ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 5, Issue 3 , March 2018

Design Procedure of Dynamic Façade to Provide Thermal Comfort

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ABSTRACT: The principle concern of this paper is to develop the sustainable design of building skin by using combination of Green Facade and dynamic facade to provide thermal and visual comfort to the Students and staff in the College, the dynamic facade used to maximize the primary ventilation and also reduce the lateral load by distributing the wind load. Active and Passive facade used in south facade side of the building, the thermal analysis Wind Flow Analysis and building performance analysis where Carried out the pre-estimated result for the kings college of engineering campus and the thermal and visual uncomforted building is find at last research work.
The combination of active and passive facade is used to provide optimum ventilation and air flow, green facade used as an passive facade to reduce the direct sun radiation on the south facing external wall, the solar cladding and the Dynamic facade is used an active facade to increase the ventilation and to generate the solar energy, the Dynamic facade reduce the wind load over a building
The Dynamic facade have the kinetic movement depending on the sun path and it's maximize the Air flow and ventilation and power supply for the Dynamic facade is taken from the solar cladding and this design made the building as an sustainable building

KEYWORDS: Dynamic facade; solar cladding; sustainable design; Green Facade; Thermal Comfort; Building Integrated Green Facade; Autodesk Formit 360; Autodesk Insight; Autodesk Flow design

I. INTRODUCTION

The research carried out to provide the thermal comfort and visual comfort to the block II in the kings College of Engineering because it's have more radiation over the south facade wall it can be minimized by using the dynamic facade and other combination of active and passive facade in the south side of the building to reduce the solar radiation
Shelters created by humans first to provide thermal comfort and protection from natural elements, and this still remains a primary objective of buildings. The Dynamic facadeworkslike a the physical separator between the interior and exterior of a building.
When designing the building envelope, building materials are important for knowing some fundamentals of and heat transfer will help you make the right trade-off decisions.

II. OCCUPANT COMFORT

Buildings are designed for people, and those people are trying to accomplish a task – whether it's raising a family, running an office, or manufacturing a product. The building needs to keep people in comfortable zone, to do their task sustainable building design prevent the occupant form the negative impact of the surrounding environment

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A. THERMAL COMFORT

Creating comfortable zone to the user which provide happiness to do their task with more efficiency. Often factors such as thermal comfort and room temperature are affected by a design, which cause the problem to the use and utilized the more energy to provide the thermal comfort, when we losses the thermal comfort it may affect our brain working efficiency about 50% in the college the marks of student may get reduced and its directly the percentage of Exam results

To keep people comfortable you need to provide the right mixture of temperature, humidity, radiant temperature and air speed. The right level of these variables depends on what activity is occurring, how active the people are, and what they are wearing. Everyone has slightly different criteria for comfort, so comfort is often measured by the percentage of occupants who report they're satisfied with the conditions.

The cold breeze can provide the thermal comfort to user by natural,because in our country, we loses the thermal conform due to high temperature and in artificial by ceiling fans and air conditioning. HVAC equipment like air conditioner, fans, and humidity controller, but temperature over a surface and moving air haveneed to be considered too

