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# Optimization of Energy use in Offices by Variable Daylighting Parameters

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**Abstract—***Careful building design can counterbalance heat loss and gain and variation in daylight availability which can cut off energy waste in office buildings. Proper planning helps in improving visual environment for creating high quality space and reducing the energy cost of the building. To make sure that no more light is produced than required photo sensors are used with proper lightning control for more comfortable and efficient environment. Minimum use of the energy and personnel's comfort is the main focus of the paper. Number of offices with automated lightning control were examined according to its installed daylight responsive system.*

**Keywords***: Daylighting, personnel's satisfaction and preferences.*

## 1. INTRODUCTION

Affordable energy is always the prime preference of the consumers so efforts are required to save as much energy as possible. The process includes:

1. Use of energy efficient equipments

2. Improved daylighting design patterns

3. Efficient lightning control devices with smart senses.

The two important domains to be considered are thermal gains and daylighting which are correlated. Design complexities of these parameters starts at very early design of the office. For savings in electricity consumptions photo sensors are needed to be installed. It is important to take in care of varying temperature conditions because depending on the affected area very cold and very hot temperature zones manifest varied daylighting parameters.

There are number of discomfort problems with different intensity lights, example south facing facades suffers glare issues.

Optimization of daylighting involves saving maximum amount of energy possible without neglecting the prime factors like quality of the energy in use. It has been observed that the performance of the officials also depends on their working environment and efficient environment renders high productivity.

In this research, method of studying the officials reactions for daylighting and lighting control has been used. In this not only attitude toward daylighting, window and control devices but to the whole working environment has been analysed.

Research analysis is done on number of buildings and different case studies have been done.

This paper is dividedinto five sections.

1. Introduction to the complete paper proceeding
2. Case studies done on three different buildings
3. Methodology used in the process of analysis
4. Results of the research process
5. And then finally concluded the research

## 2. CASE STUDIES

For the research three office buildings were examined located in hamirpur (H.P). Response system of daylight is analysed in these offices and is summarized in the table given.

Table 1.Summary of the lighting system

| Building | Type of light fixture | Control device |
|---|---|---|
| A | 600mm square downlights with 4X18W fluorescent lamps | Photosensors for a group of luminaires |
| B | Downlights for ceiling installation with 2X18W fluorescent lamps | External protosensor for interior zones for one part of the building and photosensors for a group of luminaries for the rest of the building |
| C | 600mm square downlights with 4X18W fluorescent lamps | Stand alone photosensors for each luminaire in the perimetric zone of the building |

### 2.1 "A" Building

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Fig. 1. Interior of Building A.

A two storied office of irrigation department. Office fenestration have a continuous window ( 0.8m to 2.2m)in three direction of the office, north, east, south. First floor is open office with windows in south and east directions, second floor is divided into sections making cubicles for the officials having windows in north and east direction. The room lighting systems are properly controlled using photosensors through BMS of the office.

Both the floors were carefully analyzed and survey was concluded.

### 2.2 "B" Building

A multistoried building of a college were studied five storied building with again continuous window (0.8m to 2.4m) above floor level. Core of the building includes an atrium rest all the floors are open and divided into different classrooms and laboratories studies were carried out on third and fourth floor. Analysis were based on the daylighting experience of students, professors and lab attendants.

Fig. 2. Interior of Building B.

Again controlling process includes photosensors.

### 2.3 "C" Building

Building C is a three storied building again with continuous window 0.8 to 2.3m above the floor. Analysis of the building shows no care of light controlled were taken. There were absence of shading devices and light shelves. Although stand alone photosensors were used.

Fig. 3. Interior of Building C.

In this building research analysis were carried out in second and third floor. Perimetric zone of the area were selected for the survey.

## 3. METHODOLOGY

Person of each rank, each age group as much as possible is chosen to create a homogeneous results and overcoming the evolution effect. Each person is analyzed depending on its comfort, health and on eyesight basis.

Parameters statistics were analyzed on rating basis on different scales. Research is conducted on june-july 2018 that is on fairly to clear season for appropriate result in hot temperature within working hours.

**Table 2: Number of participants in the survey**

| Building | Number of Participants |
|---|---|
| A | 21 |
| B | 50 |
| C | 27 |
| Total | 97 |

## 4. RESULTS

### 4.1 Daylighting

The three physical features that scored the most important factors affecting the humans are

1. Good light
2. Comfortable temperature
3. Good ventilation

Number of persons agreing for these factors were 24.6%, 23.8% and 21.3%

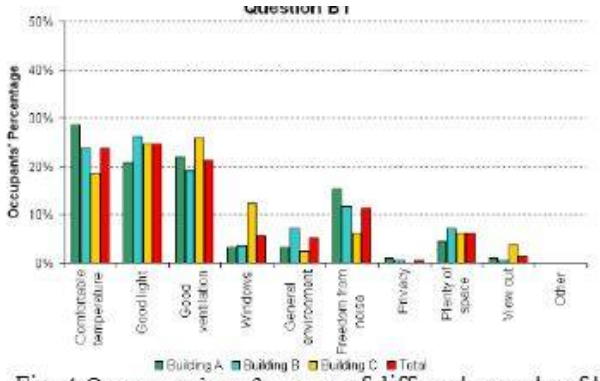


Fig. 4 Occupants' preferences of different aspects of the work place

**And in fig. 5 indoor environment preference is shown**

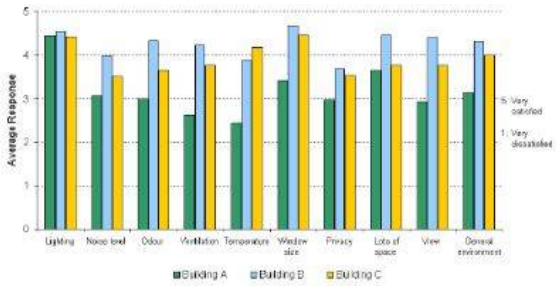


Fig. 5 Mean ratings of how satisfied are the occupants with the indoor environment of their work place, (Very satisfied: 5, Very dissatisfied: 1)

