Design of Revised Illumination Scheme for Educational Institute To Achieve Energy Saving

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Abstract- *An educational sector consumes majority of electric power for the purpose of lighting, air conditioner and computer loads. In this paper an attempt is made to present a case study carried out at an educational institute for the purpose of energy saving. The supply distribution scheme is briefly discussed, a detailing about lighting load survey is included. Some modifications are suggested for improvement in quality of illumination and energy saving. The results are verified using Lite Pack software. The economics also include in concluding part.*

Keywords- illumination, lux, Lite-Pack software

I. INTRODUCTION

Energy crisis due to demand supply gap is one of the main problems in existing world. The generating capacity increment involves lot of investment and considerable time. Hence conservation part needs more focus to reduce demand-supply gap.

Lighting systems represent an important piece in the overall building structure. This system represents approximately 10% of total electric energy load in country. More than 20% of electricity used in home goes into lighting and in a commercial building this contributes more. In all educational institutes lighting load has significant amount of contribution out of total connected loads. For the educational institute the lighting load is almost 40 to 50% of total load.

The existing lighting scheme is analysed by taking actual lux measurements of different occupancies and existing lighting load is evaluated. A revised illumination scheme is proposed by considering factors such as availability of natural light, requirement of illumination for different types of occupancies, replacement of existing luminaries by energy efficient luminaries and also by repositioning of luminaries.

II. DETAILS OF SUPPLY DISTRIBUTION AT AISSMS's IOIT

AISSMS's campus is supplied through 500 KVA transformer of 11KV/440V range. The power supply is for pharmacy, polytechnic, management, primary and secondary school and IOIT through the same transformer.

An APFC panel of 250 KVAR is provided to maintain power factor close to unity. DG set of 125 KVA is used for emergency backup supply for few essential load of college building. Total lighting load of institute is 53.75 kW.

III. LIGHTING AUDIT METHODOLOGY

Following steps are involved-

- Evaluation of existing lighting load. (Table:1)
- Measurement of illumination level using lux meter at different occupancies (Fig 1).
- Study of existing luminaries and its position.
- Design of revised illumination scheme by referring respective standards and illumination design software. (Lite-Pack) (Table 2, Fig 2).
- Compare existing illumination scheme with revised illumination scheme.
- Economic analysis.

IV. SURVEY OF LIGHTING LOAD

Survey of load is carried out to determine the connected load of AISSMS's IOIT. The existing luminaries (FTL) are counted and tabulated as below:

Table 1:Number of existing luminaries

Place	Number of luminaries					
	FTL		PL Tube		LED	
	40 w	36 w	5 w	11 w	9 w	28 w
Parking/workshop	-	155	-	-	-	-
Office and ground floor	44	132	16	7	14	16
Library and 1st year Dept.	-	213	-	-	4	-
Electrical dept.	-	173	-	-	-	-
E & TC dept.	-	145	-	-	-	-
Electronics dept.	-	137	-	-	-	-
Computer dept.	-	115	-	-	-	-
IT dept.	-	140	-	-	-	-
Instrumentation dept.	-	124	-	-	-	-
Staircases and toilets	-	43	-	35	-	-
Misc.	-	25	-	-	-	-

The lighting load consumes 53.759 kW. It includes different types of luminaries shown in table 1. According to geometrical structure of building majority (60%) portion of institute gets sufficient sunlight (250 lux) during day time. So, it is not necessary to switch on all the luminaries at the same time.

Energy consumption calculation:

The complete lighting load in terms of kW-hr is calculated for 8hrs per day, hence total energy consumption through lighting load:

- Duration of use of lights in one year excluding Sundays and holidays = 8 hrs × 303 days = 2424 hrs
- Total energy consumption = 53.759 ×2424
- = 1,30,311.816 kW-hr
- Average per unit cost is □12/-
- Annual lighting bill in □15,63,741/-

V. REVISED ILLUMINATION SCHEME

Following points are considered while designing revised illumination scheme:

- Geometry of room with respect to natural light.
- Location of working plane.
- Location of existing luminaries.
- Required lux level as per standard (IES LM 80).

