Finite Element Analysis of Automotive Muffler

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Abstract - **Muffler is a component for diminishing the measure of commotion discharged by the fumes of an inside ignition motor. Muffler is designed as an acoustic sound sealing gadget intended to lessen the tumult of the sound pressing factor made by the motor via acoustic calming. Suppressors are intended to hose the focused energy pressure beat produced by the burning interaction from an inside burning motor. The muffler is displayed utilizing CATIA V5. The analysis is carried out utilizing ANSYS workbench the steady state thermal analysis is done. Due to higher pollution levels India is undergoing tremendous changes in emissions norms, so the study and development of muffler is required.**

Index Terms - **Muffler, Catia model, Thermal analysis.**

I.INTRODUCTION

A muffler is used in vehicle as it plays a key role to reduce the vibration by increase the riding comfort. The muffler is arranged in exhaust framework after prescribed catalytic converter and furthermore end segment appended in waste gases framework. Mufflers are routed in exhaust system in internal combustion engines. It is a device designed in such a way that it is used to reduce the vibration and to reduce the sound pressure which in turn creates noise created by the engine. Each muffler is intended to lessen the commotion of any motor. This decrease in noise additionally lessens the back pressure created in the motor and improves the exhibition of the motor. The motor exhaust is associated through exhaust line to silencer called suppressor to control or diminish the exhaust commotion. The deepness and immensity of the noise will fluctuate contingent on the sort of motor like normally aspirated or turbocharged, torque created, power produce, sort of fuel and number of cycles. The pressing factor beats which are produced when exhaust valve more than once opens and gives

high pressing factor gas access to debilitate framework this make sound which we hear. The addition misfortune, noise reduction and transmission misfortune are the boundaries that portray the acoustic presentation and vibration of muffler. A vehicle running without a muffler will have a tremendous distinction in sound level a muffler can make. On the off chance that vehicles didn't have a muffler there would be excruciating measure of exhaust commotion in our current circumstance.

To reduce the noise, the exhaust is made to connect via exhaust pipe to the silencer which is also called a muffler. A tail pipe tends to carry the exhaust gases from the muffler to the back or side of the vehicle next to the wheels. Noise is a component of pressure wave shaped in the beats of rotating very high and very low pressing factor of air. In an IC engine, force waves produced when the waste gases valve over and over take out as well as gives high pressing factor gas access to the waste gases framework. These force beats are the sound. As the motor rpm increments so do the force variances and subsequently the sound discharged is of a higher recurrence. The muffler used in this project was Hyundai zen.

Fig 1: Hyundai Zen muffler cut section

II. LITERATURE REVIEW

[2.1]Design and analysis of exhaust muffler - Praveen R, S Kalyana Kumar, Mohamed Rafi.

The current paper manages the plan of a business auto suppressor, which is being utilized in current car vehicles. At first the suppressor is planned in the 3D displaying is finished utilizing CAD programming and can be imported to FEM programming.

[2.2] Design and Analysis of Automotive Muffler - Vaibhav D. Prajapati, Ankit J. Desai.

Muffler is a vital piece of the vehicle fumes framework to lessen the commotion delivered by motor burnable items when going through the exhaust framework. An ordinary suppressor of Maruti - Suzuki Wagon R is taken as reference and relying on boundaries new suppressor is planned and demonstrated in programming and examination will be done mathematical codes.

[2.3] Design, analysis and experimental validation of muffler in automotive system - Madhu Kumar M, Aravind K U, Dr. Maruthi B H, Dr. Channakeshavalu K.

Muffler are intended to hose the extreme focus pressure beat produced by the burning cycle from an interior ignition motor. The current work depicts different exhaust clamors, vibration and their commitment. Recurrence, vibration and commotion strategy is concentrated through energy stream. Subsequently, it is important to examine the conduct of suppressor by dissecting the vibration modes and vibration reaction. The suppressor is displayed utilizing CATIA V5 and FEM is completed for suppressor utilizing Altair pre-preparing apparatus.

[3] Analysis of automotive exhaust muffler using FEA and experiment - Mr. Sanchit Babarao Dhotre, S.L.Shinde.

The current work depicts different exhaust clamors, vibration and their commitment. Recurrence, vibration and commotion procedure is concentrated through energy stream. Consequently, it is important to consider the conduct of suppressor by dissecting the vibration modes and vibration reaction. The suppressor is displayed utilizing CATIA V5 and FEM is done for suppressor. The examination is finished utilizing ANSYS R15.0 the frequencies and mode shapes are found.

III. MODELLING

We design muffler using catia design software. Catia is a multi-stage programming suite for PC helped design (CAD). It is for the most part utilized for its restrained framework, outlining and delivering

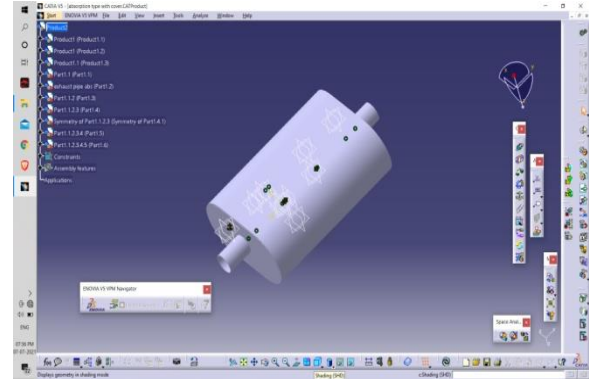innovation. It is utilized broadly by an assortment of ventures since it is easy to use.

