
Lighting Layout and Sound Index calculation

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TASK A.

A production area in a factory measures 60 metres x 24 metres x 8 metres in height.

The factory's work benches are set at a height of 1m above the floor level.

The area's reflectances are 0.3 for the ceiling and 0.5 for the walls.

The Lighting design specifies Fluorescent lamps in recessed louvre with DLOR of 50%.

(The actual size for the luminaires is 1200mm (1.2m) in length and 200mm (0.2m) wide.)

A Lighting Design Lumen (LDL) output of 18,000 lumens is required.

The illumination required for the factory area is 200 lux at the working plane.

Light Loss Factor = 0.75

1: Calculate:

1. The Room Index

Room index calculation = (Length x Width / Height from surface to luminaire (Length + Width))

$$RI = (L \times W) / (H_m (L + W))$$

What we know from the question:

Length of the room (L) = 60m

Width of the room (W) = 24m

Height of the Room (H_m) = 8m – 1m = 7m

$$RI = 60 \times 24 / (7(60+24))$$

$$RI = 1440 / 588$$

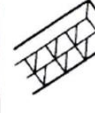
$$RI = 2.45$$

2. The Utilisation Factor (from tables)

Room index (RI) = 2.45

LOR% = 50%

Ceiling Reference = 0.3 Wall Reference = 0.5

Description of fitting	Typical outline LOR	Basic downward LOR%	Ceiling	0.7			Reflectances			0.3		
			Walls	0.5	0.3	0.1	0.5	0.3	0.1	0.5	0.3	0.1
			Room index									
Aluminium industrial reflector, aluminium or enamel high-bay reflector		70	0.6	0.39	0.36	0.33	0.39	0.36	0.33	0.39	0.35	0.33
			0.8	0.48	0.43	0.40	0.46	0.43	0.40	0.46	0.43	0.40
			1.0	0.52	0.48	0.45	0.52	0.48	0.45	0.52	0.48	0.45
			1.25	0.56	0.53	0.50	0.56	0.53	0.49	0.56	0.52	0.42
			1.5	0.60	0.57	0.54	0.59	0.57	0.53	0.59	0.57	0.53
			2.0	0.65	0.62	0.59	0.63	0.60	0.58	0.63	0.59	0.57
			2.5	0.67	0.64	0.62	0.65	0.62	0.61	0.65	0.62	0.60
			3.0	0.69	0.66	0.64	0.67	0.64	0.63	0.67	0.64	0.62
			4.0	0.71	0.68	0.67	0.69	0.67	0.65	0.69	0.66	0.64
			5.0	0.72	0.70	0.69	0.71	0.69	0.67	0.71	0.67	0.66
Near-spherical diffuser, open beneath		50	0.6	0.28	0.22	0.18	0.25	0.20	0.17	0.22	0.18	0.16
			0.8	0.39	0.30	0.26	0.33	0.28	0.23	0.27	0.25	0.22
			1.0	0.43	0.36	0.32	0.38	0.34	0.29	0.31	0.29	0.26
			1.25	0.48	0.41	0.37	0.42	0.38	0.33	0.34	0.32	0.29
			1.5	0.52	0.46	0.41	0.46	0.41	0.37	0.37	0.35	0.32
			2.0	0.58	0.52	0.47	0.50	0.48	0.43	0.42	0.39	0.36
			2.5	0.62	0.56	0.52	0.54	0.50	0.47	0.45	0.42	0.40
			3.0	0.65	0.60	0.56	0.57	0.53	0.50	0.48	0.45	0.43
			4.0	0.68	0.64	0.61	0.60	0.56	0.54	0.51	0.48	0.46
			5.0	0.71	0.60	0.65	0.62	0.59	0.57	0.53	0.50	0.48
Recessed louvre 0.23 trough with optically designed reflecting surfaces		50	0.6	0.28	0.25	0.23	0.23	0.28	0.25	0.23	0.28	0.25
			0.8	0.34	0.31	0.28	0.33	0.30	0.28	0.33	0.30	0.28
			1.0	0.37	0.36	0.32	0.37	0.34	0.32	0.37	0.34	0.32
			1.25	0.40	0.38	0.35	0.40	0.37	0.35	0.40	0.37	0.35
			1.5	0.43	0.41	0.38	0.42	0.40	0.38	0.42	0.39	0.38
			2.0	0.46	0.44	0.42	0.45	0.43	0.41	0.44	0.42	0.41
			2.5	0.48	0.46	0.44	0.47	0.45	0.43	0.46	0.44	0.43
			3.0	0.49	0.47	0.46	0.48	0.46	0.45	0.47	0.45	0.44
			4.0	0.50	0.49	0.48	0.49	0.48	0.47	0.48	0.47	0.46
			5.0	0.51	0.50	0.49	0.50	0.49	0.48	0.49	0.48	0.47