**Rest figures in 6 shows preference for the lighting conditions.**

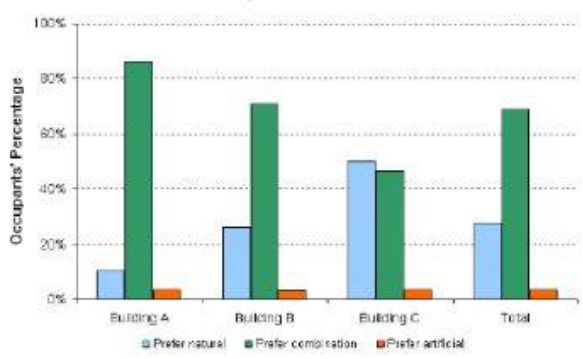


**Fig. 6. Preference for the lighting conditions by the officiala.**

In fig.7 and 8 shows response to window size and thermal conditions.

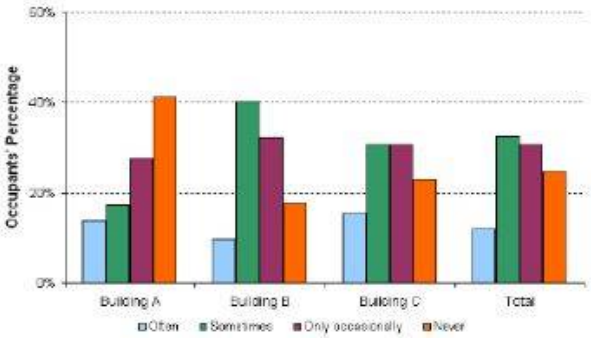


**Fig.7. response to window size**

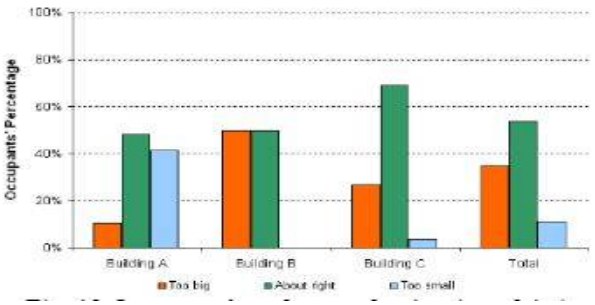


**Fig.8. ratings of the thermal gain**

**Fig.9 shows sensitivity to glare and 10 the rating of source of glare**

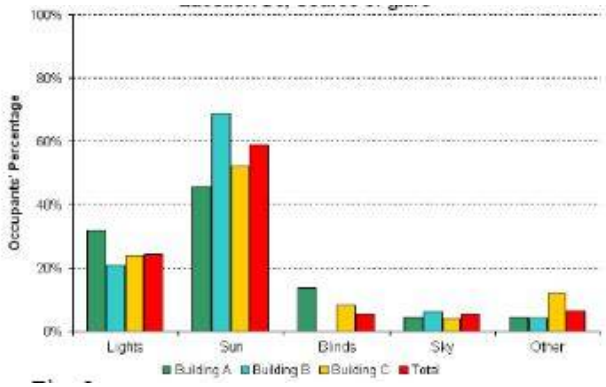


**Fig. 9: Ratings showing sensitivity to the glare**

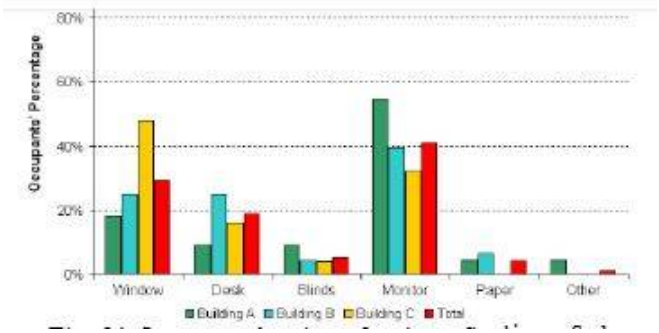


**Fig. 10: Occupants rating for the source of the glare**

## 5. CONCLUSIONS

The aim to analyze the performance of occupants depending on the daylighting has been achieved. Three buildings were analyzed and data was collected and compared, as analyzed most wanted indoor parameters turned out to be good light and temperature conditions and ventilations.

Most discomforting factors were glare and extreme temperature conditions. So special attention is required to eliminate the glare discomfort. Most efficient performance is observed in the bright areas of the office. A proper commissioning of photosensors can help in optimizing the energy use as it help in reducing the waste of energy in the building. In the end as the working officials comfort is of prime importance so design parameters and daylightining parameters should be perceived according to their comfort keeping in mind the energy efficient design.

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