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Exploring Advantages and Challenges of PV-DSF and Vertical Greening System

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ABSTRACT: *Given the fundamental requirement for human comfort, the value of an HVAC system in every business or residential structure has risen dramatically over time. Heating, ventilation, and air conditioning system regulates the factors like temperature, airflow, ventilation, inside the conditioned space of a building. Along with being able to achieve the desired comfort levels, the HVAC system must also be effective in every way. Facades are quite crucial in this situation. Facades have the ability to redirect and filter sunshine, offer natural ventilation, control heat transfer, improve occupant productivity, establish visual and physical linkages between inside and out of doors, and, most importantly, reduce a building's running costs. This study attempts to discuss several sorts of facades and how they are valuable in their own right.*

1. INTRODUCTION

Buildings are the most major energy consumers in the main housing industry in our setting. As a result, Facades offer a long-term potential to preserve energy and safeguard the environment. Many industries, particularly the development industry, are experiencing a sense of urgency as a result of the coupled crises of energy source depletion and substantial global climate change. The heating and air-conditioning load, as well as the lighting burden, can be decreased in a variety of ways, one of which is the right design and selection of building envelope components. Façades are one of the largest contributors to energy expenses and, as a result, to a building's important comfort criteria. It's also one of the most crucial aspects to consider while designing and operating a building.

The Bureau of Energy Efficiency (BEE), The Indian Energy Conservation Code (ECBC), ASHRAE and Department of Energy (DOE), have all started programs that aim at reducing building energy consumption to zero in coming years. The World Green Building Council (WGBC) is cooperating with other green building councils all around the world to reduce the energy demand.

There are simple passive solutions with a low or moderate window to wall ratio and agglutinated outside shading area can range from simple solution to highly complex design solution with automated shadings and ventilation systems, which improves performance but necessitate more operation and maintenance. These strategies have potential to reduce the use of electricity for lighting, cooling, and heating purposes.

2. LITERATURE REVIEW:

The performance of a thin film photovoltaic facade called See Through was investigated. This study used global sensitivity analysis and simulation analysis to investigate the relationships between See Through thin film photovoltaic facade design parameters and edifice energy performance in China's cold zone.

The energy saving rate of the building is calculated based on the energy consumption of the reference workplace. The findings show that when a building's photovoltaic façade faces south, the best energy savings are up to 61.22 percent, while the lowest energy savings are just 13.7 percent when the PVF faces east. [1]

Another study possesses the kinds of glass to make sure the durability of the building façade in hot arid zone. Also, it aims to receive the minimum level of natural light while not impacting the thermal comfort.

The implementation of shading devices for double glass facade decreases the consumption of cooling energy by 2–5% to become see through by 100%. As a result, it's aforementioned that a properly shaded double glass facade results lower energy consumption of the building.

Color of glass utilized in facades might be an important to offer some thought to the thermal, visual and environmental comfort. The environmental improvement is achieved by study of solar path throughout the vital hours. [2]

In addition to the above study this aims at making of a theoretical framework which deals with the types, and importance of smart materials in design. These materials will alter properties and also reverse their form or color in response to physical / chemical influences. These are the materials that have the facility to retort and adapt to external and internal environmental stimulant.

Smart materials include Property dynamical Materials e.g., Electrostrictive, Magnetostrictive, Electrochromic, Thermochromic materials and part dynamical materials. These facades square measure in analysis right currently and energy square measure been taken to begin the employment of good facades. They have the potential and will be a key to think about energy conservation in future. [3]

An important study present ways to use photovoltaic (PV) as building component to extend energy conservation and to enhance the potency of the system. The idea of Building Integrated photovoltaic (BIPV) applies to PV systems that become well-designed discipline parts or replace typical construction materials.

BIPV has created a lot of appealing to the top user by exploration of totally different color, texture, shape, transparency level. The association of the buildings with BIPV has been resulting in the expansion of recent, value effective, PV goods for an improved integration into the building skin an example of BIPV is Double Skin Photovoltaic Facade. [4]

Another study presents capabilities of adaptive Facades that scale back the energy consumption in buildings. The adaptive facade has the power to vary its properties to adapt to variable atmospheric condition, which might succeed the most effective best stage for reducing the overall energy consumption.

In this analysis two cases were studied, usage of adaptive facades in each case it has been found that the adaptive facades were capable to save 18 to 29% of the overall energy consumption. These results make sure the potential and effectiveness of the planned approach in supporting the use of adaptive facades proves it’s capability of reducing the energy consumption of buildings. [5]

Study shows thermal performance of a vertical greening system in the building. According to research and studies, installing a vertical greening system on a building's facade has various advantages, not only for the building but also for the town. The benefits of the Vertical Greening System include shade and thermal insulation, as well as lowering greenhouse gas emissions and improving the climate. Vertical greening system are categorized into two types which are mentioned below:

Green facades: Are made up of creeper plants that cover a specific area of the building. At the bottom of the structure, the plants are planted directly in the ground.

