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Study of Geo-Cooling Setup Coupled with Solar Collector for a Room

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Abstract: Geo cooling energy is a new technique in the field of Air cooling domain. In this paper presented the study of geo coupled with earth air heat exchanger and solar collector wind driven system. It shows good results were to study the Cooling setup it also exists in this similar field. We analysed earth cooling potential in our local region that result is compared with the paper titled on investigation of a coupled geothermal cooling system with earth tube and solar. To increase the airflow through the piping is introduced draft fans same way to increase the efficiency of exhaust air flow is used the solar wind driven setup. In this paper is tested the air cooling setup in a room and analyse the performance with basis of earlier model was developed is similar to this. In addition to improve the cooling we concentrated the packaging materials and continuously monitoring the soil temperature periodically relatively atmospheric condition persists on the region.

Key words: Solar collector · Geo cooling · Soil condition

INTRODUCTION

The usage of geothermal energy in Air cooling is familiarly introduced all the developed countries. On the global survey to reduce the electricity demand as well as eco friendly aspects of temperature reduction of ambient air, we go for indirectly coupled piping system with soil attachment. It provides cooling as well as elimination moisture in it. Apart from gases existing commercial air conditioning methods, the research has grown deeply over an era. Through the identification of alternate method of cooling without using commercial gases, Earth air heat exchanger (EAHE) is one of the findings arisen in current trend.

Yuebin Yu [1] developed a model investigation of a coupled geothermal cooling system with earth tube and solar chimney, In a 43 days sequence to test performance of geo thermal setup with three modes of setup likely passive cooling capacity, Active cooling capacity and soil thermal capacity. Investigation of a coupled geothermal cooling system with earth tube and solar. The results show that the coupled geothermal system is feasible to provide cooling to the facility in natural operation mode free without using any electricity.

Haorong Li [2] developed a model Performance of a coupled cooling system with earth-to-air heat exchanger and solar chimney by simultaneously utilizing geothermal and solar energy, the system can achieve great energy savings within the building sector and reduce the peak electrical demand in the summer. Experiments were conducted in a test facility in summer to evaluate the performance of such a system. During thetest period, the solar chimney drove up to 0.28 m^3/s (1000 m^3/h) outdoor air into the space. The EAHE provided a maximum 3308 W total cooling capacity during the day time. As a 100 percent outdoor air system, the coupled system maximum cooling capacity was 2582Wthat almost covered the building design cooling load.

F.Al–Ajmi [3] developed an EAHE model to measure the cooling efficiency, compared the results and performance related to ordinary cooling, without using EAHE. On his observation shows good outcome nearly 2.8°C temperature reduction in summer in the period of (middle to July) in desert climate executed at Kuwait. It shows acceptable results the impact of earth potential has vital medium to improve cooling as well as reduction of electrical demand.

In India M.K.Ghosal [3] has developed an earth air heat exchanger (EAHE) model for cooling of a green house located in Delhi. Performance of green house was evaluated in terms of thermal load levelling and coefficient of performance. Observations of green house temperature was taken all over the month in the year, it shows a

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adversely difference of temperatures, it has a good key data was helped to made an comparative agreement with that model. The temperature difference is 6-7°C more in winter and 3-4°C less in summer relatively without EAHE model. Fan et al. [4] investigated experimentally and theoretically the flow and temperature distribution in a solar collector panel with an absorber consisting of horizontally inclined fins. Numerically, the flow and heat transfer in the collector panel were studied by the means of CFD calculations. Experimentally, the flow distribution through the absorber evaluated by means of temperature measurements on the backside of the absorber tubes. Their results showed a good agreement between the CFD results and the experimental data at high flow rates. However for small flow rates, large differences appeared between the computed and measured temperatures. This disagreement is most likely due to the oversimplification of the solar collector model

