Analysis of Solar Air Heaters using Rectangular Rib and M-Shape Rib

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Abstract: In this era demand of energy is rapidly increases. In the last decade researchers are focus on Heat Transfer rate. The heat transfer rate is future key solve the problem of energy demand and cost of energy. For the analysis of proposed system use Ansys CFD tool, it's one of the best tool the analysis of liquid and floods use in both places industry as well as research labs. In the proposed work design 3D model of rectangular rib and M shape rib in Ansys and analysis the fluid flow behaviour in a duct of a solar air heater (SAH) with one of rib having rough nature and another rib having smooth nature. In this whole phenomena Reynolds number is an important parameter, there numbers are vary from 3800 to 1500.Also validate the whole model numerical model and compare result, Proposed M shape rib shows better performance as compare to other previous methods.

Keywords **- Artificial Roughness, CFD, Solar Air Heater (SAH), Heat Transfer.**

I. INTRODUCTION

For several times alternative energy has been thought-about as a supply of energy and additionally a cost-effective supply of energy as a result of its offered freely. World power sector is completely supported fossil fuels, regarding hour of the country power generation capability captivated with reserves of coal. However in few last year government of Republic of India has taken many steps to scale back the utilization of fossil fuels-based energy whereas promoting renewable generation. Solar power constitutes the plentiful renewable energy resource accessible and in most regions of the planet even its technically offered potential is way in way over this total primary energy offer. Intrinsically alternative energy technologies are a necessary key tool to lower worldwide carbon emissions. The wide selection of technologies accessible these days, to harness the sun energy, is classed into passive and active technologies. The active technologies that formed the content of this paper, are generally divided into solar thermal and electrical phenomenon, wherever solar thermal may be any classified into SOLAR-THERMAL electrical and NON-ELECTRIC applications. The marketplace for several of the alternative energy technologies has seen dramatic growth over the past few decade especially the growth of the marketplace for grid-connected PV systems and star plight systems are outstanding. At presently Republic of India is fifth largest country within the world of electricity generation. [1] [2]

Solar air heating could be a solar thermal technology during which the energy from the sun is employed by an interesting medium and wont to heat air. Solar air heating could be a renewable energy heating technology wont to heat or condition air for buildings or method heat applications. [3] [4]

II. PROPOSED SYSTEM MODEL

CFD analyses applied within the varied industries are employed in R&D and manufacture of craft, combustion engines, still as several different industrial product.

It is advantageous to use CFD over ancient experimental - based analyses, since experiments have a value directly proportional to the quantity of configurations desired for testing, in contrast to with CFD, wherever massive amounts of results is created at much no additional expense. During this method, constant quantity studies to optimise instrumentation are very cheap with CFD compared to experiments.

Post Processing: For viewing and interpretation of Result. The result can be viewed in various formats: graph, value, animation etc.

In the proposed design first design smooth rib. The Renault number of smooth rib is 3800. In the below figure 1 shows the proposed design smooth rib.

In cases where the pressure gradient is known, the usual discretization techniques can be used to obtain discretized equations for velocity, since pressure can be calculated as any other scalar. However, there is no transport equation for pressure alone, and therefore pressure must be found using another method when the pressure gradient is not known. If the flow is compressible, the transport of density is found using the continuity equation and a scalar property such as temperature is found by the combination of the momentum equations and energy equation. Then the solutions for density and temperature are used for finding the pressure using the equation of state.

The result can be viewed in various formats: graph, value, animation etc.

1. Pre-processing: CAD Model: Generation of 3D CAD model of Solar Air Heater Using Rectangular Rib and M-shape rib in Ansys Design Modeler. / CFD 3D model 1 / CFD 3D model-2 / CFD model Rectangular shape-1 / CFD model Rectangular shape-2 / CFD model Square rib-1 / CFD model Square rib-2

Mesh: Generate the mesh of Solar Air Heaters in the Ansys Mesh Software. CFD Mesh M-Shape-1 / CFD mesh Square section rib-1 / CFD mesh Square section rib-2 Shape.