Living Wall System: Because this approach does not use creeper plants, a variety of plants are used. It necessitates a wall-connected vertical support. The building is made out of completely distinct plants of various colors. The use of a green facade resulted in a temperature difference of 15°C to 16.4°C. [6]

3. MOST EFFECTIVE FACADES:

3.1. DOUBLE SKIN PHOTOVOLTAIC FAÇADE:

When compared to traditional facades, double-skin facades (DSFs) provide a number of environmental benefits. DSFs, for example, feature improved ventilation, lighting management, and noise reduction, as well as greater aesthetic and cosmetic quality and thermal comfort. Buildings that employ DSFs can save money in the long run by lowering energy usage.

Researchers have investigated several innovative DSF structures and technologies based on classic DSFs, such as the photovoltaic double-skin facade system, in order to optimize building energy efficiency (PV-DSF). PV-DSF is a common technology that blends photovoltaic modules with DSF and is currently regarded a viable façade technology since it uses solar energy in both active and passive ways.

PV-DSF structures make use of commercially available c-Si and a-Si solar cells. The heat gain from solar radiation is represented by the average solar heat gain coefficient (SHGC) and the average heat transfer coefficient (U value) under the same conditions. The insulating properties of the materials utilized to assess the thermal performance of these buildings.

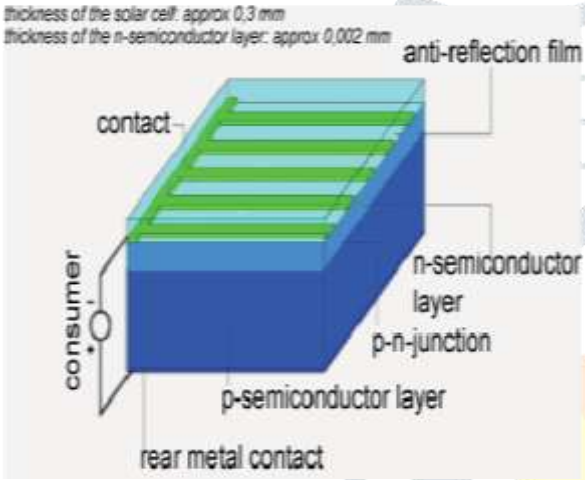

Fig (1): crystalline silicon photovoltaic

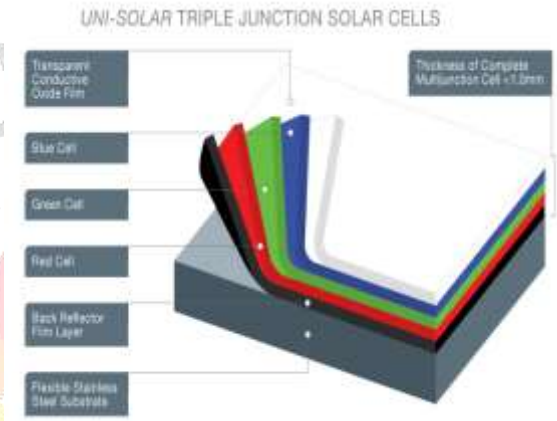

Fig (2): amorphous silicon photovoltaic

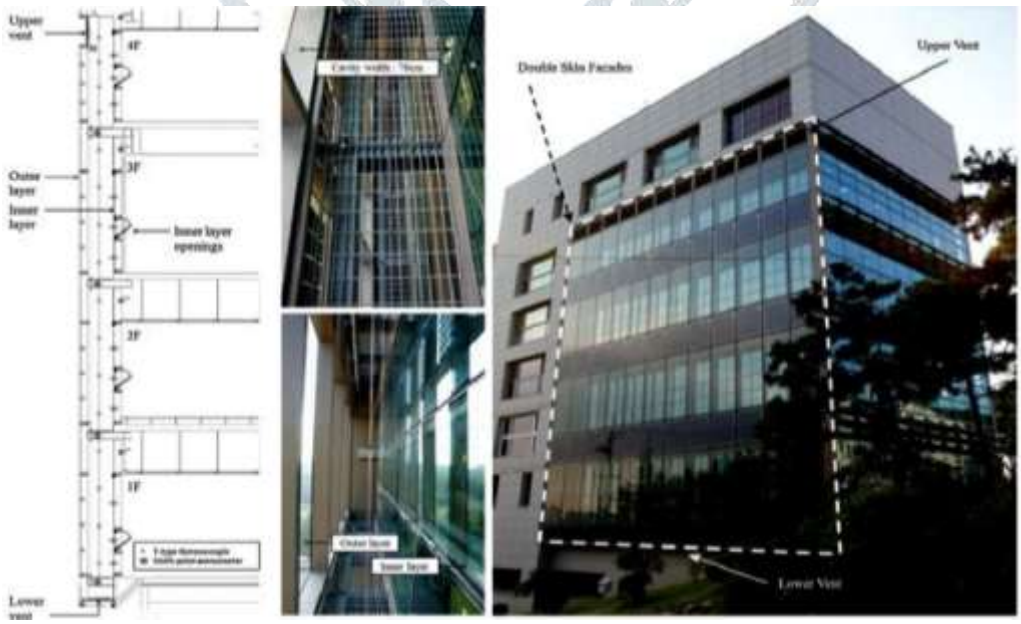

Fig (3): actual image of double skin photovoltaic facade

3.1.1. ADVANTAGE OF PV-DSF:

When comparing DSF, DSF with blinds, and PVB-DSF, the conventional DSF system without blinds has the best average SHGC, while PVB-DSF has the lowest average SHGC and also the lowest average U value, implying that PVB-DSF provides better thermal insulation than DSF with or without shading devices. Solar electricity will be absorbed more efficiently by the integrated PV shutters than by regular DSF.

3.1.2.DISADVANTAGE OF PV-DSF:

The initial cost of construction and the amount of area required for installation are the two primary disadvantages of PV DSF.

3.2. VERTICAL GREENING SYSTEM:

The plants also induce evaporation, which serves to keep the town or city's temperature cooler by reducing sunlight gain in the structure. Vertical vegetation is a hot topic right now. Wisteria and Virginia creeper, for example, have been utilized to adorn building facades. This is seen in Fig. (4).

The following are three types of vegetation:

- Creepers, which use tendrils, twining stems, or suckers to ascend;
