CFD Analysis of SAH on Subtracted Material of Single Arc on Surface

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Abstract— It is a known, when laminar converted to turbulent flow gives better energy conversion and induce efficiency single arc solar air heater (SAH) plate design due to better frictional factor and better design parameter. Single arc subtracted on plate increase roughness to increase efficient energy transfer due to that. Single arc pitch give regular thrust to solar energy conversion as source to conventional energy. Design performance for CFD investigation of single arc on roughness plate with certain pitch which gives better performance to SAH. The medium dimension for SAH plate for single arc array on plate give better design to better energy source with that. From median of plate the ratio W/w=2 and e/w=0.03 and e/W=0.015 and p/e=22, so design performance will give better result. This is one's of the unique numerical calculation to gives better design and investigation for CFD on plate to evaluate better energy source result.

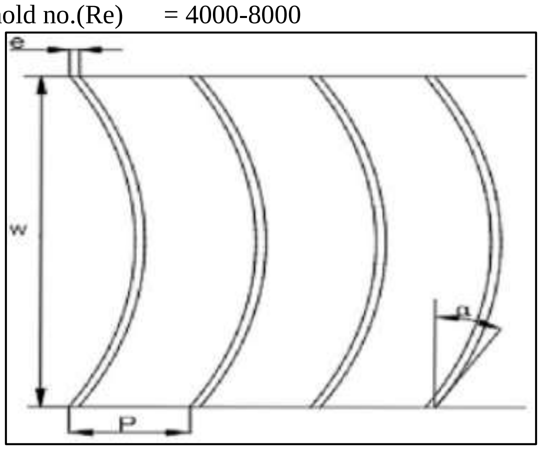
Keywords: CFD for Single Arc, SAH

I. INTRODUCTION

We have single arc subtracted on duct to cfd investigate as assigned designed to get various result as per design parameter. Rib height is one of the design parameter to depend on thermal efficiency.

II. SPECIFICATION OF DESIGN

Length(W) = 200 mm
Breath(L) = 600 mm
Thickness = 20 mm
Hydralic
Diameter(D) = 40.24 mm
Rib height(e) = 3 mm
Rib pitch(P) = 66.66 mm
Angle (α) = 20^o, 35^o, 40^o
Reynold no.(Re) = 4000-8000



III. GEOMETRY & MESHING

The single arc geometry dawn in CAD software as follows

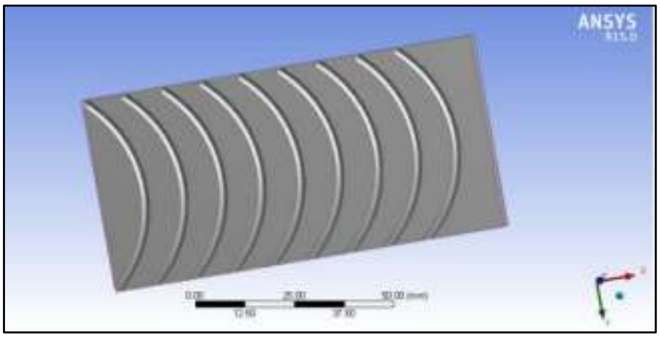


Fig. 1: Geometry of Single arc plate of SAH

After modeling, we have meshing the model so next process of numerical method.

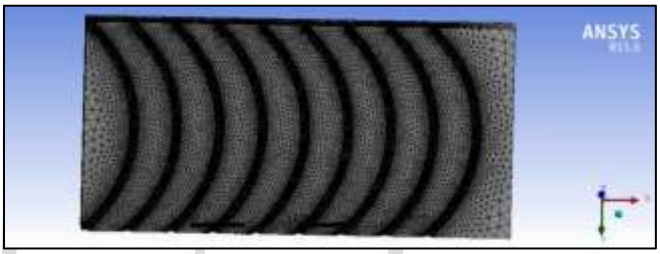


Fig. 2: Mesh of Model

Meshing detail

Type of element	Tetrahedral
No. of nodes	432140
No. of Elements	183121

IV. BOUNDARY CONDITION

A. At Inlet

Condition	Value
Pressure	101325 pa
Temperature	310 k
Velocity(m/s)	0.02 m/s
Turbulent model	K-omega
Density of fluid on duct	1.225 kg/m3
Turbulent intensity	4%
Wall	Pre-defined

B. At Outlet

Condition	Value
Pressure	0.4 bar
Temperature	370 k
Velocity(m/s)	0.04 m/s
Turbulent model	K-omega
Turbulent intensity	6 %
Wall	Pre-defined
Wall	No slip condition

V. RESULT & DISCUSSION

Contour for turbulence for K-omega due to subtraction rib efficiency improved and uniform turbulent get better performance.

