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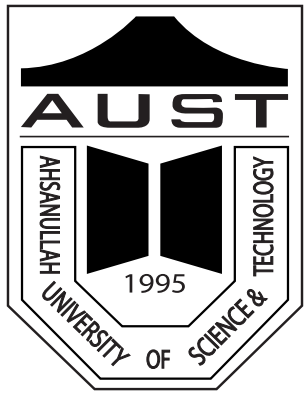

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A study of the luminous environment in an office spaces at Dhaka city in Bangladesh

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Abstract: *In the offices of Dhaka, artificial light is the main contributor to the visual environment, even though there is an abundance of daylight. Daylight should be encouraged in office spaces because, not only would it save on energy, but it also carries immense physiological and psychological benefits. There is a considerable potential for more daylight inclusion into offices by some simple modification of the existing spaces and awareness about day lighting issues during the design phase. For an office space internal partition wall play an important role on luminous environment and modification of the partition wall can change the luminous environment of that office space. The study examines a typical office space in Dhaka where internal partition wall is used as interior design element to define spaces. The study follows experimental research method with six different design options of modifying internal partition wall. The objective of this study is to analyze the effectiveness of internal layout with partition wall in office spaces of Dhaka city. The study shows how simple modification of existing buildings by which inclusion of daylight in office interior can be increased and can be applied easily in context of Dhaka city.*

Keywords: *Day lighting, Interior Space, Partition Wall, Office Space.*

1. Introduction

1.1 Literature Review

An office building is intended for a particular use and office is only in use during that part of the day known as 'office hours' (9am-5pm in context of Dhaka). In present situation though daylight is available for nearly the entire period of occupancy of office hours, artificial light is the main contributor to the luminous environment of offices in Dhaka (Joarder, 2007). From previous study, by reducing reliance on artificial lighting, daylight can be an effective means of saving on lighting energy (Muneer et al., 2000). However, this reduction is affected other associated energy needs of spaces. In Bangladesh, of all the large cities in the country, Dhaka has the highest consumption of electricity (Sharma, 2002). Considering that finite resources of energy must be conserved in global terms (Philips, 2002), and energy consciousness in the design of the luminous environment is essential which will ideally lead to daylight office buildings, with controlled supplementary electric lighting (Bell & Burt, 2995). Daylight is one of the most important natural forces available to architects to enhance the visual quality of interior spaces which is an abundant resource in the tropical city (like Dhaka, Bangladesh), (Ahmed & Joarder, 2007).

Daylight has the advantages of physiological as well as psychological benefits for users (Robbins, 1986). Daylight not only allows one to save on electricity consumption, but studies show that people actually perform better when exposed to daylight (Boyce, 2003). Daylight is often used for ambient lighting but may be used for critical visual tasks as well, in each case supplemented with electric light as needed (AGS, 2000).

The most obvious vehicle for energy savings in buildings is in exploiting the most abundant source of light available to us – daylight (Phillips, 2004). Environmentally conscious

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assessments of building design are recognizing that daylight (along with natural fresh air) is an important commodity and should be exploited to the full. But, in the interior lighting of Dhaka city's office buildings, all these benefits of daylight have been neglected.

1.2 Sky conditions of Dhaka city

The climate of Dhaka is tropical and has mainly three distinct seasons – the hot dry (March-May), the hot humid (June-November) and the cool dry season (December-February) (Ahmed, 1995). The sky can be clear or overcast in different parts of the various seasons. During summer (Hot Dry) the sky remains both clear (sunny with sun) and overcast. However, during the warm-humid (March-November) period, which includes the monsoons, the sky remains considerably overcast most of the time. It is only during the winter (December-February) that the sky

mostly remains clear. In composite climates like Dhaka, where both overcast as well as clear conditions are observed during the course of each year, designers face difficulties to choose the condition, based on which they should take the design decisions. The ways and means of tackling the two conditions are quite contrasting to each other (Ahmed, 1987). Windows with fixed horizontal overhead is suitable for overcast sky condition, on the other hand vertical and movable devices are recommended for clear sky.

Knowledge from literature review with considering sky conditions of Dhaka city two main issues are identified. First of all daylight is essential for physical and psychological betterment. Since daylight is available resource in Dhaka so designers have to conscious about inclusion of daylight in built spaces. Second issue is about composite climate of the Dhaka city with two contrasting climatic conditions. In such cases, it is the overcast sky that presents the more critical situation and hence, design for daylight should satisfy good lighting criteria under overcast conditions (Evans, 1987).

