EEE 3352

Electromechanics & Electrical Machines

Lecture 9: Examples

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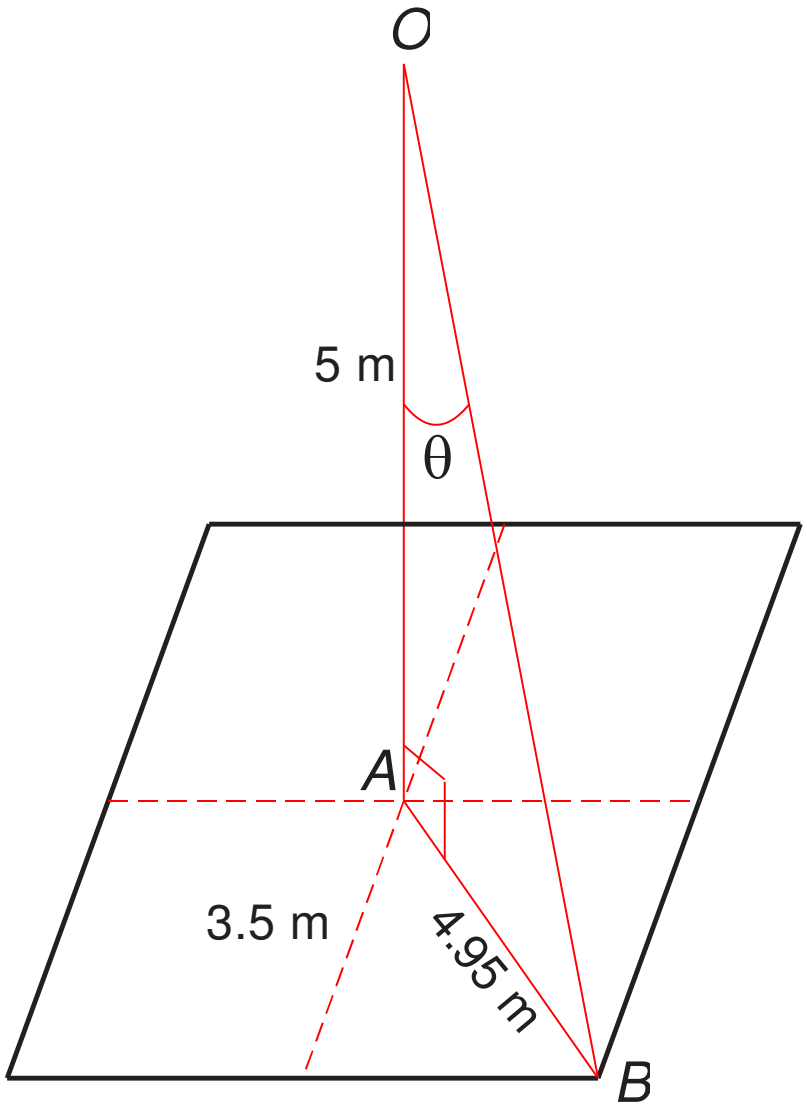
Examples 9:

1) A 500-cd lamp emits light uniformly in all directions and is suspended 5 m above the centre of a working plane which is 7 m square. Find the illuminance below the lamp and also at each corner of the square.


O
5 m
θ
A
3.5 m
4.95 m
B

- below lamp: $E_A = \frac{I}{d^2} = \frac{50}{5^2} = \underline{\underline{20\ \text{lx}}}$

- at each corner:

