



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Natural Ventilation In The Library



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A project is submitted to

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In partial fulfilment of the requirement for the degree of

BACHELORS OF DESIGN

With specialization in

INTERIOR DESIGNING

By

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KEYWORDS

1. Natural Ventilation
2. Library
3. Enhancing Indoor Environmental Quality (IEQ)
4. Building planning

ABSTRACT

Natural ventilation is an effective and efficient tool towards enhancing Indoor Environmental Quality (IEQ) and energy effectiveness in constructed libraries. Because libraries are not just buildings where people briefly come for quick information but facilities in which people spend a lot of time, both the comfort of the external climate and the need to save existing resources prevent them from making buildings comfortable. Analytically, this research focuses on design characteristics, assessment, and implementation concerns regarding natural ventilation in library buildings.

The study entails an exploration of issues affecting natural ventilation that include building orientation, window positions and sizes, thermal mass, and airflow. CFD and real-time monitoring were used to assess the airflow and thermal comfort in the identified case studies.

The results show that it is possible to reduce energy usage for cooling artificially by using natural ventilation, while at the same time applying passive architectural concepts to ensure acceptable user comfort levels are met.

These issues include changes in climate conditions, noise interference, and dust control measures and their recommendations include adopting biogeous mixed flow and forced ventilation systems. This research suggests that users' requirements should be the focus, as well as context-aware solutions catering to library functions and regional climates.

INTRODUCTION

Libraries are hubs for learning, research and knowledge and their users often spend several hours in libraries to achieve learning and intellectual objectives. It is imperative to achieve a comfortable and healthy environment indoors, especially within libraries.

While cooling system methods require extensive use of mechanical equipment and energy-consuming processes, natural ventilation on the other hand makes use of forces like wind, and differential thermal expansion among other features such as carefully located and positioned openings. Libraries can benefit

from this approach since many strategies will contribute to sustainability, meaning the reduction of the use of the air-conditioning system and therefore a low carbon footprint

Design and use of natural ventilation in libraries considered various factors such as the direction of the building, the position of windows and doors, airflow patterns, and the materials used in the construction of the library. However, the process of attaining optimum results also involves other issues, for example, fluctuating climate, noise break and dust issues. This study examines the possibility of natural ventilation concerning library buildings about its opportunities and restrictions together with the concept of its application in the planning of buildings with the purpose of improving the user's experience as well as providing energy efficiency and environmental sustainability.

PROBLEM STATEMENT

Extreme use of air-conditioners which is high energy consumed in today's life provides bad air quality.

• RESEARCH QUESTIONS

In library structures, what design approaches can enhance the natural ventilation process? What implications do window configuration and positioning, window aspect and materials used in the construction of the facades have on ventilation and thermal comfort in libraries?

• OBJECTIVE

- To provide good quality of air for the end user of the library to breathe in.
- To avoid the use of air-con and cooler.
- To prevent excessive use of energy consumption.
- To provide both common and private space for the end users.

• SIGNIFICANCE OF RESEARCH

Energy Efficiency and Sustainability Lighting, HVAC, and 24/7 functionality make the libraries one of the energy-consuming buildings on campus. Cross ventilation minimizes the mechanical systems such as cooling and heating hence conserving energy hence a sustainability goal for the world.

Indoor air quality (IAQ) is another important factor that has benefited from the introduction of this regime. It facilitates better ventilation inside a building, driving out polluted air, and high levels of carbon dioxide, and

bringing in fresh air. This is especially important as users spend so much of their time in limited spaces, especially within libraries.

Enhanced Thermal Comfort Well-designed natural ventilation systems sustain warmth control since they cool indoor temperatures through natural means hence creating an appropriate learning and working climate.

Cost-Effectiveness Incorporating natural ventilation saves costs of mechanical systems, which is a long-term advantage to the management of libraries.

LITERATURE REVIEW

1. Topic: A literature review of cross ventilation in buildings

Authors: Zitao Jiang, Tomohiro Kobayashi, Toshio Yamanaka, Mats Sandberg

Publisher: Elsevier

Publishing Date: 2023

Through effective and optimally designed natural ventilation systems in buildings, the past years' threatening problems like global warming, energy crises and different known health issues could be mitigated. Since higher temperatures can not only come from climate change but also from continuous urbanization in the future, the trend of the use of natural ventilation may be further affected. Such factors may lead to other uncertainties that may further constrain the application of natural ventilation. In the book, Heiselberg proposed the idea of hybrid ventilation where both natural and mechanical solutions are elements of the hybrid used to control the flow of air within the building to maintain the quality of the air inside the building and at the same time, maintain low energy consumption.

Research Gap

The effectiveness of natural ventilation might be affected by climate change as well as ongoing urbanisation, which may cause either global or local temperature rise.

