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# Heat Transfer Enhancement of a Rectangular Channel with Elongated Hole by using Ansys

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***Abstract*****: - Heat transfer improvement over surface results from the Great Depression forms recesses instead of projections. Generically, such options area unit called dimples, and will be shaped in an infinite variation of geometries which ends up in varied heats transfer and friction characteristics. Heat transfer improvement victimization dimples supported the principle of scouring action of cooling fluid happening within the dimple and development of gathering the delay of flow separation over the surface. Spherical indentations or dimples have shown sensible heat transfer characteristics once used as surface roughness. In this paper the modeling for the rectangular channel with elongated hole is done in the creo2.0 and simulation is done in ansys.**

***Keywords*****: - *Rectangular channel, creo2.0 and ansys***

## I. INTRODUCTION

When designing cooling systems for automobiles and spacecraft, it is imperative that the heat exchangers are especially compact and lightweight. Also, enhancement devices are necessary for the high heat duty exchangers found in power plants (i.e. air-cooled condensers, nuclear fuel rods).These applications, as well as numerous others, have led to the development of various enhanced heat transfer surfaces. The latter is particularly useful in thermal processing of biochemical, food, plastic, and pharmaceutical media, to avoid thermal degradation of the end product. On the other hand, heat exchange systems in spacecraft, electronic devices, and medical applications, for example, may rely primarily on enhanced thermal performance for their successful operation. The commercialization of enhancement techniques, where the technology has been transferred from the research laboratory to full-scale industrial use of those that are more effective and, has also led to a larger number of patents. The conversion, utilization, and recovery of energy in every industrial, commercial, and domestic application involve a heat transfer process. Some common examples are coming from domestic application to industrial ones. Improved heat exchange, over and above that in the usual or standard practice, can significantly improve the thermal efficiency in such applications as well as the economics of their design and operation. The engineering cognizance of the need to increase the thermal performance of heat based equipment's, thereby effecting energy, material, and cost savings as well as a consequential mitigation of environmental degradation had led to the development and use of many heat transfer enhancement techniques. These methods have in the past been referred to variously as augmentation and intensification, among other terms.

## II. CLASIFICATION OF ENHANCEMENT TECHNIQUES

Heat transfer inside flow passages can be enhanced by using passive surface modifications such as rib tabulators, protrusions, pin fins, and dimples. These heat transfer enhancement techniques have practical. Application for internal cooling of turbine air foils, combustion chamber liners and electronics cooling devices, biomedical devices and heat exchangers. The heat transfer can be increased by the following different Augmentation Techniques. They are broadly classified into three different categories:

(i) Passive Techniques
(ii) Active Techniques
(iii) Compound Techniques.

A. Passive Techniques These techniques generally use surface or geometrical modifications to the flow channel by incorporating inserts or additional devices. They promote higher heat transfer coefficients by disturbing or altering the existing flow behaviour (except for extended surfaces) which also leads to increase in the pressure drop. In case of extended surfaces, effective heat transfer area on the side of the extended surface is increased. Passive techniques hold the advantage over the active techniques as they do not require any direct input of external power. These techniques do not require any direct input of external power; rather they use it from the system itself which ultimately leads to an increase in fluid pressure drop. They generally use surface or geometrical modifications to the flow channel by incorporating inserts or additional devices. They promote higher heat transfer coefficients by disturbing or altering the existing flow behaviour except for extended surfaces.

B. Active Techniques These techniques are more complex from the use and design point of view as the method requires some external power input to cause the desired flow modification and improvement in the rate of heat transfer. It finds limited application because of the need of external power in many practical applications. In comparison to the passive techniques, these techniques have not shown much potential as it is difficult to provide external power input in many cases. In these cases, external power is used to facilitate the desired flow modification and the concomitant improvement in the rate of heat transfer.

C. Compound Techniques A compound augmentation technique is the one where more than one of the above mentioned techniques is used in combination with the purpose of further improving the thermo-hydraulic performance of a heat exchanger. When any two or more of these techniques are employed simultaneously to obtain enhancement in heat transfer that is greater than that produced by either of them when used individually, is termed as compound enhancement. This technique involves complex design and hence has limited applications.

