International Journal of Scientific Engineering and Research (IJSER)
ISSN (Online): 2347-3878
Impact Factor (2020): 6.733

Design & Analysis of Two-Wheeler Muffler Using Ansys Workbench

Nilesh Ashokrao Balurkar*, Prof. R. R. Kulkarni**

*PG Student, Mechanical Engg Department, CAYMET's Siddhant COE, Sudumbare, Pune, Maharashtra, India
**Mechanical Engg Department, CAYMET's Siddhant COE, Sudumbare, Pune, Maharashtra, India

Abstract: ***Mention Vehicles have become primary source for transportation, now days each house has minimum to minus more than two vehicles. At the same time, it becomes important to provide safety for the riders. Hence to provide safety, each component must be checked before and after assembly, how much external loads it may sustain and also, what problem may occur at certain condition. Keeping same objective in the mind I'm going to simulate the static and vibrational analysis of two-wheeler exhaust muffler using ANSYS workbench and if required I'm will validate the same using FFT analyzer. It is important to analyze the silencer for its vibration because parts may get looser when vibrations are induced. In this project I'm going to design a muffler using CATIA v5 software, also to compare the model with different materials for the efficient one. Also, we can conduct the optimization technique for material reduction.***

Keywords: Exhaust Muffler, FEM, Vibrational, FFT Analyzer & optimization

1.Introduction

This The main goal of this project is to study the vibrational impact caused due to the vehicle moving on irregular road surface and also due to exhaust gas pressure variations in two-wheeler muffler. Mufflers are an important component in vehicle, without muffler or silencer one can't assume an engine. After expansion in the engine exhaust gas produced containing harmful gases is exhausted in a long hollow pipe called muffler at back side of the vehicle. For time being these mufflers have been optimized in different shape, size, and material etc. the main goal of this project will be to design a new automobile exhaust piper muffler (silencer) is to increase the durability of its life. Decrease the weight, and reduce the manufacturing cost with efficient working condition.

In this project I'm going to design, analyze the model using ANSYS workbench static structural and model analysis for vibration study. If muffler or silencer part impacts high vibrations, or stress then topology will be conducted to solve the high stress concentration and vibrational impacts.

Vibrations are measured in 3 different phases which are classified as follows;

Frequency, amplitude and Phase are the three major characteristics which are used to describe a oscillation in the part or component (or vibrations).

There are 3 types of Vibration:

Free or Natural.

• Forced and.
• Damped Vibration.

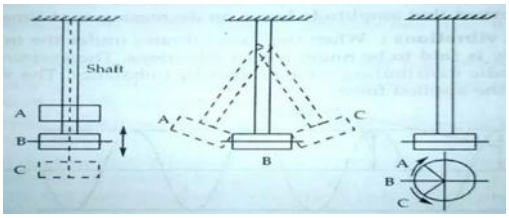


Figure 1.1: types of vibration

2.Problem Statement

Vibrations are the real problem of machines they encounter almost in all components connected to dynamic constraint. Whenever a part or component undergoes or subjected to a periodic motion the part impacts to a vibration. Following are the causes of when vibration induces.

- Unbalance: whenever vibration induces in a certain part, it disrupts the balance of it because of its higher tendency of frequency.
- Resonance: it is an effect of collision or noise.
- It effects in loosing of jointed parts, like nut & bolt loosening.
- Bearing damage: vibrations can damage the bearings by misaligning it.

For future esthetic condition high speed vehicles play a definable role, while a vehicle moves at a top speed on a irregular surface it under goes into vibrational impact caused due shock in road. this in term can result a muffler to fail due to high temperature exhaust has moving inside the silencer, also to the road terrain. Muffler may undergo to failure or cracks or loosing from the engine manifold. To prevent this one must investigate the silencer under natural forces.

3.Objective

This The main goal of this project is to study the vibrational impact caused due to the vehicle moving on irregular road surface and also due to exhaust gas pressure

variations in two-wheeler muffler.

- To minimize the vibrational impact due to damping in muffler.
- To minimize the weight of the product by evaluating it in optimization strategy.
- To increase the life by studying the fatigue factors.
- To reduce the noise.

