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**Materials Used For Natural Ventilation In The
Library**



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PRADESH**

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1. Cross ventilation
2. Single-sided ventilation
3. Stack ventilation
4. Terracotta
5. Laminated glass and tinted sheet
6. Sun path and direction
7. Acoustic

ABSTRACT

In my previous research paper, I identified an opportunity to promote natural ventilation that increases IEQ and energy efficiency for libraries that have high occupancy duration by their users. Examples using information gathered through CFD analysis and real-time monitoring are used to illustrate how passive design solutions can effectively minimize artificial cooling requirements while maintaining thermal comfort.

Recommendations focus on user-centric features, including climate adaptation features, such as adopting mixed-flow and forced ventilation systems where noise, dust and fluctuating climates can be problematic.

In this research paper, I will describe the types of natural ventilation, materials used in designing and their properties, and sun path and direction for the same topic as my previous research paper which I will apply in my library design to improve the use of natural ventilation in the library.

INTRODUCTION

Natural ventilation is the inflow and outflow of natural air through the building without involving fans or air conditioning devices. That is based on natural drafting, wind pressure, and thermal buoyancy, which results from the differences in density from the inside air and outdoors.

These forces enable the fresh air to circulate and the stale air to be removed hence improving indoor air quality, the system less relies on air conditioning which makes it environmentally friendly and improves sustainable building designs.

- **Types of natural ventilation**

1. The **cross-ventilation** is the type where air moves in one direction across a space, which is always made possible by the presence of openings on different sides of a building.
2. **Stack ventilation** relies on variation in temperatures; hot air rises and moves upwards and out through the rooms with higher vents, thus pulling in fresh air through outlets down in lower areas.
3. **Single-sided** opening means that there are openings just at one side that encourage natural convection together with wind pressure differences in the space.

- **MATERIALS**

1. **Terracotta**

Terracotta is a fine-grained clay that is shaped and then baked at certain high temperatures to make it solid. It is usually distinguishable by its red/brown colour arising from the iron oxide in the clay.

It is commonly applied in construction works, sculptural works, and products for pottery and warm stoves because of its hardness, beauty, and heat-resistant ability. In architecture, it is used in tiles, bricks and other ornamental work since it has a smooth surface, gives a natural look and has excellent heat-controlling capacity.

Terracotta as a building material has good thermal characteristics that make the building cool in summer and hot in winter. It is not affected by UV light, mould and bacterial growth and can be used internal and external flooring.

2. **Laminated glass and tinted sheet**

Laminated glass is created by having two or more layers of glass with another layer of polyvinyl butyral (PVB) in the middle. The PVB layer helps prevent sound from passing through a space.

The laminated glass prevents heat up to 50 degrees to 150 degrees Celsius and is 99 percent UV resistant. By applying tinted sheet film upon the laminated glass can be more helpful as tinted sheet also possess the property of heat and UV resistance.

3. Acoustic

Acoustic relates to the characteristics concerning sound in a given environment, its production, transmission and sound attenuation. Acoustic has the ability to enhance the comfort, clarity and usability of a room, especially in residential areas, office spaces, cinemas or recording studios.

Thick pile wool gives enhanced room sound absorption, lesser echoes, and also reduced impact sounds within the room through the use of a rug. Owing to its density and the softness of the fibres, wool is effective in the elimination of sound bounce over surfaces of rooms that are substantially of hard materials. To get the most benefit from the appearance of the large rug you will want to have one that is plush and has a thick pile with dense padding on the back side.

SUN PATH AND DIRECTION

The line of direction of the sun as the earth rotates around it and at the same time spins in its axis is the **sun path**. Sun path analysis is applied to determine the position of buildings to permit maximum penetration of natural light and heat.

Knowledge of the sun path plays a very significant role in reducing energy consumption and efforts to take precautionary measures in limiting environmental impacts in the construction of buildings through passive techniques.

The position and orientation of the sun are among the most important factors for consulting because they determine the natural amount of light, the energy supply of an enlarged room and thermal comfort. The position of the sun changes differentially by location and season and the time the sun sets and rises is larger in summer than in winter.

Sun path analysis provides architects with data for finding the best orientation of buildings, with ample natural lighting and little heat build-up or loss. For instance, southern exposure windows (in the northern) allow more solar heat during winter and use features like the overhang to minimise heat from the sun in the summer. The use of lighting control and air movement also improves thermal comfort.

These include graphical tools like the sun path diagram together with 3D models to assist the architects in placing the openings, shading systems and any space. This prevents the construction of energy-consumption, badly designed buildings that are uncomfortable for occupants.

