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Performance Evaluation on Double Pass Solar Air Heater with Broken Multiple V-Type Baffles- A Review

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Abstract: ***Thermal performance of double pass solar air heater has been found to be improved by the use of artificial roughness provided on the both side of the absorber plate. The roughness provided on the absorber plate for increasing the heat transfer is also used to increase the pressure drop due increased friction. The heat transfer enhancement of absorber plate has been experimentally determined by using v-shaped baffle with multiple gaps. An experimental study will be carried out to analyze the effect of v-shape with gap baffles used as roughness geometry on heat transfer along its friction factor. The heat transfer and friction factor data obtained from the experiment is compared with the data obtained from smooth duct under the same condition. Correlation will also develop for Nusselt number (Nu) and friction factor (f) as a function of roughness and flow parameter. The maximum enhancement in the Nusselt number and friction factor is observed.***
Keywords: Solar air heater, Artificial Roughness, Roughness Geometry, Reynolds Number, Friction factor, Nusselt Number.

I. INTRODUCTION

Energy is the basic need for human to sustain their life and development. Solar energy is very simply form of energy that produced directly by the sun and collected anywhere. Solar energy are generally available and non-polluting source of energy. By the means of solar collector solar energy are converted into thermal energy and are used for various engineering purpose. solar air heater used for study is shown in fig. 1.

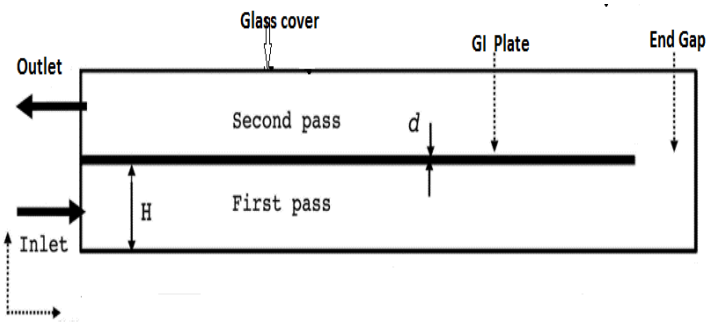

Fig.1 Solar Air Heater

There are so many heat transfer technique that has been developed to increase the thermal performance of solar air heater. The enhancement of heat transfer from the collector plate to air of solar air heater can be reached by the use of v-shaped artificial roughness on the collector plate. The v-shaped with gap roughness used in a channel are attached to the absorber plate on both side that break the thermal boundary layer on heated surface and increase the heat transfer. But this increase is followed by a pressure drop thus increasing the power requirement. Thus it is necessary to calculate both pumping power requirement and the rate of heat transfer.

II. LITERATURE REVIEW

Kumar A and Kim MH et al. [1] experimentally investigated the thermo hydraulic performance of a rectangular duct with multiple v-rib roughness shape which give us thermal and frictional characteristics of solar air heater. Kumar A, Saini RP and Saini JS et al. [2] mathematically examined the effective efficiency of discrete multi v-rib solar air channel. Kumar A and Kim MH et al. [3] examined the effect of roughness width ratio in discrete multiple v rib with staggered rib roughness on overall thermal performance of solar air channel. Kumar A, Saini RP and Saini JS et al.[4] carried out an experimental investigation to increase the heat transfer due to a gap in a continuous multiple v-rib arrangement in asolar air channel., Alam et al.[5] experimentally investigated the effect of geometrical parameters of the v-pattern perforated baffle on Nusselt number and friction S. Tamna, S. Skullong, C. Thianpong, P. Promvonge et.al [6] experimentally study the behaviour of heat transfer in a solar air heater duct with multiple V baffle vortex generator.

Bekele et al. [7] experimentally studied the effect of delta pattern obstacles mounted on one wall subjected to a constant heat flux for a rectangular channel with an

aspect ratio (W=H)=10.

Chamoli and Thakur [8] experimentally investigated the effect of geometrical parameters of the V-pattern perforated blocks on Nusselt number and friction factor of rectangular channel

Mohammadi and Sabzpooshani [9] studied the influence of baffles' pattern mounted over the absorber plate on the performance of the upward-type single-phase solar air heater.

