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# Economy and Energy Saving in Lighting of Buildings (Part II) Residential Buildings

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# Economy and Energy Saving in Lighting of Buildings (Part II) Residential Buildings

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## ABSTRACT

Lighting of residential buildings involves designing for adequate daylighting and efficient night time artificial lighting. Except for a few exerting visual tasks which need local lighting, the lighting requirement for most of the tasks in residential buildings lies between 70 to 200 lux. Efficient lighting design can provide visual comfort commensurate with the task requirement and also effect a considerable saving of energy. As an effective measure of energy conservation in lighting of residential buildings, partial replacement of incandescent lamps with more efficient cool daylight fluorescent tube is recommended. This paper presents design guidelines for adequate daylighting and night time artificial lighting with comparison cost and energy saving in partial replacement of incandescent lamps by fluorescent tubelights.

## Introduction

Daylighting design<sup>1</sup> of windows based on IS Code<sup>2</sup> of practice enables adequate illumination in residential buildings during daylight hours. For night time artificial lighting the guidelines<sup>3</sup> are available about the number and location of light points depending upon the room size and the visual task to be performed. In residential buildings, there is considerable consumption of electrical energy due to use of incandescent lamps of low luminous efficiency. For energy conservation and efficient lighting it is recommended that in rooms having two light points one of the light points should be provided with 40 watt cool daylight fluorescent tube instead of less efficient incandescent lamp. Design guidelines for adequate daylighting and night time artificial lighting and cost comparison as well as energy economy of partial replacement of incandescent lamps with fluorescent tubelights are discussed in this paper.

## Recommended Lighting Levels

Lighting level<sup>4</sup> required to perform a visual task depends upon its fineness, contrast, speed and accuracy involved. The recommended illumination for different spaces in a residential building are given in Table 1, wherein the common visual task such as cooking, reading/writing, dining and circulation are covered.

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TABLE 1  
Recommended illumination levels for  
different spaces

Particular Space	Illumination (Lux)
Kitchen	200
Study Room	150
Dining Room	100
Bed Room	100
Store Room	100
Bath Room	100
Toilet	100
Stairs	100
Corridor	70
Garrage	70

More exerting tasks e.g. sustained reading and sewing/darning require illumination level of 300 and 700 lux respectively which can be accomplished through appropriate work location of such tasks in the vicinity of a light source or through provision of local lighting.

## Lighting Design

For design purposes the lighting levels between 70 to 150 lux are adequate for different spaces in residential buildings except kitchen where it should be between 100 to 200 lux with a higher level over the main work area. Fenestration sizes for adequate daylighting depend largely upon the external obstruction<sup>5</sup> caused by opposite buildings. The required

gross area of windows with wooden frames is given in Table 2 for separation to height ratio opposite buildings as 1, 2 and 3 or more.

**TABLE 2**  
Gross window area expressed as percentage(%) of floor area.

Daylight level (Lux)	Separation to Height Ratio of opposite buildings			
		1.0	2.0	3.0 or more
Room Centre	Room rear			
150	70	16%	11.5%	10%
200	100	20%	14%	12.5%

Interior finish with ceiling white and walls off white to white and windows of height equal to 1.0 m or slightly more with a sill height of about 0.9 m above floor are recommended for good distribution of daylight in residential buildings. The windows should be provided with adequate louvres for shading against direct sunlight during summer. Properly shaded south facing windows and north facing windows minimise the heat ingress in summer and the former also help in admitting sunlight in winter. For cross ventilation the openings of nearly equal sizes on opposite sides are recommended. The choice orientation should be such as to avoid the glazing and longer facade in the west to south west directions for reducing the solar heat in summer.

In residential buildings a single light point is recommended along the centre of a longer wall for rooms of floor area upto 12 sqm. whereas in larger rooms upto 22 sqm. floor area two light points on the same longer wall or opposite longer walls are recommended with a lateral separation of about 3 m and at a mounting height of 2.1 m above floor. Two light points also recommended in kitchens where the task illumination is relatively higher than for other spaces.

Incandescent lamps which are commonly used in home lighting have an average life of 1000 hours and a light output of 10-14 lumens per watt. Accordingly, there is a considerable consumption of energy besides a recurring expenditure incurred in frequent replacement of incandescent lamps. It is, therefore, recommended that in new lighting installation as well as in existing residential buildings one of the two light points in a room should be provided with a wall mounted 40 watt bare cool daylight fluorescent tube which has an average life of 5000 hours and a light output of 61 lumens per watt. For energy conservation it is suggested that fluorescent tubelights should be used for general lighting in residential buildings and incandescent lamps should be used only for short duration whenever required.

