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Fabrication of Solar Chimney and Study the Heat Transfer Distributions

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Abstract

Solar chimney is a natural way to move the air heated by solar radiation to cause a difference of density to pass through the turbines and then converted to electricity. In this paper, a solar chimney was designed as a study of the transmitted heat distributed by the load for a miniature model in the al- Mussaib district, where several variables are studied, such as temperature, chimney height, collector diameter, as well as investigating the effect of thermal insulation .The results also show us that the geometric dimensions, the difference in the area exposed to radiation and changing the base of the system once sand again gravel through which these factors affecting the temperature distribution**.** This work was carried out in the district of Al- Mussaib , Hillah , and its parts were installed in the following dimensions: The basin is (15 cm) in high, and (1.25 m) in diameter, the thickness of the base of the basin was (1 cm) and the wall of the sink is (0.9 cm). In the case of the tower (chimney) it was (2 m) in high and (12 cm) in diameter , while the thickness of the glass was (3 mm). The structure used and shaped at an angle of (45^0) , opening from the top of the structure to the installation of the Chimney. The results show us that the geometric dimensions, the difference in the surface area exposed to radiation and changing the base material of the system once sand again gravel were these factors affecting the temperature distribution which includes the practical part of this research, , which designed a solar chimney, knowing the temperature distribution, and calculating the highest heat transmitted by convection for a miniature model and Max. difference in temperature was (20 ^oC) at 01:00 pm .

key words: solar energy, solar chimney, heat transfer temperature distribution.

1- Introduction

As a result of widespread fossil fuel utilization in practically all human activities, atmospheric and environmental pollution has resulted in numerous unfavorable occurrences that have never been seen before in recorded human history. Climate change, Global warming, the greenhouse effect, acid rains, and ozone layer loss are only a few of them. It has been scientifically understood since 1970 it has been comprehend scientifically by research and experiments that these phenomena are nearly linked to the uses of fossil fuel because they emanate greenhouse gases such as methane (CH_4) and carbon dioxide (CO_2) which handicap the radiation of long-wave terrestrial from fleeing into space and, thus, the troposphere of earth becomes hotter.
Solar energy ranks first among these resources due to its plenty and more even distribution in nature than other renewable energy resources such as biomass, geothermal, wind, tidal energy, hydropower, and wave. The development of a sustainable climate for future obstetrics must be humanity's main and universal goal. The familiar limits of fossil fuels in the long run [1].

2- Solar Chimney

A solar chimney is a sort of passive solar cooling and heating device which may be used to both regulate and ventilate the building temperature. Solar chimneys, like a solar wall, are a means to accomplish building architecture of energy efficient. Solar chimneys are basically hollow vessels that link the structure inside to the outside of a building.

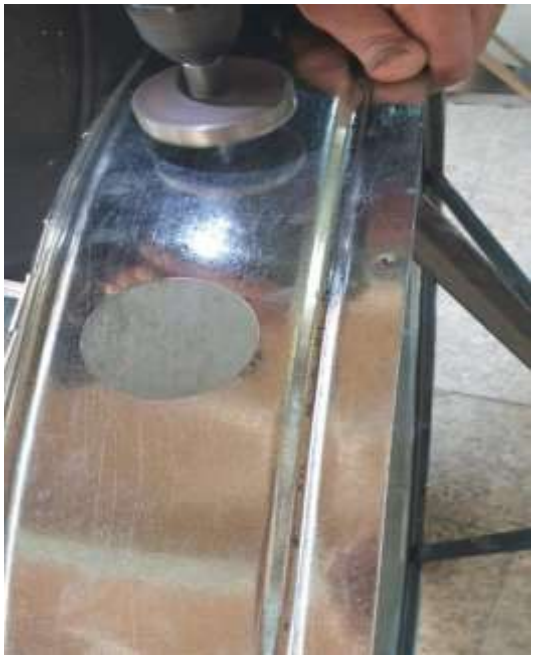
The heating process in solar chimney was known a simple , the solar fall radiation was causes increases of temperature for the facing side of solar chimney. Then the air columns interior the chimney was heated. When the top dissenter vents of the chimney are closed , then the hot air is press manifest into the living environment and this process supply convective air heating phenomena [2]. Solar chimneys are further-hand for heating, they turn on similarly to walls. Cooling the space is comparatively option than cooling using a wall. For the purpose a fulminate overhand cannot be nominated in adjunct to a solar collection, combine extra vents are presented. The clever exude has been understand, the couple at the culmination familiarize with of the smokestack [3]. The second is at the different putan end to of the structure, purveying an aperture betweenthe structure and far parade to withstand for ventilation. Intimately solar supportable hits the combine of the chimney, the platoon of similar to middle the chimney is still enthusiastic. The expel at the summit of the chimney is protected straight outsider the shoulder ergo this heated disclose is not trapped. This heated feeling is pulled helter-skelter and abroad of the chimney, seductive pioneering air in from the extensively and creating a label of "draft" lose concentration supply fresh and cooled air into the building [4-12].

