International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 15 (2018) pp. 11966-11969

Comparative Advantage of Louver Shading Device on Window for Residential Building Located at Raipur

Nisha Netam[1*], Tikeshwar Kumar Sahu[2]

[1,2]Department of Mechanical Engineering, NIT Raipur, 2010, Chhattisgarh, India.

**Corresponding author*

Abstract

Buildings require large amount of energy for cooling as well as heating. Solar heat gains through window contribute half of the cooling load for residential and non-residential buildings. In this work, a comparative study among the effect of louver shading and fixed overhung has been carried out for Raipur (21.2514° N, 81.6296° E) city. The objective of the study is to compare the heat gain through window, for without shading, fixed overhung shading and louver shading for particular day and throughout a year. The results show that the integration of louver shading device in the building reduces indoor heat gain in summer and may lead to significant energy savings. The possible energy saving if louver shading used in the residential building is 740.25 kWh for one year.

Keywords: Louver shading, Solar radiation, Thermal analysis, Cooling and Heating load, Energy saving.

INTRODUCTION

Windows are being used for day lightening and visual communication to the outside environment. Window refers to glazed system that allowing the light into the building while it transmits solar radiation also. Because of transparent surfaces major part solar radiation is directly transmitted to the interiors of the building and remaining part of solar radiation get reflected or absorbed. Due to transfer of major part of solar radiation by glazed surfaces to the interior, it plays an important role in cooling load calculations of a building. Glazed areas and shading devices have an important role in building energy consumption. The factors influencing window heat gain are – location, orientation of the window, window glazed material. Direct solar radiation depends upon incident angle of sun on vertical surface for window. East and west facing window for Northern hemisphere have large amount of direct solar radiation in summer and it decreases in winter season. South facing window has low heat gain in summer but high heat gain in winter season. Reflective coating is provided to glass to reflect solar radiation incident on it, but it has drawback as well, during day time it block the visible light. During summer season reflective glass is good as it reflect some solar radiation but in winter this shows adverse effect that block solar radiation entering through the window.

This research work, focus on reduction in cooling load in building without compromising on day lighting by providing louver on windows. The louver device intercepts the direct solar radiation before reaching the building interior through the glazed window surface. Due to interception of direct solar radiation value of direct beam radiation is neglected.

[1], Reported the effect of fixed louver shading on thermal performance of house by using TRNSYS simulation. The performance of fixed horizontal louver shading on window has reported by [2], r using Energy Plus in Rolla, Missouri, U.S. It reduced the 17 % energy consumption as compared to same house without shading. [3], Reported the energy consumption analysis of building with adopting horizontal window shading on windows. In Korea shading devices are mandatory for few public building. It is found that energy consumption has reduced by using horizontal window shading.

Effect of external shading device on building in energy consumption is analyzed at different countries and pointed out the need of similar analysis at different region to redefine the building regulation ([4],[5], [6],[7],[8] [9] and [10])

Heat gain through building depends upon various parameters like fabric heat gain, roof heat gain, heat gain due to infiltration, heat gain due to occupants, heat gain due to lightings, heat gain due to window glazed, and heat gain due to miscellaneous factor.

METHODOLOGY

Louver shading for Low income group (LIG) building as shown in figure 1, located at Raipur city is taken for analysis and comparison of heat through the window, without shading, overhung projection shading and louver shading. LIG building has three windows (i) living room (Room 1) facing west (ii) bedroom (Room 2) facing east (iii) kitchen (Room 3) facing east.

Table : Properties

Ventilation rate	6 h^{-1}
Artificial light	40 W bulbs (Three)
Occupants	Four persons
$U_{Glazing}$	5.3 W/m^2-K
U_{wall}	3.00 W/m^2-K

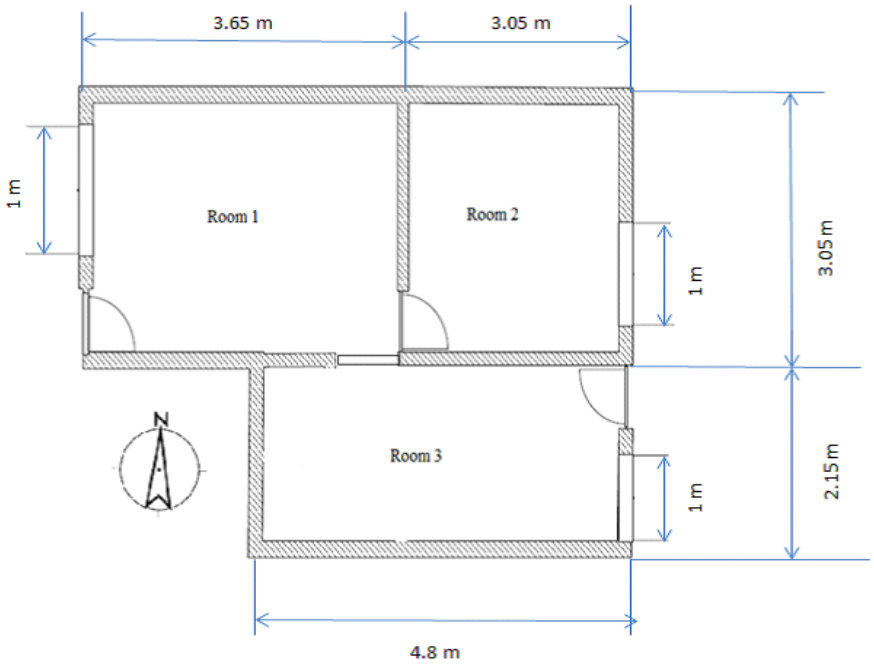

Figure 1: Layout of building.

