Benha University

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Faculty of Engineering at Shoubra
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Ameeria Integrated
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Undergraduate Course

Electric Installation Design

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Lecture (4)

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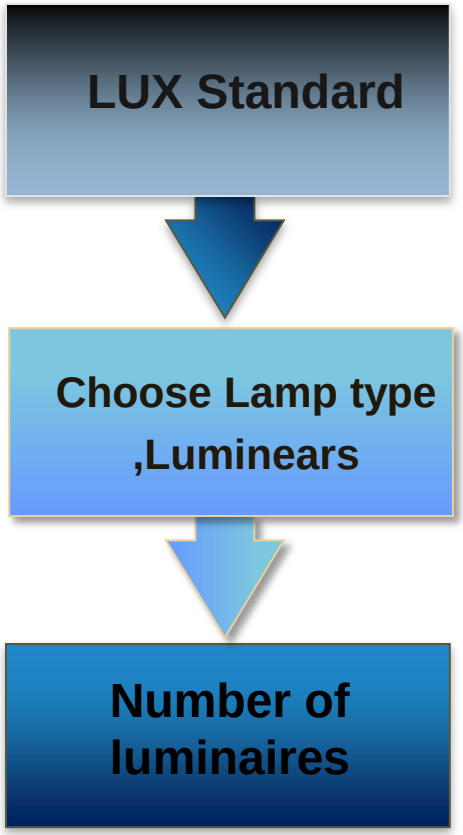
1st step

Lighting design steps



1st step : Determine the required lux in each room

Get from :

- Standard - Egyptian Code

2st step : Choose the Lamp type according to :

1- application

2- COLOR RENDERING , ROOM HEIGHT

3- MOUNTING TYPE , LIGHT DISTRIBUTION, SHAPE, COMPONENT , IP

3st step : Calculate Number of Luminaries Required

- Distribution of Luminaries

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Lux Standard (Egyptian Code)

ملحق رقم (م1) :معايير شدة الإضاءة

جدول رقم (م1): مستوى شدة الإضاءة فى الفراغات المختلفة للمبانى

المكان		شدة الإضاءة (لوكس)
المبانى السكنية	سلالم	120
	ممرات	60
	غرفة معيشة :	
	عام	150
	قراءة	300
	غرفة طعام	120
	غرفة نوم	120
	مطبخ :	
	عام	120
	أسطح العمل	500
	حمام	300
	حجرة مكتب :	
	- عام	300
	- سطح المكتب	500

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Choose Lamp According to RA

Ra	Application
Above 90	Colour Matching, Picture Galleries
80 - 90	Homes, Restaurants, Textile Industry
60 - 80	Offices, Schools, Light Industry
40 - 60	Heavy Industry
20 - 40	Outdoor

جدول رقم(2-11): خصائص المصابيح الفلورية T8 ذات اللون الأبيض

درجة البياض		درجة الحرارة اللونية (°K)	الكفاءة الضوئية (لومن/وات)	دليل أمانة نقل الألوان (R%)
Cool white	أبيض بارد	4000	80	69 – 60
Deluxe cool white	أبيض بارد دي لوكس	3800	65	100 – 90
Warm white	أبيض دافئ	3000	80	59 – 40
Deluxe warm white	أبيض دافئ دي لوكس	3000	65	100 – 90
Universal white	أبيض	3500	65	79 – 70
Daylight	ضوء النهار	6000	67	79 – 70
Deluxe daylight	ضوء النهار دي لوكس	5400	58	100 – 9

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What is the meaning of CR

Color Rendering (CR):

is a quantitative measure of the ability of a light source to reveal the colors of various objects faithfully in comparison with an ideal or natural light source.