2. Topic: A Study of Efficiency of Natural Ventilation Strategies in a Library Building

Authors: Vanlalnunpuii and Abhijit Rastogi

Publisher: International Journal of Multidisciplinary Innovative Research (*IJMIR*)

Publishing Date: 2021

Natural ventilation plays a significant role in a building's cooling to provide fresh air. Libraries are an important part of our community and in academics; hence, the library building should be designed using the method of natural ventilation to provide fresh air for visitors and workers.

Natural cooling in a building provides hygiene, reduces the use of energy, and keeps us in good health condition. Also, the use of natural ventilation is sustainable for the building.

Research gap

Because of such unintended correction, miscellaneous ventilation strategies have been implemented in the libraries, and excessive use of air conditioners which led to high energy consumption, and an undesirable internal environment. The studies therefore seek to understand the impact of natural ventilation strategies and those factors that are related to it remaining to be observed as passive cooling when it comes to a library structure. The following factors determine ventilation to a very large extent the external appearance of the building, its location and the dimensions of the openings, and the appearance on the outside.

Connection between past research studies and current research studies

Coordination from previous research on natural ventilation as an effective system to implement in libraries saw the development of fundamental concepts that included Airflow, heat stress, and designs including cross ventilation. These studies focused on energy conservation and enhancements of air quality.

Today's research expands upon this foundation of computational tools such as Computational Fluid Dynamics (CFD), focusing on climate change objectives and user experience and sustainability. Current investigations may replicate past observations through field monitoring, update the design aspects of combined systems, and examine new versatile possibilities. The connection also shows the continuity from the theoretical Abstracts to the pragmatic, prognostic Concepts.

METHODOLOGY

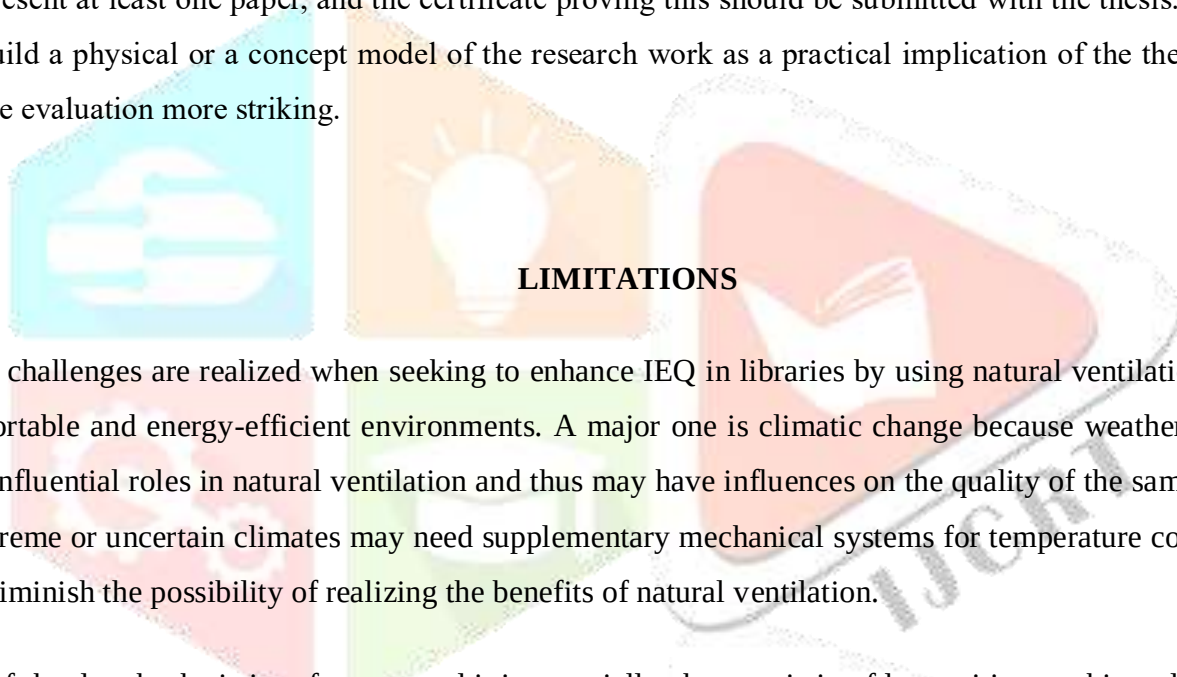
In order to compose a thesis, start with eleven potential topics and choose one that can be analyzed in a synopsis. To begin with, begin the synopsis by dedicating a brief introduction to the topic you have chosen. As specific goals and objectives or aims and objectives of the research are distinctly identified, one must be able to state a problem area and thus, define the purpose of the study.

