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Design and Analysis of Duct Air Cooling System in Automobile Radiators

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ABSTRACT: The development of advanced DUCT AIR COOLING SYSTEM, which has better conduction and convection thermal properties, has presented a new opportunity to design a high energy efficient, light-weight DUCT USING HEAT REJECTION of automobile radiator. Current radiator designs are limited by the air side resistance requiring a large frontal area to meet cooling needs. This project will explore concepts of next-generation radiators that can adopt the high performance DUCT AIR COOLING SYSTEM.

I. INTRODUCTION

The task of this project is to design an automotive radiator to work in conjunction with advanced nanofluids. The new radiator design will be used in new General Motors hybrid vehicles. These hybrid vehicles have multiple cooling systems for the internal combustion engine, electric engine, and batteries. The popularity of these hybrid vehicles is on the rise due to the decreasing fossil fuel supply, increasing the importance of a new radiator design that can possibly replace these multiple cooling systems. The first step of this project is to gather information on existing radiator designs and general heat exchangers

II. LITERATURE REVIEW

Before taking up the actual modelling and analysis the actual radiator cooling system literature survey is carried out. The main objective of the survey is to study the behaviour of the material used for analysis and to gain knowledge of modelling and analysis of the components. Literature survey helps to get to know various works being carried out at different places and the relevance of the present problem. A brief of the literature surveyed is presented in the following section. The effect of clay soil blocking the heat transfer area of the radiator on the engine coolant temperature by developing a mathematical model. The results of the study indicated that the percentage area covered resulted in a proportional increase of the inlet and outlet temperatures of the coolant in the radiator. The mathematically model developed also predicted the experimental data very well. Regression analysis showed that for every 10% increase in the area of the radiator covered with clay soil resulted in the corresponding increase of about 21 °C of the outlet temperature of the radiator coolant.

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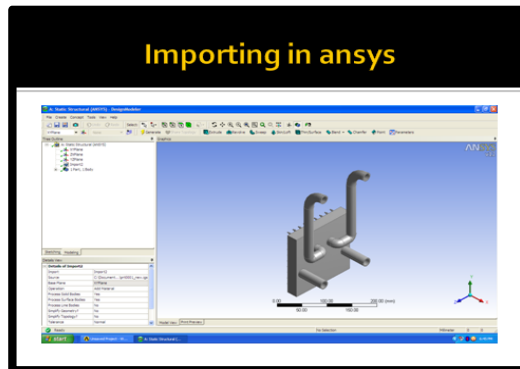


Figure 6.5: Intake air duct back view.

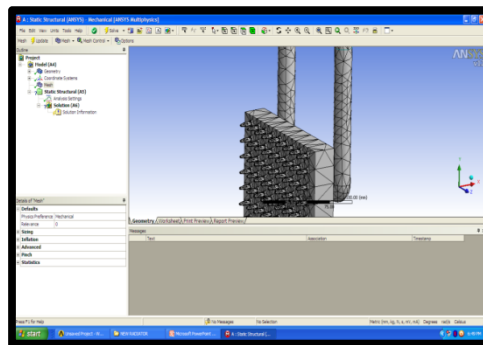


Figure 6.6: Intake air duct.

IV. EXPERIMENT RESULTS

$$\text{Speed} = \frac{\text{distance}}{\text{Time}} \quad \text{OR} \quad v = \frac{d}{t}$$

(Or)

Old design area is $0.350 \times 0.350 \times 0.020$ (m)

$$q = 0.00245 (\text{m}^3/\text{s})$$

$v = q$ because same size of inlet air fame.

New design Air flow velocity in a circular pipe can be calculated with SI units as

$$v = 1.274 q / d^2$$

v = velocity (m/s)

q = volume flow (m^3/s)

d = pipe inside diameter (m)

Inner dia of pipe = 50mm = 0.05m

$$\text{Area of pipe} = 3.14 \times (0.05/2)^2 = 0.0019625 \text{m}^2$$

$$q = \text{pipe length} \times \text{area} = 7727 (\text{m}^3/\text{s})$$

$$v = 1.274 \times 7727 / 0.0025$$

$$v = 3937679 (\text{m/s}) \text{ for one pipe.}$$

$$v = 3937 \text{ Area}_1 = 10 \text{ mm} = 78.5 \text{ mm}^2$$

$$\text{Area}_2 = 3 \text{ mm} = 7.065 \text{ mm}^2$$

Length of nozzle 50 mm

$$V_1 = 3937679 (\text{mm/s})$$

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$$V_1 * A_1 = V_2 * A_2$$

$$V_2 = 43751988 \text{ (mm/s)}$$

No of nozzle is $90 * V_2 = 3937678920 \text{ (mm/s)}$.

Here velocity V_2 is higher than V_1 . So amount of air is higher exciting air frame. So the design is safe.

