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Air Flow Analysis of the Solar Plate Collector for Drying Process

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Abstract— For drying process solar flat plate collectors are used to harness the solar energy. In order to harness more solar heat energy from the solar flat plate collector the area of distribution of air flow inside the chamber must be maximum in order to heat the air inside the chamber to maximum extent and going to analyse the air flow rate inside the solar plate collector by using SOLID WORKS FLOEXPRESS ANALYSIS WIZARD in order to determine the inlet outlet conditions which provide the required output. The conditions used to analyse the system are atmospheric conditions at mass flow rate of 0.314 kg/s.

Keywords— Flat Plate Collector, Flow Express, Flow Analysis

I. INTRODUCTION

The over use of fossil fuels in real life applications has caused their rapid depletion and fast climate change due to global warming and thus access to eco-friendly energy resources has become essential to meet the growing demand of clean energy. With this view, solar energy has proven to be an effective alternative and clean source of energy for the sustainable development of the society worldwide [1]. The solar energy can be utilized (directly or indirectly) in different applications such as solar drying, solar refrigeration and air conditioning, solar water heating, solar cooking and solar power generation. The drying of various commodities (fruits, vegetables, herbal medicines and agricultural products) is very important for their future uses through preservation.Solar collectors are currently being developed for space heating, seasoning of timber, solar cookers and drying or curing of agricultural and industrial products [3,4]. The solar drying of marine and agricultural products is among the most significant applications of solar collectors. Given that solar collectors are the main equipment for indirect drying, the performance of drying systems can be improved by increasing their solar collectors [5]. The optimizied mass flow rate is 0.314 kg/s [6].

II. AIR FLOW ANALYSIS PROCEDURE

The solar flat plate collector of (1000mm x 750mm x 450mm) is fabricated using the material wood. The glass is fixed on the top of the structure in order to receive the solar light and allow the heat energy of the sun to radiate all over the surface of the solar flat plate collector. The main theme of the solar flat collector is to transfer the heat from the sunlight to the air which is passed through the collector and interested to find the best probability of inlet and outlet of the air passage which covers high area of distribution inside the chamber and also the high values of flow in terms of velocity. By using the SOLID WORKS FLOEXPRESS ANALYSIS WIZARD and done analysis on the sixteen different ways of inlets and their respective outlets so that it will gain high area of air distribution inside the chamber which could effectively radiate heat energy from the sun to the air and reducing the time required to heat the air and have attached the results of the analysis.

