DESIGN OF AN AUTOMOBILE EXHAST SYSTEM

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Abstract : Present day engines are required to have more engine power and are also required to meet the strict pollution standards. In an automobile the exhaust muffler plays an integral role in reducing the sound of the automobile, as well as the ride itself. In order to maintain a desired noise and comfortable ride, the modes of a muffler need to be analysed. Here dynamic modal analyses were carried out to determine the mode shapes, stresses and deformations of exhaust muffler using CAE analysis.

Index Terms - Design, Auto CAD, CATIA, Automobile, Exhaust Muffler etc.

I. INTRODUCTION

The muffler reduces the noise of the exhaust gases by reducing the pressure of the used gases by slow expansion and cooling. On the other hand, the muffler must not cause any appreciable restriction to the flow of oil that could raise the backpressure excessively. The muffler contains a number of chambers through which the gas flows. The gas is allowed to expand from the first passage into a much larger second one and then to a still larger third one and so on, to the final and largest passage which is connected to the tail (outlet) pipe of muffler.

The following steps are required for the proper care of the inlet and exhaust system.

The inlet and exhaust manifolds should be checked for air leaks and the nuts and connections tightened at regular intervals.

A clogged muffler exhaust pipe or tail pipe will cause a backpressure on the pistons and a loss of power. Therefore, it must be cleaned every time during service. Sometimes, the engine overheats due to excessive carbon deposit.

II. LITERATURE REVIEW

Although the first works on this subject are more than 10 years old, the study of heat transfer in automotive exhaust systems has only recently attracted the importance it deserves due to its key role in the design of modern exhaust after-treatment systems. Such studies are today important for better understanding of these systems and, thus, being able to influence under body heat transfer, transient cold-start warm-up of the catalytic converter, thermal ageing of the converter, or the regeneration behaviour of diesel particulate traps etc.

Experimental investigation of the heat transfer rates in exhaust ports was initially aimed at supporting thermodynamic engine cycle models, especially for engine turbocharger matching applications [6]. Those experimental findings were exploited in the computer model developed by Frank [7], who also simulated manifold heat transfer by employing classical correlations applicable to curved pipes. Meitner and Sorenson [8], on the other hand, based on the experimental results of Sachdev [9], presented a comprehensive model covering also heat transfer in takedown pipes. Both models focused, however, mainly on the temperature variation during single engine operating cycles. Pattas et al. studied the thermal response behaviour of diesel exhaust systems equipped with a particulate filter [4]. Zhang et al. Developed a model computing the steady state temperature distribution in exhaust systems with single wall and with double wall, air gap insulated piping [10]. Recently, one-dimensional transient models covering a variety of exhaust system designs have been presented [3, 11, 12], presenting a model that was able to simulate real world heat transfer in exhaust systems of gasoline car sand is extensively employed in CAE investigations [3]. The experimental acquisition of useful data for the estimation of heat transfer rates and their application in the optimized design of various exhaust configurations forms the subject of the present paper.

III. CHARACTERISTICS OF MUFFLER

The design of a noise muffler incorporated into a pneumosystem. On the basis of the developed mathematical model transition processes in the pneumonia system were calculated with regard to a noise muffler installed so as to investigate the impact of the installed noise muffler on the speed of the pneumonia system's operation.
The performance of a muffler is characterized using 3 different measures.

- Insertion loss, IL
- Transmission loss, TL
- Noise reduction, NR

Insertion loss is defined as "the ratio (in dB) between the acoustic power radiated at the outlet of a reference system and the system investigated, with both systems driven by the same source" .The reference is usually a straight pipe with the same length as the investigated system.

Transmission loss is defines as" the ratio (in dB) of the incident power to the power transmitted for a given termination" . Normally a reflection free pipe. Noise reduction is defined as the "difference in sound pressure level (in dB) at two arbitrarily selected points in the exhaust pipe and tailpipe" , (upstream and downstream side of the muffler).In this work, transmission loss, TL, will be used as the measurement of the muffler performance.

IV. MUFFLER CONFIGURATION

For the least noise it is always best to have two mufflers in series. The second muffler will absorb sound missed by the first muffler, and there will be some wave type noise cancelling in the tubing between the two mufflers. Ideally, the second muffler should do most of the silencing but even a small resonator at the end of the exhaust system will make a big difference.

V. DESIGN CONSIDERATION

Present day engines are required to have more engine power and are also required to meet the strict pollution standards. To improve exhaust system performance, many design specifications are required.