Aim or work

- To survey for the current proposed components like its material, parameters & cost etc.
- To prepare the design of the muffler using CATIA v5 software.
- To study the FEM solution on the designed muffler using ANSYS software.
- To optimize the redirected solution for better material usage.
- To compare among the other material for its better application in heat as well as structural.

4.Methodology

Step 1:-I have started the work of this project with literature survey. We gathered many research papers which are relevant to this topic. After going through these papers, we learnt about topology optimization, structural analysis & model analysis of the alternator project of our aim.

Step2:-After the study, material selection criteria is surveyed in market according to availability and cost of materials.

Step 3:-After deciding the materials, the 3 D Model and drafting will be done with the help of CATIA software.

Step 4:-FEM solution will be evaluated 1st using static structural analysis.

Step 5:-Model Analysis

Step 6:-Topology Optimization.

Step 7:-Material comparison.

Step 8:-Thesis writing.

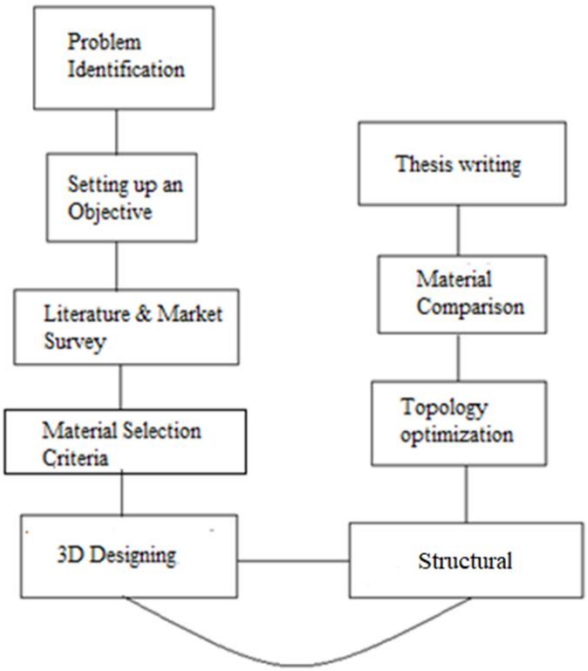


Figure 4.1: methodology or process flow of the project

5.Literature Review

This The main goal of this project is to study the vibrational impact caused due to the vehicle moving on irregular road surface and also due to exhaust gas pressure variations in two-wheeler muffler.

Sl. No	Author	Title
1.	Jashanpreet Singh	A Study on Effectiveness of Muffler on a Two-wheeler vehicle Noise
2.	Prof. Ganesha B B	Design and Thermal Analysis of Motor Bike Exhaust Silencer-A Review
3.	Mr. Vishal M. Shrivastav	Design the Exhaust System for the Two Wheeler & Analysis using FEA
4.	Mr. S. H. Kondo	Vibration Analysis of Two Wheeler's Silencer by Using FEM Package and FFT Analyzer
5.	Aminudin Abu	On the Theoretical Vibration Analysis Of The Exhaust System

Noise & vibration is one of the major disadvantages in vehicle system, in order to procure this problem study of various factors affecting in producing vibration as well noise in two-wheeler muffler system. Several publications have been studied and optimization strategies are illustrated to isolate large deflection while causing vibration.

6.Present Theories and Practices

1) Modal analysis is method to describe a structure in terms of its natural characteristics which are frequency, damping and Modal shapes and its dynamics properties.
2) Modal analysis involves process of determining the modal parameters of a structure to construct a modal model of the response.

3) Theoretical and Experimental Modal Analysis (EMA) have been very separate engineering technologies aimed for solving noise and vibration problems.
4) The modal parameters may be determined by analytical means, such as finite element analysis and one of the common reasons for experimental modal analysis is the verification/correction of the results of the software approach (model updating).

Materials

Some of the basic materials used for manufacturing mufflers are Cast iron, stainless steel, mild steel / carbon steel. Recent trends towards light weight concepts, to increase the engine efficiency weight reduction is mandatory, cost reduction and better performance, designers are progressing towards sheet metals.