Louver shading and fixed overhung on window is shown in figure 2 and 3, respectively.

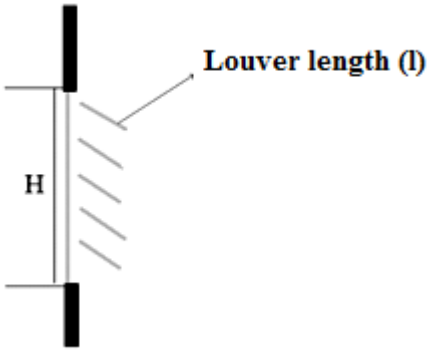

Figure 2: Design details of louver.

Window dimensions are:

Height of window (H) = 1.2 m

Width of window (W) = 1 m

Louver dimension are:

Number of Louver (n) = 5

Length of louver (l) = H/n = 0.24 m

Width of louver (b) = 1 m

Area of window (A) = H∗W

Distance between the louver (d) = 0.1 m

Overhung projection dimensions are:

P = 0.4 m

PF = 0.333

SC = 0.74

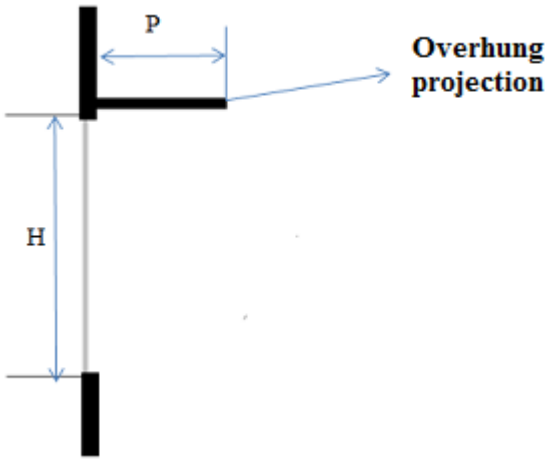

Figure 3: Window with fixed overhung

Total heat gain (Q_{Total}) will be calculated on monthly average solar radiation basis, the heat balance for room can be written as:

$$Q_{Total} = Q_{wall} + Q_{roof} + Q_{door} + Q_{window} + Q_{vent} + Q_i$$

RESULTS AND DISCUSSION

Figure 4 and 5, shows the variation in the heat gain through east window for a day and year, respectively. The study shows that for a day at 11:00 hour there is a sharp decrement in the heat gain because of the significant change in incident angle in case of the no shading and window with fixed overhung, whereas, the heat gain throughout the day is stable in case of louver shading. Louver shading has low heat gain throughout the year as shown in figure 5. Solar window heat gain is high in summer and there is decrement as rainy season starts. Also there is a significant decrement in the heat gain in winter season upon using the louver shading.

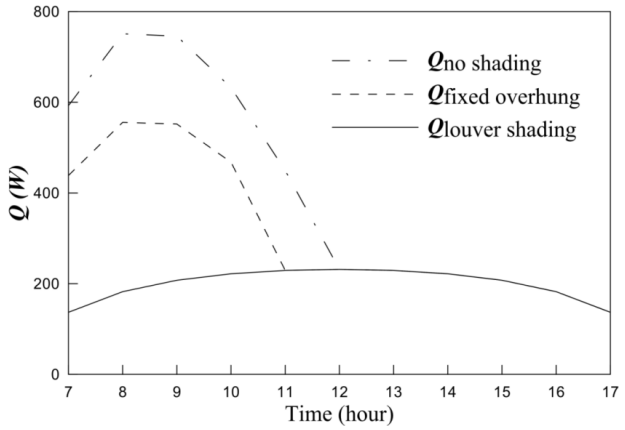

Figure 4: Variation of heat gain through east facing window surface on 15th May throughout the day.

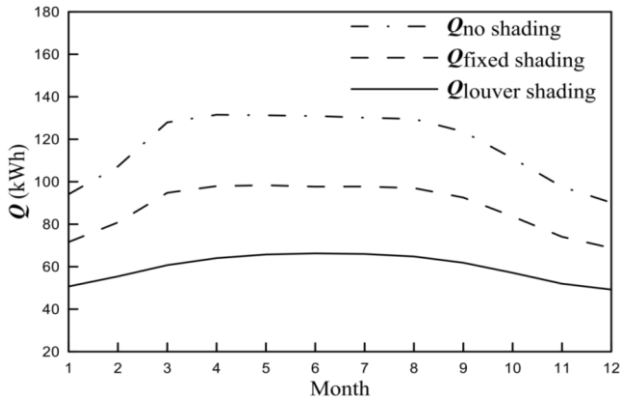

Figure 5: Variation of heat gain through east facing window surface for a year.

