

## Analysis of Rectangular Fins Using CFD

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### ABSTRACT

The engine cylinder is one of the most important vehicle components that is exposed to extreme temperature changes and thermal stresses. Fins are placed on the cylinder's surface to increase the rate of heat transfer and thereby cool the cylinder. The heat dissipation inside the cylinder can be determined by performing thermal analysis on the engine cylinder fins. Since we know that raising the surface area increases the rate of heat dissipation, designing such a massive, complex engine is extremely difficult. The main goal of this paper is to use ANSYS WORK BENCH R 16 to investigate the thermal properties of cylinder fins by varying their geometry, content, and thickness. The thermal analysis determines temperatures and other thermal quantities that vary over time. Many applications, such as cooling, are interested in the variance of temperature distribution over time. The accurate thermal simulation could help identify important design parameters for longer life. Presently Material used for manufacturing cylinder fin body is Aluminum Alloy A6061 which has thermal conductivity of 160-170W/mk. Currently, tests are being conducted on cylinder fins made of this material as well as Aluminum alloy 6061, which has higher thermal conductivities.

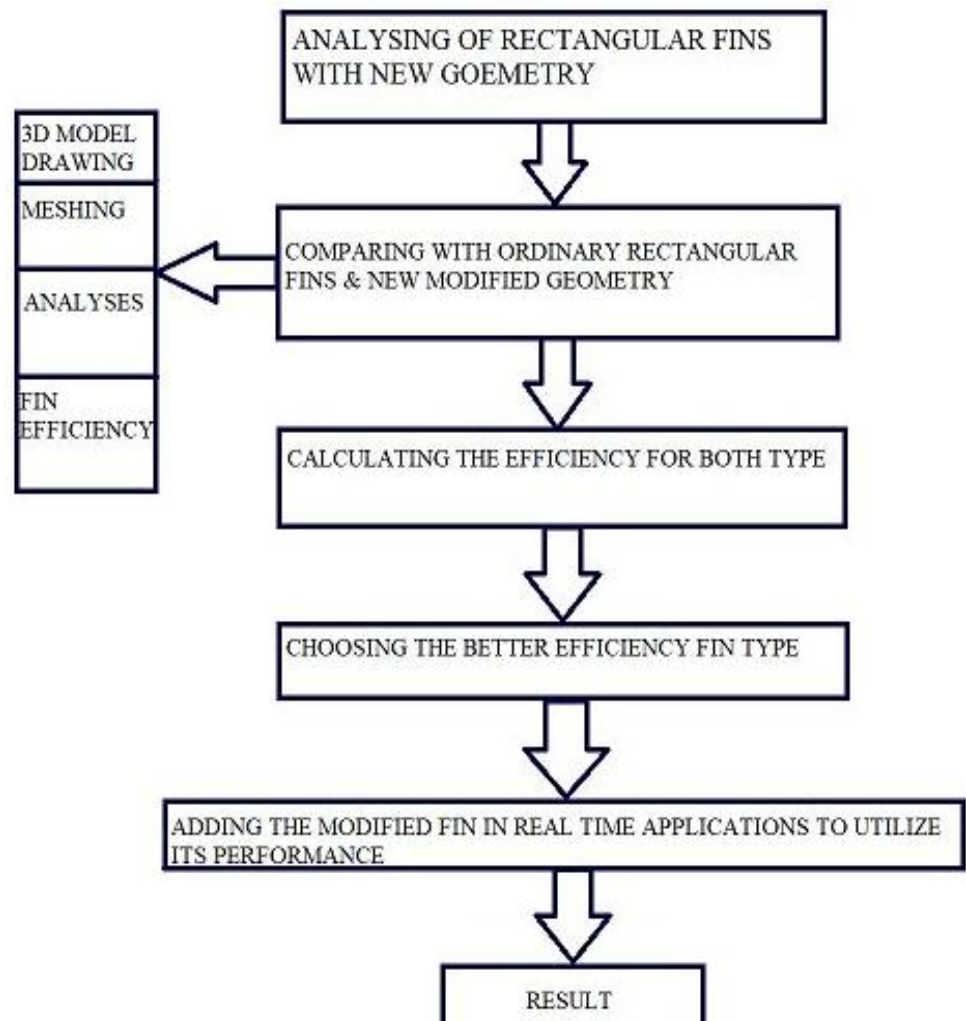
### KEYWORDS

CFD, Thermal Conductivities, Warmth Switch Fee.