Fig 3.1 – Model of muffler

DIMENSIONS:

Length muffler	380.61mm
Width muffler	190mm
Height muffler	100mm
Shell thickness	3mm
Outer diameter of perforated tube	45mm
Inner diameter of perforated tube	35mm
Baffle thickness	3mm
Perforated hole diameter (inlet pipe)	3mm
Perforated hole diameter (outlet pipe)	6mm
No. of perforated hole (inlet pipe)	84
No. of perforated hole (exhaust pipe)	44
Weight	4.6kg

IV. ANALYSIS

The FEM analysis is an overall mathematical strategy used for tackling incomplete differential conditions in space factors. To solve an issue, the FEM partition an enormous framework into more modest, more straightforward parts which is called restricted component. This will achieved by decreasing particular space in the particular measurement, which will be carried out after the development of a cross section of a mesh of an object. Mathematical area of the positioning, which will be having finite number of focuses. The finite component technique plan of a finite acclaimed issue at end results in a positioning of mathematical boundaries. The strategy approximates the obscure capacities over the space. The region of an entire space in easier part enjoys few benefits that is exact presentation of complex calculation,

incorporation of different material properties, simple presentation of the complete arrangement.

Meshing is done in the ansys workbench. First import the geometry to the ansys workbench and select geometry and select the material from the library. Click on the mesh and select the geometry to be meshed and select type and mesh and element. Click generates mesh.
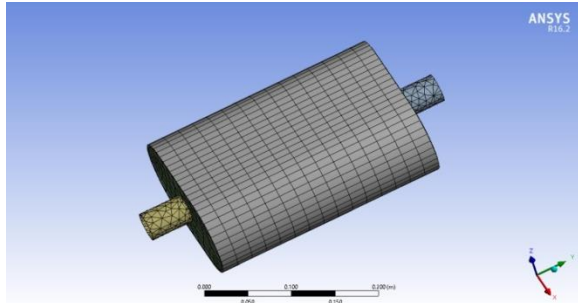

Fig 4.1 – meshed model

Total number of nodes generated = 38574

Total number of element generated = 15841

Type of element = quad

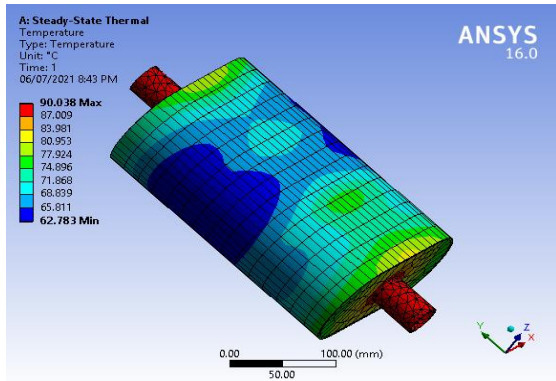Steady State Thermal Temperature analysis:-

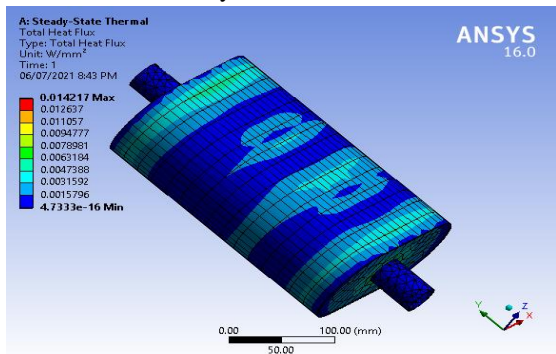Fig 4.2 – temperature analysis model

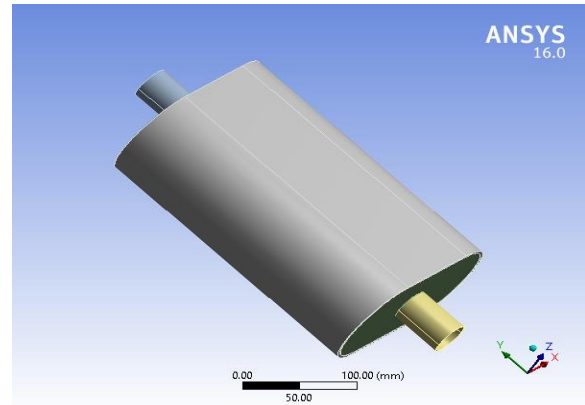Total Heat flux analysis:-

Fig 4.3 – total heat flux model

Fig 4.4 – analysis model

V. RESULT

Temperature Results

Results	
Minimum	62.783 °C
Maximum	90.038 °C

Total heat flux results

Results	
Minimum	4.7333e-016 W/mm²
Maximum	1.4217e-002 W/mm²

VI. CONCLUSION

The steady state thermal analysis has been completed. The end result of muffler model got with the utilization of CATIA demonstrating is exceptionally useful. The accompanying end has been produced using this investigation. It is seen that for a temperature channel limit condition in model, the gases enter the muffler and keeps up with the consistent state heat stream. The above table shows the overall results of temperature and heat flux.

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