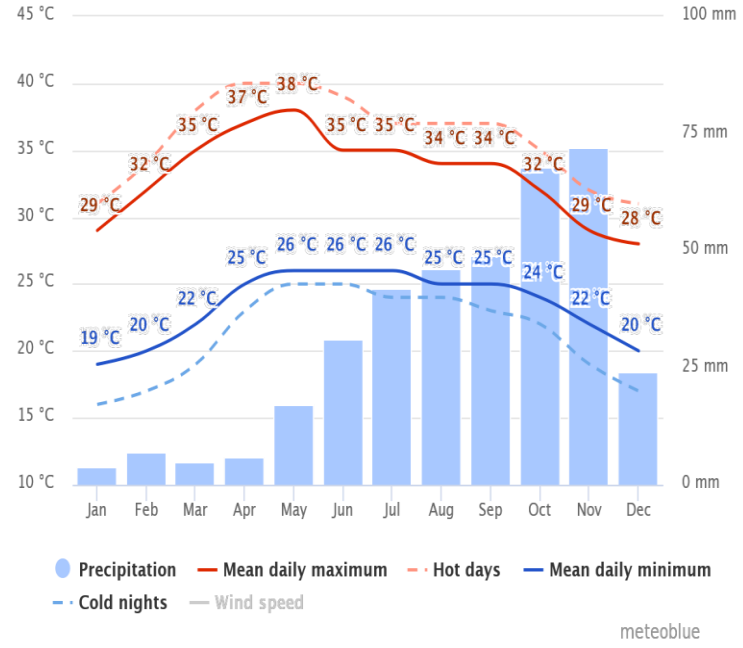

Figure 1 Average temperatures and precipitation

B. VISUAL COMFORT

Good visual helps absorb the board and to see and leaned the classes by students. Natural light are the best one even having the artificial lights. The visual conform is the important one for the concentration of student towards the professor.

The visual comfort is providing the correct amount of light it not be more power and not to dim. Lighting is often measured either by the amount of the amount of light reflecting off of a surface (luminance) or light falling on a surface (illuminance). These are objective measures, but how people experience this light is often subjective (i.e. are they comfortable?, do they experience glare?). Good visual comfort also generally means that as much of this light is natural energy. Which also save the energy for lighting porous

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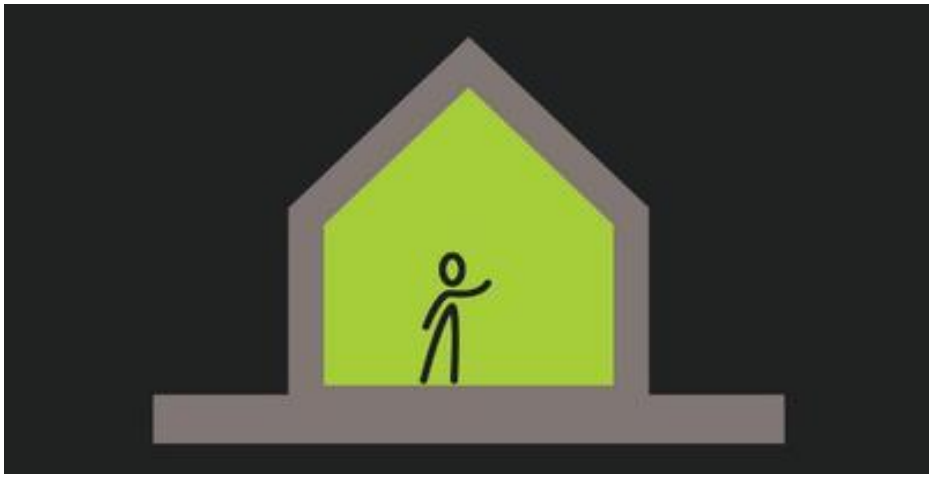

Figure 2 Visual Comfort

III. DYNAMIC FACADE ENERGY FLOWS

From an energy flow perspective, the envelope is a composition of layers with varying permeability and thermal properties. The envelope may be composed of membranes, blocks, sheets, and preassembled components. The choice of envelope is governed by the culture, climate, and available materials. The range of choices in envelope design can be illustrated by two opposite design concepts; the closed shell and the open frame.

In heavy climates, the engineers and designer frequently conceives and made chance in the building envelope as an closed shell or partially closed shell and to proceeds the selectively punch holes in it to make special and limited contact with the outdoors. This may also be true where there are unwanted external influences the as visual clutter or noise. When external conditions are very closer to the required internal condition, in this condition the open envelope is used, with pieces of a building skin which are selectively added to resist the few external forces.

The flow of heat through a building envelope varies by both season (heat always flows from a hot region to cold region and generally flows **from**a building in winter and in summer) and by the path of the heat (through the materials of an outdoor air entering or building's skin). These complexities must be considered by an architecture and designer who intends to deliver thermal comfort and energy efficiency.