Sriromreum et al[10] through experimentally and mathematically studied the effect of the baffle on Nusselt number and friction factor in a

rectangular channel having aspect ratio (W=H)=10 fixed with the in-stage and out-phase 45_ Z-pattern baffle

Chamoli [11] reviewed roughness geometries used to enhance the heat transfer in solar air heaters and keep the air in contact with the absorber and act as wings and improve Nu_{rs} of the air.

Bekele and Mishra [12] carried out the experimental studied of the turbulent air stream and heat transfer characteristics of SAC withdelta shaped obstacle attached to the upper wall of a channel.

V.S. Hans, R.P. Saini, J.S. Saini [13] experimentally investigate the relation between heat transfer and friction factor for solar air heater duct with v-ribs artificial rougnness. Eiamsa-ard et al. [14] investigated the heat transfer augmentation in a SAC with winglet delta twisted tape baffles with different βO and H_b/H_d. Their studies shows that Nu_{rs} and f_{rs} data with winglet delta twisted tape were superior as compared to without winglet delta twisted tape. Promvong et al. [15] mathematically examined the performance of Nurs and frs in square channel attached with 45° inclined baffles with a Re ranging from 100 to 1200.

Promovong [16] experimentally investigated the turbulent forced convection Nu_{rs} and f_{rs} loss behavior in a high W_d/H_d channel attached with 60° V-shaped baffels.

Akpinar et al. [17] experimentally investigate the performance analysis of four types of SAH with different obstacles and without obstacle. They reported that efficiency of SAH depends on the surface geometry of collectors, solar radiation of air stream line. Zhou and Ye [18] carried out the experimental studied of the turbulent air stream and heat transfer characteristics of solar air channel with delta winglet vortex generator baffles attached to the upper surface of a channel.

III. OBJECTIVE

A. Study the basics of Solar Air Heate
B. Compare the result obtained by conventional solar air heater and baffle plate solar air heater
C. To increase the thermal efficienc
D. To discuss about the performance factor, heat transfer rate and the influence of mass flow rate on efficiency.

On the basis of above investigations a solar air heater has been designed and the v-shape artificial roughness with symmetrical gap is used to increase the thermal efficiency. The experiment will be carried out for a double pass solar air heater fitted with a v-shape with gap roughness geometry at both side of the test section.

IV. PROPOSED METHODOLOGY

The flat plate solar air heater used for the experimental study consists of three sections, inlet section, test section and outlet section. The solar collector is composed of a single glass plate on the top, followed by absorber plate (GI plate) which is coated black and insulating material (thermocol) which is placed surrounding the frame and side cover. The test section is the section of interest

where the v shape roughness is arranged. The solar air heater used for study is shown in figure 2, in which continuous data of temperature and velocity variation is recorded and analyzed for several mass flow rates with the use of various measuring instrument.

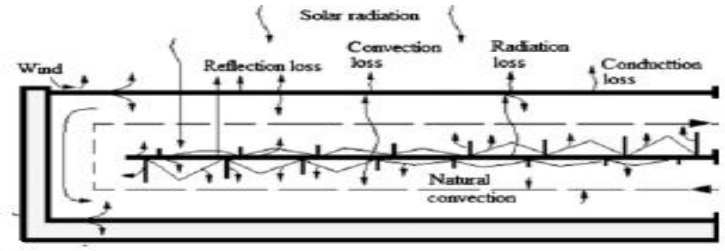

fig. 2 Heat transfer

V. CONCLUSION

The present study aim to investigate the thermal performance of solar air heater. The comparision between solar collector with smooth plate and v-shape baffle indicate that the perforamance of solar air collector depend on the solar radiation, volume flow rate , position of baffle when it is fixed on collector plate, angle of attack and number of gap. The performance of solar air heater is increased by increasing the volume of air flow rate. For getting higher thermal performance baffle plate collector should be position at an angle according to the latitude of that place.