### Introduction

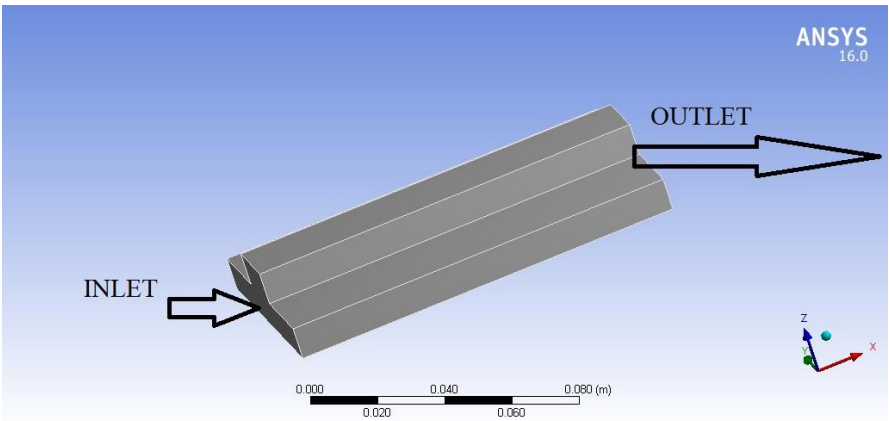
Thermal energy is generated when a physical substance, such as an object or a fluid, has a temperature that is different from its environment or another body. Thermal energy is transferred, also known as heat transfer or heat exchange, in order for the body and its surroundings to achieve thermal equilibrium. The second law of thermodynamics states that heat often transfers from a hot body to a cold one. Heat transfer between objects in close proximity can never be stopped; it can only be slowed down when there is a temperature difference between them. Heat is the flow of energy caused by a temperature difference, and heat transfer is the analysis of the rate at which this energy is transferred. Heat is thus the energy in transit between systems that occurs when they interact due to a temperature difference. Obviously, for heat interaction between systems to occur, temperature difference and communication must both be met at the same time. The process of heat exchange is irreversible due to the finite temperature difference between the systems, but heat flow cannot be reversed.

Methodology



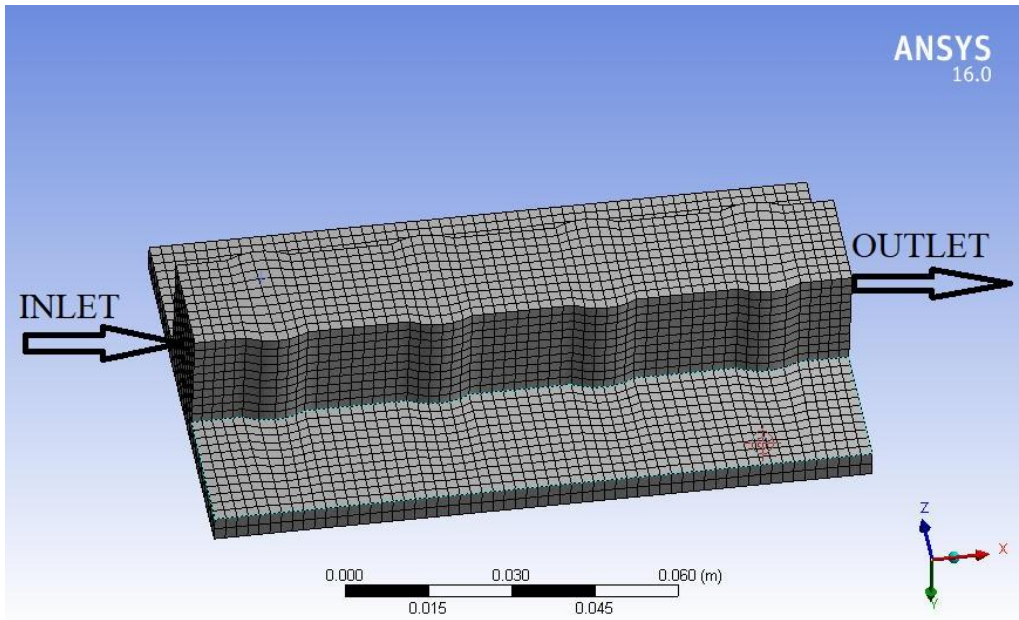
Actual Rectangular Fin (1-inlet & 1-outlet)

The rectangular fin consists of one inlet and one outlet.