IV. BUILDING ENERGY LOADS

Figure 3Dynamic Facade

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Energy loads defined as the how much energy your building needs. These demands can be provided by fuel, electricity, or by passive means such as solar power. Understanding building loads can be a complex topic because there are so many interrelated terms to navigate and it's sometimes difficult.
The load distribution analysis carried out over a dynamic facade the optimum design is generated. Thermal loads are the quantity of cooling energy and heating energy that must be removed or added from the building to keep occupant comfortable. Thermal loads come from heat transfer during the thermal operations and between the building and the external environment (envelope, external, or fabric loads).
These thermal loads can be translated to cooling loads (when the building is too hot) and heating loads (when the building is too cold). This energy use transfer to the HVAC component of a building's equipment loads (met by fuel or electricity). Other building loads include lighting loads (electricity used for lights)and plug loads (electricity used for computers and appliances).

V. HEAT ENERGY FLOWS IN BUILDINGS

There are of two types of heat flows: latent heat and sensible heat. Latent heat flow in the result of humidity to moistures. Sensible heat cause the change in surrounding and room temperature. Total heat flow is defined as the sum of sensible and latent flows. Human comfort depends on providing comfortable temperature.

A. SENSIBLE HEAT:

The heat associated with change in temperature of a material/substance/ space.

B. LATENT HEAT:

The release or storage of heat associated with change in phase of a substance, without a change in the substance's temperature. In building design and structural design, this is often heat required to remove/add the moisture content (humidity) from the air and surrounding. Whenever an object is at a temperature different from its surroundings, moisture flows from areas of greater concentration to areas of lower concentration Likewise, heat flows from hot to cold.