A chimney serves as an exhaust pipe in a stationary structure. For the internal combustion engine, It is important to have the exhaust system "tuned" (refer to tuned exhaust) for optimal efficiency. Also this should meet the regulation norms maintained in each country.

- **DESIGN CALCULATIONS FOR MULTIPORT REPRESENTATION**

A multi-port representation is a way of characterizing a duct system in the plane wave region with a matrix relation between its input and output state variables

$$Y = Gx \quad \text{---------- (1)}$$

Where,

x is the input state variables,

Y is the output state variables

- **DESIGNING OF PARTS**

The parts are designed on the solid workbench by referable conditions and respectable literatures. Solid Works is mechanical design automation software that takes advantage of the familiar Microsoft Windows graphical user interface.

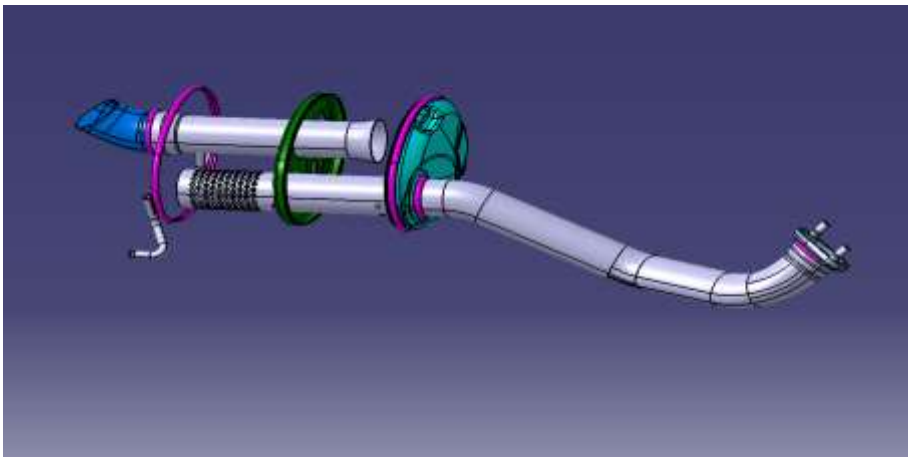

Figure 1 Sub Assembly of Silencer

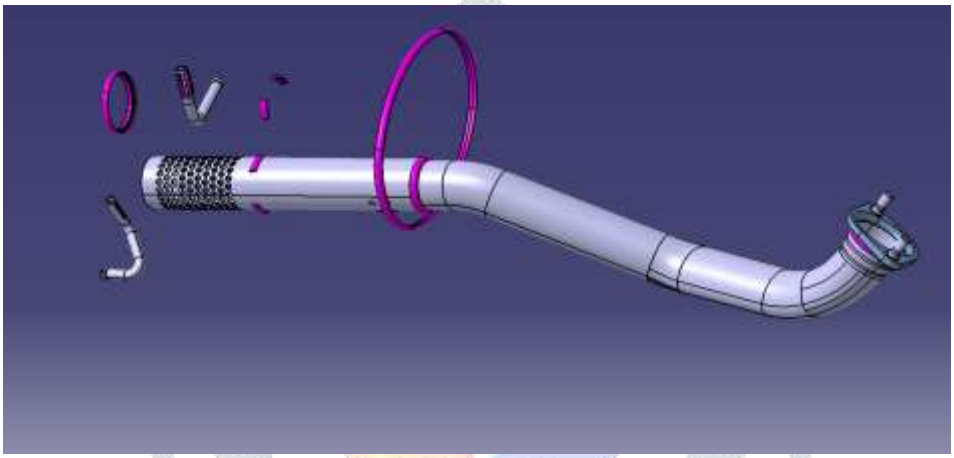

Figure 2 Front Pipe

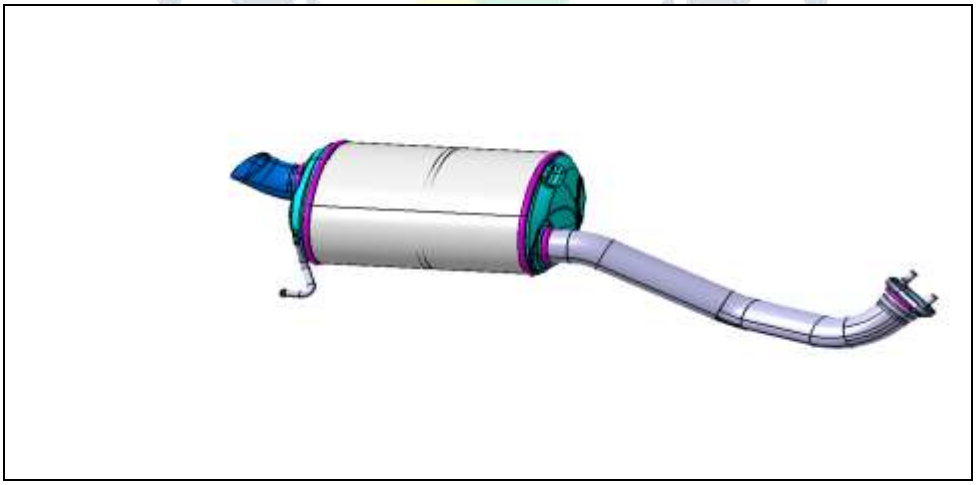

Figure 3 Assembly of Muffler & Tail pipe

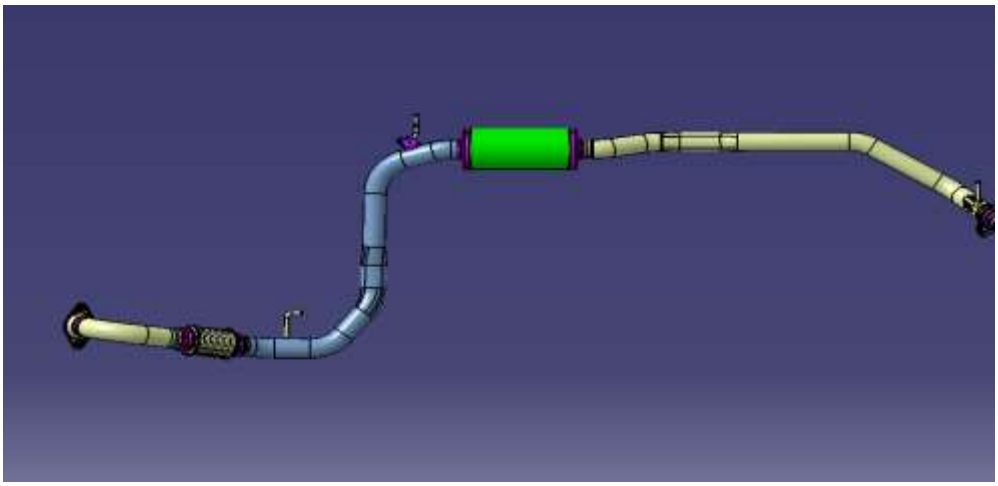

Figure 4 Pipe -b

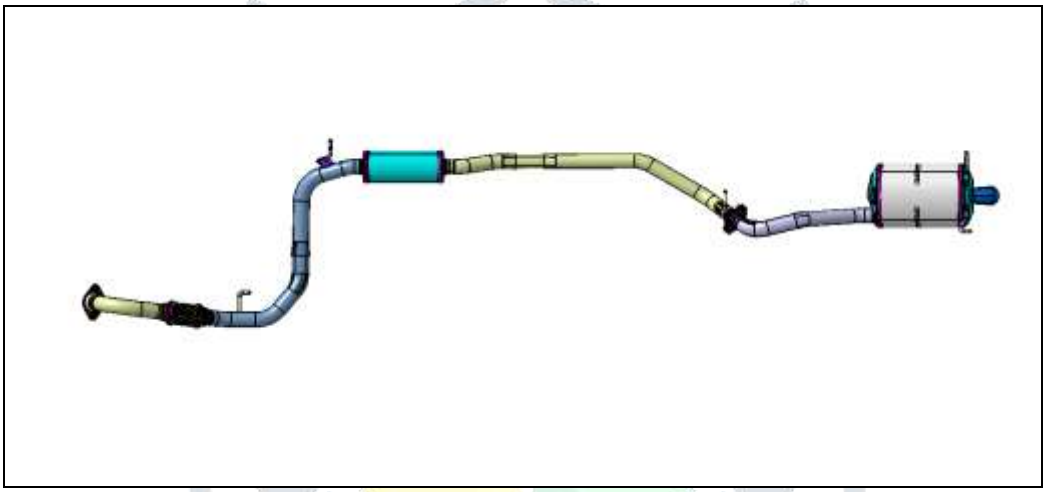

Figure 5 Assembly of pipe b & Muffler

VI. CONCLUSION

- Double expansion chamber gives better results as compared to single expansion chamber. Transmission loss of double expansion chamber is 42.48 which is more than requirement and satisfactory.
- Design and analysis of muffler guard is done in solid works.
- Modelling of muffler is done with proper dimensions
- Dynamic analysis is carried out to determine the mode shapes and stresses and deformations in the muffler using CAE.

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