Figure 6 and 7, shows the variation in the heat gain through west window for a day and year. It is observed that for a day there is significant increment in the heat gain at 12:00 hour in afternoon (figure 6). Whereas, the similar trend of results have been observed for west window as east window.

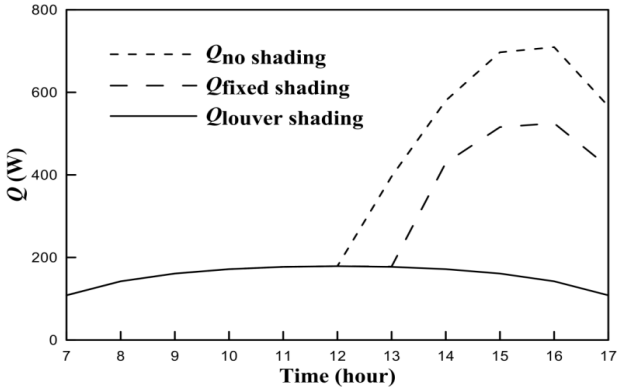

Figure 6: Variation of heat gain through west facing window surface on 15th May, throughout the day.

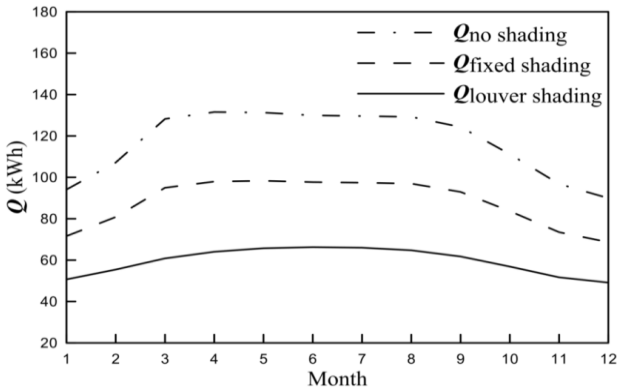

Figure 7: Variation of heat gain through west facing window surface for a year.

CONCLUSIONS

Louver shading used in east and west facing window shows good advantages throughout the year for Raipur city. Raipur city comes under hot and Torrid Zone, this region experienced three different seasons throughout a year summer, rainy and winter. Throughout a year city experienced hot climate except one or two month, therefore louver shading is very effective throughout the year. During the summer solar radiation incident on east and west facing window for this location is very high, by applying this arrangement cooling load in summer has reduced. Thus we can say that louver shading have great advantage in summer. Due to adjustable angle of louver this can allow solar radiation if required in winter season. The possible energy saving if louver shading used in the residential building with three window facing east and west, Raipur is 740.25 kWh for one year. The highest energy saved is during summer and lowest is during winter.

REFERENCES

[1] Datta, G., 2001, "Effect of fixed horizontal louver shading devices on thermal performance of building by TRNSYS simulation" Renewable Energy 23, 497–507.

[2] Brennan, C., J., 2012, "Analysis of passive louver shading technology and impact on interior environment" Masters Theses. 6941.

[3] Kim, S., Shin, K., Kim, H., and Cho Y., 2017, "A Study on the Effectiveness of the Horizontal Shading Device Installation for Passive Control of Buildings in South Korea" Article ID 3025092.

[4] Kim, M., Leigh, S., Kim, T., and Cho, S., 2015, "A Study on External Shading Devices for Reducing Cooling Loads and Improving Daylighting in Office Buildings", Journal of Asian Architecture and Building Engineering. 14. 687-694.

[5] Milan, J., 2003, "Whole Building Energy Simulation with Complex External Shading Devices", *Proc. of Eighth International IBPSA Conference 2003*, Eindhoven, Netherlands.

[6] Poirazis, H., Blomsterberg, A., and Wall, M., "Energy simulations for glazed office buildings in Sweden", 2008, *Energy Build* 40:1161–70.

[7] Palmero-Marrero, A., I., Oliveira, A., C., 2010, "Effect of louver shading devices on building energy requirements", Appl. Energy 87 (2010) 2040-2049.

[8] Kim, J., T., Kim, G., 2010, "Advanced external shading device to maximize visual and view performance", Indoor and Built Environment 19 (2010) 65–72.

[9] Bessoudo, M., Tzempelikos, A., Athienitis, A., K., and Zmeureanu, R., 2010 , "Indoor thermal environmental conditions near glazed facades with shading devices—Part I: Experiments and building thermal model" *Building and Environment* 45 (2010) 2506–2516.

[10] Shahdan, M., S., Ahmad, S., S., and Hussin, M., A., 2018, "External shading devices for energy efficient building" IOP Conf. Series: Earth and Environmental Science 117 (2018) 012034.