Different type of Lamps

Incandescent lamp) - المصباح المتوهج

1

Efficiency : 13 lumen / W
RA : 100
USED: DOMESTIC LIGHTING

Tungsten – halogen lamp)

2

Efficiency : 14-22 lumen / W
RA : 100
USED: DECORATION

Fluorescent lamp

3

Efficiency : 58-99 lumen / W
RA : 40-100
USED: GENERAL LIGHTING

(Low pressure sodium lamp, SOX) - مصباح صوديوم ذو ضغط منخفض

4

Efficiency : 100-200 lumen / W
RA : 20
USED: STREET LIGHTING

.(High pressure sodium lamp, HPS) - مصباح صوديوم ذو ضغط عال

5

Efficiency : 95-150 lumen / W
RA : 45
USED: STREET LIGHTING, COMMERCIAL

(High pressure mercury vapour lamp, HPM) - مصباح زئبق ذو ضغط عال

6

Efficiency : 55 lumen / W
RA : 40
USED: STREET LIGHTING, INDUSTRIAL

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Work plan height

Fluorescents	Mounting Heights
36 Watt	up to 4 meters
58 Watt	up to 5 meters

For heights over 5m use highbay or lowbay.

High Bay Luminaires using Metal Halide Lamps	Minimum Mounting Heights
70 Watt	2.5 meters
125 to 150 Watt	3.5 meters
250 Watt	5 meters
400 Watt	8 meters
1000 Watt	10 meters
1500 Watt	12 meters
2000 Watt	15 meters

استخدام الوات المرتفع علي ارتفاع قليل قد يسبب بهر glare غير مقبول

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Luminaries types

Selection of luminaries determined by

Luminaries components

* Lamp type
* Ballast

* Housing

Luminaries classification

* Mounting type (Recessed-surface)
* Light Distribution
* IP
* Shape

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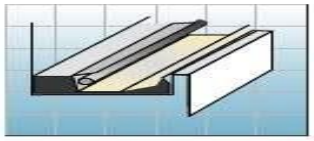
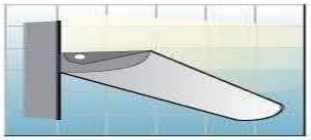
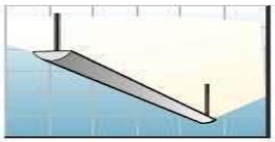
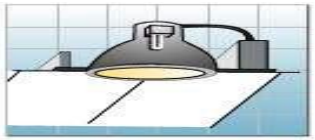
Luminaries classified by mounting type


Cove-mounted Uplighting


Wall-mounted Uplighting

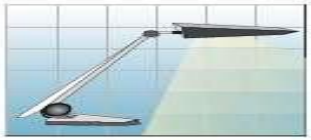

Suspended Linear Fluorescent Luminaire


Recessed Round Downlight


Open HID High-bay (Metal Reflector) Luminaire

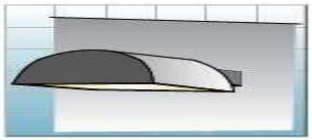

Recessed Round Wall-washers


Decorative Pendant Downward Light

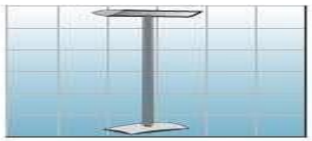

Portable Task Lighting

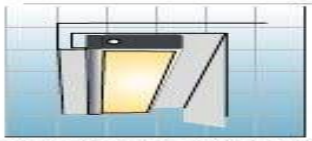

Track Lighting (Metal Halide)

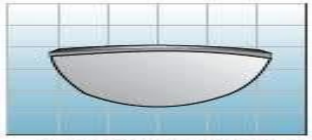

Track Lighting (Incandescent)