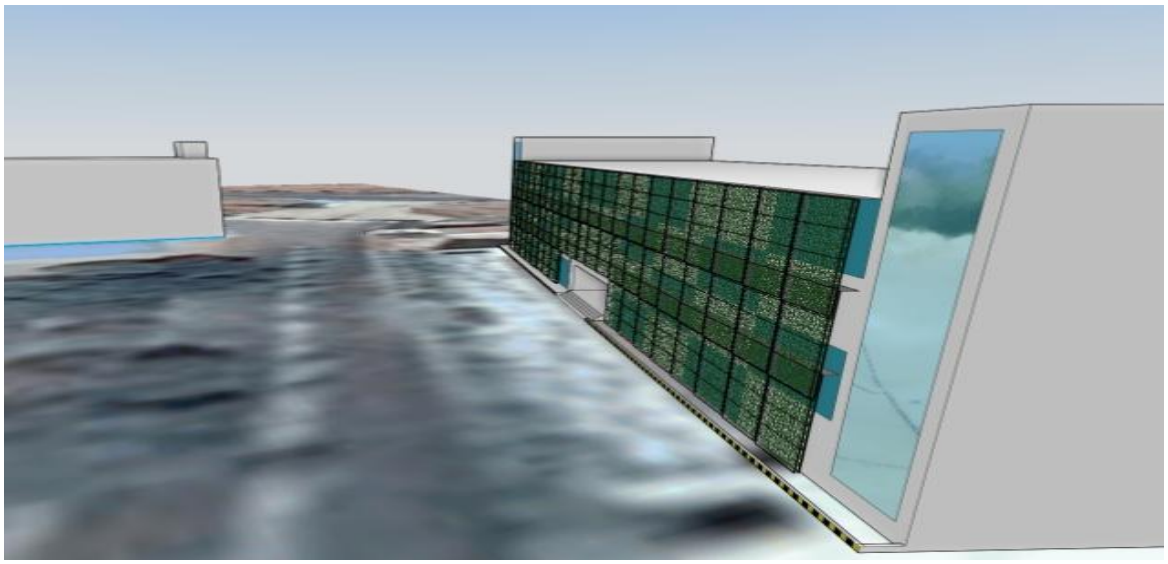

Figure 4 Green Facade as an passive Facade

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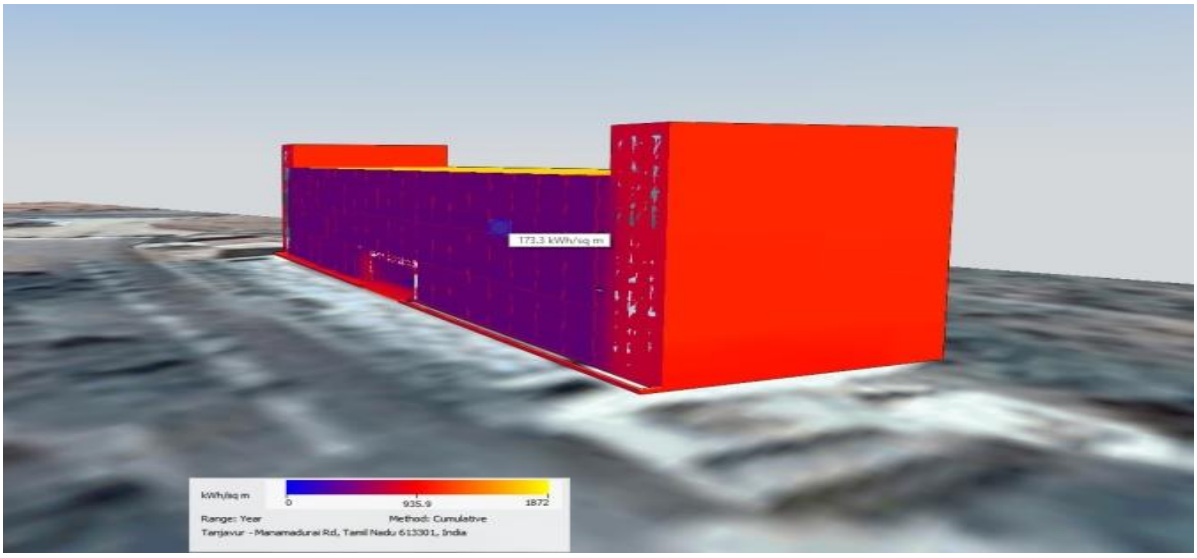

Figure 5 Thermal analysis after placing Green Façade

C. CONDUCTION, CONVECTION, AND RADIATION

Buildings lose sensible heat to the environment (or gain sensible heat from it) in three principal ways:
1) Conduction: The transfer of a heat between substances or an element which are in direct physical contact with each other. Conduction occurs when heat flows through solid materials.
2) Convection: The movement of liquids and gasses caused by heat transfer. As a liquid or gas is heated, it warms rises and expands because it is less dense resulting in natural of convection.
3) Radiation: When electromagnetic waves travel through surrounding, it is known as radiation. When these waves transmitted from the sun, (for example) if they hit an object, it will transfer their heat to that object.

VI. DYNAMIC THERMAL EFFECTS

Although the general principles remain the same, analysis of heat flow under dynamic (rapidly changing) conditions is more complex than "steady-state" or under static effects of **heat storage** within materials become a larger concern under dynamic motion conditions. Under static conditions, heat flow is primarily a function of thermal resistance (the resisting force)and temperature difference (the driving force). Building materials or elements lose or gain heat energy over time as surrounding temperature change and these heat absorbing properties are determine how much energy can be stored within a given element or material, and how quickly that energy will be released or gained

