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Design of Energy Efficient Solar Control Film based Window Glazing System for Homes and Office Buildings

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Abstract: ***This paper proposes an energy efficient solar control film window fixed in glazing system for homes and office buildings. Traditional methods use the films that have less impact on solar radiation. The solar films have the ability to control the radiations and maintain the room temperatures with less energy consumption for cooling. Tiruchirapalli district of tamilnadu state is accompanied by hot climate with heavy heating all through the year. This paper presents an analysis of the solar control film window system fixed in glazing system on a normal and clear window glass in an occupant in Tiruchirapalli (TN). Hence implementing a solar film window in an occupant in tiruchirapalli shows a reduction in the heat obtained by solar radiation with comfortable room temperature and less energy consumption. Furthermore this approach was carried out to control the radiation levels on thermal and effective performance of physically ventilated houses and buildings.***
Keywords: ***solar control film window, solar radiation, glazing system, energy consumption, glass coating.***

I. INTRODUCTION

A solar control film window system works on the principle of minimizing the radiation level of the solar energy that enters through the windows in a home as well as office buildings by gradually increasing the properties of the glazing system either by the method of reflection or absorption. The windows with the neat coatings and the proper films replicate the energy back to the environment and provide additional cooling to the buildings. The solar films are based on the properties of optical with glass technology. These films are mainly developed by means of thin plastic substances that are applied to the inner part of the glass windows. These films will also reduce the effect of visible, infrared and ultra-violet rays since it consists of tints and colours with flat and visible mirror like film. These films are mere identical like the normal glasses. These control films will block the infrared emission of the light more than the normal visible light thereby increasing the cooling temperature of the buildings by providing high visible light transmissions. Some films will absorb the transmitted energy and others will reflect the radiated energy back to the clear environment. Solar films consist of both liquid and plastic applied films. Solar films can be applied by cleaning the window glass and applied the plastic or liquid coating in the cleaned windows. If the solar films are fixed in a professional manner then it will function over a long duration especially between 10-20 years. It is also difficult to differentiate the coated glass with the non-coated one. Improper installation of solar films will leads to peel off or bubbles on the applied coating and also laminating failures will occur. The term solar heat gain coefficient is used to measure the performance of the solar control of the window. The solar energy that is absorbed in the window is normally transferred to the outer surface either by conduction, convection and radiation. The SHGC is normally absorbed by the ratio of energy flowing inside to the energy flowing outside of the window glazing either by the surface emission or by the gas fills applied in the glazing system. The window will consist of single and double glazing system. Traditional glazing system is basically double glazed and the solar film coated windows are single glazed systems. The single glazing system will have the absorbing and insulating layers in the relative portions of the windows. The windows with an outer coating in the double glazed windows will have less impact over the system with inner coating in the single glazed systems. The films which area applied to the external surface of the window will have the negative impact with respect to the pertaining factors such as radiation, weather conditions and abrasions etc. Hence it is difficult to use it in the multiple floor buildings. There are two new types of solar films are available with the insulating properties namely moderate and very low remittances within the range of 0.5-0.05rad/m^2. This will help to lower the values of solar heat gain coefficient. Hence a large amount of energy is dissipated to the external environment.

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II. LITERATURE SURVEY

This paper presents the codes of buildings, issues related to energy conservation in houses, thermal resistance within the buildings, responsive and zero energy buildings and the analysis, simulation and modelling of the buildings with zero thermal effect. It also explains the strength and weaknesses of the above concepts [1]. This paper presents the hybrid renewable cooling system by the method of utilizing the solar energy with the ground source. It also focus on the air conditioning parts of the buildings with the impact on solar heat pump system, solar absorption cooling system and the conventional vapour air conditioning system [2]. This paper presents the placing of window glazing system with respect to various locations when compared to cooling effects, penetration of sunlight through the windows, the use of best shading devices, the thermal consideration within the eastern states of India. It also presents the building height recommendations issued by the national building code of India [3]. This paper proposes the various types of glazing types that is suitable for different room locations under the hot and humid climate conditions. The glass types EC-30 did not produce acceptable results when compared to EC-60 and low glazing E types [4]. This paper proposes a new methodology to measure the various performance of different class of glazing units and the thermal characteristics of the glasses also verified with the positive results. It also shows the energy saving points with the higher and lower transmittances compared to visible and infrared spectrum [5]. This paper summarizes the process of providing the thermal coefficient on thermal comfort throughout the hot and humid climate with respect to the year ahead. It also designed the solar energy with passive system components which reduces the heat absorbed in the window of the buildings [6].

III. SYSTEM IMPLEMENTATION

Solar control films are most suitable for the window glazing system when compared with the cooling coefficients and the temperature conditions. It was shown in Fig.1.