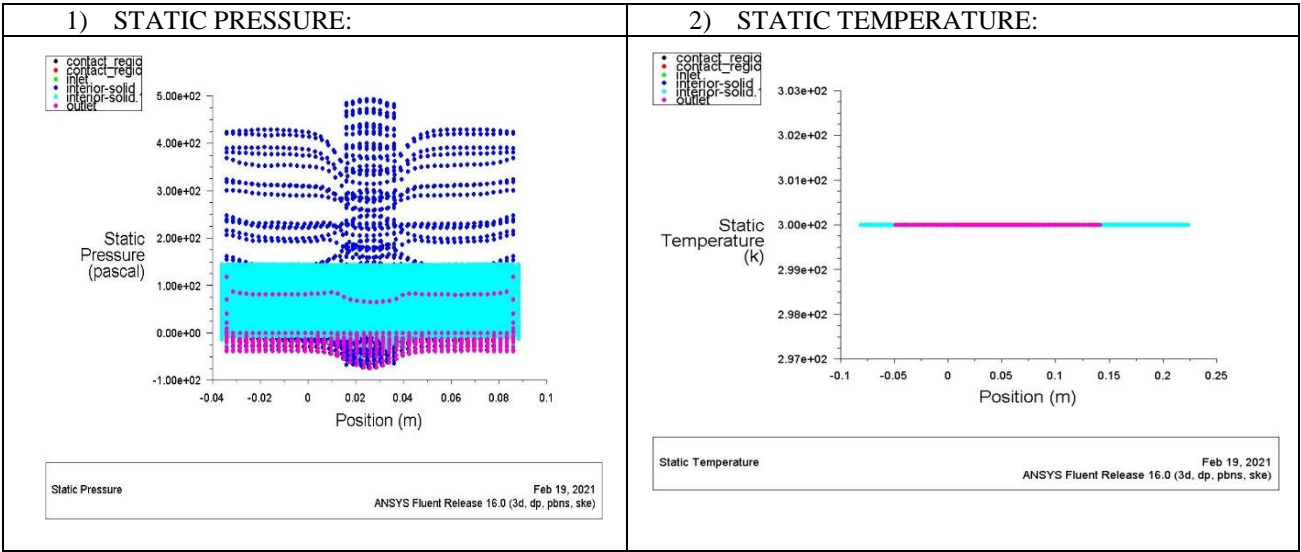
Modified Rectangular Fin (1-inlet & 1-outlet)