## III. LITERATURE SURVEY

Awasarmol et al. [1] investigated experimentally the heat transfer enhancement of perforated fin array with different perforation diameter and at different inclination angles under natural convection. They concluded that perforated fins give enhanced heat transfer and saving in material as compared to solid fins. Md. Farhad Ismail et al. [2] numerically investigated turbulent heat convection from solid and longitudinally perforated rectangular fins. They concluded that circular and square perforated fins have almost the same amount of heat removal rate but circular perforated fins have significantly less pressure drop than that of square perforated fins. Shaeri et al [3] studied numerically the effects of size and number of perforations on laminar heat transfer characteristics of an array of perforated fins with the maximum perforations and concluded that in a laminar flow and at a constant porosity, a fin with fewer perforations is more efficient to enhance the heat transfer rate compared with a fin with more perforations. Damook et al. [4] carried out experiments to determine the effect of perforation on heat transfer and pressure drop characteristic. They concluded that, the Nusselt number increases with increase in number of pin perforations whereas both the pressure drop across the heat sink and fan power needed to pump the air through them reduces. Huang et al. [5] investigated numerically the overall convection heat transfer enhancement for long horizontal rectangular fin array with perforations through the fin base and found that perforations improved heat transfer performance significantly and the overall heat transfer coefficients could be more than twice as large as that without perforations for long fin arrays. Kundu et al. [6] investigated analytically the performance and optimum design of porous fin. They concluded that as compared to a solid fin there was a considerable increase in heat transfer through porous fins for any profile. Shaeri et al. [7] investigated numerically the heat transfer of a heated array of rectangular perforated and solid fins attached on a flat surface and concluded that perforated fins give better performances and effectiveness by increasing number of perforations. Kundu et al. [8] studied analytically annular step porous fins and found that with the consideration of the porous material and moving condition of fins, heat transfer can be increased for a constraint mass of a fin. Lin et al. [9] investigated numerically the average heat transfer and fluid flow characteristics of the staggered circular tube bank fin heat exchanger with curved delta winglet vortex generators (CDWVGs) and found that interrupted annular groove fin shows excellent performance at higher Reynolds number and the annular groove's radial and circumferential locations have a very low effect on the average heat transfer and fluid flow characteristics.

**Boundary conditions**

Length of fin array = 75mm
Height of fin = 27mm
Thickness of fin = 2mm
Number of fins = 10
Heat input = 15W, 25W, 35W and 45W

Total exposed area of solid FAB (Ae) = Exposed area of middle fins + exposed area of two end fins + exposed area of base channels = $[(L \times H \times 2) + (H \times t \times 2) + (L \times t)] \times (N-1) + [L \times H + H \times t + L \times t] \times 2 + [L \times S \times (N-1)]$
So, we get A = .046038 m²

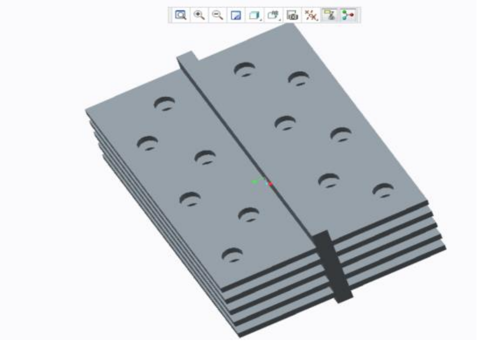

Fig:- 3-D modeling of rectangular channel

Fig: - Experimental setup ( from literature )