The revised illumination design is obtained by Lite-Pack (Havells-version 3) software. In this software, the design can be obtained by two methods

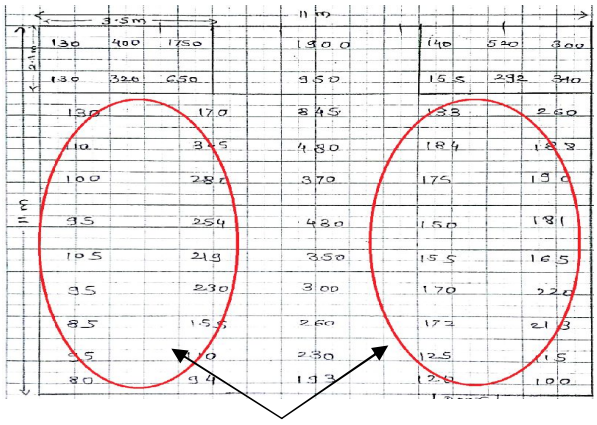
1) Point by Point method
2) Quick layout method

In point by point method, we can locate luminaries as per our requirement to obtain required lux level and in quick layout method, the software decides the location of luminaries. For the analysis of AISSMS's IOIT building, we have used point by point method.

The institute is seven storey building. The geometry of building is such that it uses maximum sunlight. The availability of light is more on 5th ,6th & 7th floor. By considering this factor, new design of revised illumination scheme is obtained so that number of luminaries will reduce and which will provide required lux (300 lux).

A sample case study of Microprocessor & Control system lab is shown in fig:1. From the readings we observed that average lux is 286 lux, which is improved because of sunlight available at window side which is not a working zone. Highlighted zone is the actual working zone where there is insufficient illumination (average lux 130 lux).

Window area



Working zone

Fig:1 Actual lux measurement of Microprocessor & CS lab

Table 2 shows the repositioning of the luminaries obtain from Lite-Pack software.

No. of luminaries	X (m)	Y (m)	H (m)	O (°)
1	2	1.10	4.00	90.00
2	.00	1.10	4.00	90.00
3	8.43	4.00	4.00	90.00
4	2.00	6.50	4.00	90.00
5	2.00	9.12	4.00	90.00
6	2.00	5.00	4.00	90.00
7	4.80	7.80	4.00	90.00
8	4.80	4.00	4.00	90.00
9	8.43	6.50	4.00	90.00
10	8.43	9.12	4.00	90.00

Table 2: Revised positioning of luminaries

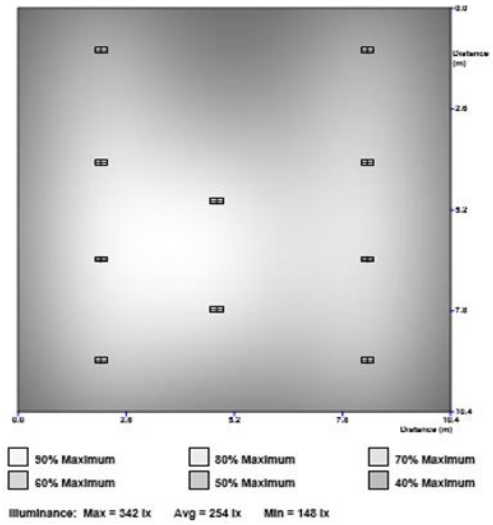


Fig 2: Grey scale diagram of revised illumination scheme

From above grey scale diagram of revised illumination scheme (Fig 2) we can conclude:

1. Uniform illumination is obtained due to revised design.
2. The lux level obtained is increased in the working zone (from 130 lux to 280 lux) which matches with standards.
3. By **relocating** the same number of luminaries required lux can be obtained.

The above process is repeated for remaining occupancies like classrooms, labs, office, passage etc.

VI. ECONOMIC ANALYSES

During data collection & data analysis process it is found that there are following places where replacements of existing luminaries with LED tubes is required, Those places are passage of every floor, office and Recreation Hall

Table 3: Replacement of existing luminaries with LED tubes

Parameter	Existing illumination scheme	Revised illumination scheme	Savings
Wattage (kw)	6.524	3.872	2.652
Annual consumption in (□)	1,89,770	1,12,628	77,141
Installation cost involved (□)	7503	70,800	-
Life hours	15,000	25,000	10,000
Lumens given by tube	2450	2500	50
Quality of light	FTL is Non-directional light source	LED is directional light source.	

Note: - 40- watt and 36-watt FTL's are replaced by 22-watt Philips LED tubes

Payback period calculation-

Annual saving in □ 77,141/-
Saving per month in □ 6,428/-
Extra initial cost involved in □ 63,297/-
Payback period – 9.8 months (approx. 10 months)

VII. CONCLUSION

A careful analysis of lighting system in organization will lead to manage energy system in organization at minimum energy cost. This paper shows that the energy saving is also done by proper positioning of luminaries and considering naturally available sunlight. The revised illumination scheme is verified by using lite pack software

The replacement of conventional FLT (40 watt) with LED (22 watt) tube can give savings of □ 77141 annually. The payback period is 10 months.This proves to be an effective economical solution

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