2. Methodology:

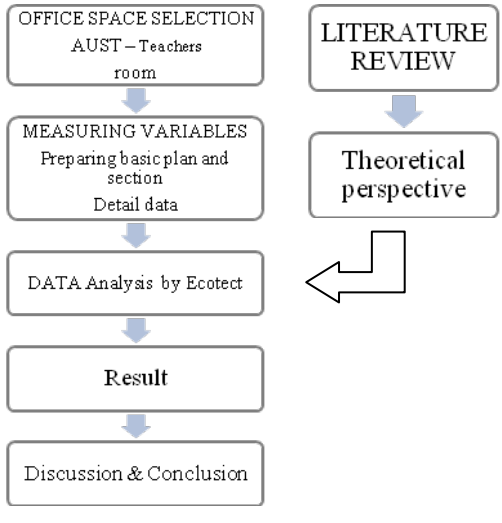


Figure1: *Outline of Methodology.*

2.1 Selection of Site and Building for simulation

The climatic characteristic of Dhaka City is different from other cities of the country due to its location and rapid physical development. Physical and environmental characteristics are modified in different locations within the city. This is due to the density of built environment, building types, building heights and orientations, surface quality of the area – whether hard or soft depending on vegetal cover and presence of water bodies and ponds - materials used for construction, and other related factors (Joarder etal. 2009). The criteria for site and building selection to determine the typical example office interior space was based on the following factors:

a) The site should be within the urban boundary and should have characteristics of the general urban fabric of Dhaka city.

b) The example office space should represent the trend of typical office interior design in Dhaka;

c) Internal layout of the example office space should be such that, there should be provision for daylight inclusion and distribution.

Based on the above criteria, the eight storied building of Ahsanullah university of Science & Technology was selected for the study. The 2nd floor of the building (teachers' room) was chosen as the example space for simulation. The building has a 6m wide road on the west, some single-storey semi-permanent establishments at other three sides.

2.2 Simulation study

The amount of daylight penetration and its quality in office interiors due to the changes in the location of internal partition wall can be assessed by simulation study. In reality, due to the simultaneous influence of many different factors, it is difficult to isolate the exclusive effect of one single aspect, or the changes due to it. Daylight simulation allows the study of the effect of changes in any one aspect, keeping other aspects constant. In this study simulated programs were used to investigate the impact of partition wall on daylight level at work plane height. The parameters of the model of the example space, which were incorporated from values found in a physical survey, are as follows.

Room dimensions	11.5m x 16.7m
Total area	249.5 sqm
Usable office space	187.8 sqm
Service area	61.7sqm
Clear height of office space	2.4 m
Window to floor ratio	0.27
Work Plane height	0.75m

The following parameters of existing internal finish materials (as found in the field survey) were used in the model for simulations.

Ceiling : Gypsum

Internal wall : Single pane of glass with aluminium frame

Floor : white ceramic tiles finishes

Glazing : Single pane of glass with aluminium frame

Figure2: *Surroundings area of selected building.*

Figure3: *Interior space of selected building.*

3. Performance evaluation process

For the purpose of the simulation, the entire office space was divided into grids with reference to column-structural grid (Figure 2). Then 76 points atonly task area in the open office space were selected for generation of daylight levels at 0.75m above floor level, representing the work plane height for offices in Dhaka. Daylight simulation was done by Ecotect for these grid points to find predicted daylight levels first. The simulated illumination values were then plotted into Tables with the codes coinciding with intersection of letters (rows) and numbers (columns) (Table 1). These values were then compared for different situations.