The Utilisation Factor = 0.46

3. The Number of lamps required

Luminance (E) = 200 Lux

Area (A) = Length x Width = 60m x 24m = 1440m²

Flux (F) = 18,000 Lm

Utilisation Factor = 0.46

LLF (Light Loss Factor) = 0.75

Number of Lamps Required = $\frac{\text{Luminance} \times \text{Area}}{\text{FLUX} \times \text{Utilisation Factor} \times \text{Light Loss Factor}}$

FLUX x Utilisation Factor x Light Loss Factor

$$\text{Number of Lamps Required} = \frac{200 \times 1400}{18,000 \times 0.46 \times 0.75} = \frac{288,000}{6210}$$

= 46.37 = **48 Lamps Required is the suitable option**

4. A suitable layout (value of S) for the lamp fittings

The number of Lamps that is required is 46.37 which is 48 Lamps in this case. We need to work out how much spacing we need for the Fluorescent tubes in Diffusing Luminaires. The Smax Formula can be used to work this out, see the formula below:

$S_{\max} = 1.5 \times H_m$ (The mounting Height)

$H_m = 7$ Meters

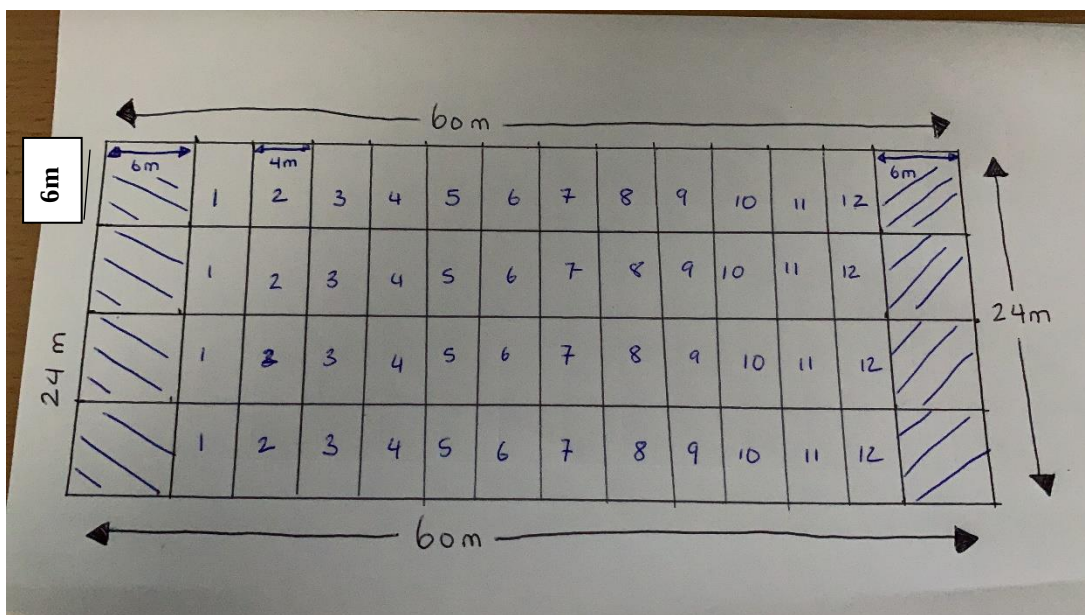
$S_{\max} = 1.5 \times 7 = \mathbf{10.5m \text{ apart.}}$

This means each light can have a maximum distance 10.5m apart in the area required.