PROBLEM STATEMENT

Even though these strategies have been seen to provide efficient means of enhancing thermal comfort and energy utilization, several building designs lack essential parameters like the path of the sun and the wind direction together with the characteristics of the building materials.

- **OBJECTIVE**

1. During summer days to generate cool air and during winter to generate hot air.
2. In order to achieve precise application of thermal and mechanical energy.

- **SIGNIFICANCE OF RESEARCH**

This research suggests the practice of natural ventilation strategies, properties of materials to be used and analysis of sun path in the design of libraries to improve thermal comfort and energy efficiency.

Given that these are high occupancy structures, libraries tend to gain the most from passive cooling and heating techniques mainly to minimize the utilization of artificial systems.

With the use of terracotta and laminated glass with tinted sheets incorporated in the study, the authors encourage the use of energy-efficient construction that goes hand in hand with green building.

It also relates to some specific problems of urban climate like noise, dust, and unstableness of wind by using the adaptive mixed-flow and forced ventilation systems. It helps to create robust buildings in terms of climate dispersion and constant comfort for users, as well as enhanced IEQ.

Also, the study helps in promoting sustainable architectural practice through the methodology that has been provided to minimize the emission of greenhouse gases and the costs of energy. It provides fundamental guidance in positioning the building and its openings as well as shading devices and annual sun path analysis of the building.

Lastly, realisation of the research insights can be useful to architects, policymakers and key stakeholders to increase awareness of passive design advantages and promote progress in library design. It stresses what can be achieved with sustainable construction namely nearly zero-energy buildings that are comfortable, practical and efficient in terms of resource use.

LITERATURE REVIEW

1. **Topic:** Sun-path model as a simple helping tool for architecture students in understanding saving energy building design

Authors: L H Sari, E N Rauzi, Muslimsyah, M Mahmud

Publisher: IOP Publishing

Publishing Date: 2021

The present research study focuses on the effectiveness of the sun-path model as a student – a teaching aid for architecture to grasp effective energy-saving designs. The study focuses on sunlight analysis for the design of energy-efficient building systems especially in different climates. It features more of a practical aspect since students design their 3D sun path using ordinary materials such as wire and foam boards to draw the sun's path throughout different seasons. This exercise aids the students in understanding how the direction and altitude of the sun affect building construction and therefore promote energy-sensitive architectural choices.

RESEARCH GAP

The research gap that has been highlighted in this study includes a lack of teaching materials to address the topic of teaching architecture students the application of sun-path analysis inefficient building designs. Other resources that currently exist are usually only focused on energy conservation and do not offer live, more tangible methods that let the students see how the movements of the sun impact building performance in various seasons, and climates. To address this issue, the paper puts forward an ideal and easy-to-implement way for students to build sun-path models, to achieve a richer learning approach.

2. Topic: Terracotta products for maintaining sustainability in architectural and construction methodologies.

Authors: Ar. Gaikwad Anup, Ar. Malani Seema

Publisher: International Journal of Novel Research and Development (IJNRD)

Publishing Date: 2024

The authors stress aspects, like energy efficiency, ease of maintaining sustainable structures, and the durability and attractiveness of terracotta. The point of the material that was considered as its ecological affinity is thermal efficiency, flammability and cost-effectiveness.

The paper also pinpoints the appropriateness of terracotta to a range of architectural offerings including tiles, bricks, cladding and ornaments. To wit, the article analyzes the material's ability to maintain stable temperatures indoors to minimize the use of artificial heat or cooling. This harmonizes with the global quest to minimize carbon footprints in construction practices.

Much emphasis is paid to the historical and current uses of terracotta, and its ability to combine classic and avant-garde tendencies. The research proves its suitability for performance in regions with seismic risks and compliance with fire and acoustic standards.

Through supporting the increased usage of terracotta due to its renewable nature, the paper supports its use in green buildings. This is in synch with global tendencies of green building construction and opens up the window for groundbreaking green building ideas.

3. Topic: Acoustic Advantages of Wool Carpeting

Authors: McNeil Steve

Publisher: AgResearch Limited

Publishing Date: 2014

In his research paper titled "Acoustic Advantages of Wool Carpeting" McNeil explains how wool carpets act as an optimised sound and impact-absorbing surface as well as a surface that minimizes sound bounce back. Wool carpets greatly reduce airborne sound by giving room for the sound energy waves to penetrate the wool carpets

converting the energy into sound vibration instead of hard floor surfaces which reflect the same. This quality of the products makes them suitable for diminishing the echoes and enhancing the sound quality in homes, offices and other communal facilities such as classrooms and restaurants among others.