CASE-1 Smooth Rib

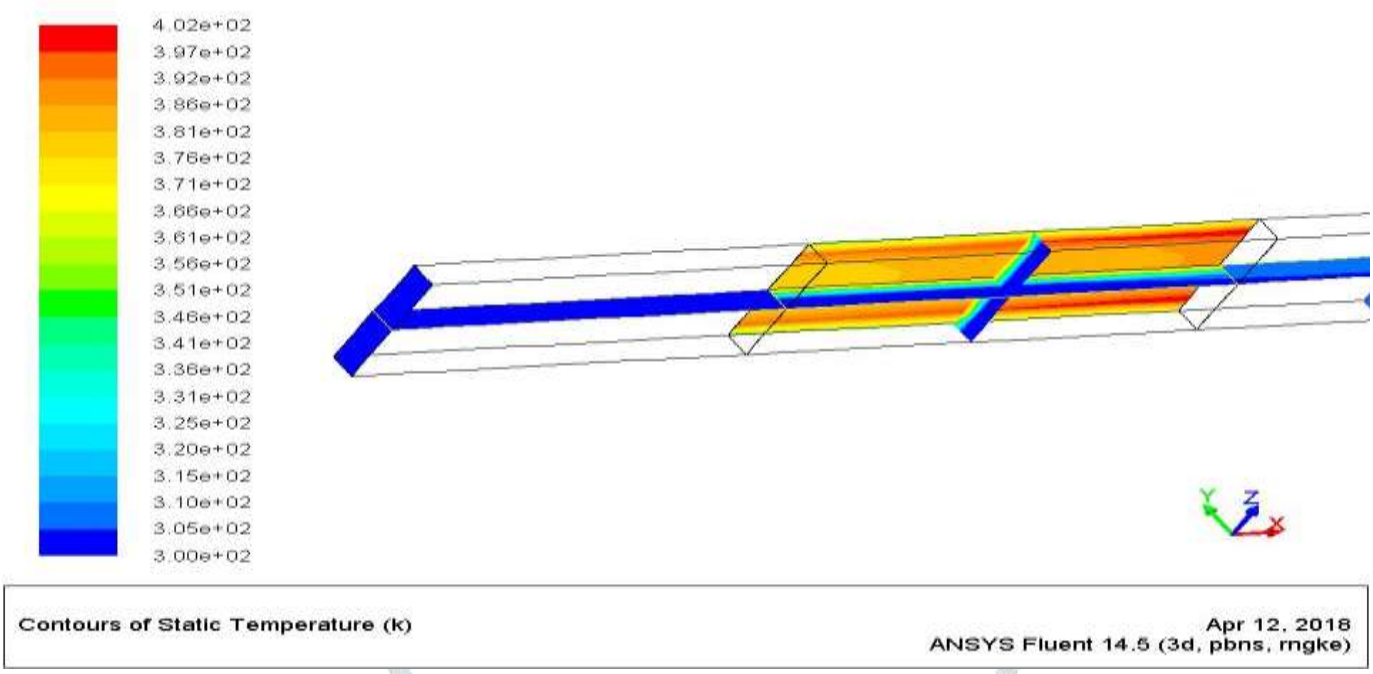

Figure: 1 Smooth-RE-3800-Temp 1

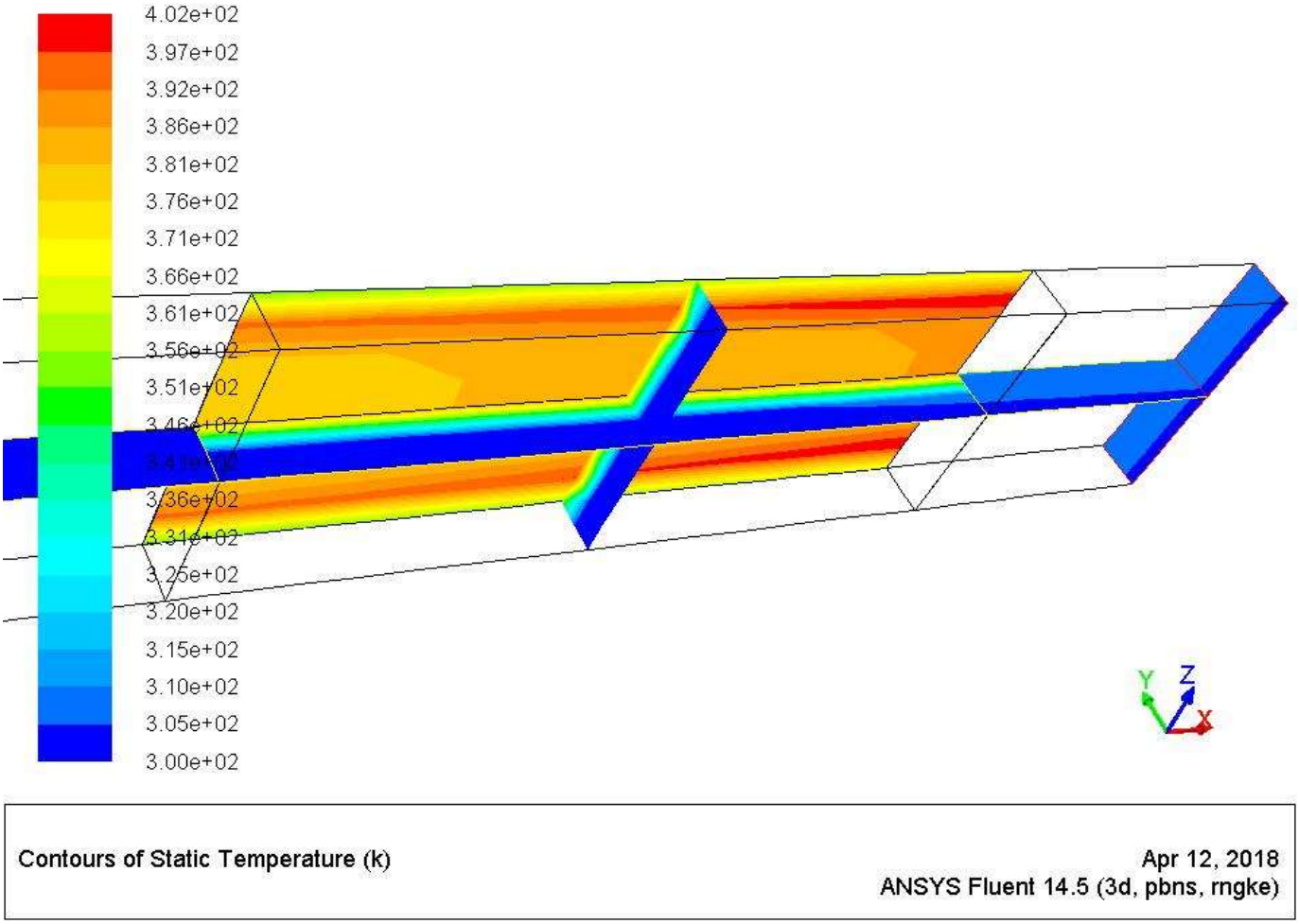

Figure: 2 Smooth-RE-3800-Temp 2

CASE- 2 Square Shape

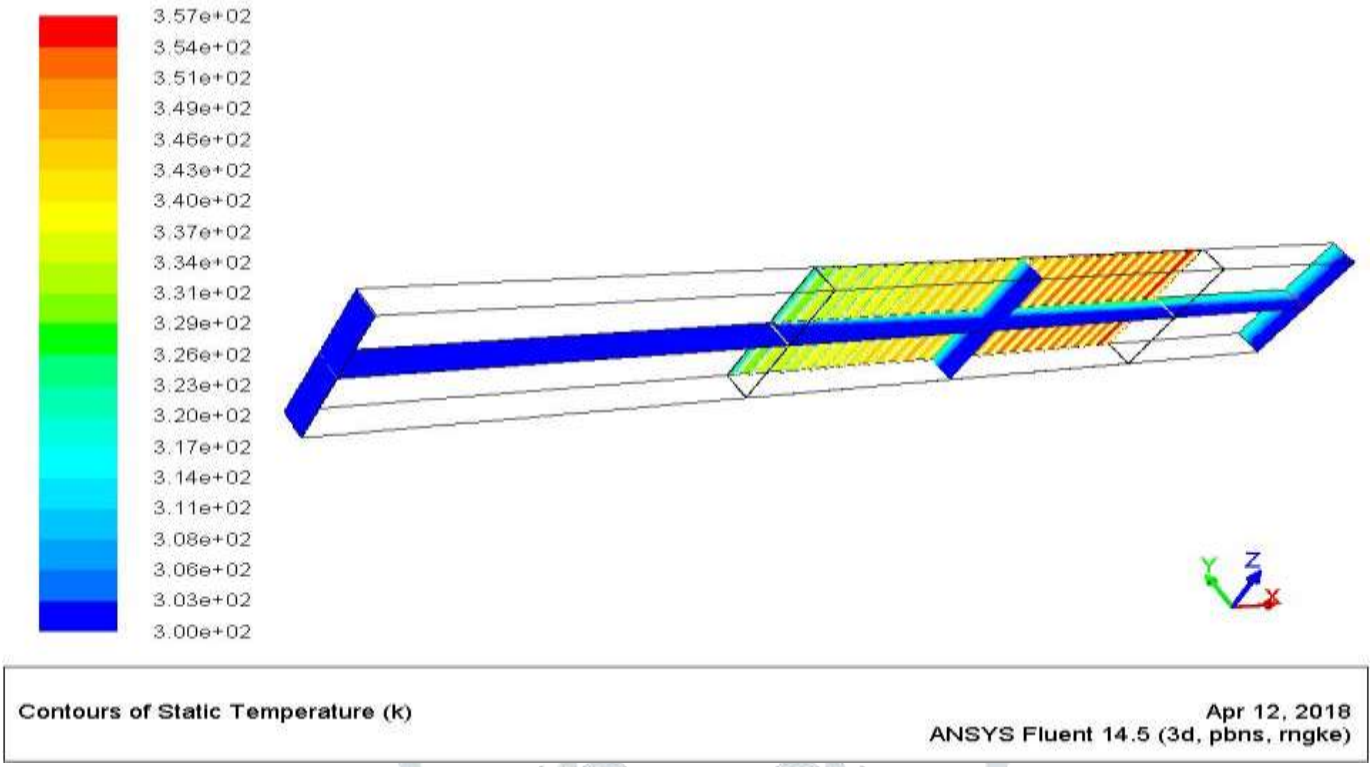

Figure: 3 Square-re-3800-Temp 1

CASE-3 M-SHAPE

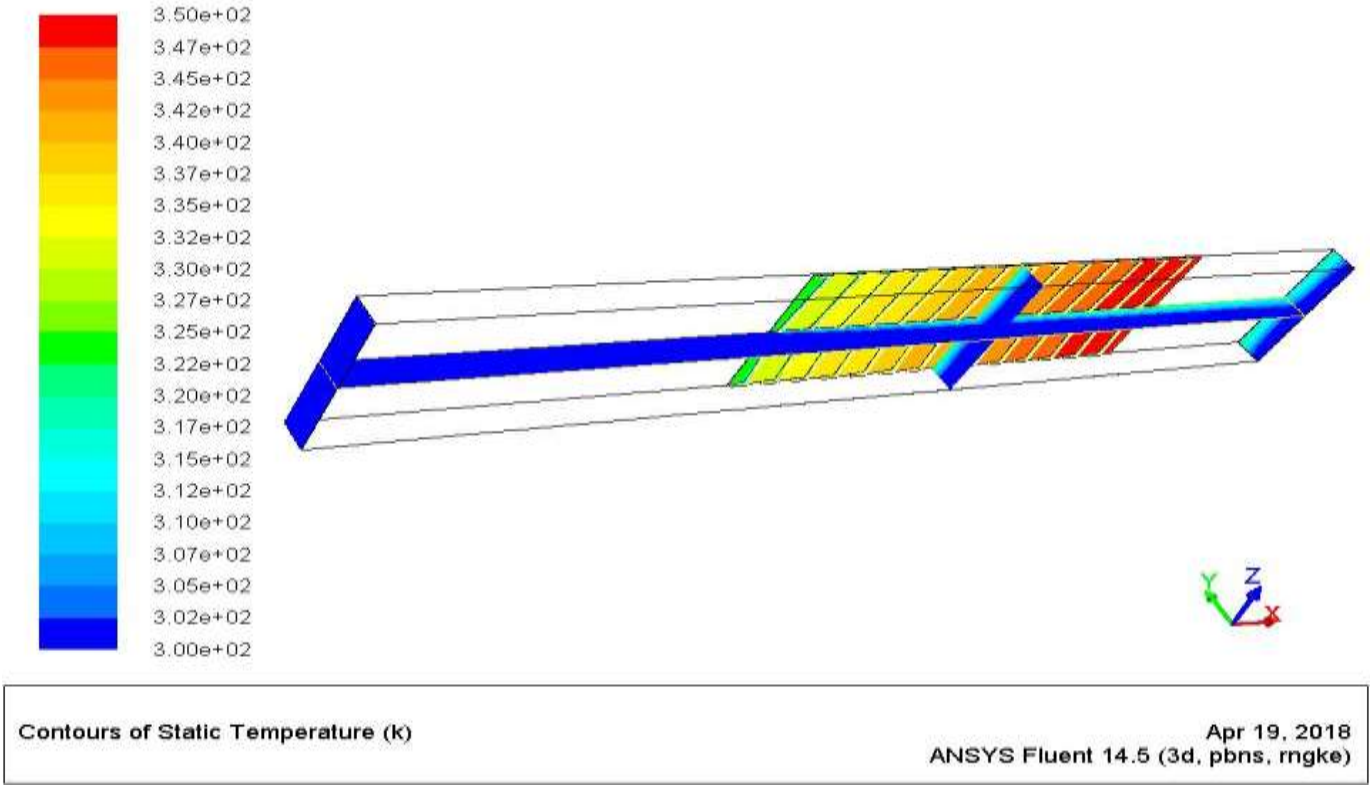

Figure: 4 M-Shape-re-3800-Temp 1