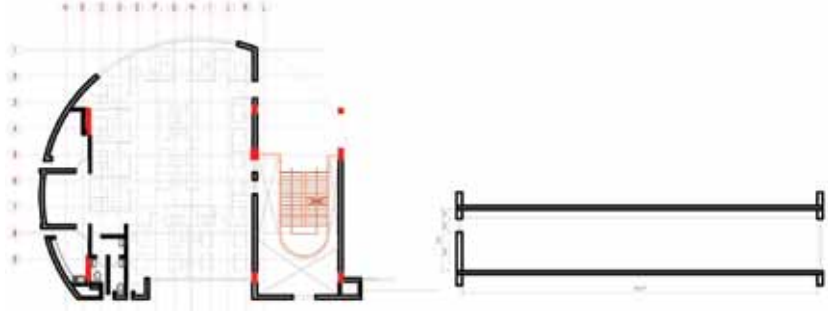
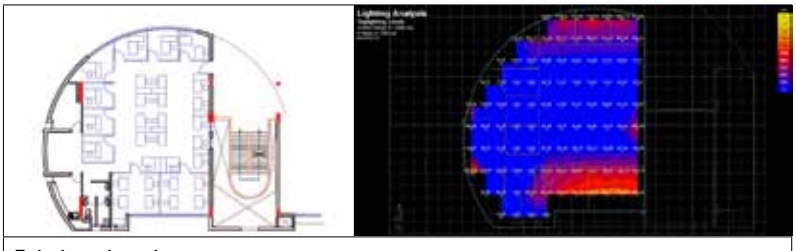
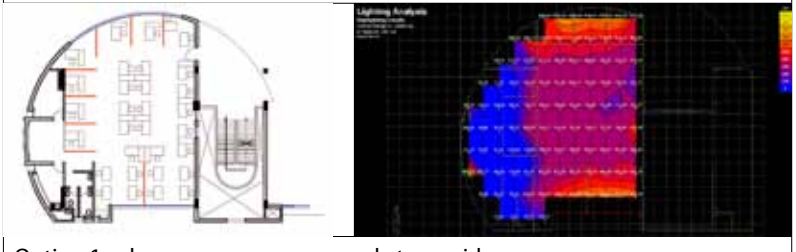


Figure 4: *plan showing node references at task area with internal layout and Section showing window height at north and south wall.*

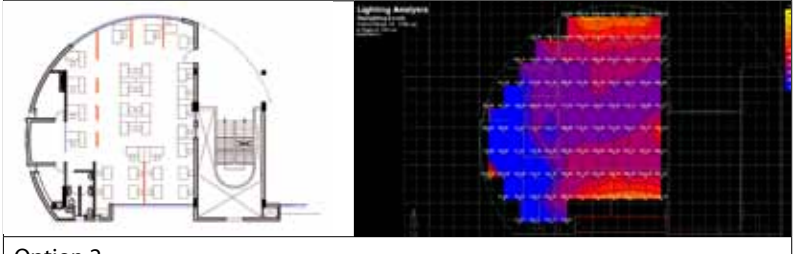
Table 2 summarizes the simulation results for daylight illumination level on the 75 visible nodes of the grid for the different situation of partition wall. At existing situation, maximum illumination level 1683 lux when average illumination level is only 312.84 lux and 46 node points with values lower than 300 lux. At option1 to option 6 no. of points with values 300-900 lux is increased to 70 points within selected 75 nodes point. From the experiment option 6 is the best condition where only one node point with values lower than 300 lux. It also can be said that option 1 to option 6 are very much better than existing situation. Here from simple modification we get desired level of illumination level in existing space (Table 3).



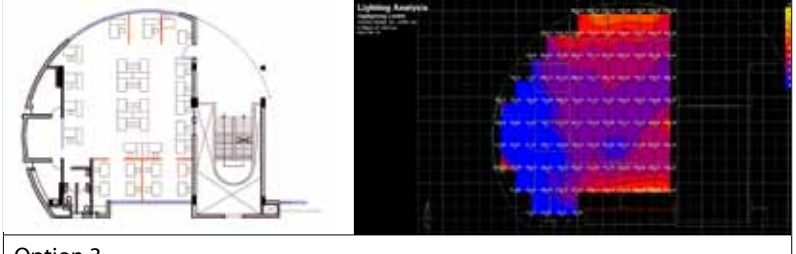
Existing situation



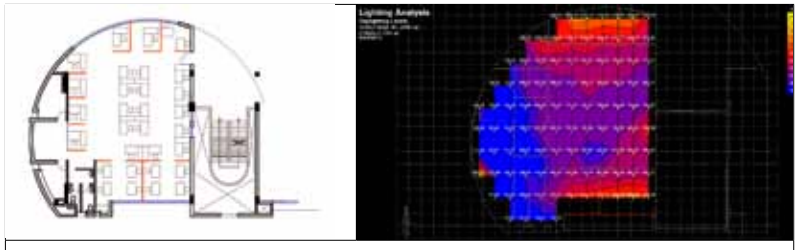
Option 1: where rooms were opened at one side