2. Draw the plan layout on a scale drawing of the factory floor indicating Your 'best fit' design for the luminaire installation.
Points on the row layout should indicate the position of the lamp centers.

The Number of lamps required from the calculation is **48 Lamps**

Taken from the question it states ' (The actual size for the luminaires is 1200mm (1.2m) in length and 200mm (0.2m) wide.) '



So I have decided that the best layout is **4 Rows of 12 Lamps**

Here is the drawing of the layout of the Lamps

TASK B.

1. A brick wall of area 20m^2 contains a window of area 4m^2 .

The values of sound reduction indexes are:

50dB for the brickwork

10dB for the window.

Calculate the overall sound reduction index for the entire wall.

Overall Sound Reduction index for the entire wall:

Brickwork = 20m^2 (50dB)

Window = 4m^2 (10dB)

Brickwork

$$SRI = 10 \times (\text{Log}_{10} (I/T))$$

$$50 = 10 \times (\text{Log}_{10}(I/T))$$

$$50/10 = (\text{Log}_{10}(I/T))$$

$$5 = (\text{Log}_{10}(I/T))$$

$$I/T = 10^{-5}$$

$$T = 10^{-5}$$

$$T = 0.000010$$

Window

$$SRI = 10 \times (\text{Log}_{10} (I/T))$$

$$10 = 10 \times (\text{Log}_{10}(I/T))$$

$$1 = \text{Log}_{10} (I/T)$$

$$T = 10^{-1}$$

$$T = 0.10$$

$$T = \frac{(T1 \times A1) + (T2 \times A2)}{A1 + A2}$$

$$T = \frac{(0.000010 \times 16) + (0.10 \times 4)}{16 + 4}$$

$$T = \frac{(0.00016) + (0.4)}{20} = 0.020008$$

$$\begin{aligned}SRI &= 10 \times (\text{Log}_{10} (I/T)) \\SRI &= 10 \times (\text{Log}_{10} (I/0.20008)) \\&= 10 \times (\text{Log}_{10} (49.98)) \\&= 10 \times 1.6987 \\&= 16.987 \\&= 17 \text{ dB Overall Sound Reduction}\end{aligned}$$

2. Discuss the implications of frequency and wavelength in internal sound management, partition wall construction technique and insulation choice. (500 words)

Should Be focused in focus in sound, transmission, Absorption and Reflection.

We consider sound management with construction methods and partition composition

How? What measures do we take? What consideration in design

Sound

Sound waves are spread through particles as it moving further away from its Source. Sound can be measured and controlled by looking at the range of sound that is emitted. This can be classed as High or Low sound and range from below 20Hz to over 20,000 Hz. Low sound is classed as infra sound and the higher Hz is classed as Ultra Sound. Measuring sound when undergoing construction is so important to have the best quality possible. Noise that is being created outside of the house needs to be reduce as it enters in the house to reduce earing health related problems and unnecessary stress and mental issues for the occupant of the household. Noise can be created from many different sources and create a problem for the occupant, things that could create noise that could be a problem are:

- Traffic
- Nearby Construction Sites
- Machinery
- Loud Music from TV's, Music Players etc.
- Talking and nearby Parties
- Restaurants
- Pubs
- Nearby Industrial Works such as the Steel Works