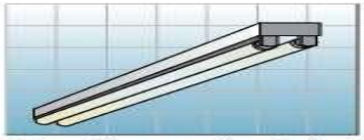

Functional Wall Sconce

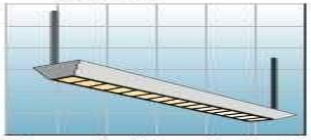

Open Fluorescent Luminaire, Refl. Industrial


Portable Torchiere Uplight

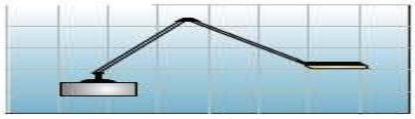

Task Lighting, Fixed and Furniture Integrated


Decorative Wall Sconce

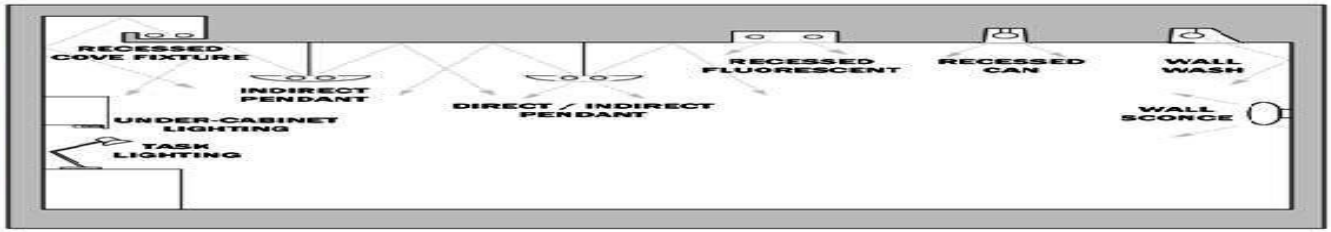

Open Fluorescent Luminaire, Striplight


Suspended Direct-Indirect Fluorescent Luminaire (mostly up)


Open HID High-bay Luminaire, Glass or Plastic Reflector


Typical Compact Fluorescent Task Light

LED Exit Sign



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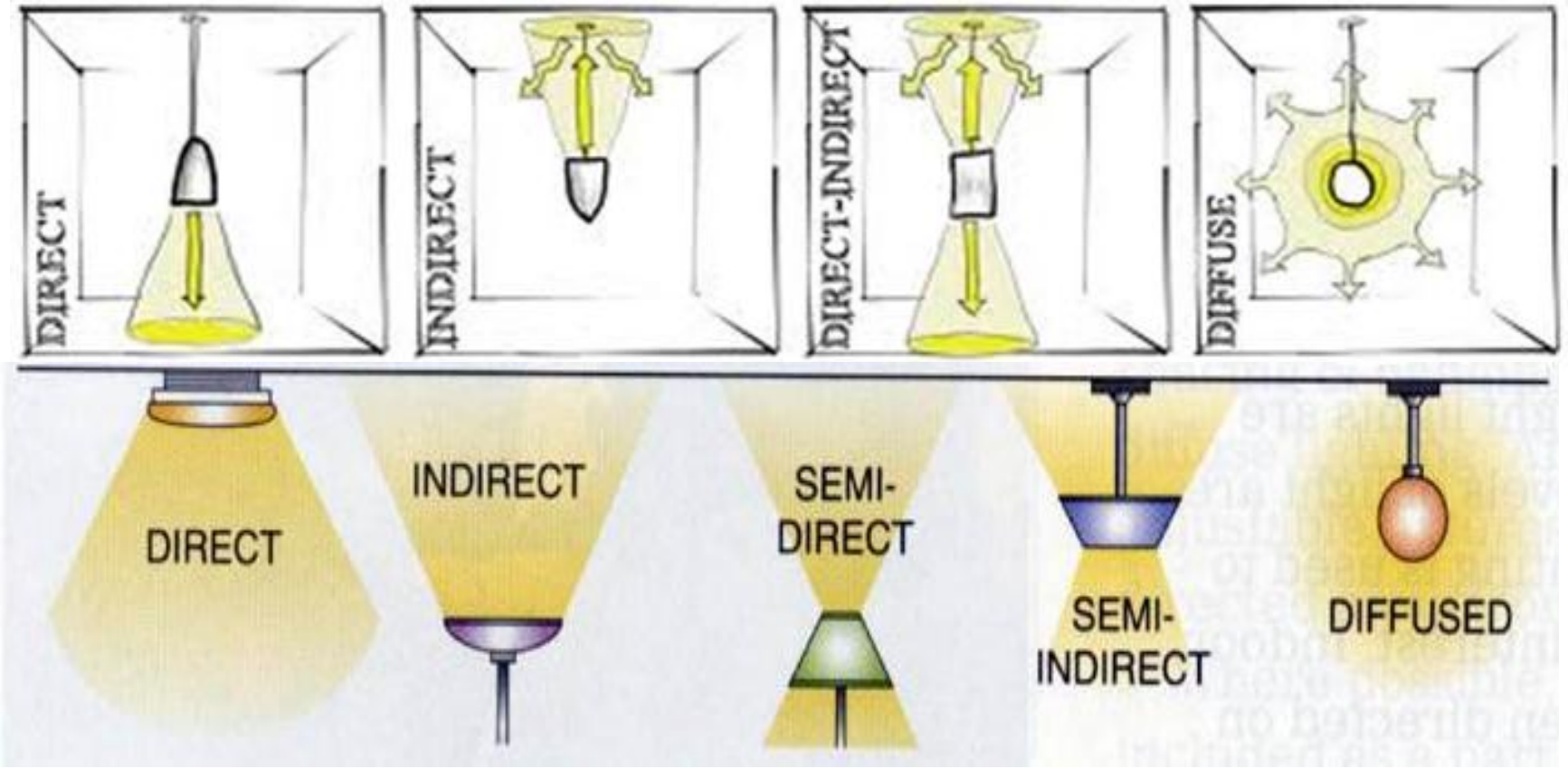
Luminaries classified by light distribution