3- Experimental works:

The fabrication of the solar chimney done was composed from the following parts:

3-1 The Basin

The basin was made from the Wrought Iron in dimensions (15 cm) depth , (125 cm) in diameter , and The thickness of the basin base was (1 cm) and the wall of the basin is (0.9 cm) , and the holes were made at the bottom to allow the entry of natural air to inside system . These openings were distributed as opposite slots in a frame.



3-1 The basin made

3-2 - The Structure:

The structure is designed from wrought iron because the galvanized iron is difficult and has the required shape. Regular iron was used and formed at (45º). It was opened at the top in the structure to install the Chimney on it, it will be explained below.

3-2 The structure made

3-3- The Chimney

The pipe of chimney was made from wrought iron with (200 cm) height and (12 cm) as diameter.

3-3- the chimney pipe

3-4 - The Glass:

The glass of window type of (3 mm) thick to allow of a solar radiation inside the system. It has week reflection (or constant reflection), and high transparency level .

3-4 The glass used

3-5 Coating

The Rust-oleum painter 97% were used , as paint media to enhance the sun rays absorption efficiency for the coated sections and its absorption rate of about 97% (this process was done in the college laboratory using the source-solar card-within the a suitable laboratory conditions).

3-6 The lower base:

It is the last part of our system presented. It was designed with two different heights to take readings in more than one case. The legs were designed under the lower base in two parts. The first was (10 cm) high connected with a circle and is fixed and the second is movable with alength of (10 cm) and includes the rotating wheel.

3-6 The lower base used

3.7 The Devices Used

3.7.1 Temperature Recorder

The thermocouples reading were supplied, saved in a computer desktop using recorder of the type (MakeLutron-BTM-42085D), as shown in Figures (3.7, 3.8).

3.7 The recorder of temperature

Figure (3.8) Sensors of the recorder temperature

3.8 Experimental Procedures

i. we install the more above devices in the system (basin, chimney, glass, structure , lower base and temperature recorder) .

ii. write the temperature distribution difference for all Sensors of the recorder with time (one read for one hours) at the base of the basin , the wall of the basin and glass, and also floating sensors were placed in the air in the middle of the basin and outside the basin, which sensed the air temperatures inside and outside the basin .

iii. draw the readings and relationship analysis between temperature and time.

5-Results and Discussion

All runs were established on May and June 2021 in Iraqi Atmosphere .
and we assume the following symbols:

B: Temperature of the base basin. , W: basin wall temperature.