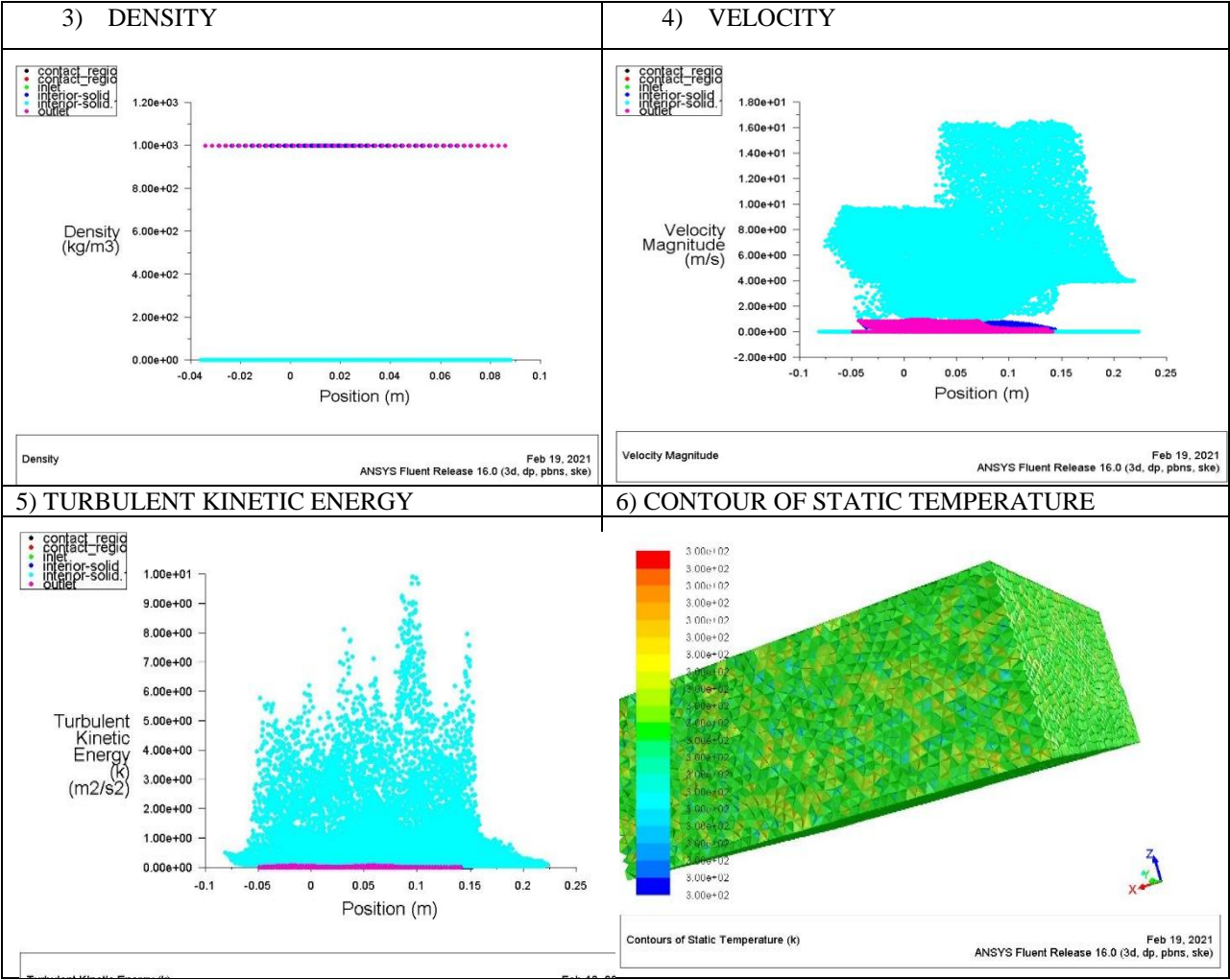
The rectangular fin consists of one inlet and one outlet.



