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A Study On Energy Efficient Lighting

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***Abstract*: - Energy efficient lighting, whether it is from natural source or artificial source (electric devices) or a combination of both, should provide for the optimal visual performance and visual satisfaction. Besides this it also gives clear economic and social benefits. This may be related to productivity in factories and offices, sales promotion, creation of suitable atmosphere in hotels and restaurants, road traffic safety, national pride and heritage or efficient Lighting with blending of natural light with artificial Light and blending of light aesthetics with energy conservation. The sources of natural light are direct sunlight, clean (blue) sky light, clouds, reflection from ground and nearby buildings and moon light. The sources of artificial light may be incandescent lamps, fluorescent lamps and light intensity discharge lamps.**

1. INTRODUCTION

1.1 LIGHTING SYSTEM

Every lighting system consists of lamps, fixture or luminaries and control system. Each component is an important part of the system and each offers opportunities for improved performance and energy savings [1]. The various aspects of study of lighting technology are (i) Light Generation (ii) Light Distribution (iii) Lighting control (iv) Lighting maintenance.

1.2 RULES FOR ENERGY EFFECTIVE LIGHTING

In order to get the right light, at the right place, at the right time it is necessary to define the situation in terms of problems such as task type, task location and area, occupancy and environment (Physical and Aesthetical) [2]. The comparative performance data for light types is given in Table.1.

i. Design the installation in order to obtain the solution for best lighting for minimum watts, maximum flexibility for minimum kWH, optimum total energy management.
ii. Analyze cost-performance to choose by comparing alternative solutions and then select final design and operation.
iii. Optimize quality and quantity of light after considering the important parameters like Illumination, luminance, luminance ratio, luminance efficiency, co-efficient of utilization, Color temperature and color rendering index (CRI) and lighting quantities.
iv. Selection of Illumination should depend upon the contrast, size, time, luminance (measured brightness), and color (related to both contrast & ill-luminance).
v. Luminance is the bounce back light that enters our eye and creates visual sensation.
vi. Luminance = (Reflectance x Ill-luminance)
vii. Luminance Efficiency = light output emitted by a luminance / Light output emitted by the lamp & ballast combination.
viii. Co-efficient of Utilization = light output from the lamp received on a plane / Light output emitted by the lamp and ballast combination.
ix. Luminance Ratio which refers to the ratio of the brightest object in the eye's field of view to the darkest. Ratios of three to one or less create even, comfortable lighting for work spaces, While ten-to-one (or higher) ratios create dramatic contrast which are suitable for retail stores, theaters, or restaurants [3]. Our eyes sees only the difference in luminance and not absolute.
x. Color Temperature which refers to the temperature of a black body radiator of comparable color. The higher the color temperature the "cooler" or Bluer the light [4].
xi. (x) Color Rendering Index describes the ability of a light source to accurately render a sample of eight standard colors relative to a standard source. High CRI sources render better than low-CRI sources.

2. BALLASTS

There are two ballasts are Electronic and Magnetic ballasts. The advantages of electronic ballasts are that it has high power factor, power saving by almost 30%, higher luminance efficiency, increase in overall efficiency [5], increased lamp life by 25% due to cooler conditions, high operating life, no requirement for starter, instant start, continued function with low voltage and dimming control. The typical application for types of lamps is shown in Table.3.

3. LIGHT DISTRIBUTION AND MAINTENANCE

For More efficient distribution, a lamp and its luminary must be optically matched. The selection of luminaries should depend on the utilization factor of the luminaries and Maintenance [6]. Regular cleaning of Lamps, Luminaries, Interior room surfaces are required. Sufficient lighting is provided when and where it is required. Lighting should be reduced or switched off whenever and wherever it is appropriate to do so. Switching and lighting control are given in Table.2.

Table: 1 Comparative Performance data – Lamp types

Lamp type	Rating (W)	Initial efficiency lmW)	Useful Life (h)	Remarks
Incandescent (GLS)	25 - 75 (cc) 100 - 30 (cc) 500-1500(cc)	9 - 12.5 13.6 -16.7 16.4 - 19.7	1000	In each group efficacy increases with wattage
Tubular fluorescent (TL) (halo	20/40/ 65/80	40 - 60/50 - 75 55-75/48- 68	6000 to 8000	In each size the lower efficacy value relates

phosphate)				to lamps with the better colour rendering properties
Narrow-band	18 – 58 18 – 58	90 - 96 63	6000 to 8000	CRI of > 80 CRI of > 90
Compact	9 – 32	67	6000 to 8000	CRI of > 80
High pressure Mercury fluorescent (MBF)	50/80 125/250 400/700 1000	40/45 50/52 54 58	8000 to 10000	
Metal – halide (MBI) 90	175/250/400/ 2000	60/75/80/ 95	6000 to 10000	
Low Pressure Sodium Vapour (SOX)	35/55/90/131	130/140/145/200	8000 to 10000	
High Pressure Sodium Vapour	100/150/250/ 400/1000	95/100/110/120/ 130	8000 to 10000	Lm W-1 values are for clear outer jacket types. Intermediate wattage are made for direct replacement of MBF lamps

Table: 2 Lighting Controls

Photocell Switch	Day Light Linked	Photocell & Regulator
Time Switch	Automatic	Programmed Controller
Local Switching	Automatic /Manual	Automatic control
Group switching	Automatic / manual	Automatic control

Table: 3 Light Generations

Si.No	Lamp Type	Typical Application
1	Low Pressure Sodium	Road lighting, security area lighting (poor colour rendering)
2	High Pressure Sodium	Medium and High bay industrial, road and area lighting
3	Modern Fluorescent	In factories, Offices, shops, hotels, restaurants and some domestic application
4	Metal Halide	Floor lightning of sports stadium and arenas; high bay industrial and studio lighting; commercial lighting
5	Mercury Fluorescent	Industrial and road lighting, some commercial application
6	Compact Fluorescent	Comparable to low wattage tungsten lamps. Application as for tungsten GLS
7	Mercury blended	Used mainly as a plug-in replacement for tungsten GLS where a longer life is required
8	Tungsten Halogen	Floodlighting, display lighting, projectors and vehicle lighting
9	Tungsten GLS etc	Domestic and many amenity type applications in commerce and industry. Display lighting

4. CONCLUSION

The key steps to creating an efficient and effective lighting system follows:

Design to get the right amount of light for the task and distribute the light to prevent glare. Take advantage of natural day light whenever possible, but avoid direct sunlight and install appropriate control for the electric lights.

- ❖ Use high efficiency fluorescent and incandescent sources to round out the lighting system and provide visual interest.
- ❖ Use high intensity Discharge (HID) systems, particularly high-bay lighting.
- ❖ Use right kind of energy saving lamp and electronic ballast.
- ❖ Use High efficient luminaries.
- ❖ Improve Room properties (Increase reflectance of ceilings, floors, walls and properly arranged furniture in the room)
- ❖ Reduce un-utilized sources.
- ❖ Control light through electronic controllers
- ❖ Take good maintenance programme by the group re-lamping and cleaning of lamps, luminaries and windows periodically.
- ❖ Take awareness programme (i) for the manufactures and (ii) for users.
- ❖ Arrange interactive programme with the industry and Educational centers.
- ❖ Plan Energy management in Lighting for a long duration of minimum 5 years.

5. REFERENCES

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