A. Following Conclusion Can Be Drawn

1) Volume of air flow rate and intensity of solar radiation are the main factor which affect the performance of SAH

2) Thermal performance of the v-shape baffle with equal gap is better than the smooth channel solar air heater.

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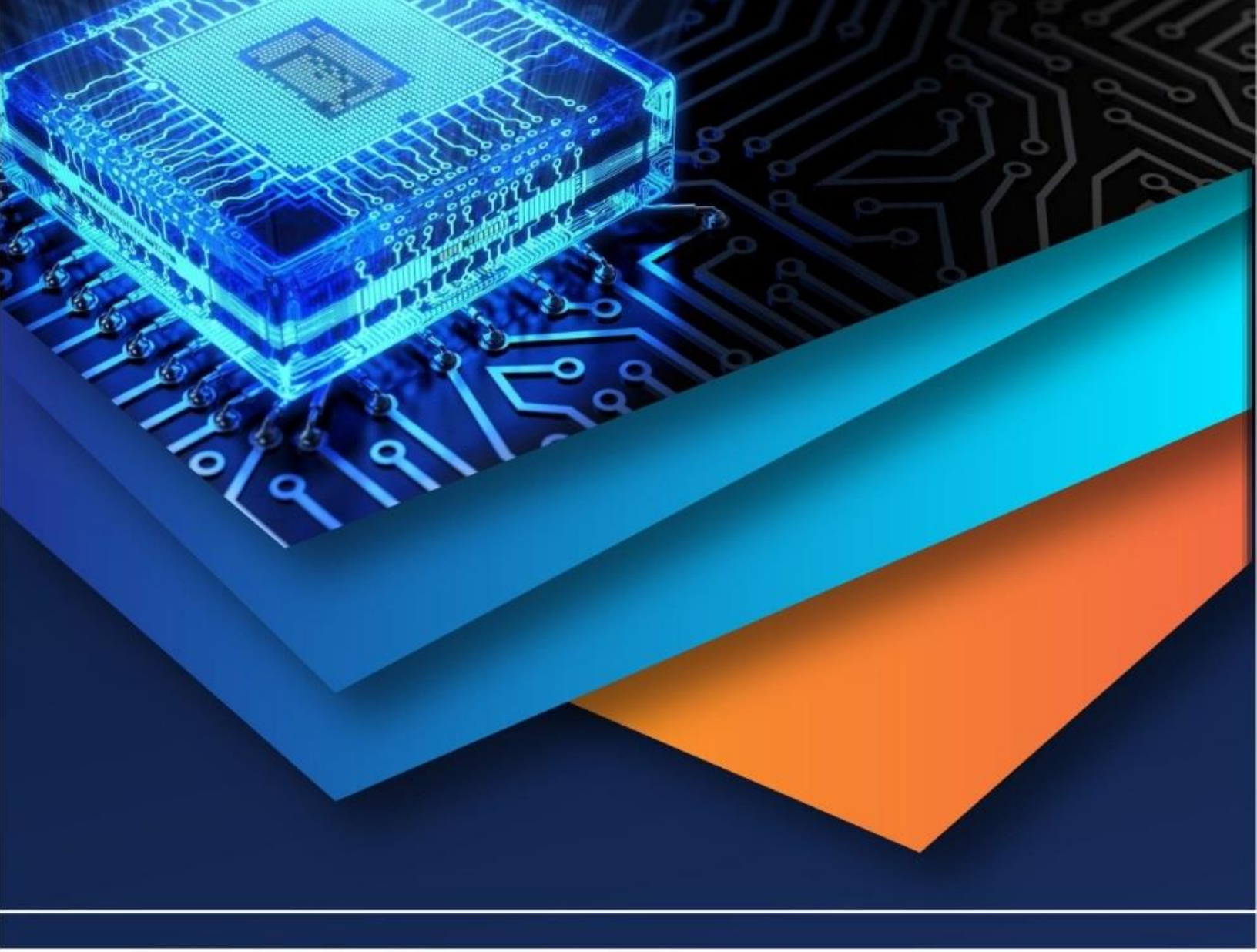

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