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Design And Modelling Of Solar Chimney And Geo-Thermal Cooling In Building Ventilation System

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Abstract: The construction and operation of green energy buildings contribute to environmental sustainability by reducing energy consumption, minimizing carbon emissions, and conserving resources. They also offer economic benefits, such as lower operating costs through energy savings and increased property value. Additionally, green buildings promote a healthier and more comfortable living or working environment for occupants. The objective of current research is to evaluate the feasibility of curtain roof in inducing natural ventilation inside building space. The modeling and analysis of building space is conducted using ANSYS simulation package. From the simulation the air flow distribution, temperature distribution is generated. From the CFD analysis, the temperature distribution, pressure distribution and eddy viscosity plots are obtained. The CFD results have shown that use of curtain roof can induce natural ventilation inside building space. The temperature value is lower at the bottom floor and is higher at the top floor.

IndexTerms **– Green energy, building**

I. INTRODUCTION

Green building, usually referred to as green construction, is the practice of designing, constructing, operating, maintaining, renovating, and deconstructing buildings in an ecologically friendly and resource-efficient manner. Comparatively speaking, green buildings utilize fewer natural resources, water, and energy than conventional structures. Additionally, they contain elements like efficient water usage, energy consumption, and eco-friendly environments. They also produce less trash and provide better living environments.

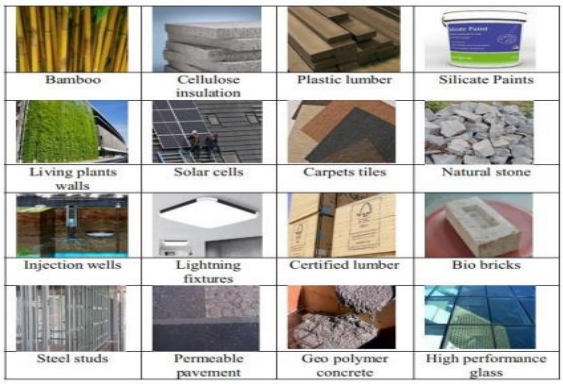

Figure 1: Sustainable materials for green building construction [12]

The primary objective of green buildings is to optimize the utilization of energy, water, and other resources, safeguard the well-being of occupants, and enhance workforce efficiency, all while minimizing waste, pollution, and ecological deterioration. Despite the ongoing development of novel technologies to complement existing practices in the construction of environmentally sustainable buildings, the objective of achieving ecological sustainability persists.

II. LITERATURE REVIEW

Ahmad et. al. [1] It is essential to comprehend the development process if you want to see Green Buildings (GBs) adopted. The many paradigms of GB development research, their individual contributions and limitations, their areas of overlap, and prospective techniques for upgrading these paradigms were examined via a thorough examination of 77 pertinent studies. A script using Boolean operators and keywords is used to search internet databases (such Scopus and Web of Science) to find relevant academic

publications up to February 2019. The project delivery attributes (PDAs), key success factors (CSFs), barriers, drivers, risks, and incentives have been recognized as the six paradigms of GB development research.

Saka et. al. [2] Governments provide incentives to encourage the use of ecologically friendly building practices in the construction industry. Unlike rigid-regulatory incentives, which must be accepted, voluntary incentives are presented to construction stakeholders with the option to accept or reject them. The issue at hand relates to construction stakeholders' lack of access to a full list of possible incentives and rewards that they may choose to accept for the purpose of planning and building ecologically friendly structures. The academic and practitioner literature for this research was gathered using a quasi-systematic method, and a narrative assessment was used to determine the many incentives and rewards that encourage the development of green buildings. The report reveals nine different types of remuneration and prizes that the government has established as optional incentives for those working in the construction industry. The initial result of the current research relates to how the government is extending its incentive programmes. The design process is optional, therefore the scaling of incentives and pay is rather cautious.