- Creepers that require a structure in front of the wall to allow them to develop and ascend;
- Plants that grow from pots on the roof or balcony and hang from the ceiling (these plants require more care: fertilizer, water and protection against frost)

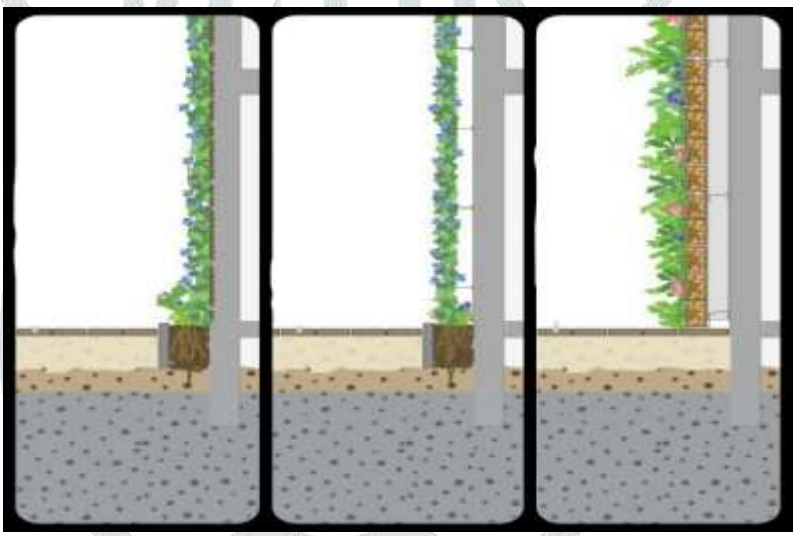

Fig (4): vertical greening system

The walls are shielded from direct radiation by vertical plants. In the dark, the facade warms up, absorbs heat, and emits heat more slowly. Evaporation causes the plants to release water vapor, which helps to chill the surrounding region. Vertical vegetation, in short, has a cooling impact on extreme temperatures. Ivy and other evergreen creepers cover the face of the building. Ivy and other evergreen creepers protect the facade from cooling in the fall and winter. In both winter and summer, adjusting the temperature can result in energy savings from heating and cooling. Climbing plants may also be utilized for pergolas to provide shade. No other façade material can offer the following features in one package:

- Remove contaminants from the air
- Reduce the temperature in cities.
- Benefits to buildings in terms of heating and cooling
- Enhance biodiversity
- Reduce the amount of rainwater that falls on the ground.
- Reduce the amount of noise
- Boost your productivity and creativity.
- Enhance your sense of well-being
- Advantages to your health

Fig (5): Actual Image of vertical greening system

Evergreen plants may help protect the structure from rain and keep the walls dry. Figure (4) shows the real image of the vertical greening scheme. Buildings that are already experiencing increased humidity as a result of existing structural flaws or damage, on the other hand, may be further harmed by vegetation.

The issue of climbing plant roots causing damage to a building is frequently brought up. Some individuals are afraid about insects getting into their homes through the plants on the exterior walls. This may be avoided by keeping plants out of the windows.

CONCLUSION:

This study aimed to evaluate a few research publications in order to highlight recent developments in the subject of Facade Selection. According to current research, the ideal facades for increased energy saving in any structure are the Double Skin Photovoltaic Facade and Vertical Greening System. In the near future, adaptable facades, as well as smart facades, have a lot of promise. Any of these can be utilized depending on the situation and application. You may also experiment with and adapt alternative approaches to further increase the effectiveness of these facades. A list of references is provided to provide a more comprehensive understanding of the techniques mentioned.

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