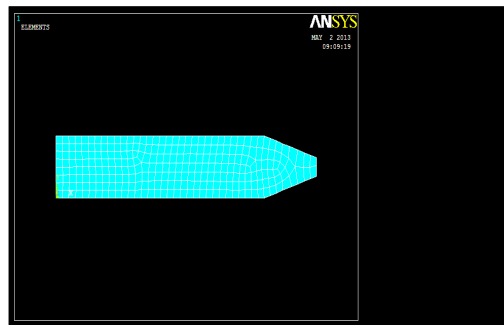


Figure 6.9: FEA model for nozzle

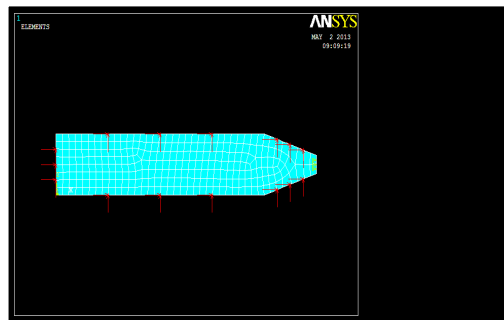


Figure 6.10: Load and Boundary condition.

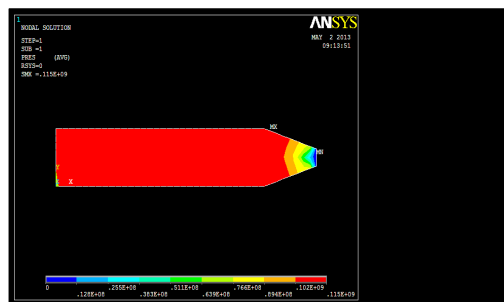


Figure 6.11: Result of Pressure Diagram.

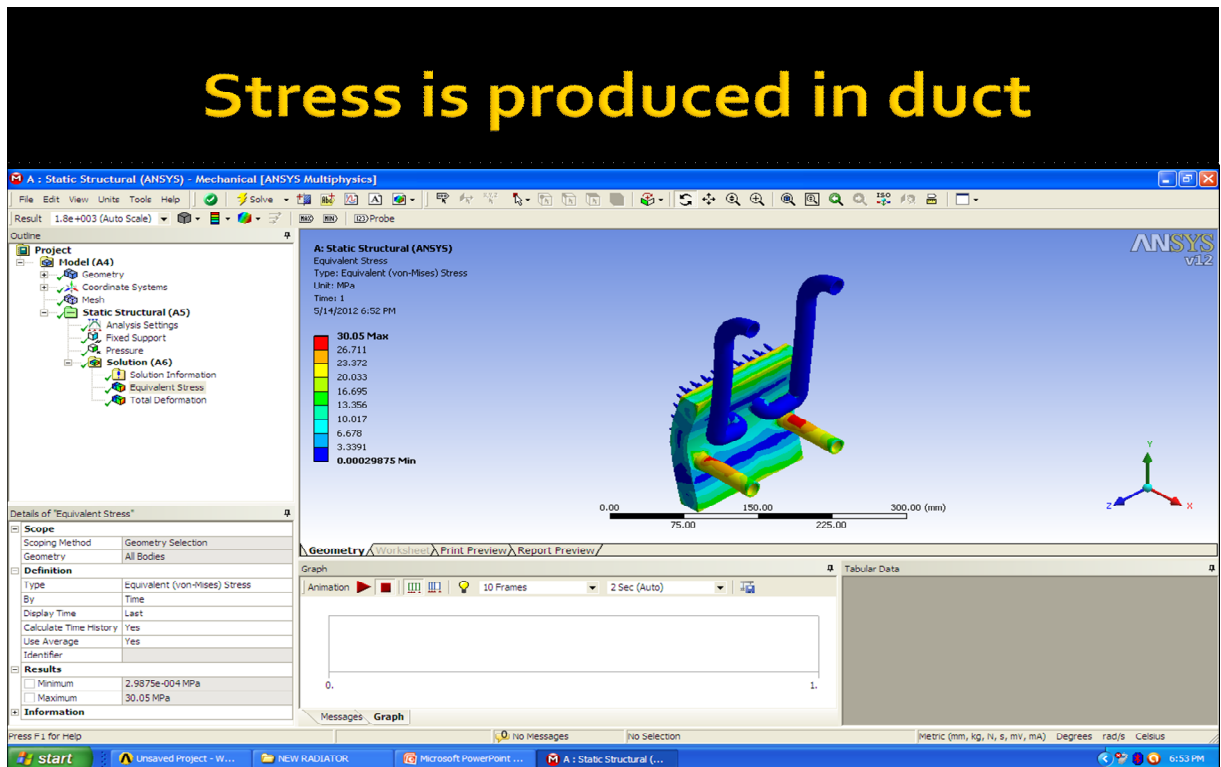
- In this air duct cooling system having stresses within the yield limit (max 30.05Mpa).

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V. CONCLUSION

The efficiency of the internal combustion engine cooling system depends mainly on the performance of its units. The main unit in this system is the radiator. And the new type of radiator setup is used to increase the amount of air. Finally it's recommended to use due to higher temperature drop. The radiator air duct is recommended due to lower cost.

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