Mao et. al. [3] A positive vision for green building in China's future has been produced by the country's rapid real estate expansion. The Chinese people are becoming more and more interested in adopting green architecture. The market is marked by an extensive range of regulations that include both local and global areas. Future developments in sustainable building are probably going to slow down. The lack of a reliable assessment method is the main issue impeding the advancement of green building. There are many newly built structures that need a reliable evaluation. As a result, there is a need to give the assessment of green building systems even more attention. With a focus on their use in China, the article undertakes a thorough examination of their characteristics and offers an overview of different green building evaluation methods. The paper then offers suggestions for improving such systems and explores tactics for developing sustainable building practices.

Gang et. al. [4] Based on the idea of green construction, this research proposes a sustainable development model for urban green building. The approach is put forward in response to China's urgent need to promote green construction practices. The idea of environmentally friendly building practices in urban settings was first explained, as well as the role of important players in supporting them. Our research mainly looked at the relationships between different project stakeholders and sustainable building methods. Researchers looked at stakeholders' behaviors in green construction. The study's objectives were to evaluate the sustainability of urban green building and determine the importance of each aspect. The idea of the human component of green building in the context of sustainable urban development was then developed, and the connections between stakeholders and game theory were then examined. Through empirical research, the connection between the legislation of urban green building development and its internal links was better understood. Several recommendations were then made for the long-term growth of urban green building [5].

Cui et. al. [6] Green buildings have been popular as a way of attaining sustainable development throughout the period of fast architectural improvement in response to a number of urgent issues, including poor construction quality execution and subsequent maintenance management features. The foundation of the current study is a thorough examination of the body of literature on green buildings. It seeks to assess the present state of green building development and to identify important problems and probable future growth trajectories. According to the study, management planning for the full green building construction process is lacking. The book suggests a number of concepts for a green building management plan that would aid in the development of green buildings sustainably throughout the whole process, beginning with the design phases and ending with the construction stages.

III. OBJECTIVES

The objective of current research is to evaluate the feasibility of curtain roof in inducing natural ventilation inside building space. The modeling and analysis of building space is conducted using ANSYS simulation package. From the simulation the air flow distribution, temperature distribution is generated

IV. RESEARCH METHODOLOGY

The analysis stage, the design of G+1 building is developed and imported in ANSYS simulation package. The developed model of G+1 building is shown in figure 2.

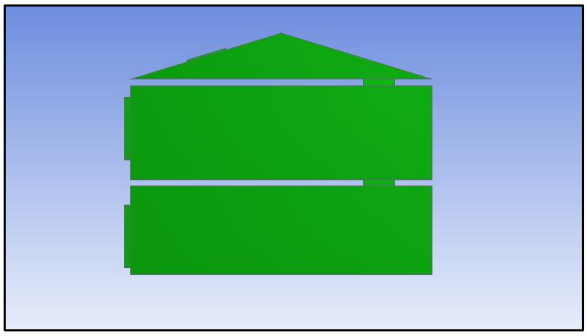

Figure 2: CAD design of building

The imported design of building is checked for various types of edge errors, imperfections etc. The computational domain is generated based on air flow conditions and computational volumes. This computational volume is discretized using tetrahedral element types.

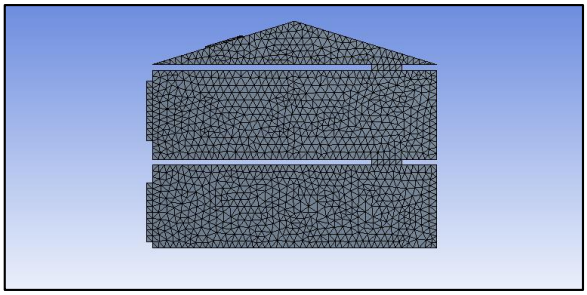

Figure 3: CAD design of building

The model of building is meshed using tetrahedral element type as shown in figure 3 above. After discretization, the loads and boundary conditions are applied on the computational model. The boundary conditions involve air inflow condition, air outflow condition and reference pressure.