METHODOLOGY

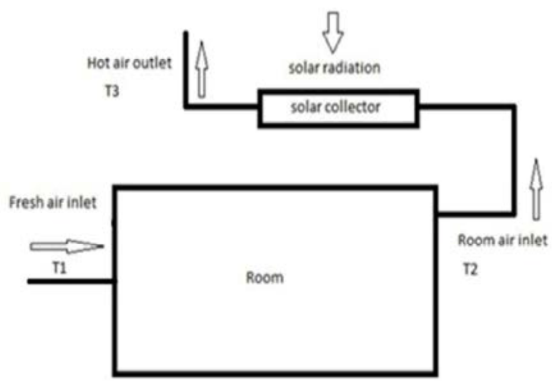

Fig. 2: Exhausts air circulation setup

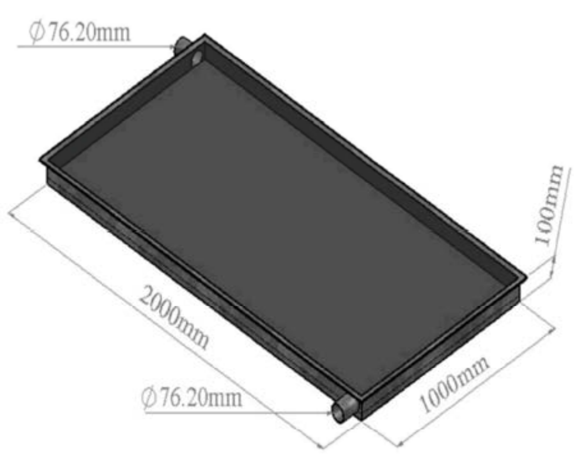

Fig. 1: Solar collector tray

PVC - Polyvinylchloride
HVAC - Heating, Ventilation and Air Conditioning
ACH - Air Change per Hour
VOC - Volatile Organic Compound
IAQ - Indoor Air Quality
CFD - Computational fluid Dynamics
A - Area
ñ - Density
V - Flow rate through the collector [m^3/h]
R - Gas constant
Qu - Heat gain by the air [W]
P - Pressure [K pa]
I - Radiation from the artificial sun [W/m2]
Cp - Specific heat of the air [J/ kgK]
ΔT - Temperature difference across the collector [K]
T - Temperature [°C]
v - Velocity [m/s]

Room Air Condition Analysis: Pipe Installed in Pit is coupled with Solar Collector

Fig. 3: Pipe air circulation setup

Fig. 4: Position of solar collector

The complete data which has been measured is compared to our developed model results. The first and third tests were natural airflow Mode from July 24th to August 6th in 2009 and August 16th September 4th, respectively. During the natural cooling mode, the airflow rate varies from 0 m^3/h to maximum 500 m^3/h. The peak value of the ventilation air occurred during the daytime when high solar intensity was strong. The second test was in a forced airflow mode with the constant speed fan turned on continuously. The airflow rate kept a constant Value at 2750 m^3/h. Under the natural airflow condition, the indoor air temperature fluctuated in a narrow range of 21–24°C and the indoor air relative humidity was also maintained in between 50% and 70%. For most of the time in the natural passive cooling mode, the indoor air environment satisfied the ASHARE standard 55-2004 for acceptable thermal comfort [5].The results suggest that there exists an optimal value that the airflow rate not only enhances the cooling capacity of the EAHE but also provides a high cooling capacitance to the coupled system. When a forced fan is applied with the EAHE coupled cooling system, a minimum control on the fan speed or damper position is needed to increase the flexibility, balance the cooling capacity demand and supply and create more stable room air thermal comfort.

