Analysis and comaprison of Muffeler design using different Material

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Abstract

One of the objectives when designing a new automobile muffler is to lengthen its durability period, which can be measured in terms of its life span and mileage. The exhaust pipe is subjected to several stresses, most of which are due to vibration. Particular attention should be given to gas forces which will induce vibration. These vibrations will then induce a fatigue life to the system.

Keyword: ***Muffeler, FEA, Mild steel, aluminium***

1. INTRODUCTION

In this type of muffler Inlet and outlet tube are extended in chambers. Reactive mufflers generally consist of several pipe segments that interconnect with a number of larger chambers. The noise reduction mechanism of reactive silencer is that the area discontinuity provides an impedance mismatch for the sound wave travelling along the pipe. This impedance mismatch results in a reflection of part of the sound wave back toward the source or back and forth among the chambers. The reflective effect of the silencer chambers and piping (typically referred to as resonators) essentially prevents some sound wave elements from being transmitted past the silencer. The reactive silencers are more effective at lower frequencies than at high frequencies, and are most widely used to attenuate the exhaust noise of internal combustion engines.

2. LITERATURE REVIEW

Jigar.H.Chaudhri et al. [1] investigated Muffler Design for Automotive Exhaust Noise Attenuation. In these review paper different types of mufflers and design of exhaust system belonging engine has been studied. The object of this study is deciding muffler design which one reduces a large amount of noise level and back pressure of engine. In designing, there is different parameter which has to take into the consideration. These parameters affect the muffler efficiency. Different types of muffler and designing methods are studied. After studying this methods and procedures for designing a muffler, we conclude that combination type of muffler is more efficient than reactive and absorptive mufflers.

N.V.Pujari et al. [2] carried out optimization of Silencer an Integrated Approach of Acoustic Performances & Backpressure. They have studied the acoustical and engine performance was predicted using CFD techniques. Using the integrated approach, it was possible to optimize the design and reduce the design cycle time. The objective of this study is to develop an integrated methodology to predict the performance of the silencer at the design stage resulting in an optimized time and cost effective design.

M Rajasekhar Reddy et al. [3] investigated Design and Optimization of Exhaust Muffler in Automobiles. The present work aims at improve the Frequency of NSD (Nash Shell Damper) muffler by controlling the noise level of a diesel engine by developing an exhaust muffler for the same, since exhaust noise is the single largest contributor to the overall noise from the engine. The TATA INDICA TURBOMAX TDI BSIV four-cylinder diesel engine car was considered for test purposes.

M.Rahmanet et al [4] studied Design and Construction of a Muffler for Engine Exhaust Noise Reduction. An inherent drawback of IC engines is that it is a major source of noise pollution. That is why the reduction of exhaust noise from engines is, now-a-days, an important issue. Attaching a muffler in the exhaust pipe is the most effective means of reducing noise. But muffler requires specific design and construction considering various noise parameters produced by the engine. In our country, the conventional design does not include much of a parametric noise analysis or other engine characteristics. A muffler

for stationary petrol engine has been designed and manufactured. The performance characteristics, i.e. noise reduction capability of the muffler, has been tested and compared with that of the conventional muffler.

Shital Shah et al [5] studied Practical Approach towards Muffler Design, Development and Prototype Validation. Mufflers are important part of engine system and commonly used in exhaust system to minimize sound transmissions caused by exhaust gases. Design of mufflers is a complex function that affects noise characteristics, emission and fuel efficiency of engine. Therefore muffler design becomes more and more important for noise reduction. This paper deals with a practical approach to design, develop and test muffler particularly reactive muffler for exhaust system, which will give advantages over the conventional method with shorten product development cycle time and validation.

Zeynep Parlar et al [6] Acoustic and Flow Field Analysis of a Perforated Muffler is done. Nowadays, the perforated reactive mufflers which have an effective damping capability are specifically used for this purpose. New designs should be analyzed with respect to both acoustics and back pressure. In this study, a reactive perforated muffler is investigated numerically and experimentally. For an acoustical analysis, the transmission loss which is independent of sound source of the present cross flow, the perforated muffler was analyzed by COMSOL. To be able to validate the numerical results, transmission loss was measured experimentally. Back pressure was obtained based on the flow field analysis and was also compared with experimental results. Numerical results have an approximate error of 20% compared to experimental results.