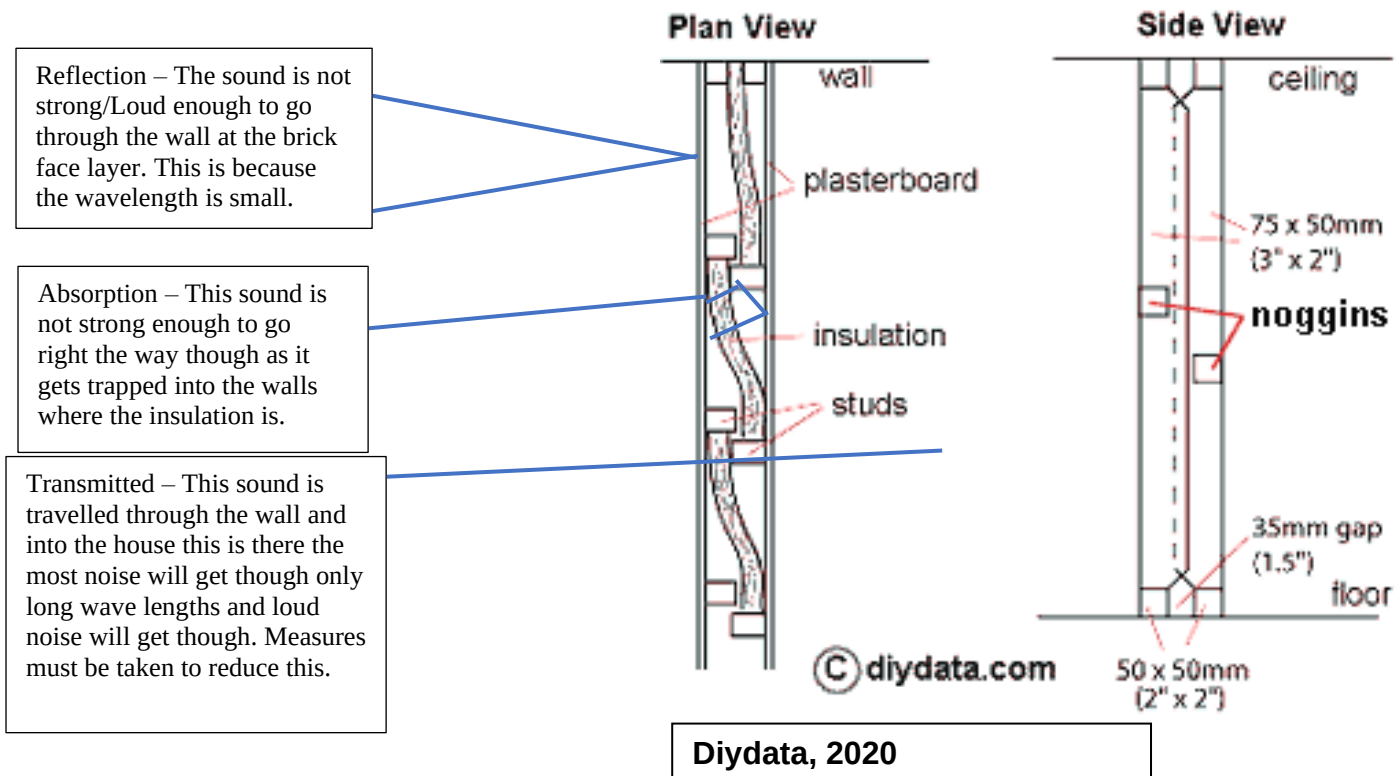
To control these Noises and sounds or decrease them to be able to live in that house without problems, you could undertake a few ideas. The standard of the construction is always changing and improving and there are also measures that are put in place to decrease these noises as stated above, such as building regulations and also under **Part E, Resistance to the passage of sound** which sets the minimum standard for construction of houses to deal with the noise, in the design and the construction process. In order to control other sources that are not easy to measure

is traffic and loud music as these will change on a daily basis but there are things that will need to be done extra to just the stud partition itself to block the sound waves from hitting the house itself, you could add a protection barrier to muffle the sound of the traffic or increase the amount of insulation in the walls or better quality insulation to increase the protection from outside noise.

Timber Stud Partition Walls with insulation

In the timber stud partition it is important when installing insulation that you take the three factors into consideration, *transmission, Absorption and Reflection*.

When looking at the timber stud partition walls it is important to look at how much is reflected, transmitted and absorbed during the process of noise hitting the stud partition. This will all depend on the barrier that is in place and what is put there to decrease the projection of that sound. In the design of the timber stud partition it is important to reduce the noise that comes into the building, see a typical design of Timber Stud Partition:



References

(Diydata, 2020) - Picture of a stud partition Retrieved from :
https://www.diydata.com/general_building/sound_partition/partition_proof.php