C: glass temperature. , A_i: inlet air temperature

A_o: outside air temperature . , A_f: Air flow velocity inside the device

The Sunday 30.5.2021

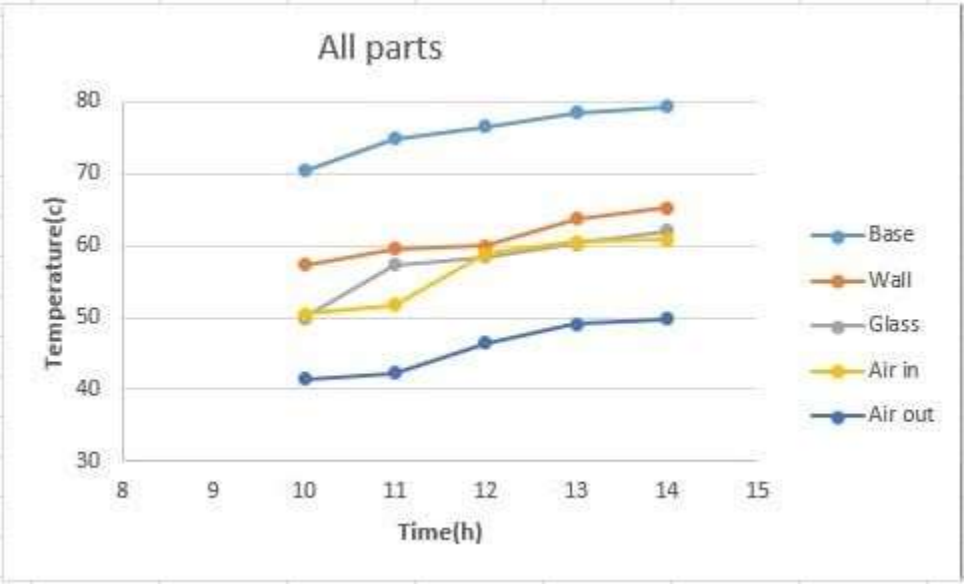


Figure (5.1) Temperature against time of all parts

At this day , we begin the reading at (10 AM) and we note increasing in the temperature differences for all parts and continue to (2 pm) according to a city weather and max. difference was (32 C^0) at the base .

The Tuesday 1.6.2021
i .The base

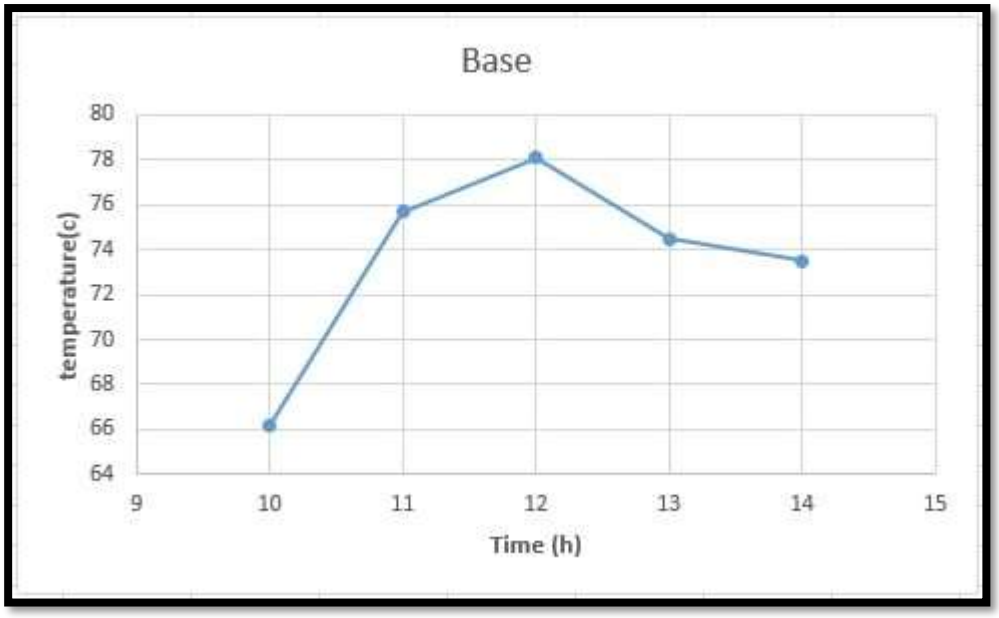


Figure (5.2) Base temperature with time

A rise in temperature can be seen starting from (10 AM) in the morning until it reaches its peak at (12 AM) in the afternoon , and then it begins decreasing due to the weather conditions, and max. difference was (30 C^0) at the base.

