# Review on Solar Chimney Ventilation

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*Abstract*— Energy is being used in maintaining indoor environment clean and comfortable. Modern buildings are equipped with the gadgets making indoor environment comfortable to the occupants. There is huge electrical energy consumption associated with these electrical systems. Since the concern over depletion of conventional fuels and environmental impact on their usage is increasing globally, it is needed to search options for reduction of electrical energy usage in several applications. Passive design of buildings does not use the electrical and mechanical systems in providing comfortable indoor environment. In this paper the application of this strategy involving usage of ambient energy in the form of solar energy has been presented in natural ventilation of buildings and spaces.

***Keywords:*** Weld Joints, Quality Improvement, Weld Analysis

## I. INTRODUCTION

Ventilation can be defined as the supply and removal of air, to and from any space, in order to control the level of air contaminants, humidity or temperature within that space. Air may or may not undergo conditioning during the process of ventilation. Since ventilation in buildings plays a major role on the health, comfort and productivity of their occupants, ventilation standards have been issued in many countries around the world. It is estimated that the minimum volume of fresh air needed for the purpose of breathing is approximately 1.2 liters per second per person but for comfort purposes, it is essential to supply more than this minimum amount in order to meet the occupants' oxygen requirements, for dilution of odors, dilution of carbon dioxide concentration and to minimize the increase in air temperature in case there are extreme sensible heat gains. A ventilation system in a building is an important design criterion as it helps to improve thermal comfort and the indoor air quality. The latter is dependent on the following factors:

1) Climatic parameters including humidity, velocity of air, temperature and levels of air contaminants.
2) Parameters related to the occupants such as moisture, carbon dioxide, odours and tobacco smoke.
3) Parameters related to the building and outdoor sources such as formaldehydes, volatile organic compounds, radon, biological agents and airborne particulates.

The ventilation process in buildings can either take place naturally or mechanically. Natural ventilation is dependent on wind or thermal buoyancy for the movement of air while an external power input is required for mechanical ventilation.

## II. LITERATURE REVIEW

During the last two decades, increasing awareness of greenhouse gas emissions and the need for effective, efficient and ecologically sound building ventilation has led to renewed interest in solar chimneys. In recent years, a number of experimental, numerical and theoretical investigations have contributed to the current understanding of solar chimneys. The effects of solar chimney height, solar absorptance of the absorber wall, solar transmittance of the glass cover and the air gap width are investigated by Lee and Strand [1] under various conditions. The effects of chimney inclination angle on number of air changes per hour and indoor flow pattern , and also chimney inlet size and width were numerically and analytically investigated by Bassiouny and Korah [2, 3]. An experimental investigation was done by Burek and Habeb [4] to investigate heat transfer and mass flow in thermo-syphoning air heaters, such as solar chimneys and trombe walls. Experiments were carried out by Chen et al[5] using an experimental solar chimney model with uniform heat flux on one chimney wall with a variable chimney gap to height ratio. A simple and useful tool to study energy performance of different ventilated facades typology was done by Balocco [6].Several modeling tests were carried out by Coussirat et al. [7] on a well-documented experimental test case taken from open literature in order to obtain a suitable model forthe double glazed facades. A commercial CFD package was used by Guohui Gan [8]to predict buoyant air flow and flow rates in the cavities. Thermal performance of a solar chimney for natural ventilation was experimentally investigated by Arce et al. [9]. The experimental model was implemented on full scale and real meteorological conditions. A parametric analytical study of roof solar chimney coupled with wind cooled cavity using spread sheet computer program has been presented by Aboulnaga [10]. A low energy consumption technique to enhance passive cooling and natural ventilation in a solar house, using a system consisting of a solar chimney and an evaporative cooling cavity has been proposed by Maerefat and Haghighi [11]. A numerical study is presented by Giabaklou, and Ballinger [12] to demonstrate the passive evaporative cooling system efficiency and air flow rate through building. There have been relatively few reports of detailed measurements using multi solar chimneys. So, the present research was directed to study the effect of multi solar chimneys at different directions on natural ventilation. In this work, experiments were carried out using a solar chimney experimental rig under actual outside operating conditions (hot and dry) of Aswan city at South Egypt. Air temperature and velocity for different chimney parameters (height, gap, orientation, and numbers) were measured to provide further understanding of the ventilation performance of solar chimney.Solar chimneys are often painted black to improve the absorption of solar radiations. When the solar radiations are absorbed by the absorber the heat so obtained is utilized in heating of air. The hot air then provides the suction of cold air and flow of this air in the upward direction and thus enabling the ventilation. Figure 1 shows a line diagram of solar chimney concept.

 

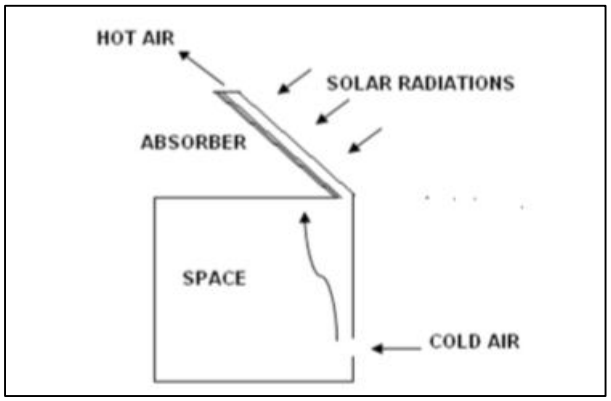


Fig. 1: Concept of Solar Chimney

Studies on solar chimney technology have been carried out by the researchers globally. These studies include theoretical, experimental and numerical studies. These studies are based on the design concepts of solar chimney, operational parameters, performance and economic aspects of solar chimney. A set up of solar chimney was built in Florid in 1997 [13]. The chimney was 7.92 m high of diameter 2.44 m at inlet and gradually decreasing to 0.61 m at the top with Laxan roof which was covered collector of 9.15 m diameter. The study was performed on three types of collectors as Type I, Type II and Type III for different material of the collector and arrangement and size of collector. The temperature rise found by them in different cases was 15 °C, 25 °C and 28 °C in Type I, Type II and Type III respectively. Solar chimney power plant as an option of power generation with the use of renewable energy source has also been developed. The power generation through this technology involves green house, solar energy collector and wind turbine. It has severable potential advantages over conventional technologies involving fissile fuels. The solar radiations in both the forms of direct and diffused can be utilised, no cooling water requirement are the key advantages of this technology of power generation [14]. A small prototype was built in the campus of RMIT University, Bundoora, Australia in 2002. This prototype was having a experimental solar pond of approximate diameter of 4.2 m with depth of 1.85 m. The solar chimney was 8 m high and 0.35 m in diameter [15] & [16]. The results of measurements showed the temperature rise of entering air from 17 C to 28 C at exit. The velocity of air flow measured was 1 m/s.

## III. Conclusion

Use of renewable energy in passive building design is the need of the modern buildings. This provides our environment clean and comfortable without the cost of electricity. This paper provides the use of solar energy in ventilation of buildings and spaces. The strategy of ventilation through solar energy is based on the heating of the air with the use of solar radiations. The temperature difference between the air entering the space and that leaving the space produces draft. This draft removes the indoor air and the indoor environment is ventilated. No need of electricity in the solar chimney reduces the overall consumption of energy of conventional form and save the environment also. The literature reviewed and presented in this paper shows that the worldwide concern over application of solar chimney in ventilation and electricity generation is increasing. Numerical study with the use of Computational Fluid Dynamics (CFD) may also be implemented to design and predict the performance of solar chimney.

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