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Implementation of Energy Efficient Lighting System for Hostel Building

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Abstract – *The rapidly growing energy consumption in the world has raised concerns over energy supply difficulties, exhaustion of conventional energy resource and environmental impact such as Global warming, ozone layer depletion, climate change etc. Energy saving is an important measure. Energy wastage is caused due to usage of inefficient consumer electronics. Particularly, a light accounts for a great part of the total energy consumption. The current installed lighting systems are outdated and energy-inefficient. This paper proposes to replace existing inefficient lighting system with energy efficient LED lighting system. The existing building does not require any architectural modification, the LED lighting system could be fitted on to existing inefficient system. The proposed lighting system reduces total power consumption of the building up to 41.03%. The payback period for the proposed lighting system lies between 0.92 years to 2.8 years depending on the type of LED lighting system.*

Key Words: **Energy saving, LED lighting system, Total Power consumption**

1. INTRODUCTION

Energy saving solutions has become essential in recent years due to environmental issues such as global warming and climate change. The World Total electricity consumption for residential, commercial and industrial lighting represents 20% of the world's total electricity consumption, with an increasing trend over time[1]. The growth in population and increase in per capita energy consumption demands increase in building services and comfort levels.

The electricity consumed for lighting is about 18 % in the country. The majority of the lighting system used is incandescent light bulbs or General Lighting Systems (GLS). The General lighting system has low efficiency[2]. Only 10% of the energy consumed by GLS is converted as visible light and over 90% of electricity consumed by GLS is wasted as heat. The energy efficiency of LED products is typically characterized using efficacy, which in basic terms is the ratio of power input to light output—or more technically, emitted flux (lumens) divided by power draw (watts). Energy efficient LED lamps consume much lesser energy than Fluorescent Tube Lights (FTL) and Fluorescent Lamps (CFL), also having higher lumens per watt and cooler to touch.

1.1 Need for energy efficient lighting

Electric lighting system is a major energy consumer. Enormous energy savings are possible using energy efficient equipment. Improving efficiency across a range of residential appliances is vital to counteract the upward pressure on demand in the buildings sector. By using energy efficient lighting system heat emitted is reduced, thus saving air-conditioning energy and improving thermal comfort. Electric lighting design also strongly affects visual performance and visual comfort by aiming to maintain adequate and appropriate illumination while controlling reflection and glare. The use of energy efficient lighting system reduces overall energy consumption which helps in reduction of damage to the environment. The energy conserved can be utilized in other area such as village electrification which can reduce the need of new power generating station which uses conventional or non-conventional energy sources. The energy conserved reduces the use of fossil fuel in conventional power generating station.

2. METHODOLOGY

An extensive survey of the building[3] was conducted which was taken up for study. The survey was conducted by taking the entire electrical load into account. The entire electrical load was taken into account to determine the overall energy savings. In the electrical load only GLS was considered. Total loads with respect to each room of the building and total load of the entire building was noted. For all these loads, energy consumption on daily basis was calculated considering hourly load and peak load. For the entire building if all GLS are replaced by new energy efficient lighting system will consume less energy and will be energy efficient.

In the following tables, it is shown how much power can be saved for an entire year and how much beneficial it will be, if we implement energy efficient lighting systems.

Table -1: Existing load Analysis

Sl. No.	EQUIPMENT	Capacity in watts	No. of fittings	Hours of Operation	KWh/ day
1	Tube light	50	47	6	14.1
2	Fan	90	18	5	8.1
3	TV	110	5	4	2.2
4	Exhaust Fan	90	2	4	0.72
5	Mixer/Grinder	350	2	0.5	0.35
6	Computer	250	2	2	1
7	Printer	480	2	0.25	0.24
8	Copier	1280	1	0.25	0.32
9	Fax Machine	110	1	0.25	0.028
10	Focus light	250	4	7	7
11	CFL Street light	30	3	8	0.72
12	Water Pump 0.5 Hp	375	1	1	0.375
13	Total				35.15

Table -2: Considering only General lighting load

Sl. No.	EQUIPMENT	Capacity in watts	No. of fittings	Hours of Operation	Total power in watts	KWh /day
1	Tubelight	50	47	6	2350	14.1
2	Focus light	250	4	7	1000	7
3	CFL Street light	30	3	8	90	0.72
4	Total				3440	21.82

The table 1 depicts the energy consumption per day of all the electrical equipment in the hostel building. Energy consumption of all loads per day is 35.15 KWh/day. The table 2 depicts the energy consumption per day of only general lighting system such as tube light, focus light and CFL street light. The energy consumption for only General lighting System is 21.82 KWh/day which forms significant part of total Electrical load. The peak power of General lighting system is 3440 watts.

Table -3: Proposed modification of existing GLS load with Energy efficient LED lighting

Sl. No.	EQUIPMENT	Capacity in watts	No. of fittings	Hours of Operation	Total power in watts	KWh /day
1	LED Tubelight	18	47	6	846	5.076
2	LED Focus light	70	4	7	280	1.96
3	LED Street light	15	3	8	45	0.36
4	Total				1171	7.396

The table 3 depicts the energy consumption per day after the proposed replacement of the GLS with energy efficient LED lighting system.