$$E_B = E_A \cos^3 \theta$$

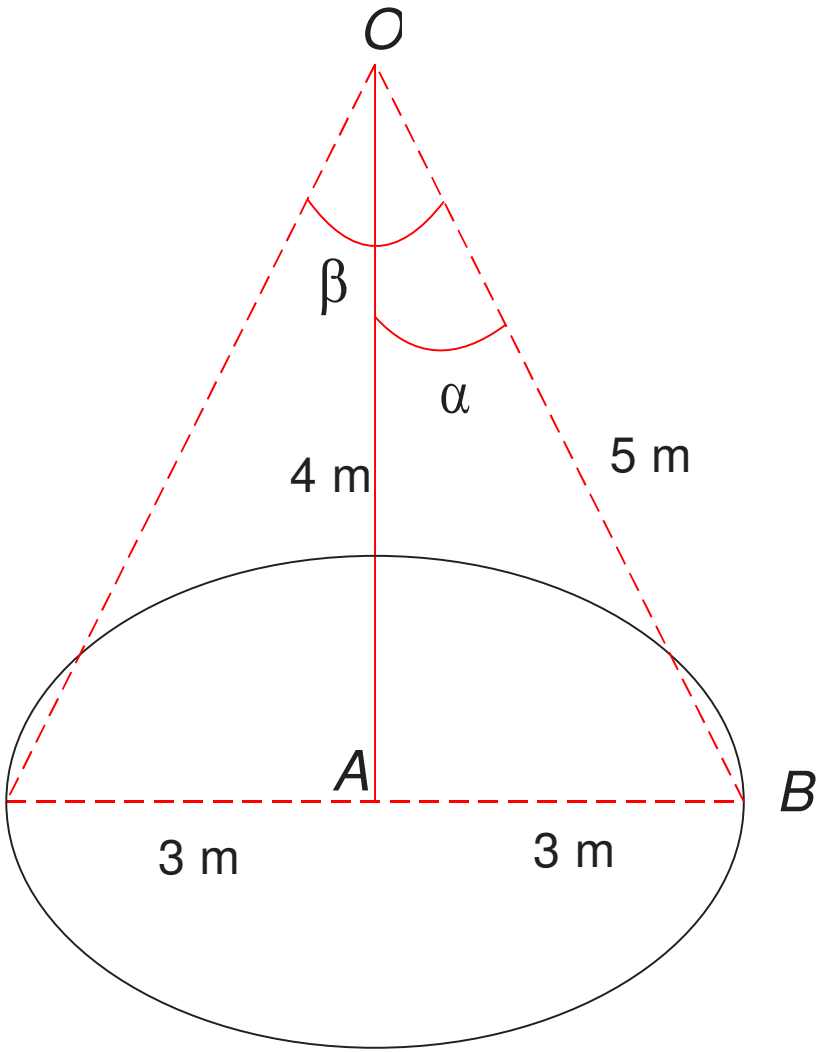
$$\cos\theta = \frac{5}{\sqrt{5^2 + 4.95^2}} = 0.71$$

$$E_B = 20 \times \cos^3 0.71 = \underline{\underline{7.18\ \text{lx}}}$$

2) A lamp having a luminous intensity of 500 lumens per steradian is hung 4 m above a circular area of 6 m diameter.

Calculate the illuminance at

a. centre of area
b. periphery of the area
c. average illuminance on the area


O
β
α
4 m
5 m
A
B
3 m
3 m

a. centre of area

$$E_A = \frac{I}{h^2} = \frac{500}{4^2} = \underline{\underline{31.25 \text{ lx}}}$$

b. periphery of the area

$$\alpha = \cos^{-1}\left(\frac{4}{5}\right) = 0.8$$

$$E_B = E_A \cos^3 \alpha$$

$$E_B = 31.25 \times \cos^3 0.8 = \underline{\underline{16 \text{ lx}}}$$

c. average illuminance on the area

$$\omega = 2\pi(1-\cos\alpha) = 2\pi\times(1-0.8) = 0.4\pi$$

$$\phi = I\omega = 500\times 0.4\pi = 200\pi$$

$$A = \pi r^2 = 3^2\pi = 9\pi$$

$$E_{av} = \frac{\phi}{A} = \frac{200\pi}{9\pi} = \underline{\underline{22.2\ \text{lx}}}$$

1) A drawing hall 30 m x 15 m with a ceiling height of 5 m is provided with general illumination of 120 lx. Taking U.F. = 0.5, M.F. = 0.71, determine

   a) the number of fluorescent tubes required

   b) their spacing

   c) mounting height and total wattage.

The luminous efficacy of a fluorescent tube is 40 lm/W for an 80-W tube.

a) the number of fluorescent tubes required

$$A = 30 \times 15 = 450 \text{ m}^2$$

$$\text{total lumens} = \frac{EA}{U.F. \times M.F.} = \frac{450 \times 120}{0.5 \times 0.71} = 151200 \text{ lm}$$

W

$$\text{wattage}_{(80\text{-W bulbs})} = \frac{EA}{U.F. \times M.F.} = \frac{151200}{40} = 3780 \text{ W}$$

$$\#\text{ of bulbs}_{(80\text{-W})} = \frac{3780}{80} = 47.25 \simeq \underline{\underline{48}}$$

