The sound of water feature can overlap the unwanted traffic noise from the outside to enhance noise reduction.

3. Application of ornamental façade
   - The façade is made of stacking bricks into multiple strips and array it on the external wall.
   - It can act as noise reflection from the traffic noise.
   - The effectiveness is only minor but higher effectiveness can be achieved with greeneries outside.



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An Architects Guide to Soundproofing. (2021, March 01). Retrieved from https://www.soundproofcow.com/soundproofing-101/architects-soundproofing-guide/

GREEN, A. (n.d.). Recommended reverberation times for 7 key spaces. Retrieved from https://blog.knauf.solutions/recommended-reverberation-times-for-7-key-space