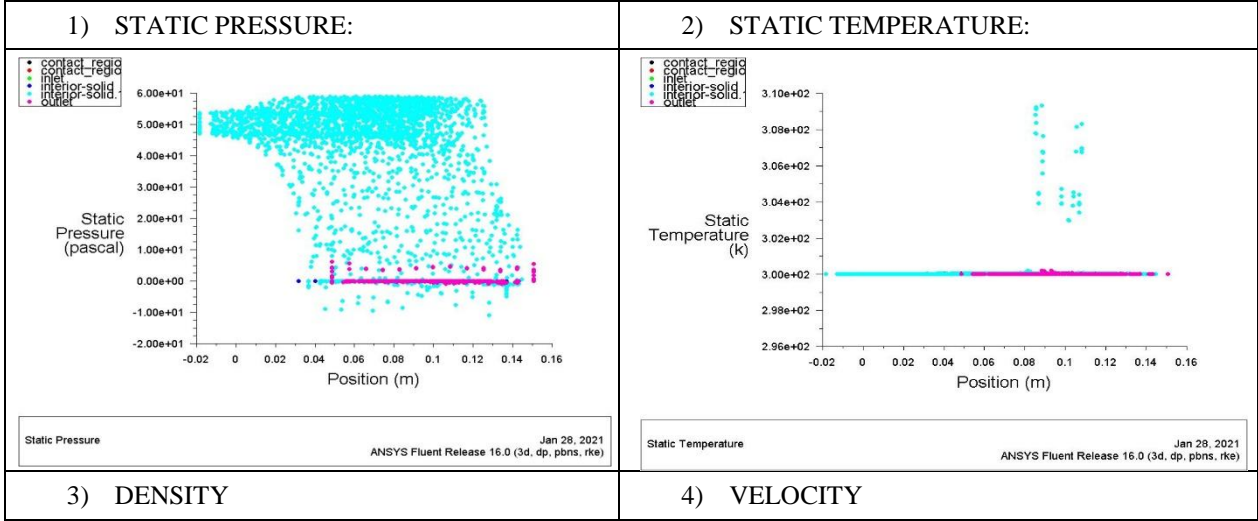
Experimental Setup Analysing Diagram

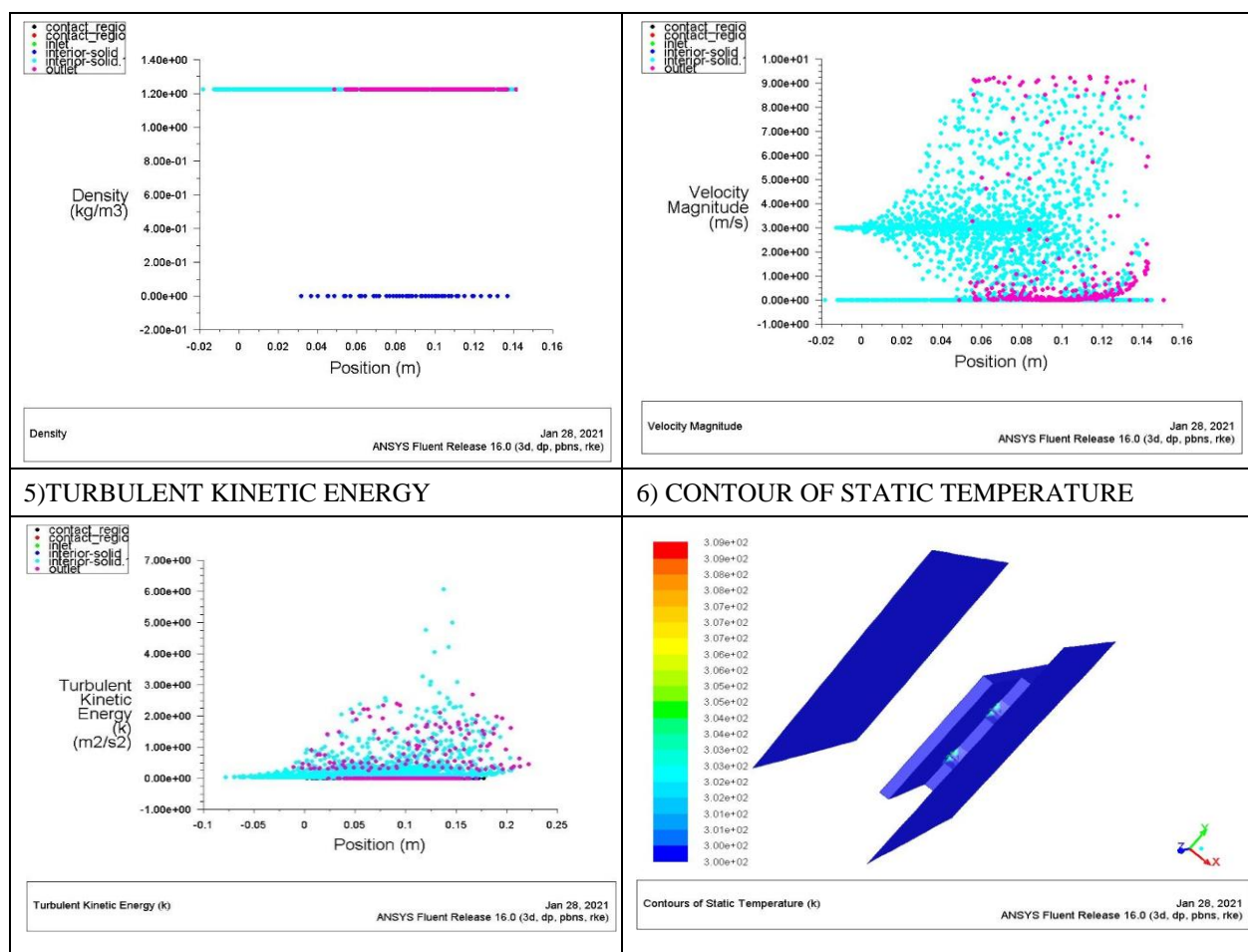
Actual Rectangular Fin





**Modified Rectangular Fin**





## Properties of Aluminium 6061 Alloy

- The aluminium 6061 alloy is easy to work with and shape.
- Aluminium 6061 alloy has a good weldability.
- Machining capability of aluminium 6061 alloy is Good
- Corrosion resistance of aluminium 6061 alloy is Excellent
- Heat treatment can be done by aluminium 6061 alloy
- 6061 is an aluminium alloy with a medium strength.
- Aluminium 6061 alloy is used in Structural Applications
- Aluminum 6061 alloy has a density of 2.70 g/cc.
- Aluminium 6061 alloy has a yield strength of 145-276 MPa.
- Thealuminium 6061 alloy has a tensile strength of 241-310 MPa, making it suitable for building.
- The modulus elasticity of the 6061 aluminium alloy is 68.9 GPa.
- Thermal conductivity of Aluminium 6061 alloy is 154-167 W/m-K
- Coefficient of thermal expansion of Aluminium 6061 alloy is 23.6  $\mu\text{m/m-}^\circ\text{C}$
- Shear strength of aluminium alloy 6061 is 207 MPa.
- Aluminium 6061 alloy has a fatigue strength of 96.5 MPa.
- Aluminium 6061 alloy has a 68.9 GPa elastic modulus.
- Aluminium 6061 alloy has a Poisson Ratio of 0.33.
- Elongation of Aluminium 6061 alloys is 12-17%
- Hardness & Brinell value of Aluminium 6061 alloy is 95

- Aluminium 6061 alloy has a shear modulus of 26 GPa.

## Working Principle

Now we are going to draw the rectangle fins using Solidworks first we want to select the plane which are we going to use I select the front plane and click on origin to plot x-y axis then click on the rectangle icon then select the rectangle and draw in the plane which the dimensions of rectangle length is 120mm and width is 70mm and extrude 10mm in one direction then select the drawing which is used to draw another rectangle in the same rectangle then mark the dimensional which is from the top to Centre is 25 mm and from Centre to bottom is 25 mm and remains position is another rectangle and extrude to 10mm in one direction and select the second rectangle to draw the circle in that to extrude down wards and each circle diameter is 23 mm and save to draw in IGS file for open in workbench for Cfd analysis.

Now we are select the workbench 16.0 software then we have to select the fluent Cfd analysis to analysis is drawing which are draw in work solids the first select the geometry to insert the geometry to that and select the import geometry and select the file which are save in IGS file format then click on generate to generate the drawing in geometry and then close the geometry and then select the mesh icon in that fluent components and click on generate to generate the drawing and move the mouse to left side of rectangle and double click on that and select the named selection and rename as inlet and click on the