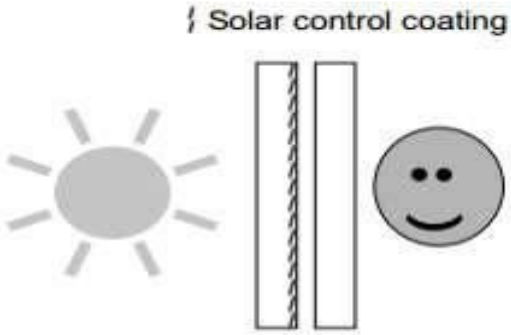

Fig.1. Solar Control Film

The consumed energy can be measured with the help of the methodology and the measurement output diagrams with the help of simple simulation outputs. Hence the solar radiation levels are measured with the necessary diagrams as shown in Fig.2.

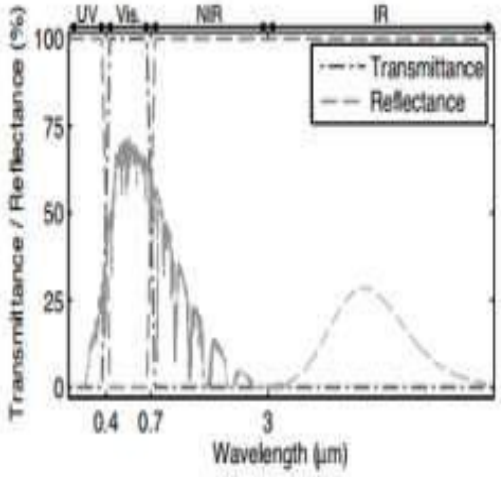

Fig.2. Energy Measurement Output

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The solar control film was fixed in the window with the room size of 5*4*3m^3. The film was coated in the standard 5mm window clear glass. The floor plan of the room with the window spacing was shown in the Fig.3.

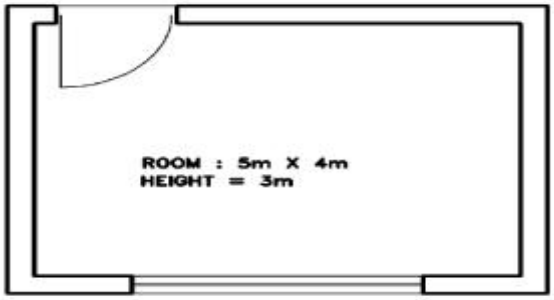

Fig.3. Plan of Room size with single window spacing

Three types of window materials are normally available. It consists of clear glass, reflective with low E-Film, Laminated glass with low E-Film Coating. The solar film is fixed in these three types of window materials within the duration of 15 days. This was shown in Table.1.

TABLE I
SOLAR CONTROL FILMS IMPLEMENTED IN WINDOW MATERIALS

Sl No.	System	Window materials	Duration
1	W1	Clear Glass	1st June to 15th June
2	W2	Reflective with low E-Film Coating	1st June to 15th June
3	W3	Laminated glass with low E-Film Coating	1st June to 15th June

The measured data are taken from the system implemented duration from 1st June to 15th June 2016. The measurements are taken in the natural ventilation of 40% opening of window throughout the entire working period. It takes nearly 15 days to collect the required data.

IV. RESULTS AND DISCUSSION

The results are obtained from the three different types of solar control film coating namely clear glass, reflective with low E-Film coating, laminated glass with low E-Film Coating with the impact on various factors such as solar radiation and the external heat dissipation. The result shows the three independent values depends on the glass materials used. Thus the results were shown below from figures 4-6.

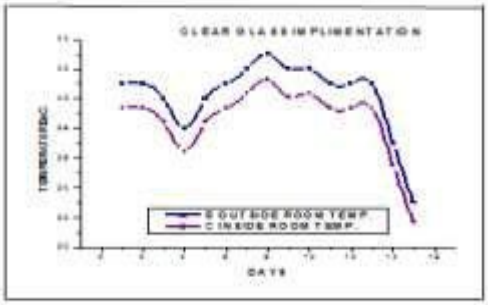

Fig.4. Radiation and Temperature level on Clear Glass

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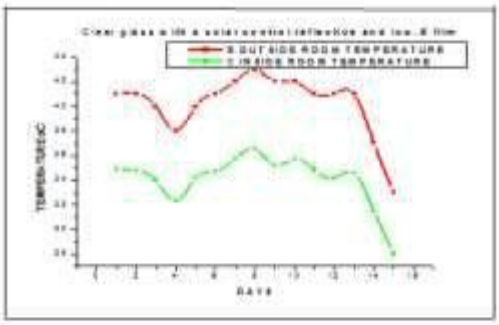

Fig.5. Radiation and Temperature level on Reflective with low E-Film Coating

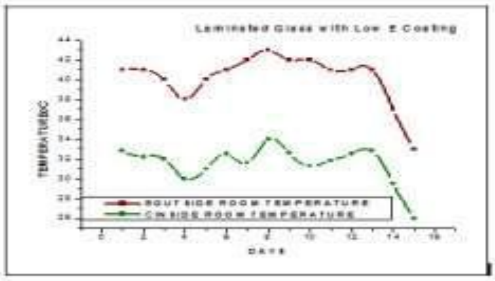

Fig.6. Radiation and Temperature level on laminated glass with low E-Film Coating

The results obtained are used to implement the system with the entire building which was finished within the entire duration with the different types of solar control film coatings. Hence the window glazing system successfully implemented in the building was shown in the Fig below. The front view of the building was shown in Fig.7 below.

