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Appendix A

Grid and time independent test

The grid and time independent study have been conducted for the case of flat natural convection SAH at four different sections placed longitudinally after definite gap between them. Each section is placed across the flow channel where the local velocity and temperature variations have been recorded as shown in Fig. A.1.

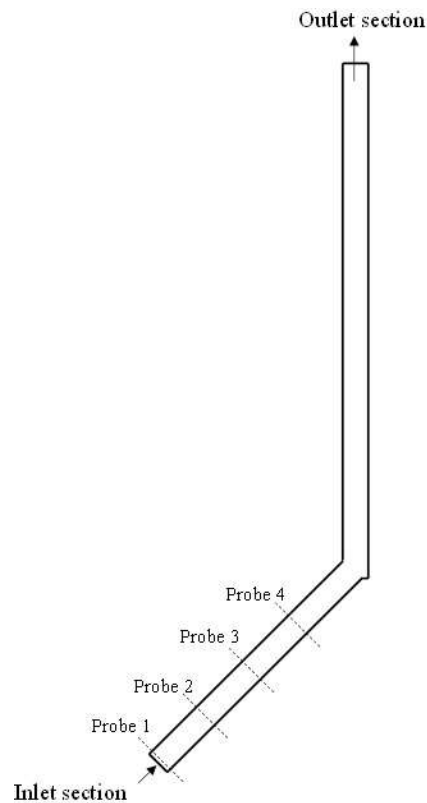


Figure A.1: Flat natural convection SAH with four different sections placed longitudinally one after the other across the flow channel.

A.1 Grid independent test

The grid independent test have been performed for four different number of elements are mentioned in Table A.1 below:

Table A.1: Grid independent test details

| S.No. | Grid Symbol | Number of elements | Nusselt number (Nu) |
|-------|-------------|--------------------|---------------------|
| 1 | a | 274954 | 18.19 |
| 2 | b | 154873 | 18.24 |
| 3 | c | 118123 | 18.24 |
| 4 | d | 81000 | 18.58 |