N.Vasconcellos et al [7] carried out Structural Analysis of an Exhaust System for Heavy Trucks. A finite element model was generated including the complete vehicle and the exhaust system. Static and dynamic analyses were performed in MSC. Nastran software simulating different loading conditions. The results obtained assure the structural integrity of the exhaust system and also contribute to a better understanding of this system behavior and its structural strength.

Sudarshan Dilip et al [8] carried out Experimental and CFD Analysis of a Perforated Inner Pipe Muffler for the Prediction of Backpressure. Backpressure is essential for the performance of a silencer. Pressure drop of exhaust system includes losses due to piping, silencer, and termination. In this paper the effect of change in dimensions of perforation diameter and change in porosity of internal tube is investigated using CFD analysis and the simulated data is compared with experimental results. It is found that the porosity of the muffler has pronounced effect on the Backpressure. The Backpressure reduced almost by 75% if the porosity is doubled. Also, if the diameter of the hole increases the backpressure decreases sharply by 40%.

Shankar Gouda et al [9] performed Modal and Static Structural Analysis of Exhaust Collector Box for Compressor test facility**.** Collector box is one of the influencing factors for stability of operation of test compressor. Collector box in compressor test facility is used to collect the high pressure exhaust air from the exit of the test compressor. It is subjected to flow fluctuation during compressor testing, making it vulnerable for structural related problems like high vibration. The results indicate that Compressor- Collector box interactions may strongly affect compressor performance unless the lowest resonant frequency of the collector box is much higher than the natural frequency.

2.1 OBJECTIVE

1 The main objective of the study is to find frequencies at different mode shapes of model using different materials and parameters.

2 Optimization of model with different material and different topology vibration response.

3 Find out best material which will reduces the weight of muffler and gives less vibration.

4 Comparison of results of Ansys using two different materials.

3. METHODOLOGY

- The geometric properties of the elements (length, area, and the like).
- Define the element connectivity's (mesh the model).
- Define the physical constraints (boundary conditions).
- Define the loadings.
- The preprocessing (model definition) step is critical.

➢ *Solution*

During the solution phase, finite element software assembles the governing algebraic equations in matrix form and computes the unknown values of the primary field variables. The computed values are then used by back substitution to compute additional, derived variables, such as reaction forces, element stresses, and heat flow. As it is not uncommon for a finite element model to be represented by tens of thousands of equations, special solution techniques are used to reduce data storage requirements and computation time. For static, linear problems, a wave front solver, based on Gauss elimination is commonly used.

➢ *Post processing*

Analysis and evaluation of the solution results is referred to as post processing. Postprocessor software contains sophisticated routines used for sorting, printing, and plotting selected results from a finite element solution. Examples of operations that can be accomplished include:

- Sort element stresses in order of magnitude.
- Check equilibrium.
- Calculate factors of safety.
- Plot deformed structural shape
- Animate dynamic model behavior.
- Produce color-coded temperature plots.
- While solution data can be manipulated many ways in post processing, the most important objective is to apply sound engineering judgment in determining whether the solution results are physically reasonable.

MS		**Al**	
Model-1	**Model-2**	**Model-1**	**Model-2**
791.52	747.8	775.52	706.98
803.03	789.16	786.7	746.07
978.5	837.49	958.79	791.76
1811.12	1412.79	1774.52	1335.65
2041.12	1499.37	1999.86	1417.5
2780.16	1627.72	2723.97	1538.8

➢ *Stage-I*

In this stage iges file is imported to the meshing software like Hypermesh. The CAD data of the muffler structure is imported and the surfaces were created and meshed. Since all the dimensions of muffler are measurable (3D), the best element for meshing is the tetra- hedral.

➢ *Meshing*

A structure or component consists of infinite number of particles or points hence they must be divided in to some finite number of parts. In meshing we divide these components into finite numbers. Dividing helps us to carry out calculations on the meshed part. We divide the component by nodes and elements. We are going to mesh the components using 3D elements. As all dimension of muffler are in proportion we use the tetra-hedral elements for meshing.

4.RESULT AND DISCUSSION

Frequency values at different modes for two models of aluminum muffler and mild steel muffler are shown in following table. From comparison table it is clear that Aluminum muffler of model 2 shows less frequency than other muffler. It shows that aluminum has better damper behavior than mild steel.

5. CONCLUSIONS

1.From comparison table it is clear that aluminum muffler of model no. 2 has lessfrequencies than other models.
2.It means aluminum muffler of model 2 has less vibration.
3.Due to use of aluminum weight of the muffler is also reduced with betterresults of modal analysis.
4.A % weight reduction of 69.80 % is achieved.

6. REFERENCES

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