This should be followed by a literature review where available literature will be reviewed and summarized in preparation for the comparison of the gaps the intended study seeks to fill.

Second, describe the method that is the plan of action, the means, the ways to use, and the methods that will be applied. Identify and describe venues of study and limitations that may characterize the full conduct of the research. Explain expected results, and what may be discovered or provided to the existing scientific research.

The synopsis should be completed with a brief overview of the value of the study and list references accordingly. Visit an area of interest so as to collect data from the actual environment and use this data in writing various research papers. Produce papers alongside coordinating and designing parts of the study at the same time.

Present at least one paper, and the certificate proving this should be submitted with the thesis. Last of all, build a physical or a concept model of the research work as a practical implication of the thesis to make the evaluation more striking.



LIMITATIONS

Some challenges are realized when seeking to enhance IEQ in libraries by using natural ventilation to create comfortable and energy-efficient environments. A major one is climatic change because weather conditions play influential roles in natural ventilation and thus may have influences on the quality of the same. Libraries in extreme or uncertain climates may need supplementary mechanical systems for temperature control which will diminish the possibility of realizing the benefits of natural ventilation.

One of the drawbacks is interference, and it is especially characteristic of large cities or objects located near highways. Problems such as noise pollution are usually caused by openings such as the windows and vents which naturally facilitate indoor natural ventilation. Likewise, dust control becomes an issue, particularly in areas with source pollution or with high particulate content, since natural ventilation shafts convey contaminants and intrude into the interior space, thus lowering the quality of the air and comfort levels of the end users.

Physical limitation is equally a factor because natural ventilation is influenced by factors such as building orientation, window design and thermal mass. Adapting existing library structures to incorporate natural ventilation therefore turns out to be expensive and sometimes cumbersome. Further, user factors can be a barrier to implementation, as library users or staff may formerly be acquainted with mechanical cooling for convenience and immediate and modifiable comfort.

Last of all, conflict over space may be experienced. Public spaces give ways while private spaces offer privacy; and at the same time, libraries are supposed to have proper ventilation. This challenge is topped by other requirements such as incorporating natural ventilation into the overall design of the aesthetic appearance and functionality of the building. Overcoming these limitations is possible by adopting dual passive stack ventilation, context-driven solutions, and user-oriented, regional climate, library functional, and operational requirements-specific designs.

RESULT

Natural ventilation as a method of controlling indoor ambience has been established to have many benefits among them being; that it is cost-effective, and improves indoor air quality among others but the approach may have the following disadvantages; it increases the risks of noise pollution of the environment, security, and may require frequent maintenance. In cases where the systems of natural ventilation are to be used at their optimal capacity, then it is likely that a hybrid regulation of natural plus mechanical ventilation should be acquired.

The study explored whether natural ventilation was viable and efficient as applied to the interior design of libraries. The studies also show that if proper building orientation, window placements, and ventilation shaft design are integrated, improved IAQ and thermal comfort could be achieved.

In the context of the current research study, the concept which is investigated as capable of influencing library interior design is that of natural ventilation. Studies reveal that even positions and structures that are usually overlooked in building construction, for instance, the orientation of the building and the position of the windows and air ventilation ducts can greatly improve IAQ and thermal comfort. The major strategy named is cross ventilation which appears to be one of the most efficient as it facilitates air exchange and minimizes the use of mechanical systems.

However, some of these limitations such as climate dependency and noise intrusion require a specific study of climatic conditions within the building environment. As much as natural ventilation provides an efficient and sustainable solution, modulation of both natural and mechanical ventilation may be desirable for different climatic conditions and library configurations.

CONCLUSION

The findings of this study have indicated the roles of natural ventilation in improving the IEQ and energy performance of library structural systems. Since the building envelope can be carefully planned to capture natural forces like wind and solar radiation, the libraries can reduce the dependency on the mechanical systems which in turn would maximize the operational cost and comfort of the users. Some of the findings from this study are; that the use of cross ventilation allows for air exchange and control of temperature.

However, achieving the goals of natural ventilation depends on other factors such as the orientation of a building, the position of windows, and the mass of building elements. However, when using natural ventilation, it subjects itself to so many drawbacks that come with climate constraints, noise, and air quality management.

For natural ventilation systems to be effective it may be necessary to apply a combination of natural and mechanical ventilation. Hence, the subsequent studies should investigate proper means of enhancing natural ventilation technology in libraries through noble architectural design for improving upon architectural designs like bio-climatic architecture together with the optimization tools in building physics like advanced building simulation.

Through the practice of sustainable design, libraries can design spaces that are adequate for the user with the right level of health, and comfort and are environmentally friendly.

REFERENCE

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