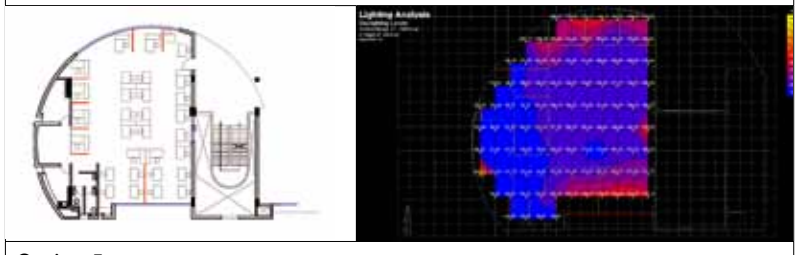
Option 2



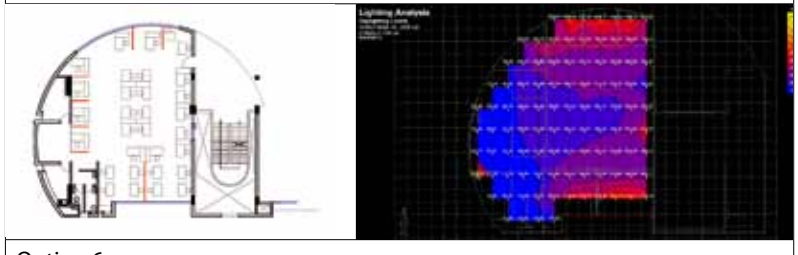
Option 3



Option 4



Option 5



Option 6

Table 1: *Daylight distribution on different situation of partition wall.*

	Analyzing nodes	Minimum illumination value (Lux)	Maximum illumination value (Lux)	Average illumination value (Lux)	No. of points with values higher than 300 lux	No. of points with values lower than 300 lux	No. of points with values within 300-900 lux
Existing	75	00	1683	312.84	29	46	7
Option 1	75	85.05	1818.41	480.67	71	4	37
Option 2	75	85.05	1824.71	882.82	70	5	35
Option 3	75	170.49	1824.71	873.46	73	2	42
Option 4	75	174.99	1685.36	820.54	70	5	45
Option 5	75	40.03	1392.92	812.25	68	7	53
Option 6	75	160.09	1433.78	539.85	74	1	70

Table 2: *Daylight distribution on selected node points at different situation of partition wall.*

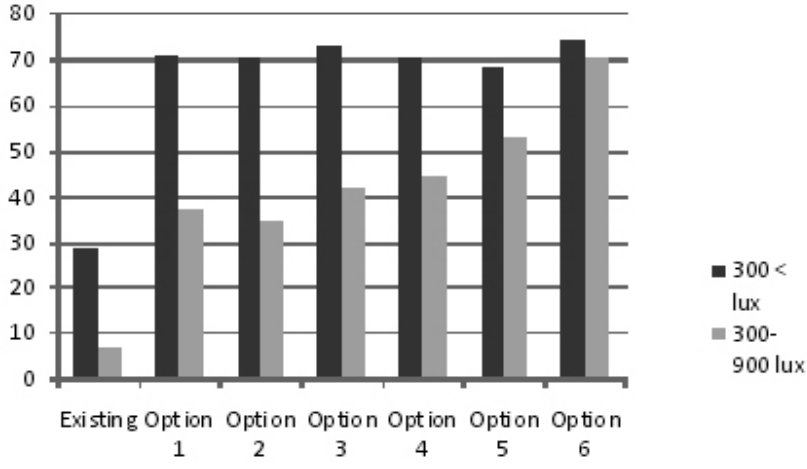


Table 3: *Illumination level at different arrangement.*

4. Conclusion:

This paper presents the importance of responsiveness of the interior design. These findings show that though introduction of partition wall produces an overall reduction of illumination on the work plane throughout the interior space but awareness in designing partition wall to ensure daylight at work plane level can change the situation.

Due to unavailability of proper instrument the research consider only result from software. The study also considers only overcast sky condition. This simulation study was performed to find out the effectiveness of location and amount of internal partition wall on internal day lighting level but there are scopes of further research with materials & height of partition walls, window level, window size etc. Our awareness in designing partition wall the study shows that simple modification of internal partition wall can ensure acceptable illumination level at our office space.

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