Properties of materials

Grey cast density = 7.20 g/cm^3
Stainless steel = 7.65-8.03 g/cm^3
Steel = 7.86 g/cm^3
Titanium = 4500 g/cm^3

Parameters.
VOCADO PE-1 Hero CBZ Slip-on Exhaust System (Mild Steel)

General
Brand VOCADO
Model Number CBZBYKEXTSYSTM5819
Material Mild Steel
Type Slip-on Exhaust System
Vehicle Brand Hero
Vehicle Model Name CBZ
Vehicle Model Year 2018
Series PE-1
Model Name Bike Exhaust System for Hero CBZ
Weight 2 kg

Figure 6.1: Muffler

Advantages

1. Software analysis can minimizes testing cost.
2. Increased strength
3. Lower weight
4. Less cost & maintenance.
5. Increased product life.
6. Minimized vibrations.

Hero Splendor Plus Dimensions

The Hero Splendor Plus Dimensions 1970 mm in length, 720 mm in width and 1040 mm in height with a wheelbase of 1230 mm. By knowing the Hero Splendor Plus dimension, you can be clear about the minimum space, which you require to park the bike in your garage.

Dimensions mm cm inches feet
Length 1970 197 77.56 6.46
Width 720 72 28.35 2.36
Height 1040 104 40.94 3.41
Wheelbase 1230 123 48.43 4.04
Ground Clearance 159 15.9 6.26 0.52

7.Design

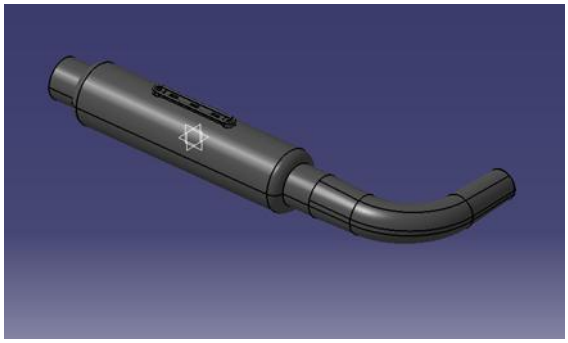


Figure 7.1: CATIA v5 muffler design

8.Analysis

8.1 Unit system adopted

Table 8.1: Unit System

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

8.2 Geometry

Table 8.2: Geometry Properties

Bounding Box		
Length X	376.21 mm	30. mm
Length Y	1058.1 mm	230.41 mm
Length Z	152.4 mm	13.5 mm
Properties		
Volume	9.4325e+005 mm³	40007 mm³
Mass	7.4045 kg	0.31406 kg
Centroid X	-23.443 mm	-2.8303e-004 mm
Centroid Y	159.71 mm	1.9717e-003 mm
Centroid Z	4.1136e-003 mm	80.835 mm
Moment of Inertia Ip1	7.4624e+005 kg·mm²	1660. kg·mm²
Moment of Inertia Ip2	49606 kg·mm²	28.351 kg·mm²
Moment of Inertia Ip3	7.6496e+005 kg·mm²	1681.9 kg·mm²

8.3 Meshing

Table 8.3: Mesh Definition

Object Name	Patch Conforming Method	Body Sizing
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	2 Bodies	
Definition		
Suppressed	No	
Method	Tetrahedrons	
Algorithm	Patch Conforming	
Element Order	Use Global Setting	
Type		Element Size
Element Size		10.0 mm
Advanced		
Defeature Size		Default
Behavior		Soft