ii .The Glass

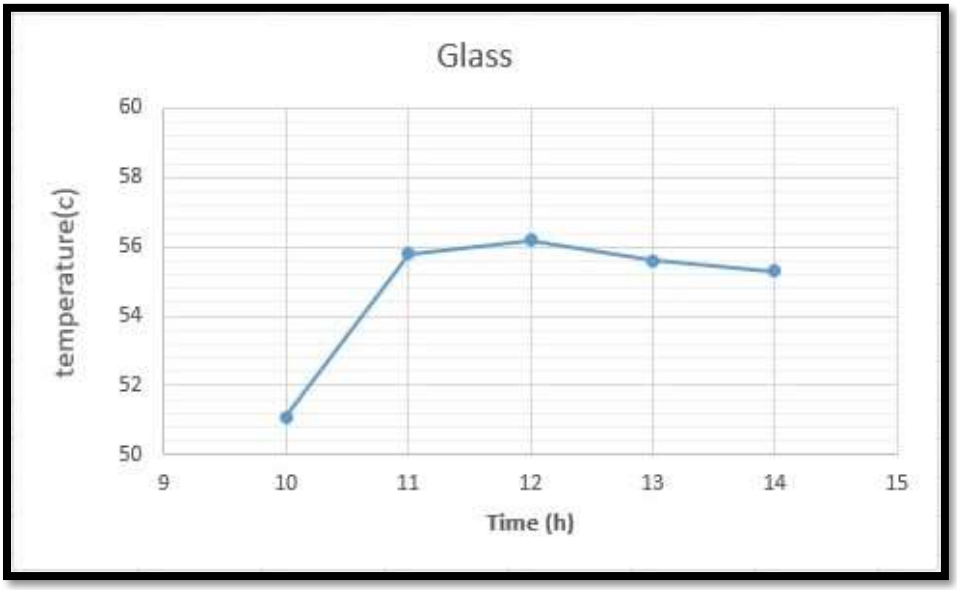


Figure (5.3) Glass temperature with Time

Also in the glass, the temperature begins to rise from (10 am). until it reaches (12 PM). and then begins to decrease according to the weather conditions and max. difference was (8 C^0) at the glass .

iii. Air Out

Figure (5.4) Out air temperature with time

We got the highest temperature on this day for the air entering at (12 pm). where it reaches a peak of approximately(59 C^0) and then decreased at (2 pm). where it recorded 57 C^0.

iv. Air in

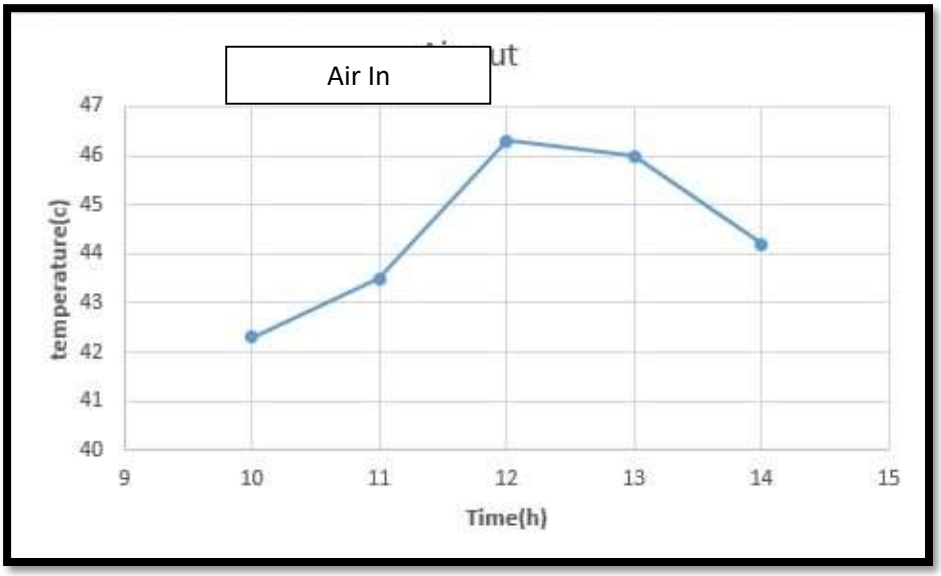
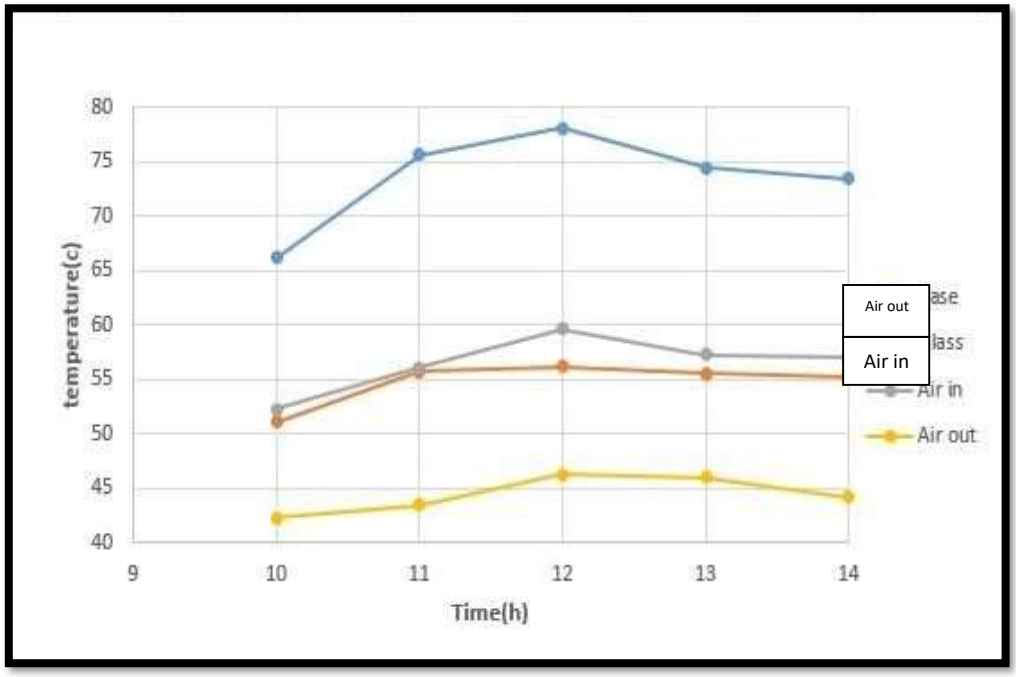