Developed Model – Review [1]: An experimental study of a coupled geothermal cooling system is presented. In this system, an earth-to-air tube is coupled with a solar collector enhanced solar chimney to achieve free space cooling in summer. In order to analyze the performance under both the natural and forced airflow/cooling conditions, the effect of the air on the underground soil temperature and the recovery ability of soil temperature by itself, the paper carried out three continuous field tests with an existing facility. Testing period was divided into three time portions with three different tests. The testing period lasted for 43 days from July 24th, 2009 till September 4th, 2009. The three tests were a passive cooling test with natural airflow, an active test with forced airflow and another passive cooing test. The data from the experiments on the outdoor air conditions, indoor environment, soil temperature at various locations and depths were analyzed. In addition to the previous observations, following conclusions can be made based on the analysis. Air is induced into the pipe using an exhaust fan whose velocity ranges from 3 m/s to 5 m/s at a temperature ranging from 28°C to 33°C. The outlet velocity of the air ranges from 2 m/s to 3 m/s and the outlet. This pattern of room air temperature and relative humidity changed after the active

Cooling Mode Was Initiated: The material for connecting pipes to room and solar air collector is PVC (Polyvinylchloride) is used in ventilation to deliver, remove air and it has a low conduction rate. The installation of our project is shown in fig 3.3. For example, supply air, return air and exhaust air. PVC also delivers, most commonly as part of the supply air, ventilation air. As such, air ducts are one method of ensuring acceptable indoor air quality as well as thermal comfort and insulation,

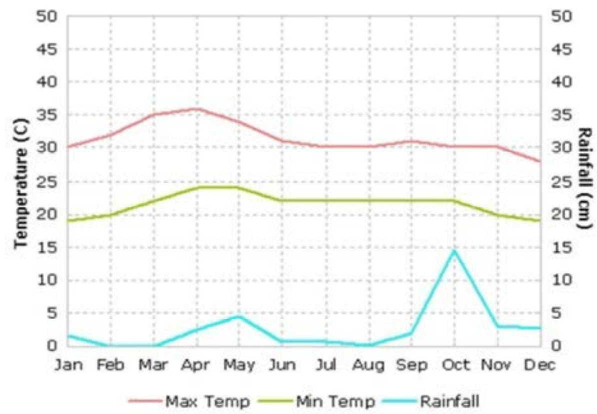

Fig. 5: Temperature variation

RESULTS AND DISCUSSIONS

Experiments and analysis have been carried out in order to evaluate the cooling capacity that the coupled system can provide to the test room and the impact factors. In the test, the coupled system was operated in a natural passive mode. Without any mechanical component, the air was driven into the building by means of the passive solar energy and the stack effect. During the natural airflow test, the coupled system was able to maintain the indoor thermal environmental comfort conditions at a favorable range that complied with ASHRAE standard for thermal comfort. The indoor air temperature was maintained at a range of 21.3-25.1ºC, while the indoor humidity ratio was maintained at a range of 50-78%.

Geo thermal with solar setup system is popularized in air conditioning in that mostly PE, PVC and HDPE pipes are used for geo-cooling process to cool rooms. This paper aims in investigating the effect of aluminum pipes in geo-cooling process. The pipe is installed at a depth of 2.4 m from the ground surface. Air is induced into the pipe using an exhaust fan whose velocity ranges from 3 m/s to 4.8 m/s at a temperature ranging from 26°C to 33°C. The outlet velocity of the air ranges from 2 m/s to 3 m/s and the outlet temperature is expected to be ranging from 21.8°C to 23.8°C.

In addition to geo cooling setup for enhancing the removal of exhaust air from room, solar air collector is installed on the roof. A solar air heater is using aluminium and the glazing has been developed and its performance in the field condition has been investigated.

The air heater is capable of providing hot air of temperature difference (36°C-83°C) on a moderate sunny day. It therefore a suitable air heater for producing hot air of space heating and also reducing hot air from the room by natural ventilation and[6] agricultural drying applications. The hot air can be easily ventilated using solar air collector. The average efficiency of solar collector is 56.91%.The volume of air in the room is 89.96m^3, this can be displaced in six hours using solar air collector.

CONCLUSION

The project solves the purpose of heating or cooling the atmospheric air depending upon the climatic conditions. It can be developed for commercial purpose to cool rooms or as a refrigerator with more proper mechanical aids of our proposed air collector has higher efficiency than the flat plate collector it aids to enhance the air flow rate.

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