III. ANALYSIS RESULTS

3.1 CONSIDERING A AS INLET AND E, F, G, H AS OUTLETS

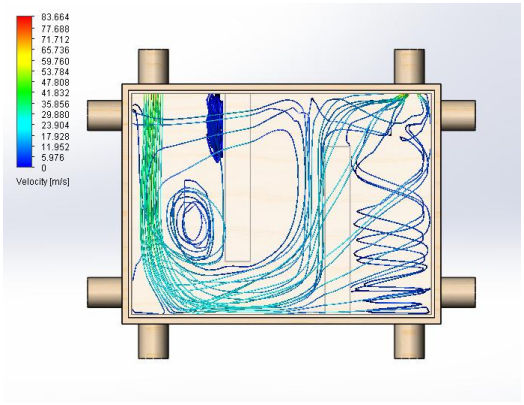

Fig 3.1 A inlet and H outlet

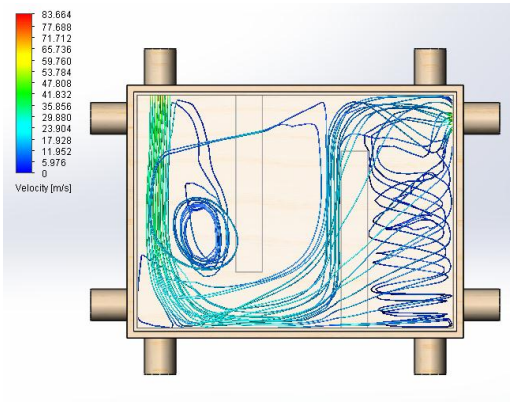

Fig 3.2 A inlet and G outlet

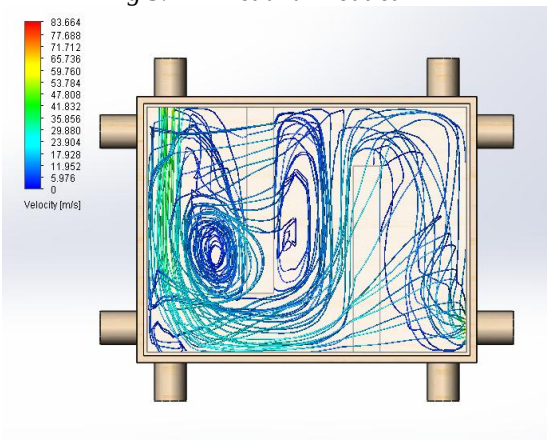

Fig 3.3 A inlet and F outlet

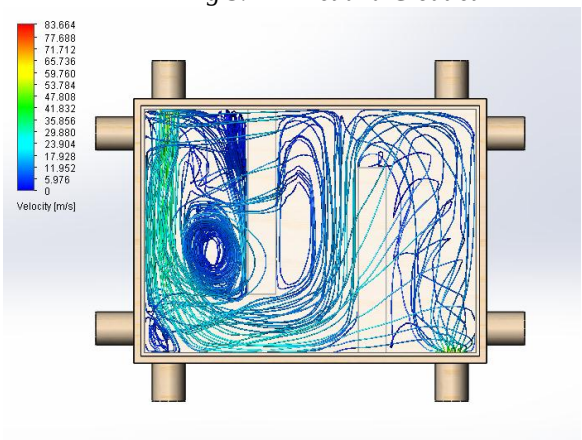

Fig 3.4 A inlet and E outlet

3.2 CONSIDERING **B** AS INLET AND **E, F, G, H** AS OUTLETS

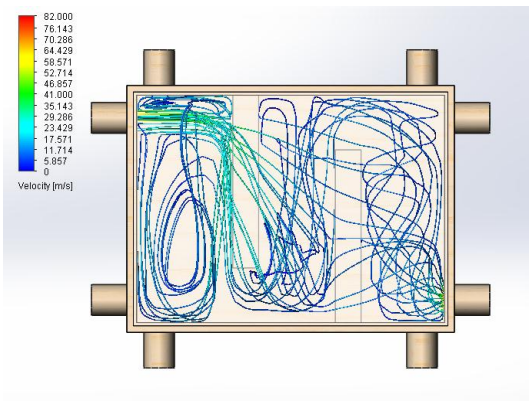

Fig 3.5 B inlet and F outlet

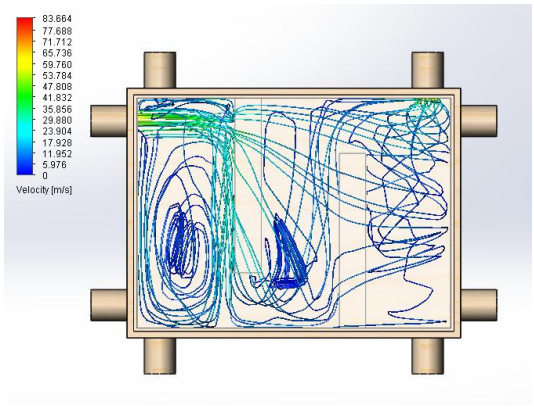

Fig 3.6 B inlet and H outlet

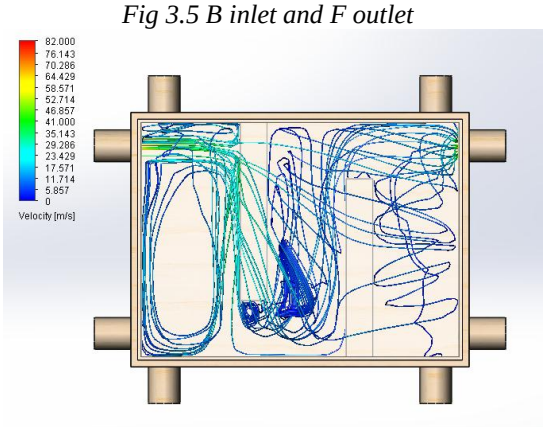

Fig 3.7 B inlet and G outlet

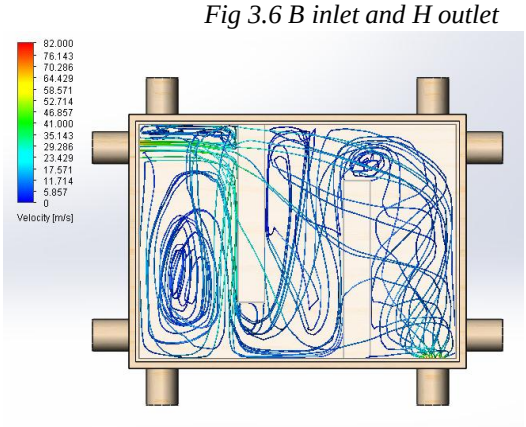

Fig 3.8 B inlet and E outlet

3.3 CONSIDERING C AS INLET AND E, F, G, H AS OUTLETS

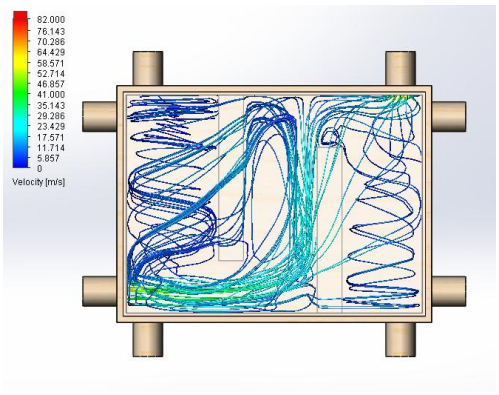

Fig 3.9 C inlet and H outlet

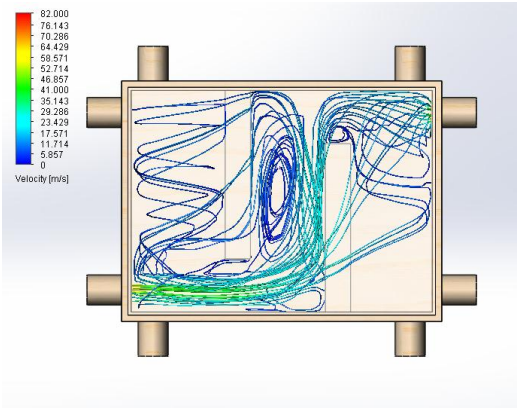

Fig 3.10 C inlet and G outlet

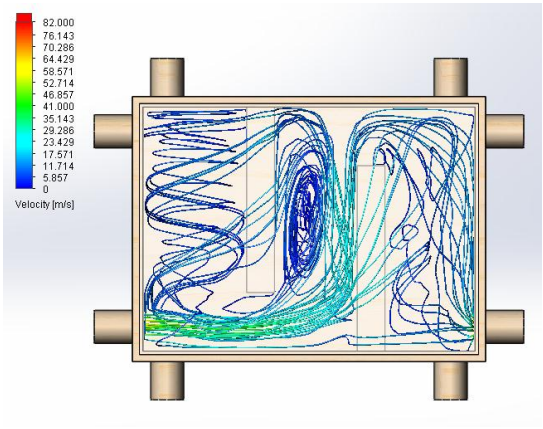

Fig 3.11 C inlet and F outlet

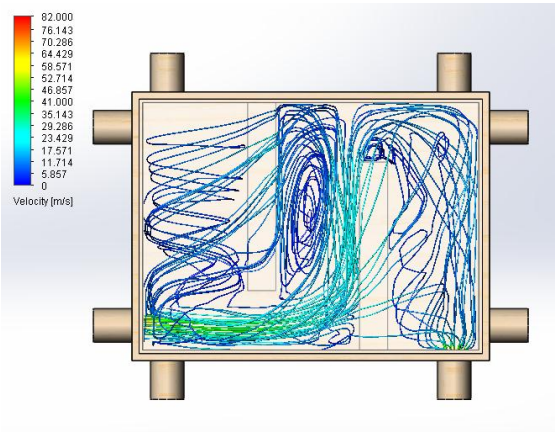