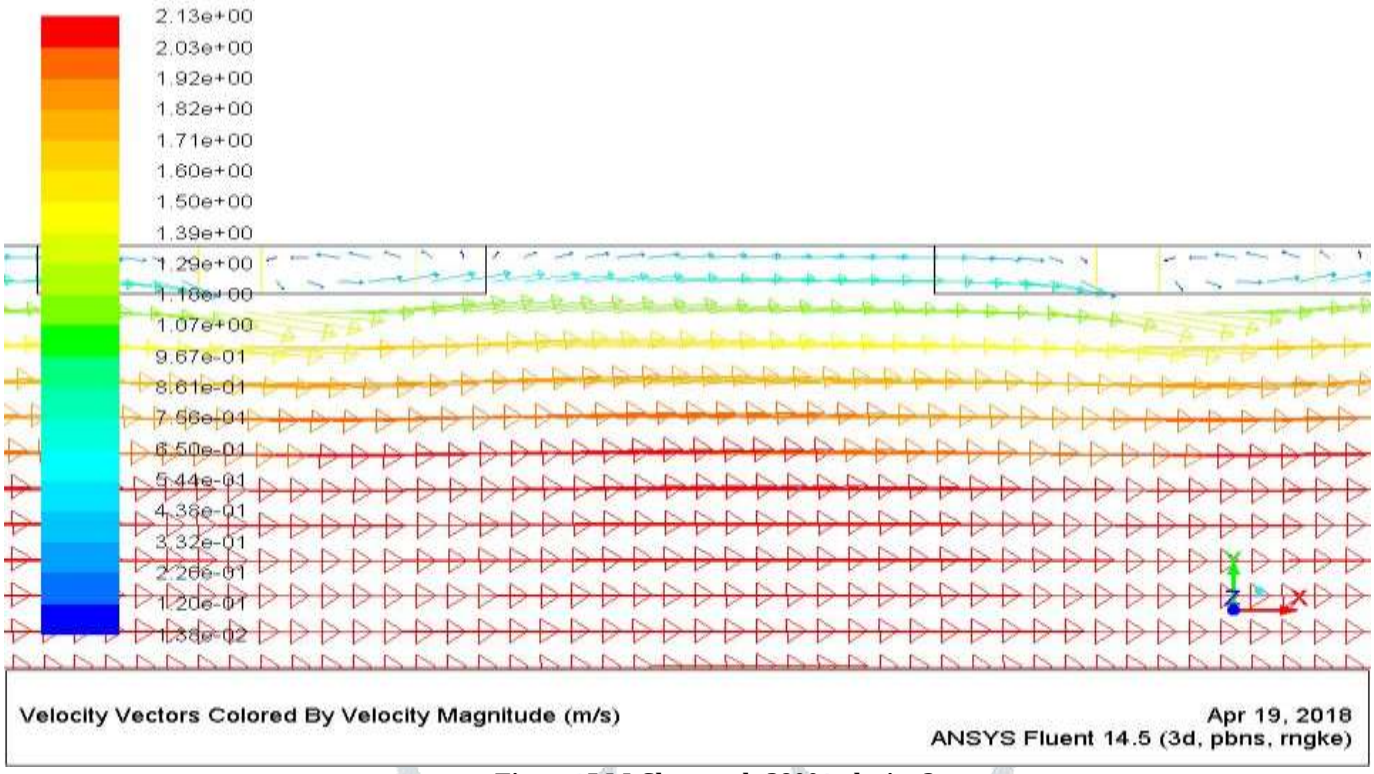

Figure: 5 M-Shape-reb-3800-velocity 2

III. RESULT AND ANALYSIS

In this section discuss the result of proposed M shape rib. There are different result parameter are analyzed in this part such as maximum enhancement of average (Nu), heat transfer (HT) and pressure drop. For the analysis of proposed work calculate the different parameter that is shown in