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The study of a cylindrical vertical solar chimney with internal PVC obstacles

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Solar energy is the most renewable energy widely spread on the globe with several applications such as power generation and thermal comfort amelioration inside buildings. In the present study, one of the multiple solar energy techniques is discussed. New, simple and low-cost solar chimney (SC) made of polyvinyl chloride (PVC) tube with internal PVC obstacles was investigated experimentally. Heat transfer of air passing through the new device were studied and results show SC ability of increasing air temperature from 25°C to 48°C and reducing relative humidity from 40% to 10%. Internal PVC obstacles were responsible for increasing outlet air temperature by more than 7°C in 63% of compared cases with simple PVC tube SC without internal obstacles.

Buoyancy or stack effect is the SC driving force. Air inside SC exposed to solar radiation heat up, which reduces its density forcing it to rise and leave SC by the outlet. This phenomenon allows fresh air to penetrate inside the building from outside by suction force continuously. Nowadays, conventional SC is composed of several parts: dark inclined surface serving as absorber covered with glass plate on top and thermal protection at both sides, air inlet at the bottom and air outlet at the top of the device, a plastic or a metallic support. This technique could be combined with other forms of renewable energy in the same building like wind or geothermal energy using techniques such as wind catcher or heat pump.

Building cooling and natural ventilation. Using numerical and reduced scale experimental model, they reported that the new system was able to reduce inside temperature by 5°C and generate until 9 ACH (air change per hour). Jiménez-Xamána et al. [31] investigated numerically the natural ventilation efficiency of SC connected to a single room in Mexico. They found that this technique ameliorates ventilation rate in both winter and summer by 25% and 45%, respectively.

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