Fig.7. SCFW Glazing System Implemented in a Building at tiruchirapalli district.

V. CONCLUSION

This paper implements the three different types of glazing system and their performance with impact on the solar radiation and the thermal heat constraints. The glass with the low E-Coating has the best significant effect among all the other types. Especially the laminated glass with low E-Film Coating proves to be better than the other two types. These system performances are more cost effective than the traditional systems. This method was most suitable for heat dissipation and thermal comfort for windows with glazing system built in the homes and office networks. In the future work, this system was implemented all over the buildings in the various states of the country.

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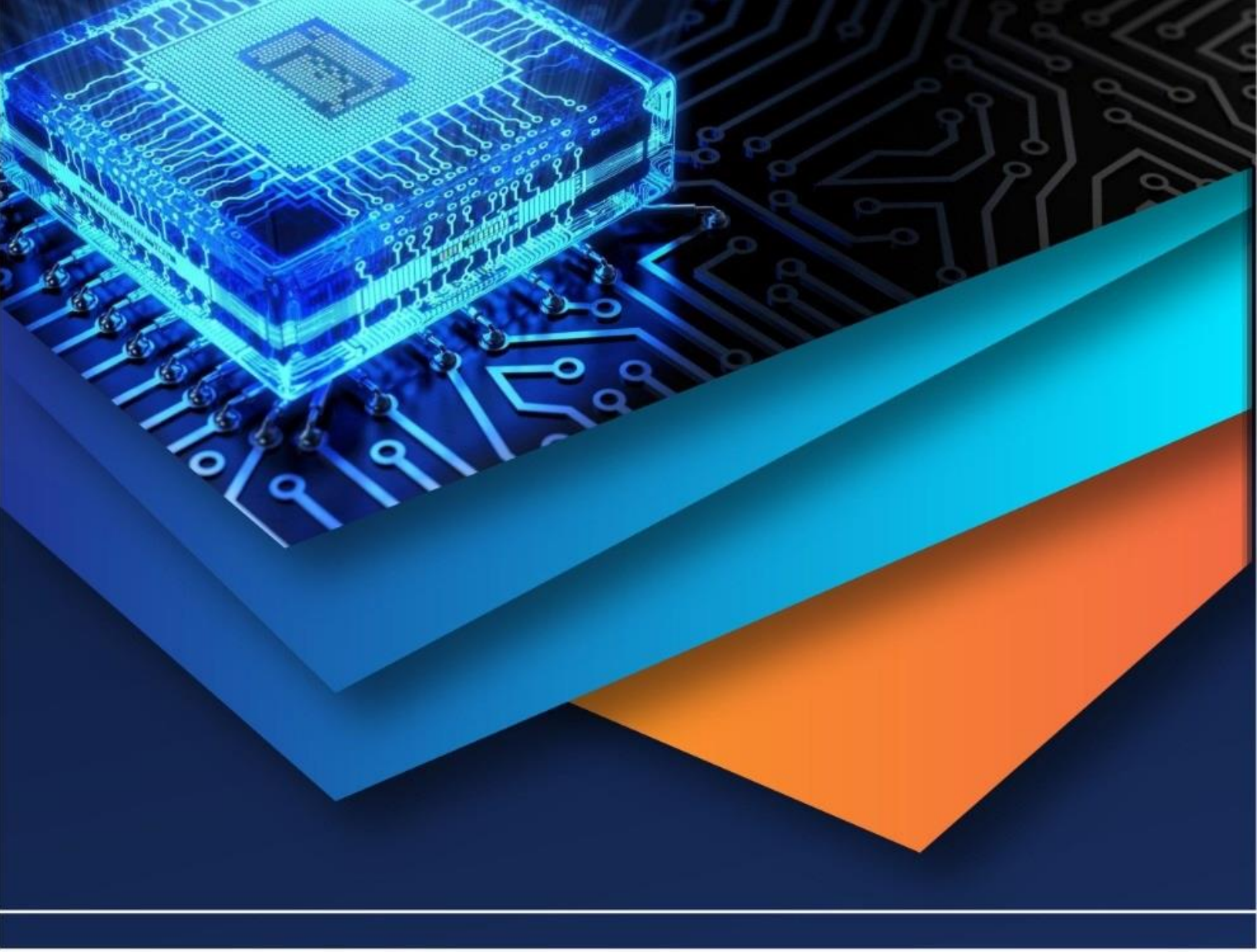

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