below table 1. In this table shows the different parameters of M shape rub.

Table: 1 M-SHAPE

Reynold no.	**Air inlet vel m/s**	**Mass flow inlet kg/s**	**Air-inlet temp k**	**Air-outlet-temp k**	**Temp of plate**	**Pres-drop in pa**	**Air avg vel**	**Friction factor**	Heat Transfer (ht)	**Maximum Enhancement of Average** (Nu)=hd/k	Q
3800	1.682	0.00412091	300	306.844	340.468	3.522694	1.68205	0.05989	27.36443	37.3151	28.3853
5000	2.213	0.00542183	300	305.235	335.469	5.227825	2.21301	0.05135	31.05996	42.3544	28.5701
8000	3.541	0.00867542	300	303.280	328.572	10.29559	3.54100	0.03949	37.97829	51.7885	28.6392
12000	5.312	0.01301442	300	302.202	324.142	18.79501	5.31204	0.03204	44.72152	60.9839	28.8525
15000	6.639	0.01626552	300	301.745	321.829	27.13222	6.63901	0.02961	48.68661	66.3908	28.5691

In the above table 1 shows the different result parameters that is air inlet temperature measured in kelvin (K), similar that air outlet-temperature, pressure drop measured in Pascal (P), friction factor, heat transfer

and Maximum Enhancement of Average. On this basic of these parameters compare the M shape rub rectangular shape rib.

