DESIGN AND MODEL ANALYSIS OF MUFFLER

K. Archana[1], V. Sai Ritesh Reddy[2], M. Akash[3], B. Sai Rohit[4]

[1]Assistant professor in Mechanical Department at St. Martin's Engineering College
[2,3,4]Student in Mechanical Department at St. Martin's Engineering College

ABSTRACT

In recent years, the influence of automobile emissions and noise on the environment has become an increasingly serious problem. Particularly, exhaust system is known to be a predominant component of the automobile emissions and noise. Fortunately, over the last few decades, engine exhaust noise is controlled through the use of silencers or mufflers. Mufflers are installed within the exhaust system of most internal combustion engines. The muffler is engineered as an acoustic soundproofing device designed to reduce the loudness of the sound pressure created by the engine by way of acoustic quieting. We can install an aftermarket muffler when engine tuning in order to increase power output or reduce fuel consumption because of economic or environmental concerns. Here in this project we designed a muffler model by using solid works design software and done analysis by using various materials such as stainless steel, 2014 aluminum alloy and titanium alloy. We have done static analysis to find the maximum stresses and deformations of muffler and modal analysis to find natural frequencies and deformations induced in muffler these analyses are done in solid works simulation tool, various commands, different types of analysis and material properties are studied in this project.

DESIGNMETHODOLOGY

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MufflerInternalsDesign

Themufflerinternalconstructionsismainlybasedon numberofbaffles,diameterofthepipe,lengthofthepi peandnumberofperforations. The amount of absorption materialstomeetthebackpressureand acoustics targets.

POSSIBLEMUFFLERDESIGNS

Therearenumeroustypesofautomotivemuffler scurrentlyinthemarketplaceand describedbelowarethekeyfeaturesandbenefits of various muffler designs that may befoundonavehicle.Thefollowingtypesofmuf flers have been widely tested and the generalobservations from such tests are described. The commercial automotive mufflers usually consistof circular or elliptical cross section. A circularshaped cross section is best suited in a vehicle asitdelays theonset of higherorder modes.

Most formulas that are used to predict the transmission loss of am uffler as sume plane wave propagation.The properties of the following designs are only valid up to the cut off frequency,where high reorder modes occur.Generally for all mufflers maximum transmission loss occurs at odd multiples of aquarterwavelength.

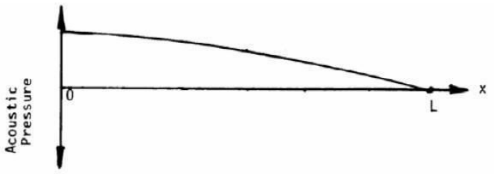


Fig-Quarterwavelength

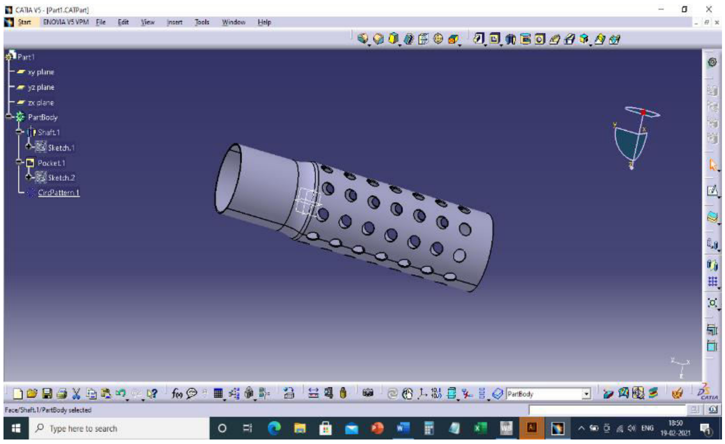
The most basic type of silencing element thatmay be used for intake and exhaust mufflers isthe expansion chamber. It consists of an inlettube, an expansion chamber and an outlet tube asshown in Figure. The inlet and outlet tubes may be coaxial known as a concentric expansion chamber or offset known as an offset expansion chamber.

MUFFLERDESIGN

Generally an exhaust muffler is required to satisfy some basic requirements such as adequate insertion loss,low back pressure,muffler sizing which could affect the cost and durability to with stand with roughuse,some considerations should be taken for an optimalmufflerdesign.

- Mufflers with extended tube chambers arebetterthansimple chambers.
- Theremightbeaslightdifferenceininsertion loss with flow reversal chamberscomparedto extended tube.
- Theefficiencyincreaseswithno.ofchambers.
- The increase in the number of chambers generally increases the insertion loss at higher frequencies but decreases it at lowerfrequencies.

DIMENSIONALVIEWOFMUFFLER



Fig–DesignofMuffler

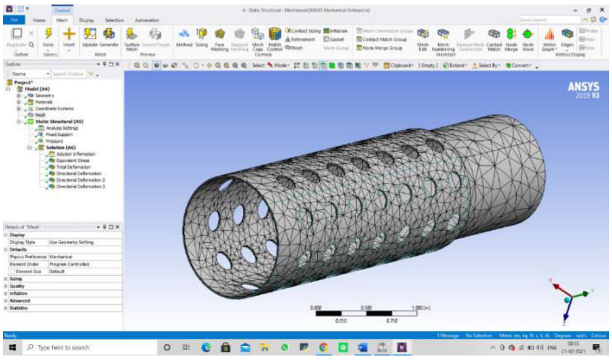
The muffler model was created in some particular dimensionslike diameter ofthebigend and small end and the I-section of the beamand the fillet radius of the muffler and thicknessofthemuffler.