Figure (5.5) Incoming air temperature with time.

The highest air temperature the system was recorded at (12 pm) and then began to decrease according to the weather conditions.

v. All Parts:

Figure (5.6) Air temperature with Time for all parts



From above fig. we notes that, the temperature inside the system will increasing from begin test for (12 PM) approximately, and then decrease with time continue , due to weather parameters. And the difference temperature distribution was (Base, Glass , Air outside and Air inside) respectively .

The Wednesday 2.6.2021

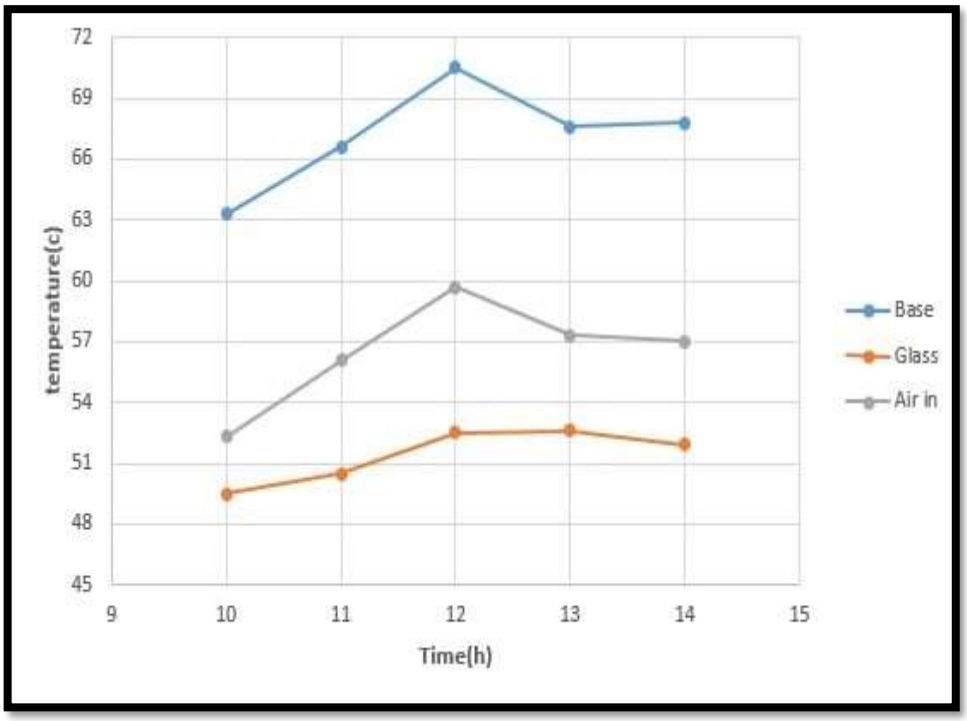


Figure (4.10) Temperature of all parts with time

Day 2/6 Looking at the drawings , we notice an increase in glass temperature. This increasing continued until (12 PM) in the morning.It started to back off and it became clear. Then decrease .The reason for the volatility is due to the high wind price in the weather which was previously recorded on this day, as it ranged between (11-13 km/hr) , but after (12), the

wind speed rose above (19 k/hr).The same applies to the base and inlet air temperature.

Conclusion

The average of heat transfer temperature distribution depend on many factors (designed dimensions of all system parts i.e. type of material for all parts and heat transfer coefficients and weather parameters).

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