b) lamp spacing

30 m x 15 m

48 = 48 x 1

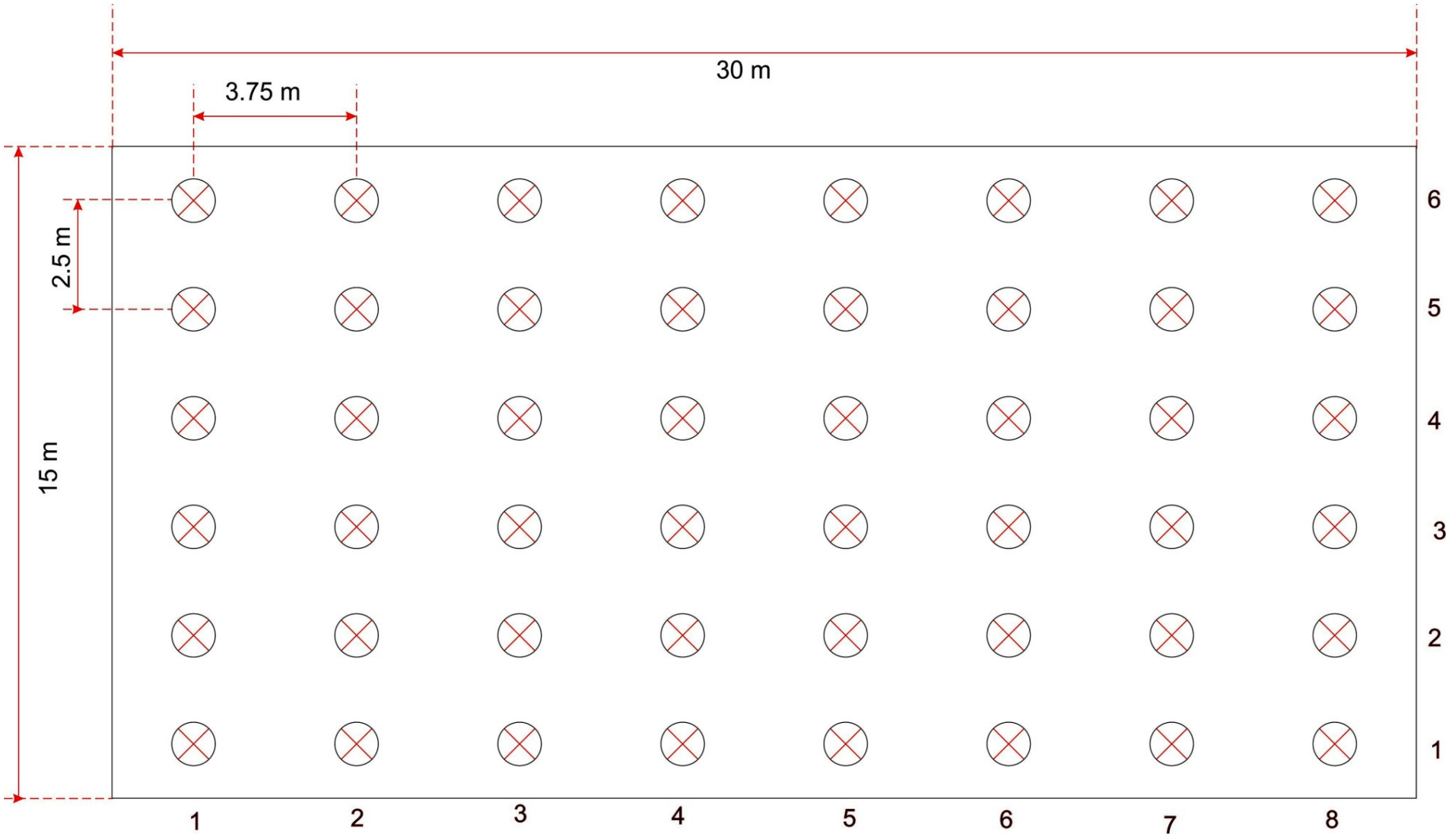
= 24 x 2

= 12 x 4

= 16 x 3

= 8 x 6

a) mounting height and total wattage



- Assume a mounting height of 2.5 m above working surface

Ass 9 illumination

	A	B	C	D	E	F	G	H
1								
2	number	n	48		3			
3	width	w	15	m				
4	length	l	30	m				
5	height	h	2.5	m				
6					width-spacing	lenth-spacing	ratio_width	ratio_length
7		# width	# length		d_w (m)	d_l (m)	(d_w)/h	(d_l)/h
8		1	48		15	0.625	6	0.25
9		2	24		7.5	1.25	3	0.5
10		3	16		5	1.875	2	0.75
11	*	4	12		3.75	2.5	1.5	1
12	*	6	8		2.5	3.75	1	1.5
13								

- Assume a mounting height of 2.5 m above working surface

  - width $d / h = \frac{15/6}{2.5} = 1.0$

  - length $d / h = \frac{30/8}{2.5} = 1.5$

Total wattage = 3.78 kW