## Energy Saving and Cost Comparison

The commonly required illumination level of 150 Lux can be provided in a part of a room by an incandescent lamp of 100 watt or by a fluorescent tube of 40 watt mounted at 2.1 m above floor level. For a typical case of two rooms and kitchen of a house each having two 100 watt incandescent lamps burning daily for four hours and one hour respectively, the former is assumed to be replaced by a 40 watt fluorescent tube light for comparison of cost and energy saving over a period of ten years. For the purpose of lamp replacement the average life of incandescent lamp and fluorescent tube has been considered as 1000 hours and 5000 hours respectively. The cost of electricity is taken as Rs. 0.50/- unit and the cost of fixtures and lamps is according to prevailing market rates as given in Table 3.

**TABLE 3**  
Cost of Fixtures and lamps

Sl. No.	Item	Cost Rs.
1.	40 watt bare fluorescent tube with wall mounting fixture, choke and starter	80
2.	100 watt incandescent lamp with holder and shade	20
3.	40 watt bare fluorescent tube	25
4.	100 watt incandescent lamp	5

In this illustration the lighting of spaces other than two rooms and kitchens and also the cost of wiring and the likely escalation of cost has not been considered.

**TABLE 4**  
Energy consumption and expenditure on lighting of a typical house over a period of ten years.

S. No.	Types of lamps	Cost of fixtures and lamp replacement Rs.	Energy consumption KWH	Running Cost Rs.
1.	Incandescent lamps (bulbs) only.	375	5480	2740
2.	Partial replacement of bulbs with fluorescent tubes.	495	3280	1640



The estimated initial and recurring expenditure on lighting of a typical house considered in this illustration is given in Fig. 1 which shows that the partial replacement of incandescent lamps with fluorescent tube lights is economical despite higher initial expenditure which is offset by the saving on energy consumption in about one and a half years time. The energy consumption and expenditure over a period of ten years for the same illustration is also given in Table 4. It is seen that about 40 per cent saving of energy and about 30 per cent saving on total expenditure on home lighting is achieved through partial replacement of incandescent lamps with more efficient fluorescent tubelights.

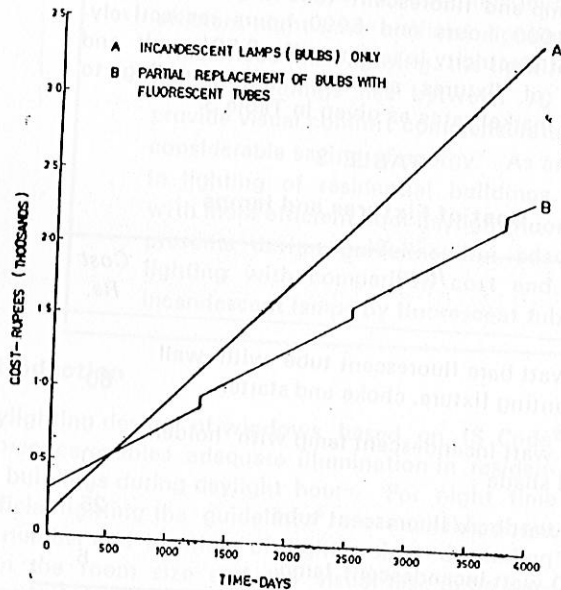


Fig. 1. INITIAL AND RECURRING EXPENDITURE ON LIGHTING OF A TYPICAL HOUSE

### Concluding Remarks

1. Windows of adequate size with window height of about 1.0 m or more and sill height of about 0.9 m above floor are recommended for satisfying the daylighting requirement alongwith appropriate provision of openings for cross ventilation.
2. Windows should be provided in the orientation facing North and South or slightly tilted towards North-west and South-east for minimising solar heat in summer while taking advantage of prevalent wind direction.
3. Windows should also be adequately shielded against incursion of direct sunlight during hot weather conditions.

4. For providing a good amount of internal reflected light, the finish for the ceiling and walls is recommended to be white and white to off white respectively.
5. Except for situations where light is required for a short duration, fluorescent tubelights should be preferred over medium to high wattage incandescent lamps, because of much higher light output and longer life of the former as compared to the latter.
6. It is recommended that wherever two incandescent lamps are provided in a room, one of them should be replaced with a bare 40 watt cool daylight fluorescent tube mounted on one of the longer walls at a height of 2.1 m above the floor.
7. Partial replacement of incandescent lamps with more efficient fluorescent tubelights results in a substantial saving on recurring consumption of energy in lighting of residential buildings which is able to offset the initial extra expenditure incurred on fluorescent tubes in about one and a half years time.

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