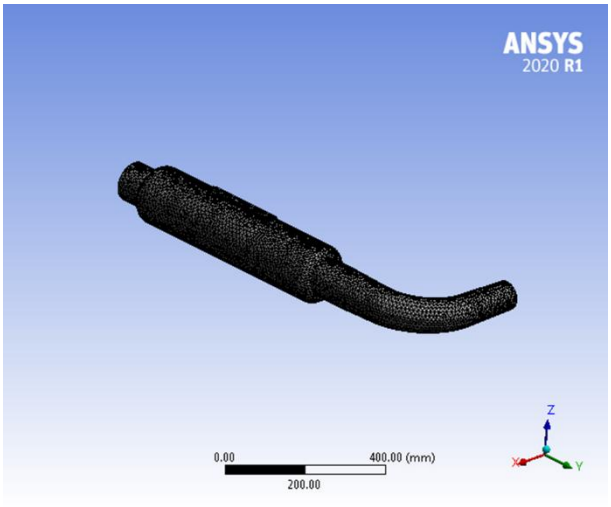


Figure 8.3: Mesh

8.4 Boundary condition

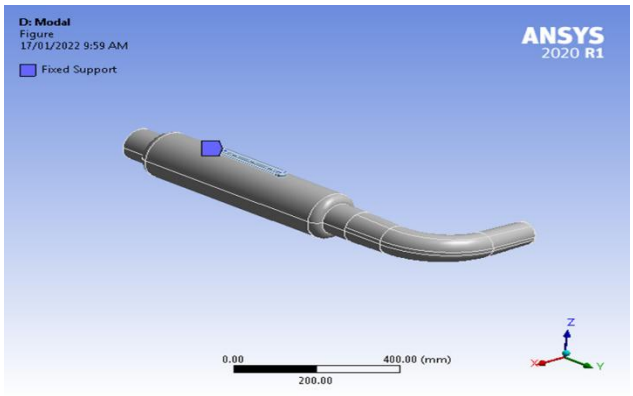
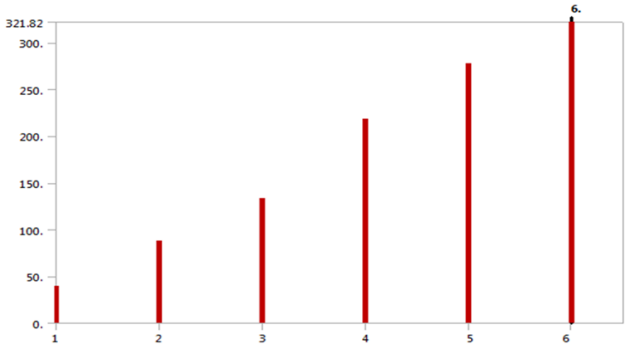


Figure 8.4: boundary condition fixed type

Table 8.4: condition type

Object Name	Fixed Support
State	Fully Defined
Scope	
Scoping Method	Geometry Selection
Geometry	6 Faces
Definition	
Type	Fixed Support
Suppressed	No