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Luminaries classified by shape or form

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Ingress Protection (IP)

- **Ingress Protection Rating**

- consists of the letters IP followed by two digits and an optional letter.
- it classifies the degrees of protection provided against the intrusion of solid objects, dust, accidental contact, and water in electrical enclosures.
- Max IP = 68

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Number of luminaires

$$N = \frac{E \times A}{\varphi \times LLF \times Uf}$$

Where:

N: Number of Luminaries

E: Lux of Location (code)

A: Area

Φ: Lumen of Lamp (lamp catalog)

LLF: Light Loss Factor (Take this Factor: (0.8 → Residential, 0.6 - 0.7 → Industrial)

UF: Utilization Factor (In most cases we take it 0.8)

Note:

- Number of Luminaries (N) may be 5.4 so we approximate it to 6 Luminaries.
- Distance between two luminaries must be equal double distance between to wall and luminaries.

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An example of calculating the number of indoor lighting luminaires

1. **Given**

a) An office area has length: 20 meter; width: 10 meter; height: 3 meter.

b) The ceiling to desk height is 2 meters.

c) The area is to be illuminated to a general level of **250 lux** using twin lamp 32 watt CFL luminaires.

d) Each lamp has an **initial output** (Efficiency) of 85 lumen per watt.

e) The lamps **Light Loss Factor (LLF)** is 0.8

f) **Utilization Factor (Uf)** is 0.8 and **space height ratio (SHR)** is 1.25.

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2. Calculation

a) **Total wattage of luminaires=** Number of lamps x each lamp's watt.

$= 2 \times 32 = 64$ Watt

b) **Lumen per luminaire=** Lumen efficiency(Lumen per Watt) x each luminaire watt

$= 85 \times 64 = 5440$ Lumen

c) Number of **luminaires=**

$$N = \frac{E \times A}{\varphi \times LLF \times Uf}$$

$= (250 \times 20 \times 10) / (5440 \times 0.8 \times 0.8) = 14.36$ luminaires

(We will need 16 luminaires)

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d) **Minimum spacing between each luminaire**

The ceiling to desk height is 2 meters and space height ratio is 1.25, so

Maximum spacing between luminaire= 2 × 1.25 = 2.25 meter

e) **Number of required rows of luminaires along with width of room**

Number of rows required= Width of room/Max. spacing=10 / 2.25

= 4 rows

f) **Number of luminaires required in each row**

Number of luminaires required in each row=Total luminaires/Number of rows

= 16 / 4= 4 luminaires in each row

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g) **Axial spacing between each luminaire**

Axial spacing between luminaires= Length of room/Number of luminaires in each row

=20 / 4 = 5 Meters

g) **Transverse spacing between each luminaire**

Transverse spacing between luminaires= Width of room/Number of luminaires in row

=10 / 4 = 2.5 Meter.