THERMALANALYSIS

The exhaust muffler mode lin CATIA it is analysed in ANSYS WORKBENCH 14.5. The thermal analysis has been made under the material and dimensional specification.

Table:MaterialPropertiesofMuffler

Density	g/cm^3	7.7
Specificheat	J/(kg*K)	500
ThermalConductivity	W/(m*K)	16.2



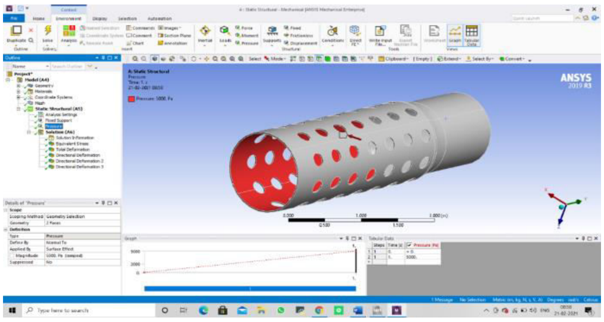
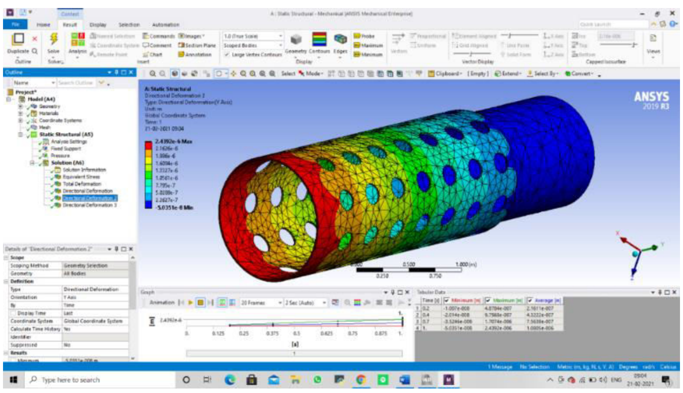


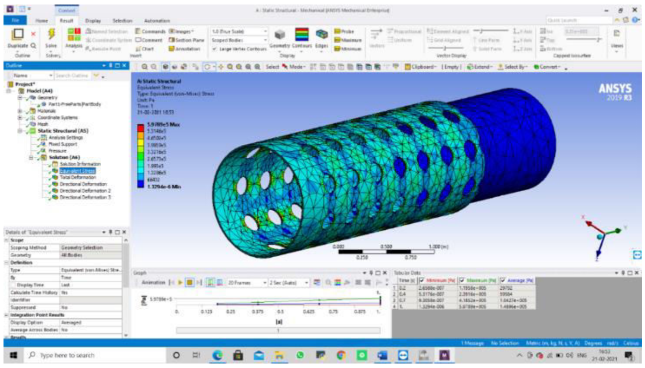
Fig-Steadystateheat flowmuffler

The Modelled muffler is Meshed using CATIAand the steady state heat flow is analyzed. Theanalysis is done at the temperature of 50°C.ThentheSteadystateThermalanalysisisanalyzed.



Fig– SteadyStateThermalanalysis

The steady state thermal analysis is performedinthemufflerand theresultsareplotted.



Fig–TotalHeat Flux

The Total Heat Flux analysis is performed inthemuffler and theresults areplotted.

RESULT AND COMPARISON

<u>COMPARISON TABLE FOR STATIC STRUCTURAL ANALYSIS FOR A MUFFLER</u>

From the above analysis of a muffler in ANSYS 19.3 the results are collected in tabular form for different materials.

We have noticed a change in both

temperature basis and static factors.

	STRUCTURAL STEEL	STAINLESS STEEL	ALLUMINIUM ALLOY, WROUGHT, 6061 T4	ZINC-ALUMINUM ALLOY,CAST	TITANIUM ALLOY,TI-12MO 6ZR-2F
TOTAL DEFORMATION,(M)	1.2155e-6	1.2661e-6	3.5182e-6	2.8835e-6	3.2722e-6
EQUIVALENT STRESS,(PA)	6.006e5	5.9976e5	5.9782e5	6.0267e5	5.9789e5

CONCLUSION

Our project is to design and analysis of a MUFFLER on different material namely STRUCTURAL STEEL, STAINLESS STEEL.ALUMINUM ALLOLY, WROUGHT-6061- T4, ZINC-ALLUMINIUM ALLOY, CAST, TITANIUM ALLOYTi12 Mo-6Zr-2Fe.

We have designed A MUFFLER in CAD software namely CATIA V5 and analysis is done using ANSYS 19.3 and the thermal and static analysis id drawn under required thermal conditions.

we have observed ALLUMINIUM ALLOY, WROUGHT material shows good results when compared to other material and regular using material i.e., cast iron. In static analysis aluminum alloy, wrought material used for a muffler shows lower deformation and less affected to stress and strain factors when compared different materials

Even stainless-steel shows nearly equal results as Aluminum alloy, wrought ,606, T4 which can be encouraged after cast iron material.By this project we want to conclude that by using Aluminum alloy, wrought-606-T4 in place of cast iron shows good physical bearable properties. We even conclude that stainless steel is also comparatively good material.

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