inlet which are visible on the corner of mesh dialog box and click on inlet to generate and move to right side of rectangle and double click on that and select the named selection and rename as outlet and click on the outlet and click to generate then click on updated icon in that dialog box to updated the diagram and now we can see the mesh diagram then click on left side of small dialog box will appear the relevant select that and rename that core as into fine and mesh diagram which see in small box that mesh part and close that mesh dialog box then click on step up icon the click on double precision icon to start the step up then step up dialog box will appears then first select the general icon then check the report quality and select gravity to on and select y direction make the value as -9.81 and then select models icons then energy on and select the viscous and select the In viscous model dialog box choose k-epsilon Choose materials on double on air to change the material of the fluid, create /edit materials dialog box will open. Select fluent database to select the material of the fluid Choose water liquid (h2o) select copy to the material. Choose cell zone conditions and select edit fluid dialog box will open. In material name drop down list choose water – liquid and select ok. Select inlet and choose the type of inlet in nearby drop down list (click on velocity inlet), then click edit, velocity inlet dialog box will open Enter the velocity of fluid in velocity magnitude box and select ok Select Outlet and choose the type of outlet (click on pressure outlet) in nearby drop down list, then click edit, pressure outlet dialog box will open and then select ok to continue Select Solution initialization, In initialization methods tab choose standard initialization In compute from tab choose inlet and select initialize to button to start Select run Calculation and specify number of iterations Then click on Calculate button to start the calculation Select graphics and Double contour in graphics dialog box, contour dialog box will open Select pressure in contours of drop down list then take different graph in different position and save the image in the any folder.

## Conclusion

- With the assist of Solid works and Ansys workbench we will capable of see the quantity of warmth switch fee in a digital manner.
- By the usage of this geometry of engine fins we will growth the warmth switch fee.
- By the usage of this geometry, we will growth the engine performance to run an engine for a long term with none trouble.
- The square fin with unmarried step extrude has been located to be the maximum green fin profile in phrases of most warmth loss and fin performance.
- The most efficient fin dissipated is 3.4% greater warmth and supplied 1 better performance than different profile.

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