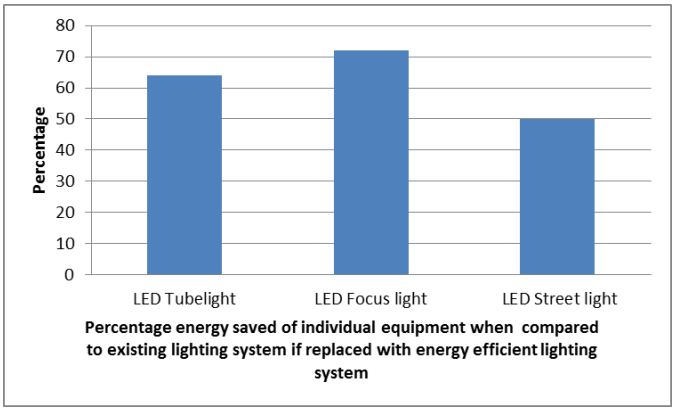

Chart -1: Percentage Energy saving

The chart 1 depicts the percentage energy saving of each equipment. If an existing Fluorescent tube light is replaced with LED tube light the percentage energy saved is 64%. If an existing sodium vapour focus light is replaced with LED focus light then the percentage energy saved is 72%. If an existing CFL Street light is replaced with LED Street light then the percentage energy saved is 50%. The average energy saved for the three lighting equipment is 62 %.
This depicts that if we are replacing the existing general lighting equipment with an energy efficient LED lighting[4] equipment than high percentage of energy savings is achievable. The heat dispersion from the energy efficient LED lighting equipment is very less compared to that of Existing General lighting equipment which in turn also reduces the energy consumption of the HVAC system present in the building[5].

The following table 4 depicts the overall reduction in the existing load if the replacement of existing light load with energy efficient LED lighting system is carried out.

Table -4: Reduction in total load after proposed replacement of Existing GLS with Energy Efficient LED Lighting

Sl. No.	EQUIPMENT	Capacity in watts	No. of fittings	Hours of Operation	KWh/day
1	LED Tubelight	18	47	6	5.076
2	Fan	90	18	5	8.1
3	TV	110	5	4	2.2
4	Exhaust Fan	90	2	4	0.72
5	Mixer/Grinder	350	2	0.5	0.35
6	Computer	250	2	2	1
7	Printer	480	2	0.25	0.24
8	Copier	1280	1	0.25	0.32
9	Fax Machine	110	1	0.25	0.0275
10	LED Focus light	70	4	7	1.96
11	LED Street light	15	3	8	0.36
12	Water Pump 0.5 Hp	375	1	1	0.375
13	Total				20.7285

Table -5: Energy saved if Existing load is replaced

Sl. No.	Load Analysis	Capacity	Unit
1	Total Existing load per day	35.1525	KWh/day
2	Total Load after proposed modification of existing lighting load per day	20.7285	KWh/day
3	Total energy saved after modification of existing light load per day	14.424	KWh/day
4	Percentage of energy saving	41.03	%

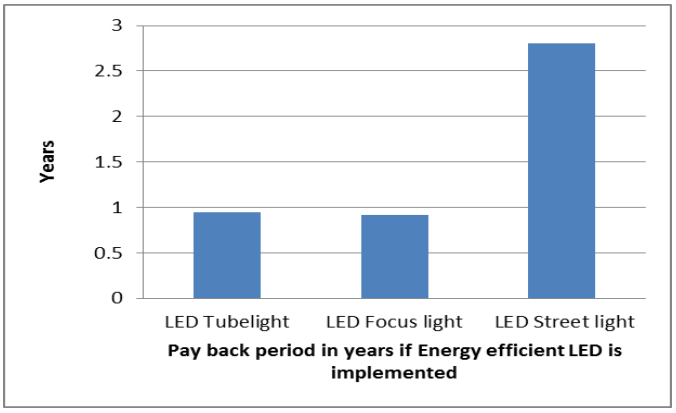

Chart -2: Payback period in years

In table 5 depicts the energy saved in the total load if the replacement of existing GLS with energy efficient LED lighting system is carried out. The chart 2 depicts the payback period in years for the equipment, the payback period in years for LED tube light is 0.94. The payback period in years LED focus light is 0.92 and the payback period in years for LED Street light is 2.8.

3. CONCLUSIONS

In this paper, it is concluded that by replacing lighting fixtures we can save up to 14.424 units of energy per day. The percentage of energy saved is 41.03%. The payback period for the proposed lighting system lies between 0.92 years to 2.8 years depending on the type of LED lighting system. This necessitates for modification of existing systems so that by energy savings at consumer point and generating point is possible. The consumer has cost benefits and has great impact on environment. The replacement also is economically viable.

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