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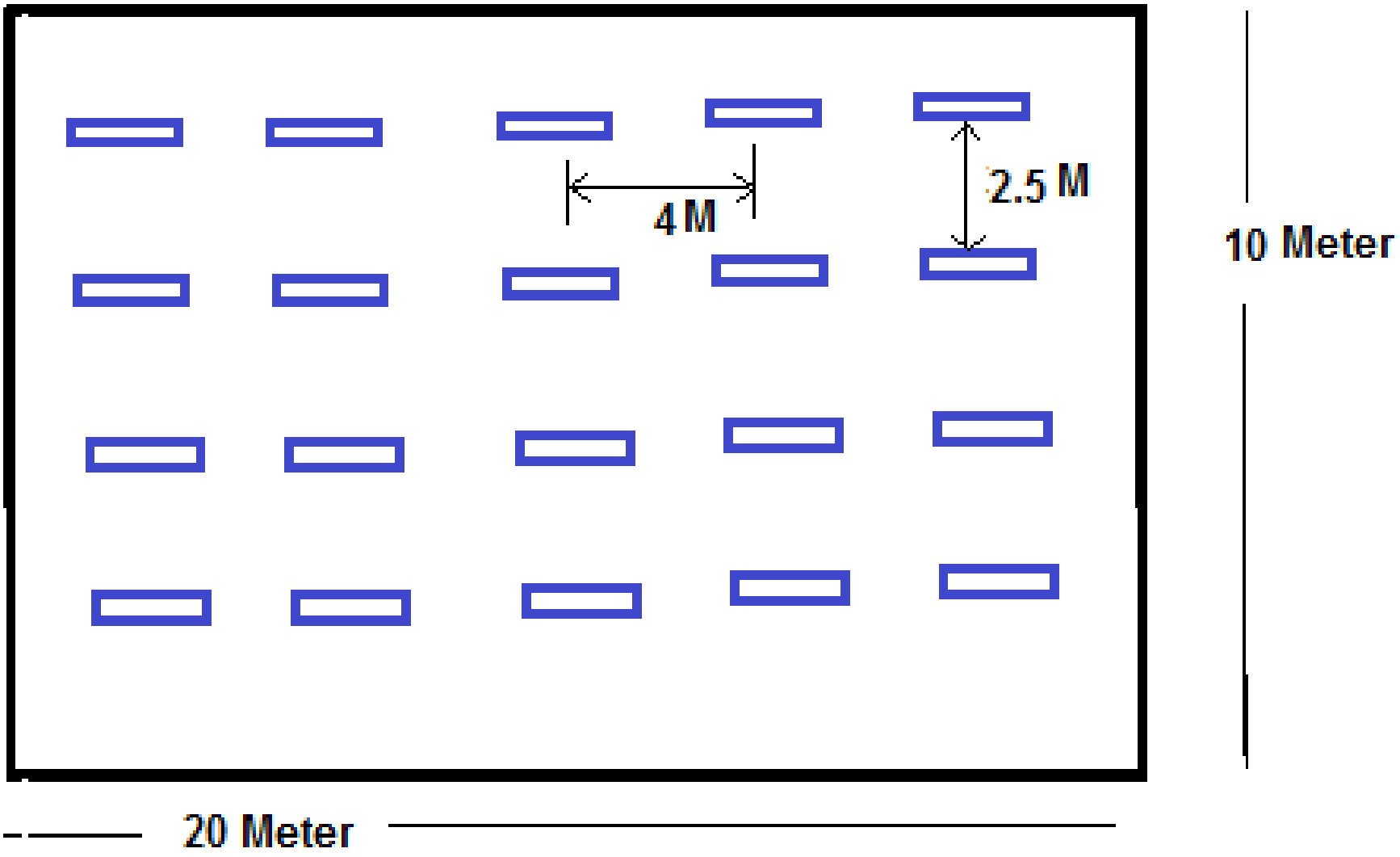