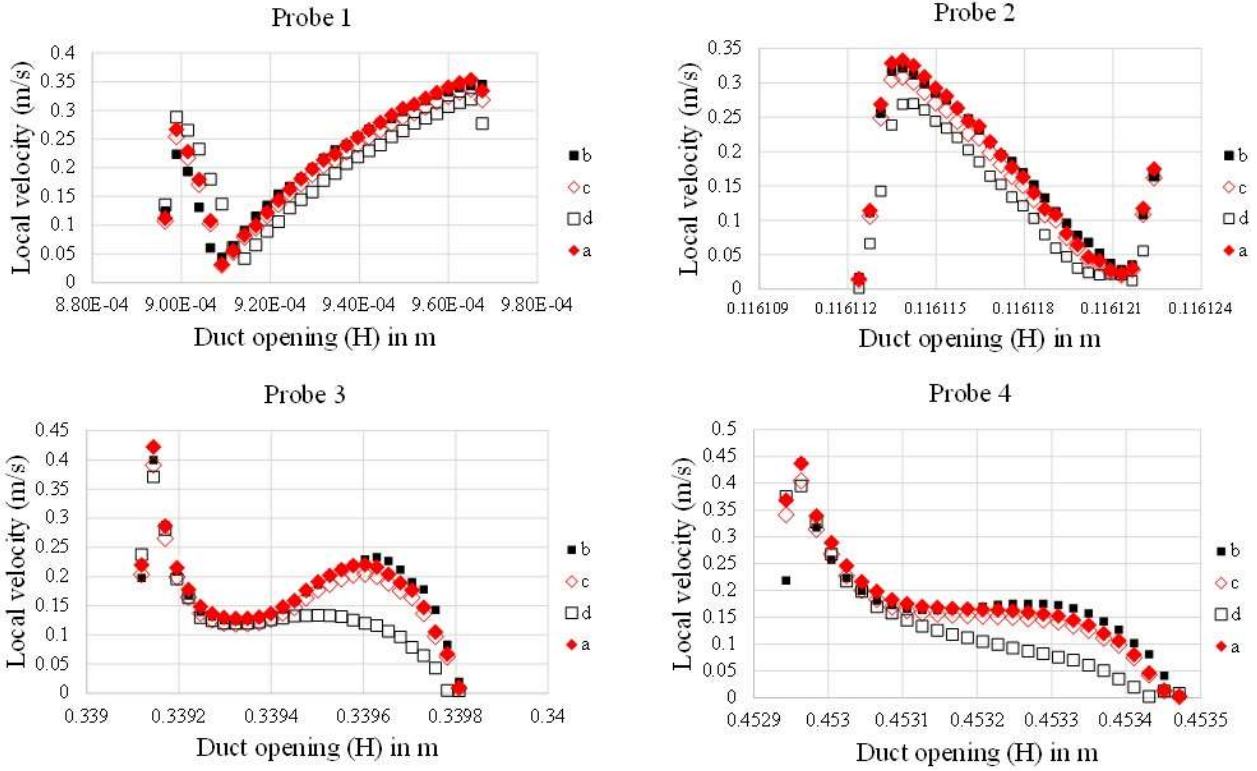


Figure A.2: The velocity profiles at four different sections have been shown for flat natural convection SAH for different number of mesh elements.

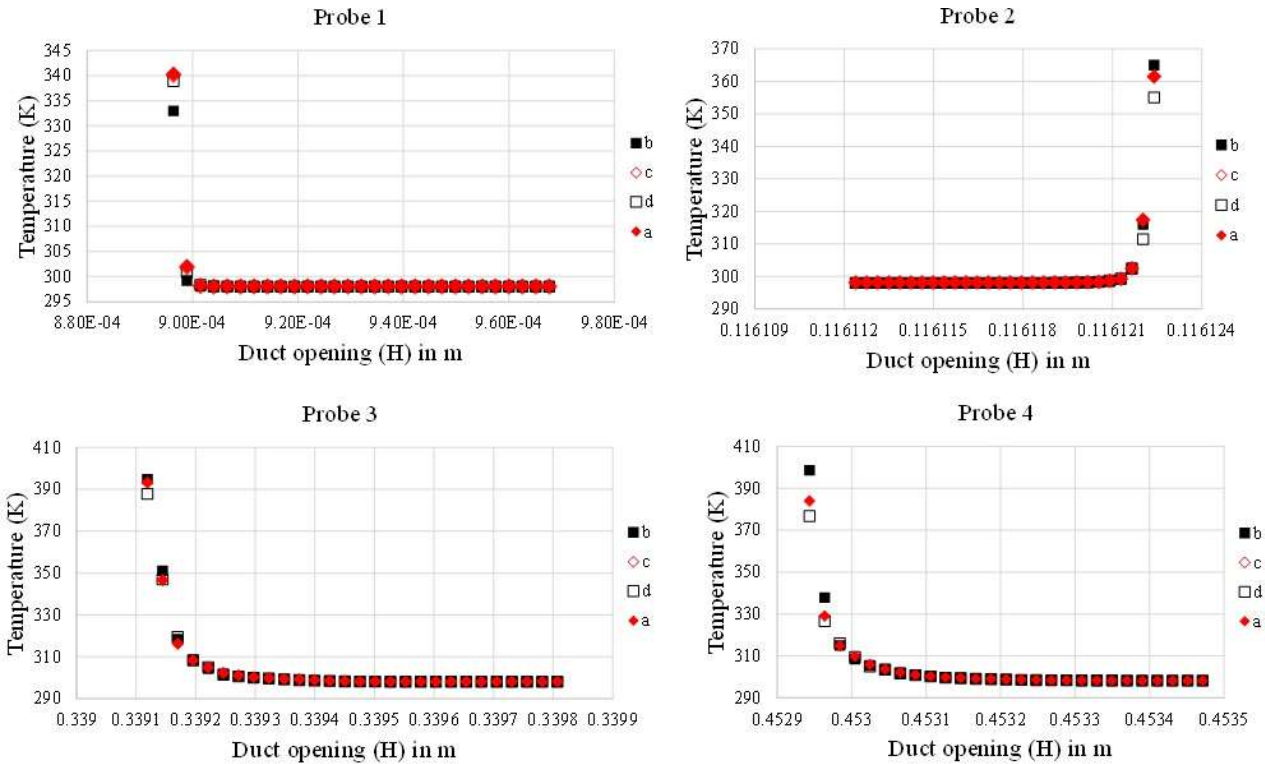


Figure A.3: The temperature profiles at four different sections have been shown for flat natural convection SAH for different number of mesh elements.