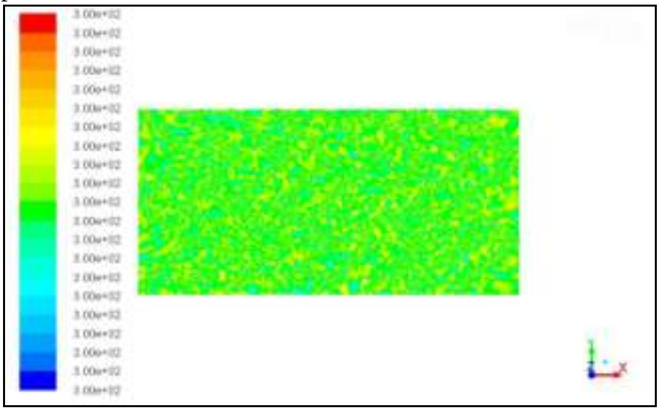


Fig. 3: Turbulent contour

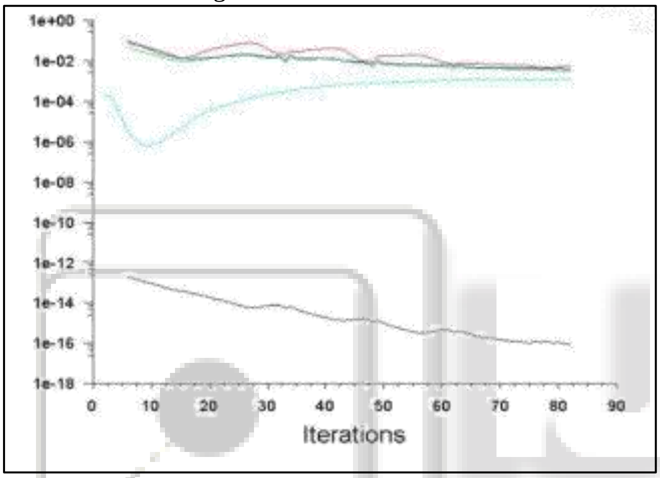


Fig. 4: Result graph

VI. CONCLUSION

For various angle of attack various turbulent result got better performance. Verified result.

REFERENCES

[1] Skullong S., Thianpong C. and Promvonge, P., 2015, Effects of rib size and arrangement on forced convective heat transfer in a solar air heater channel, Heat and Mass Transfer, pp. 1- 11.
[2] Kalogirou, S. A., 2013, Solar energy engineering: processes and systems. Academic Press.
[3] Yadav A. S. and Bhagoria J. L., 2013, Heat transfer and fluid flow analysis of solar air heater: a review of CFD approach, Renewable and Sustainable Energy Reviews, 23: pp. 60- 79.
[4] Sukhatme K. and Sukhatme S. P., 1996, Solar energy: principles of thermal collection and storage, Tata McGraw-Hill Education.
[5] Twidell, J. and Weir, A. D., 2006, Renewable energy resources, Taylor & Francis.
[6] Cengel Y. A. and Cimbala J. M., 2006, Fluid mechanics (Vol. 1), Tata McGraw-Hill Education.
[7] Prasad K. and Mullick S. C., 1983, Heat transfer characteristics of a solar air heater used for drying purposes, Applied Energy, 13(2): pp. 83-93.
[8] Prasad B. N. and Saini J. S., 1988, Effect of artificial roughness on heat transfer and friction factor in a solar air heater, Solar Energy, 41(6): pp. 555-560.
[9] Prasad B. N. and Saini J. S., 1991, Optimal thermo-hydraulic performance of artificially roughened solar air heaters, Solar Energy, 47(2): pp. 91-96.
[10] Liou T. M. and Hwang J. J., 1993, Effect of ridge shapes on turbulent heat transfer and friction in a rectangular channel, International Journal of Heat and Mass Transfer, 36(4): pp. 931-940.
[11] Gupta D., Solanki S. C. and Saini J. S., 1993, Heat and fluid flow in rectangular solar air heater ducts having transverse rib roughness on absorber plates, Solar Energy, 51(1): pp. 31-37.
[12] Saini R. P. and Saini J. S., 1997, Heat transfer and friction factor correlations for artificially roughened ducts with expanded metal mesh as roughness element, International Journal of Heat and Mass Transfer, 40(4): pp. 973-986.
[13] Karwa R., Solanki, S. C. and Saini, J. S., 1999, Heat transfer coefficient and friction factor correlations for the transitional flow regime in rib-roughened rectangular ducts, International Journal of Heat and Mass Transfer, 42(9): pp. 1597-1615.
[14] Verma S. K. and Prasad B. N., 2000, Investigation for the optimal thermos-hydraulic performance of artificially roughened solar air heaters, Renewable Energy, 20(1): pp. 19-36.
[15] Murata A. and Mochizuki S., 2001, Comparison between laminar and turbulent heat transfer in a stationary square duct with transverse or angled rib turbulators, International Journal of Heat and Mass Transfer, 44(6): pp. 1127-1141