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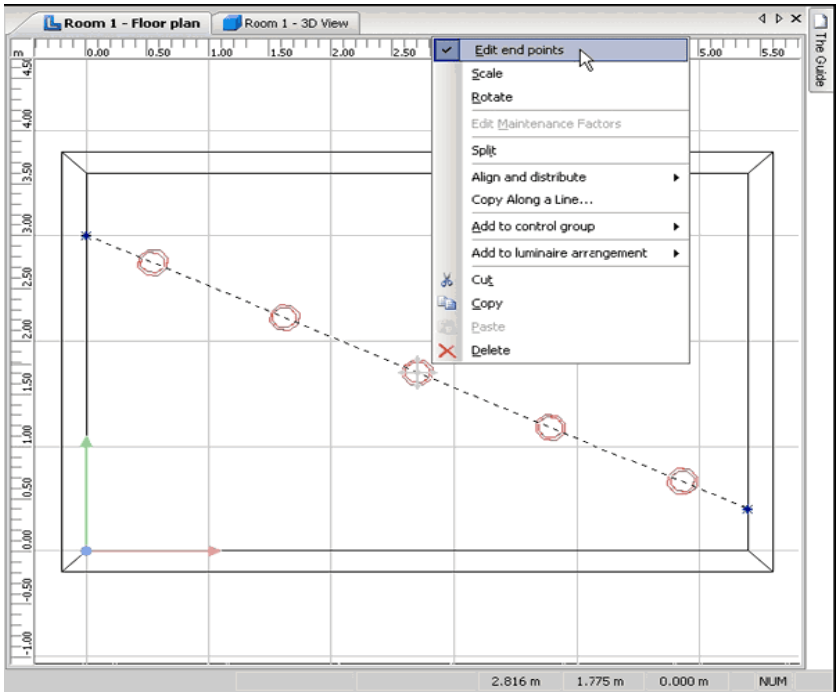
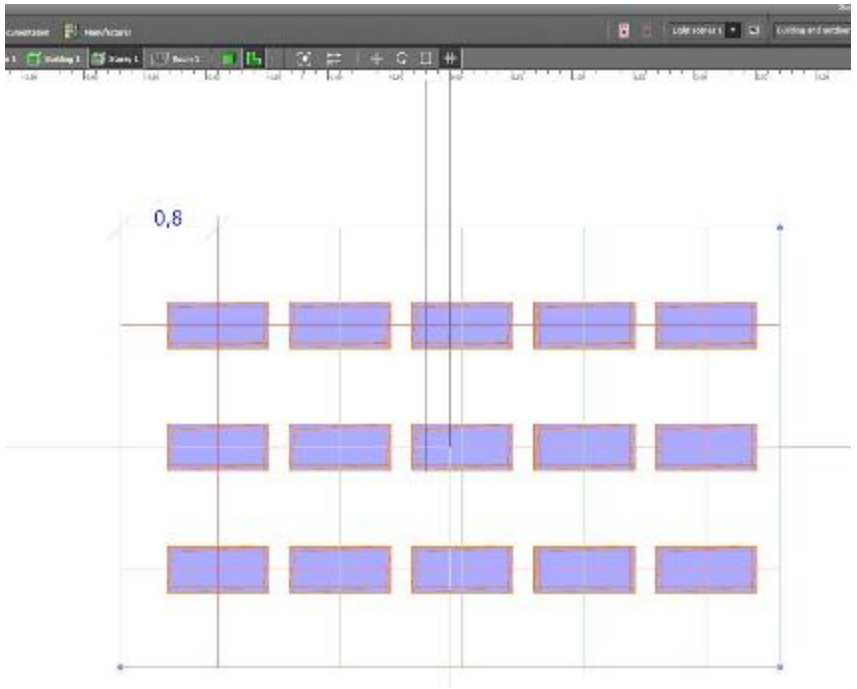
Arrangement of Luminaries