A.1.1 Grid independent test of local velocity as parameter at different sections (refer Fig. A.2)

A.1.2 Grid independent test of temperature as parameter at different sections (refer Fig. A.3)

As the grid 'c' =118123 number of mesh elements gives reasonably close results in comparison to finer grid sizes i.e. 'a' and 'b', the number of elements 118123 has been chosen to be optimum number of mesh elements to conduct further simulation study for different cases.

A.2 Time independent test

The time independent test was performed by considering optimum number of mesh elements (118123) for the case of flat natural convection SAH.

The time independent test has been performed for three different time steps are mentioned below in Table A.2.

Table A.2: Time step test details. Three times steps has been considered: time t , $t/2$ and $2t$.

| S.No. | Time step (second) | Number of elements | Nusselt number (Nu) |
|-------|--------------------|--------------------|-------------------------|
| 1 | 0.05 ($t/2$) | | 18.15 |
| 2 | 0.1 (t) | 118123 | 18.24 |
| 3 | 0.2 ($2t$) | | 18.20 |

It can be noticed from the table 2 that Nusselt number do vary significantly by either doubling the time step or lowering the time step by twice. We have used a time step of $t = 0.1$ second.

Appendix B

The SAH thermal performance has been studied for a constant grooves pitch, as the Reynolds number, Re and groove relative height ratio, $\frac{e_f}{H}$, are the most influencing parameters.

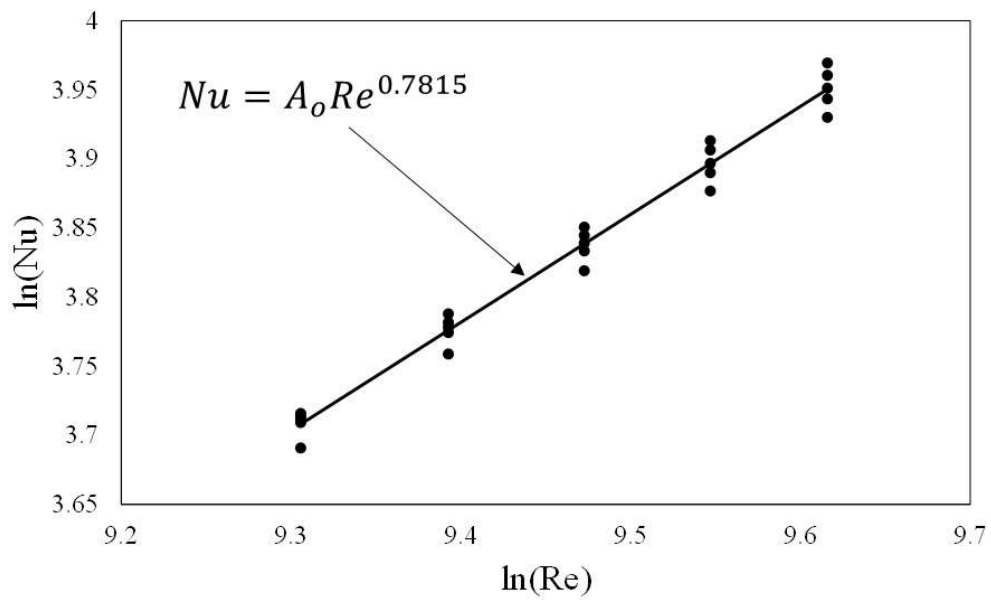


Figure B.1: Trend variation of $\ln(Nu)$ versus $\ln(Re)$ for SAH having curved design equipped with quarter-circle ribs.

To develop the bridge between Nu and Re , the variations has been obtained in logarithmic form for Re in the range 11000-15000 is obtained in Fig. B.1. The relationship among $\ln Nu$ versus $\ln Re$ are of the following form:

$$Nu = A_o Re^n \quad (B.1)$$

where $n = 0.7815$

The expression for Nu in Eq. B.1 obtained from appropriate data points of SAH having curved flow channel integrated with quarter-circle ribs. The R-square method was used to fit the data is shown in Fig. B.1.

Brief Bio-Data of the Author

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LIST OF PUBLICATIONS

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3. 'Solar air heater integrated with Trombe-wall' App. Number - TEMP/E-1/3543/2020-DEL.
4. 'An improved hybrid solar chimney based power generation system' App. Number - TEMP/E-1/22582/2020-DEL.
5. 'An improved high flow solar chimney power plant' App. Number - TEMP/E-1/36762/2020-DEL.

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