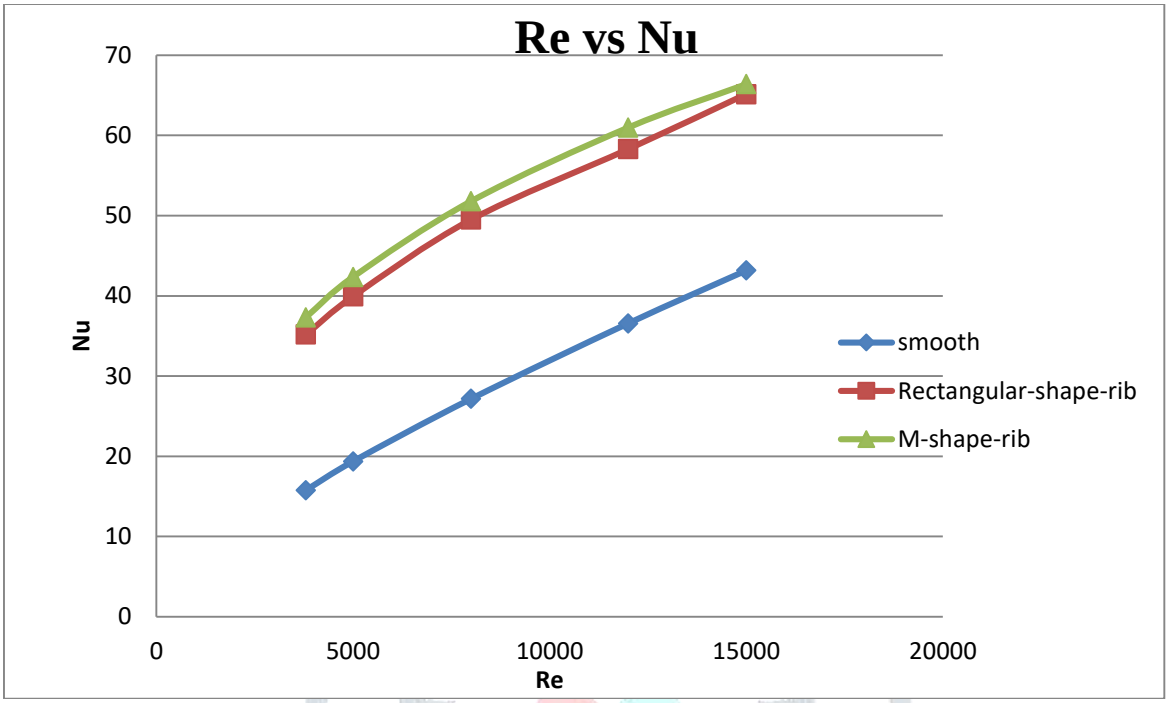

Figure 8: Renault number vs Maximum Enhancement of Average (Nu)

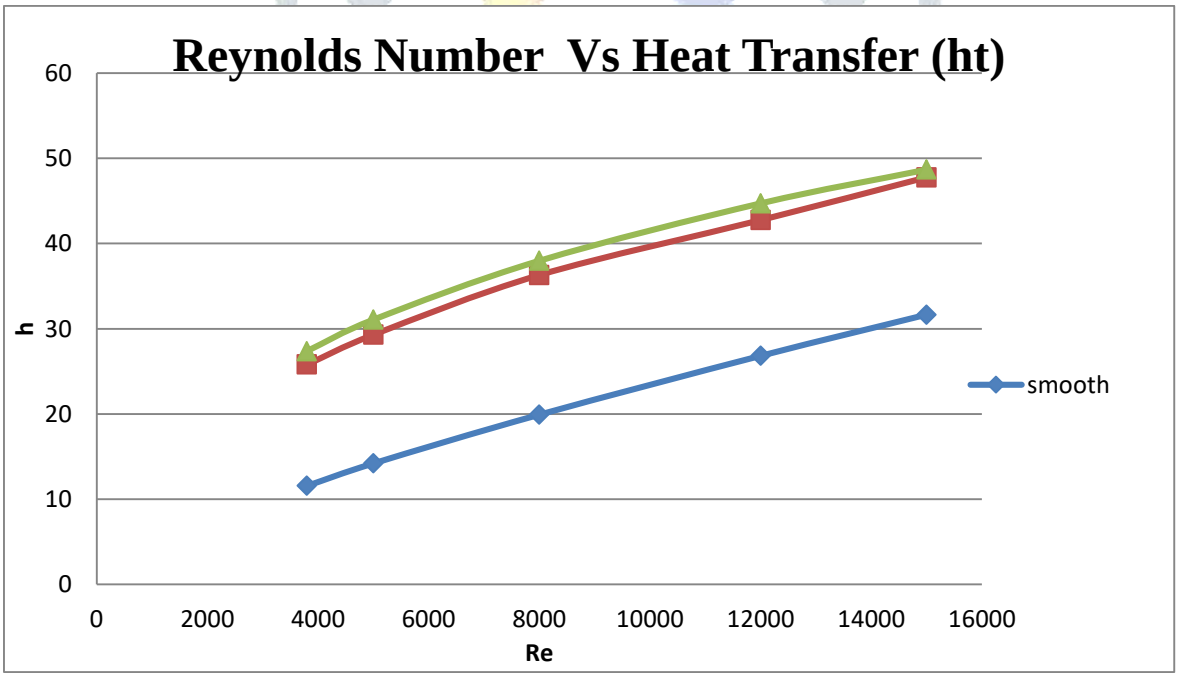

Figure 9: Reynolds Number (Re) Vs. Heat Transfer (ht)

In the above figure 8 and figure 9 shows the comparison of M rub with rectangular rub on the basis of maximum enhancement of average (Nu) as well as heat transfer (ht). In both of the figure clearly see that M shape rib shows better output as compare to rectangular shape rub. In the nest figure 10

shows the comparison of pressure drop of different shape rub. M shape rib shows better pressure drop as compare to the rectangular shape rib.