8.5 Solution



Graph 8.5: Nodal Frequency

Table 8.5: Nodal Frequency

Mode	Frequency [Hz]
1.	39.264
2.	87.423
3.	133.06
4.	218.32
5.	277.07
6.	321.82

8.5.1 Total deformation

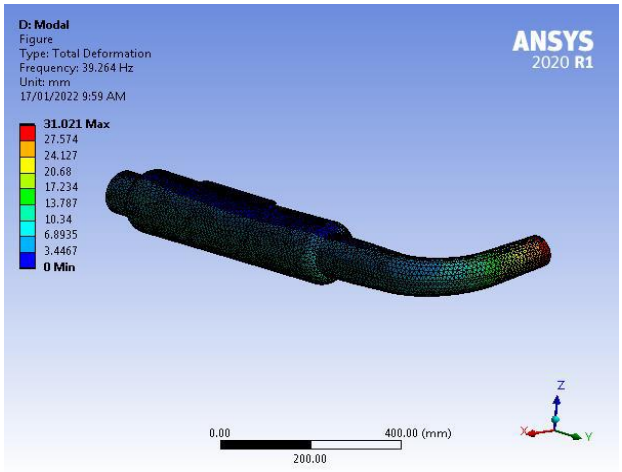


Figure 8.5.1: Total Deformation

8.5.2 Total deformation 39.264 Hz

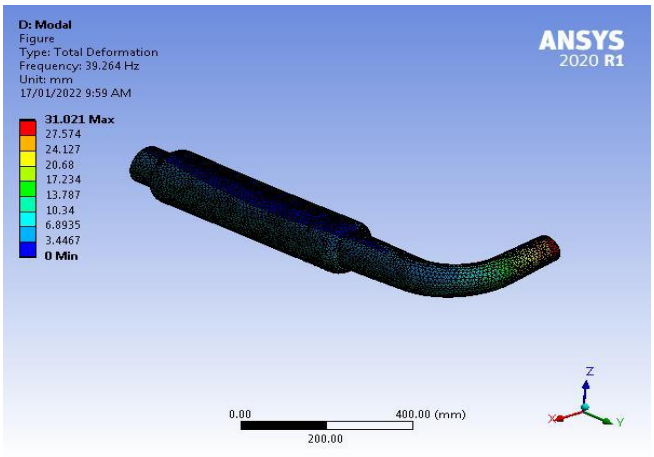


Figure 8.5.2: Total Deformation at 39.264Hz

8.5.3 Total deformation at 87.423 Hz

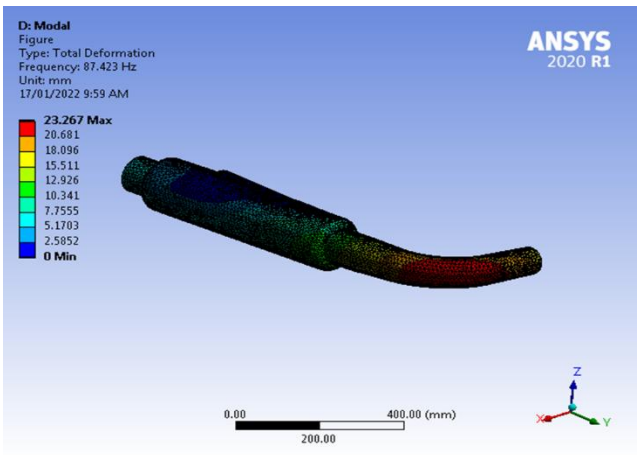


Figure 8.5.3: Total Deformation at 87.423

8.5.4 Total deformation at 133.08

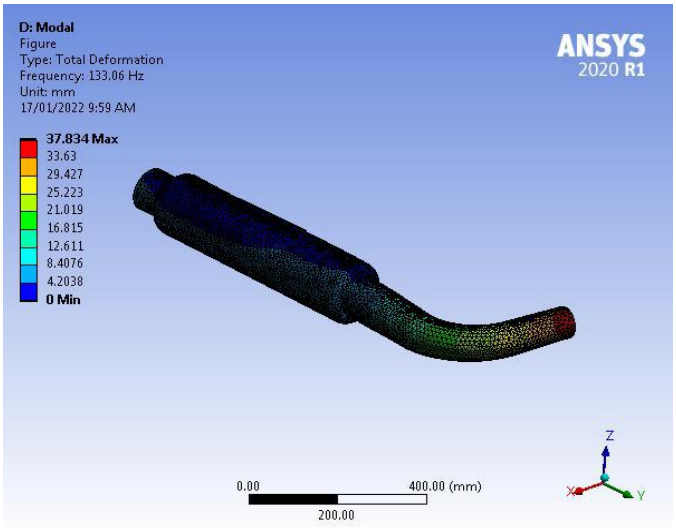


Figure 8.5.4: Total Deformation at 133.08

8.5.5 Total deformation at 218.32

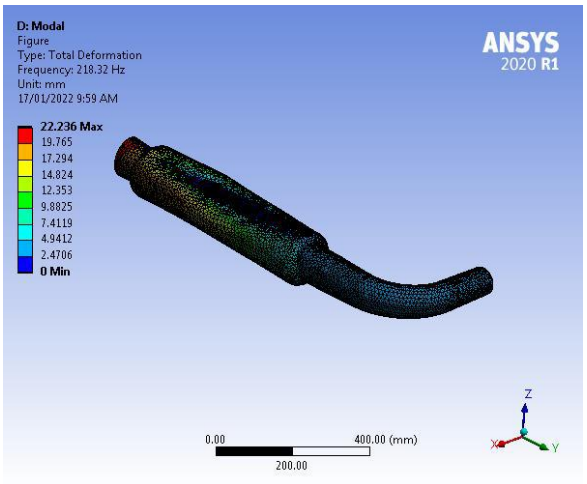


Figure 8.5.5: Total Deformation at 218.32

8.5.6 Total deformation at 277.07

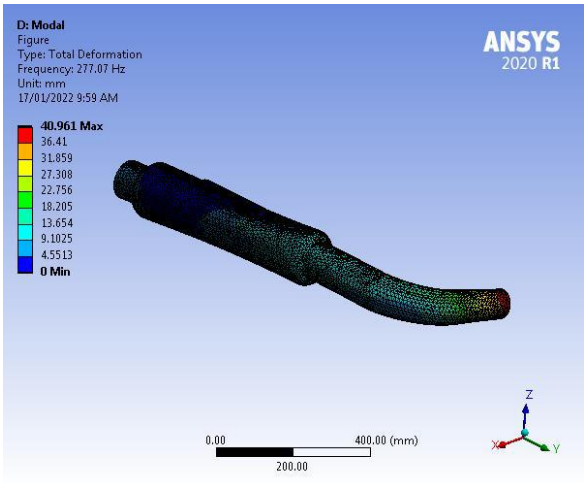


Figure 8.5.6: Total Deformation at 277.07

8.5.7 Total deformation at 321.82

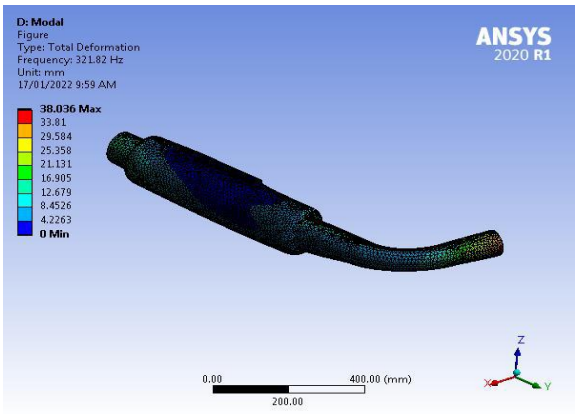


Figure 8.5.7: Total Deformation at 321.82

Table 8.5.7: Overall Result

Object Name	Total Deformation 2	Total Deformation 3	Total Deformation 4	Total Deformation 5	Total Deformation 6	Total Deformation 7
State	Solved					
Scope						
Scoping Method	Geometry Selection					
Geometry	All Bodies					
Definition						
Type	Total Deformation					
Mode	1.	2.	3.	4.	5.	6.
Identifier						
Suppressed	No					
Results						
Minimum	0. mm					
Maximum	31.021 mm	23.267 mm	37.834 mm	22.236 mm	40.961 mm	38.036 mm
Average	9.6413 mm	9.4923 mm	8.1692 mm	9.1515 mm	9.0555 mm	9.6036 mm