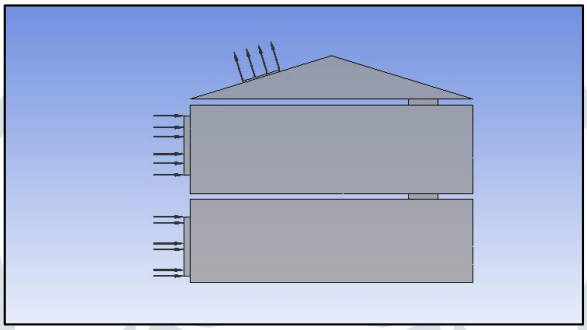

Figure 4: Inlet and Outlet boundary condition

The air inlet boundary condition includes temperature definition of 300K with pressure outlet of 0Pa. The turbulence model is defined for computational domain.

IV. RESULTS AND DISCUSSION

CFD simulation, the eddy viscosity plot, pressure distribution plot and temperature distribution plots are obtained.

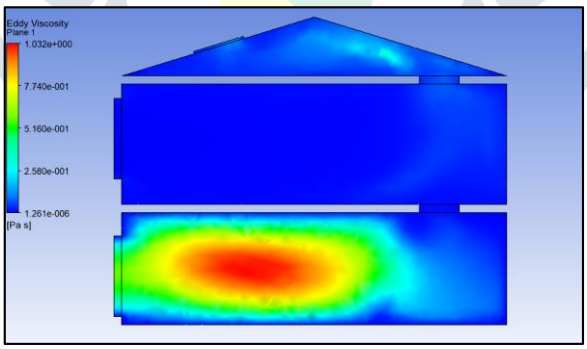

Figure 5: Eddy viscosity plot

The eddy viscosity distribution plot is generated for G+1 building. The eddy viscosity is higher at the bottom building space wherein the magnitude is more than .77Pa S.

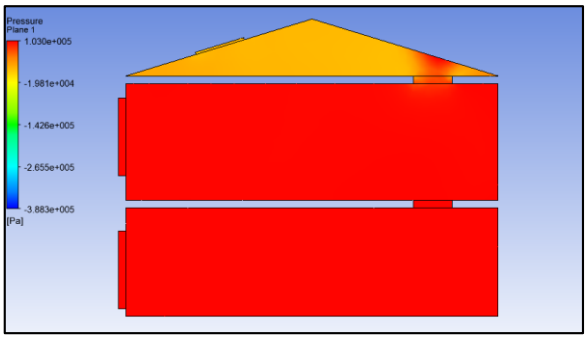

Figure 6: Pressure distribution plot

The pressure distribution plot is generated for building. The pressure is higher at the ground floor and is uniform throughout. The pressure reduces on the topmost domain wherein the magnitude is 1961Pa.

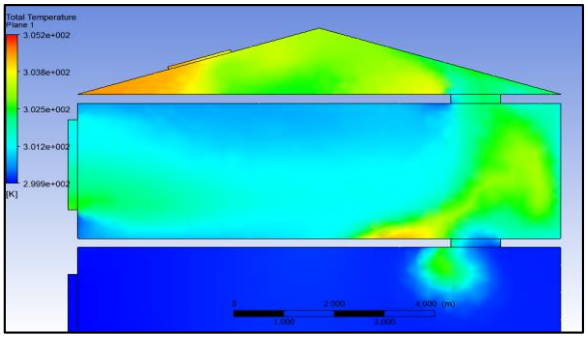

Figure 7: Temperature distribution plot

The temperature distribution plot is generated for building. The temperature is higher for the air in immediate contact with the glass. The temperature at this region is 305.2K. The temperature at the middle of topmost zone is 302.5K. The temperature on 1st floor space is 301.2K.

V. CONCLUSION

The CFD analysis tool enabled to determine the natural ventilation of building with curtain roof. From the CFD analysis, the temperature distribution, pressure distribution and eddy viscosity plots are obtained. The CFD results have shown that use of curtain roof can induce natural ventilation inside building space. The temperature value is lower at the bottom floor and is higher at the top floor.

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