## IV. HEAT TRANSFER IN ANSYS

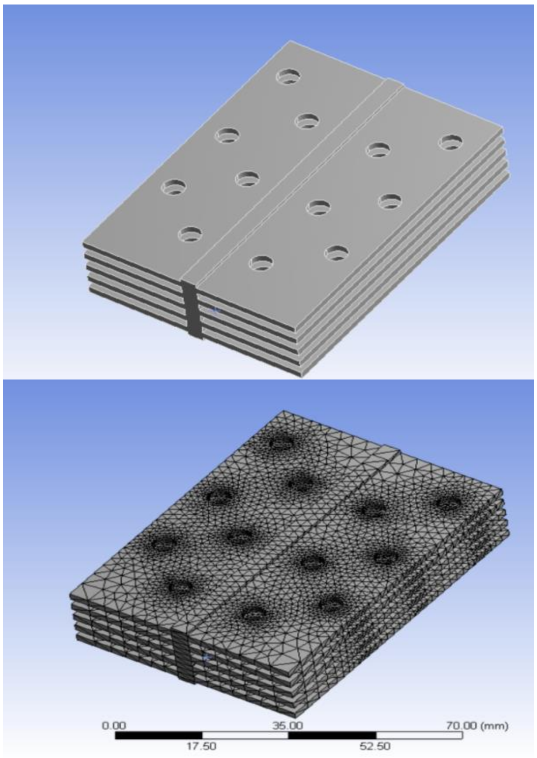

Fig: - Imported and meshed body

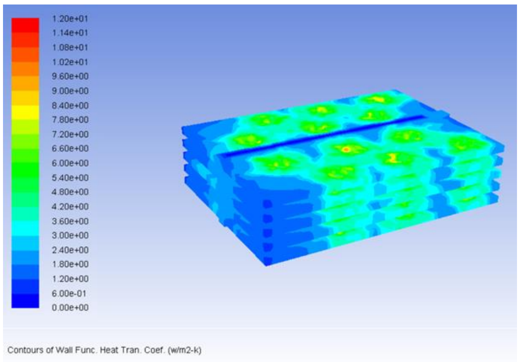

Fig: - Heat transfer coefficient

## V. RESULTS AND DISCUSSIONS

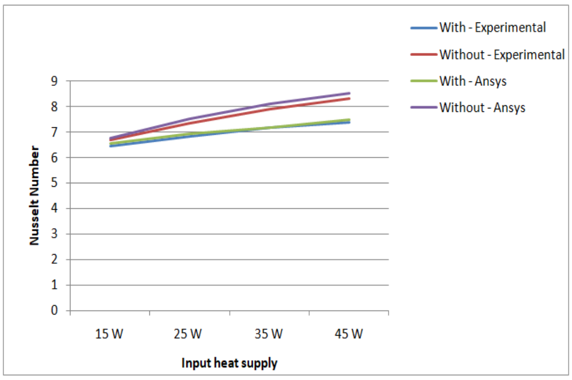

Fig:- comparison of nttusselt number with experimental and ansys simulation

From the results, we observed that there is minimum difference between simulation and experimental results.

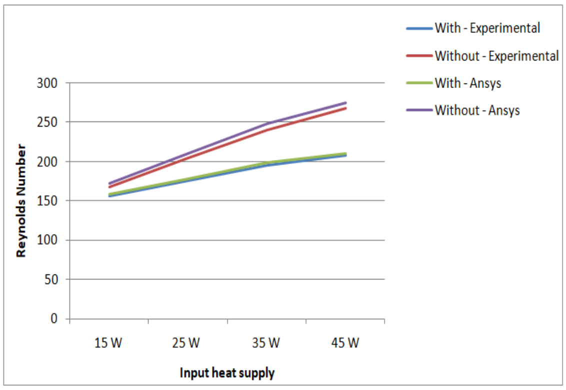

Fig:- comparison of Reynolds number with experimental and ansys simulation

From the results, we observed that there is minimum difference between simulation and experimental results.

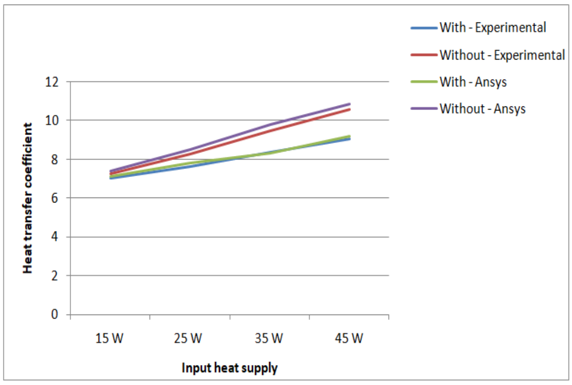

Fig:- comparison of heat transfer coefficient with experimental and ansys simulation

From the results, we observed that there is minimum difference between simulation and experimental results.

## VI. CONCLUSION

A workplace was designed and 10 numbers of heat sinks completely different of various fin spacing and different perforation diameters were forged, machined and tested. Outcome of the Experimental and simulation investigation are as follows:

1. The check results showed a rise in heat transfer from perforated fins as compared to solid fins.
2. There's a rise within the natural convection heat transfer constant with the rise within the diameter of the perforated fins.
3. The perforated fins not solely enhance the warmth transfer rates however decrease the fin materials size, weight and value still.
4. From the results, we observed that there is minimum difference between simulation and experimental results.

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