Fig 3.12 C inlet and E outlet

3.4 CONSIDERING D AS INLET AND E, F, G, H AS OUTLETS

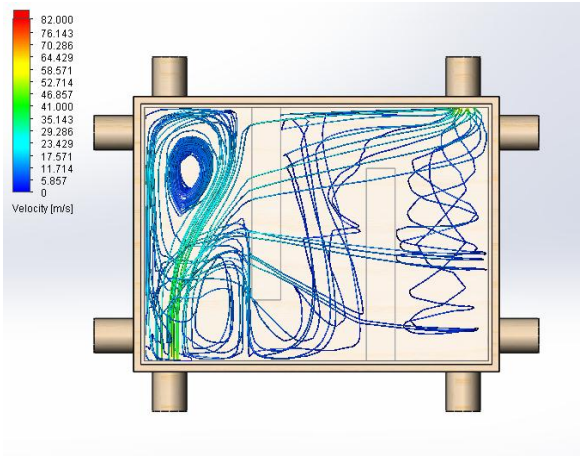

Fig 3.13 D inlet and H outlet

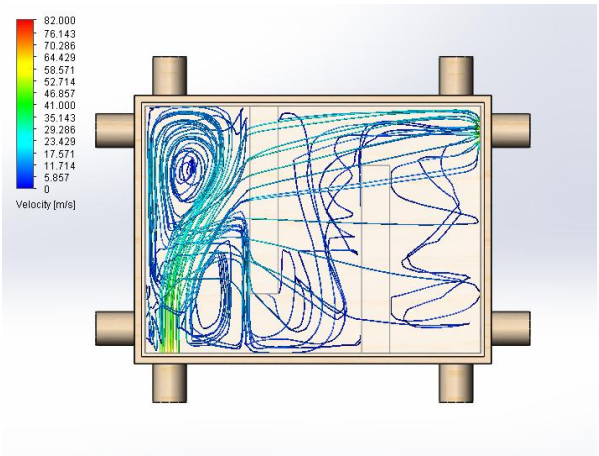

Fig 3.14 D inlet and G outlet

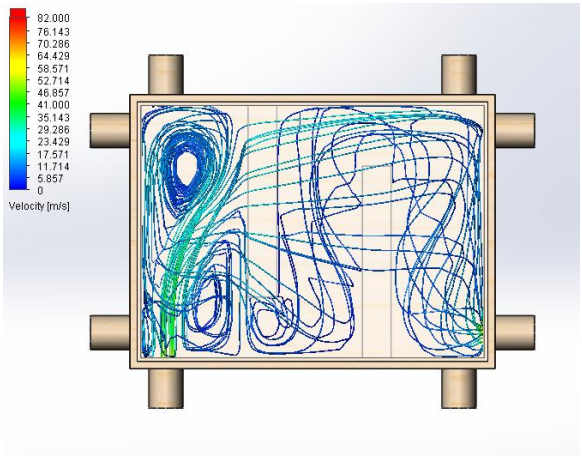

Fig 3.15 D inlet and F outlet

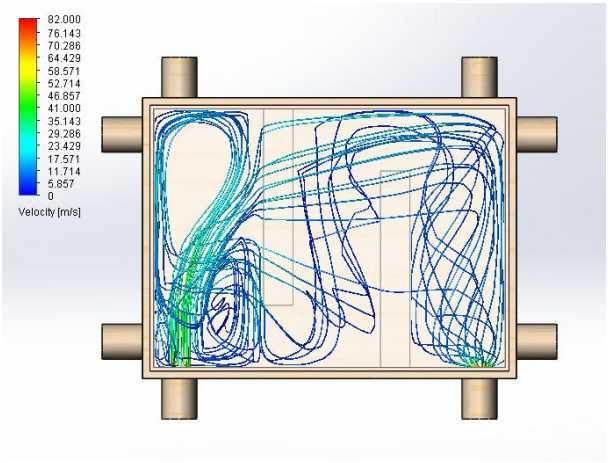

Fig 3.16 D inlet and E outlet

TABLE 1 .VELOCITY TABLE

S.NO	INLET	OUTLET	VELOCITY (m/s)
1	A	E	83.158
2	A	F	79.585
3	A	G	80.578
4	A	H	79.893
5	B	E	82.223
6	B	F	80.037
7	B	G	81.022
8	B	H	80.546
9	C	E	84.312
10	C	F	78.713
11	C	G	82.856
12	C	H	80.044
13	D	E	84.160
14	D	F	80.211
15	D	G	81.538
16	D	H	80.136

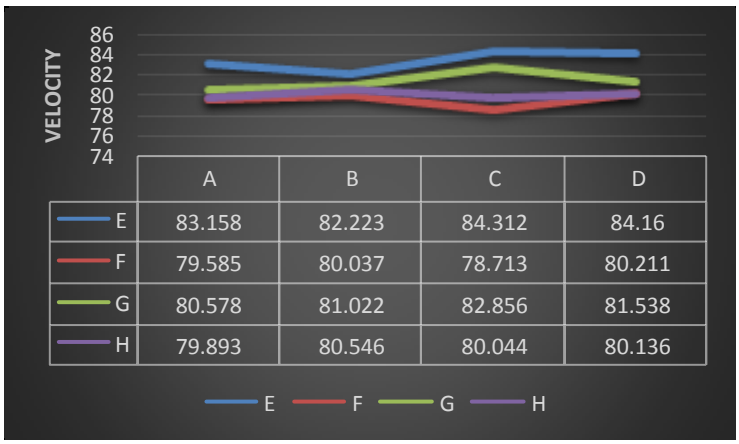

Fig 3.17 Velocity Chart

IV. **RESULTS**

As it can be seen the air flow analysis for the solar flat plate collector is completed and the results were extracted. The distribution of air across the chamber for the structure which has the inlet A and outlet H and it can be seen air flow can create more area of distribution across the solar flat plate collector. If the velocity component is choosen the structure which has the inlet C and outlet E. At the given mass flow rate of 0.314kg/s this structure can provide an output velocity of 84.321 m/s under the atmospheric conditions. Thus the air flow of the solar flat plate collector has been analysed and the inlet and outlet of the solar flat plate collector with high effectiveness can save the time on performing experimental analysis on it which consumes time, money, material, energy.

V. CONCLUSIONS& DISCUSSIONS

The use of zig zag structured baffles interrupt the direct air flow inside and experiments can be performed by changing the baffle structures

The air flow analysis has been done keeping the inlet holes and the outlet holes at an angle of 90 degrees to the wall of the solar flat plate collector, perform analysis can be done changing the angle with respect to the wall of the collector

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