Luminaries Arrangement

line arrangement



field arrangement



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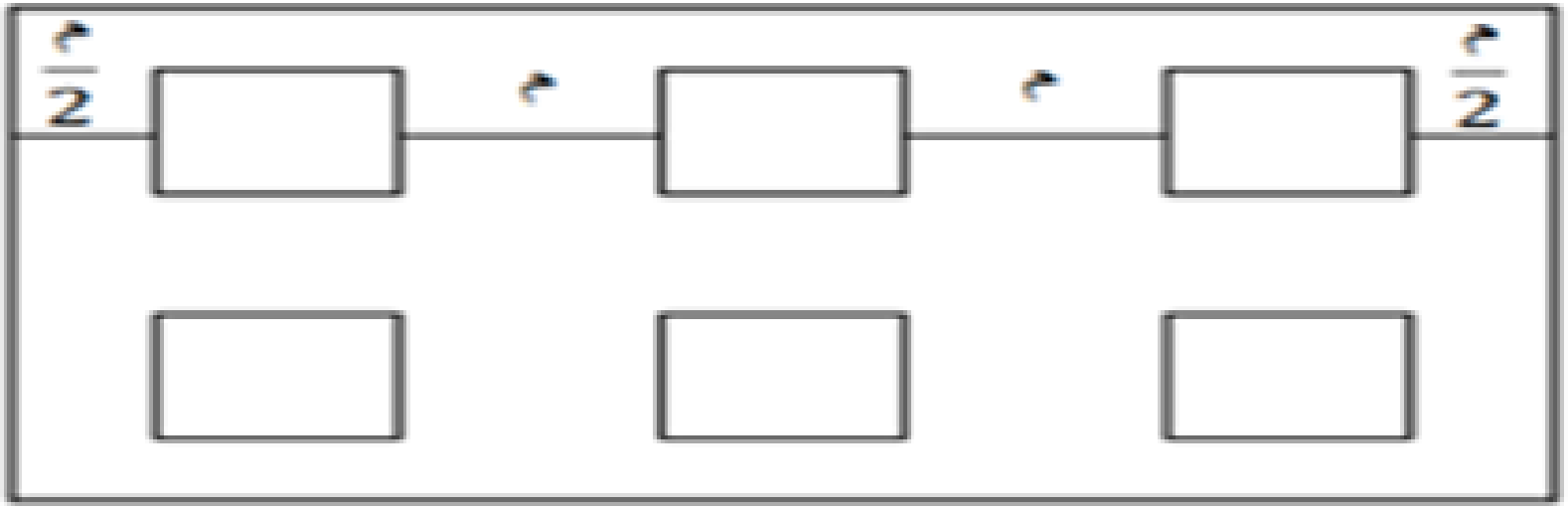

Number of luminaries in length= $\sqrt{no.of.lumiaries * \frac{length}{width}}$

Number of luminaries in width= $\sqrt{no.of.lumiaries * \frac{width}{length}}$

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Arrangement Constraints

- Distance between Luminar and another Luminar= double the distance between Luminar and Wall.
- Space height = 0.8 to 1.2

  * **Where:** Space → Distance between Luminaries

    Height → Distance between Luminar and work plane.
- E_{av} = Desired E ± 10%
- Uniform Distribution Factor: $E_{min}/E_{max} \geq 0.5$.
- Percentage of Eye Comfort: $E_{av}.E_{max} \geq 0.4$