Minimum Occurs On	Clamper |Part Body					
Maximum Occurs On	Silencer |Part Body					
Information						
Frequency	39.264 Hz	87.423 Hz	133.06 Hz	218.32 Hz	277.07 Hz	321.82 Hz

9.Conclusion

Simulation of Model analysis for splendor muffler has been conducted using ANSYS workbench. The above result has been obtained & the results obtained respective to deformation are minimum and workable for fabrication.

References

[1] Jashanpreet Singh A Study on Effectiveness of Muffler on a Two-wheeler vehicle Noise CETCME-2017
[2] Prof. Ganesha B B Design and Thermal Analysis of Motor Bike Exhaust Silencer-A Review International Journal of Engineering Research & Technology (IJERT) http://www.ijert.org ISSN: 2278-0181 IJERTV6IS090125 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Published by: www.ijert.org Vol.6 Issue 09, September-2017
[3] Design the Exhaust System for the Two Wheeler & Analysis using FEA Mr. Vishal M. Shrivastav IJSRD-International Journal for Scientific Research & Development| Vol.6, Issue 05, 2018 | ISSN (online): 2321-0613
[4] M Rajasekhar Reddy & K Madhava Reddy. "DESIGN AND OPTIMIZATION OF EXHAUST MUFFLER IN AUTOMOBILES" International Journal of Automobile Engineering Research and Development (IJAuERD) ISSN 2277-4785 Vol.2, Issue 2 Sep 2012 11-21.
[5] Tirupathi R. Chandrupatla & Ashok D. Belegundu "Introduction to Finite Elements in Engineering" 3rd edition, 2001.
[6] www.vibetech.com ME'SCOPE visual engineering service and Data Physics Corporation.