This paper can establish the fact that due to the inherent mechanical structure of the wool fibre and especially the ability to favourably absorb the impact of other frequencies, wool tops are other commonly used well-known natural and synthetic sound-absorbing materials in the market.

Moreover, together with underlays, wool carpets further intensify these sound attenuation characteristics for multi-storey constructions. In addition to good acoustic properties, wool carpets provide thermal comfort, sustainability, and design, which makes them a universal product for today's interiors.

METHODOLOGY

When starting to write a thesis, one is allowed to choose one out of eleven topics proposed with a possibility of further classification in synopsis. The first part of the synopsis should include a basic introduction of the selected concentration with statements of the research aim and objectives. This will assist the researcher to identify a problematic area and to define the objective of the study.

The next section should be a literature review in which different related works are discussed and presented in a way that shows the reader where the intended study seeks to fill the gaps.

After that, outline the research strategy, action strategy, the mode of operation, strategies and techniques that will be used, and sites of study. Moreover, elaborate on all constraints that could occur while conducting the study. Explain what the study will achieve, and how this study will help the advancement of scientific knowledge.

Finally, the synthesis, briefly explains the relevance of the research and list of bibliographical references. To enrich the study, go to a related area, and search for primary data to incorporate in writing different research papers. Submit one of these papers as an additional file together with a certificate of presentation as part of the thesis.

In the second paper, one should consider only the materials component of the given research theme. Finally, as a utilization component, build either an instrumental use model or a symbolic use model of the overall research conclusions to enhance the evaluation.

LIMITATIONS

- I will use tinted laminated glass on the glass wall and windows but will not use it on the railing on the mezzanine floor.
- I will use a thick wool rug pile only in the reading area for acoustics.
- I will use tile flooring only in the reception, shelves and seating areas.
- I will use floor seating only on the mezzanine floor near the glass railing.
- I will use only a thick pile wool rug for flooring on the mezzanine floor.

RESULT

The study emphasizes natural ventilation systems and passive design approaches to improve energy efficiency and thermal comfort with high occupancy in library buildings. This research focuses on cross-ventilation, single-side ventilation, and stack ventilation intending to minimize the use of artificial ventilation. It is preferred for the thermal performance of terracotta, laminated glass with the option in tinted sheets providing UV & heat protection (passive solutions for sustainability). There are also acoustic concerns met by arranging thick pile wool rugs in the reading sections in that they dampen echoes and improve on the sound insulation.

Likewise, the research reveals that sun path should be critical in defining the orientation of construction and shading techniques. When certain aspects of design are ruled by the path of sunlight's natural curtains, it is easy to optimize light and eliminate the use of artificial lighting. These integrated strategies sought to achieve near zero-energy, low-energy, green library buildings that enhance the comfort of the building occupants and internal environment quality. Thus, the findings contribute a significant base for the architects, the interested parties and the policymakers and effectively support the sustainable architectural strategies that emphasize the passive methods in contemporary constructions.

CONCLUSION

They will further confirm that natural ventilation systems and passive design improve energy efficiency and thermal comfort in HOB libraries. Due to cross ventilation, single-sided ventilation, and stack ventilation, frequent use of artificial systems such as cool and heat is avoided hence enhancing energy conservation.

The study gives details on specific materials to include, for example, terracotta for its thermal regulation, laminated glass with tinted sheets to avoid heat and UV penetration, and wool rugs for acoustic purposes, to affirm that integration of such materials enhances the formation of the sustainable and functional library environment.

Also important is the sun path and orientation analysis which is crucial in natural light control, thus little use of artificial light and air conditioning. These considerations make it clear that sun path analysis should become an indispensable element of architectural bureaus' work focused on energy-saving designs.

The research gives specific input for architects, policymakers and related interest groups as to how such passive design solutions can drive Zero near-energy. It promotes the principles of sustainable architectural processes that aim at preserving the environmental capacity as it seeks to improve the quality of indoor air for the users of libraries. In overlooking noise, dust, and climate fluctuation issues as barriers to sustainable passive design and incorporating appropriate design solutions to overcome them for improved environmental design quality, this research aligns with the goals of green architecture practice and the sustainable development of the world.

REFERENCE

1. Sari L H, Rauzi E N, Muslimyah, Mahmud M, 2021, Sun-path model as a simple helping tool for architecture students in understanding saving energy building design, IOP Publishing.
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