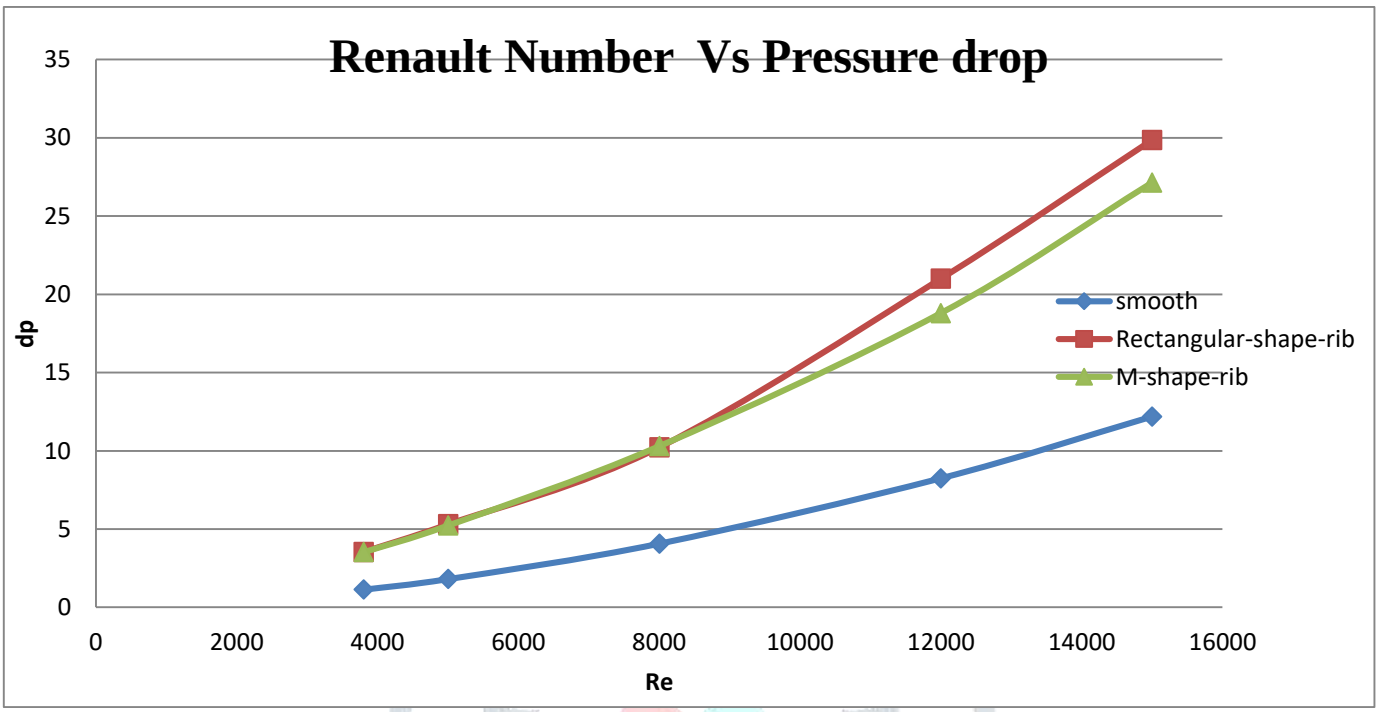

Figure 10: Renault Number vs. Pressure drop

IV. CONCLUSION

In the last section, discuss the conclusion of proposed work. The proposed M shape rib shows better output in terms of pressure drop, maximum enhancement of average (Nu) as well as heat transfer (ht). The CFD technique has been used as it is powerful for dealing with the wide range of parameters and complicated analysis that involve fluid flow. The CFD technique can also be applied successfully by use cross validation technique on wide range of parameters and complicated analysis which cannot be done through experimental investigation.

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