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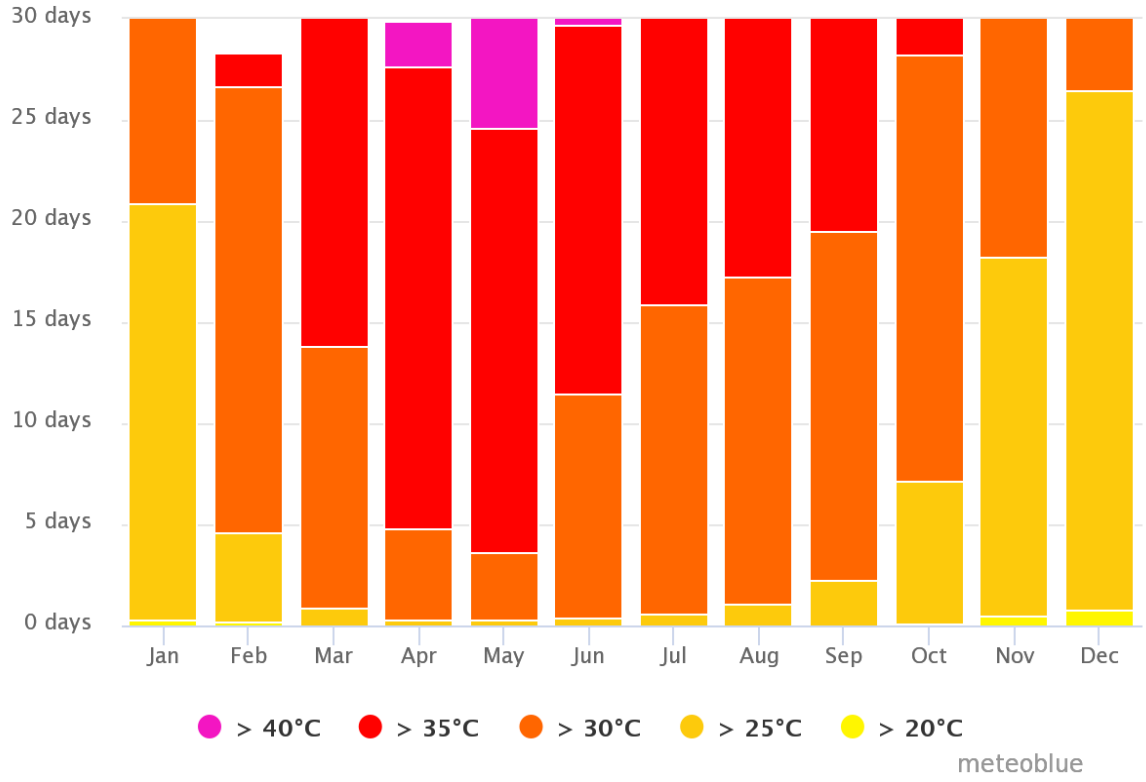

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Figure 6 Temperature for the period of 2017

VII. DYNAMIC FACADE WIND FLOW TEST

The Dynamic is the type of active facade and it have dynamic movement coordinated with the solar path, air flow analysis is done in wind tunnel

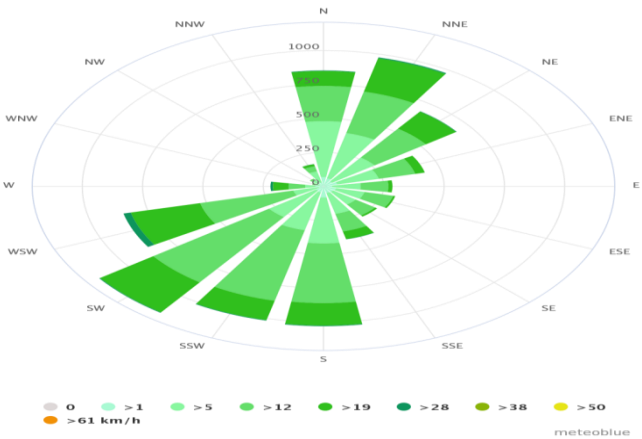

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Figure 7 wind Rose diagram

ISSN: 2350-0328

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VIII. RESULT

The optimum and sustainable design of Dynamic facade is designed by referring the building performance analysis, thermal analysis wind flow analysis. The building integrated green facade BIGF & Dynamic Facade in recent years has evolved conceptually from a primarily aesthetic design, gardening, or of artistic expression by the designer or the manifestation of economic power by the promoter, no a "vegetated architecture" in which the vegetation is another element of the building, with specific functions to develop the building as well as its relationship with the environment (energy aspects, acoustic protection material, support of biodiversity, provide thermal comfort).the green facade reduce the HAVC load and give the oxygen by the process of photosynthesis a vertical vegetation cover could lower the temperature of a facade wall and buffered its fluctuation with time, leading to reduced power loading air-conditioning. Time lag in temperature increase reflected that a vegetated cladding could mitigate the potential impact of solar heat that continued to affect the indoor space after sunset

With a green plant cover on a facade over south elevation wall, student could be benefited by a physical and mentally and get good result in exams. The management can have cheaper electricity bill in addition to the ecological merits of the vertical green panels and solar cladding, Dynamic facade.In general, the use of vegetation and Dynamic Facade, so well designed and managed, can be a useful tool for passive and active thermal control of buildings with the consequent energy saving. This can occur in four ways, often related, thermal insulation, and the interaction with solar radiation, i.e. shade, evaporative cooling, and the variation of the wind on the building.

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ISSN: 2350-0328

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