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Design, Analysis & Fabrication of Handlebar of Motorcycle by Changing Material

[1] Tushar Rajendra Chavan, [2] Rahul B Barjibhe

[1]Master's of Engineering Student, [2]Associate Professor Mechanical Engineering Department,
[1]Mechanical Engineering Department,
[1]Shri Sant Gadge Baba College Of Engineering & Technology, Bhusawal,India

Abstract-In this era, All machines, vehicles and buildings are subjected to dynamic forces that cause vibration. Most practical noise and vibration problems are related to resonance phenomena where the operational forces excite one or more modes of vibration. Modes of vibration that lie within the frequency range of the operational dynamic forces always represent potential problems. Mode shapes are the dominant motion of a structure at each of its natural or resonant frequencies. Modes are an inherent property of a structure and do not depend on the forces acting on it. On the other hand, operational deflection shapes do show the effects of forces or loads, and may contain contributions due to several modes of vibration. This paper deals with optimization and modal analysis of the handle bar of Pulsar 150.

Keywords-Mode shape,FEA analysis,handlebar

I. INTRODUCTION

A Motorcycle handlebar is a tubular component of a motorcycle's steering mechanism. Handlebars provide a mounting place for controls such as brake, throttle, clutch, horn, light switch and rear view mirrors; and they may support part of the rider's weight. Even when a handlebar is a single piece it is usually referred to in the plural as handlebars.

Handlebars are made from hollow metal tubing, typically aluminum alloys, mild steel, chrome plated steel and Stainless steel but also of carbon fiber and titanium, shaped to the desired contour. Holes may be drilled for the internal routing of control cables such as brake, throttle, and clutch. Risers hold the handlebars above their mounting position on the upper triple tree or the top of the fork, and may be integrated into the bar itself or separate items. Bar-end weights are often added to either end of the handlebar to damp vibration by moving the bars' resonant frequency away from that generated by the engine. Electrical heating elements may be added under the handlebar grips to provide comfort to the user in cold weather.

Fig.1.1 Two wheeler handle bar

II. PROBLEM DEFINITION

Vibration analysis is usually carried out to ensure that potentially catastrophic structural natural frequencies or resonance modes are not excited by the frequencies present in the applied load. Sometimes this is not possible and designers then have to estimate the maximum response at resonance caused by the loading.

2.1. Objectives

The main objective of the study is to optimize and find natural frequency of handle bar. This optimized model will have better performance.

To achieve this objective following steps must be taken:

- To study various research papers to know the work done on handle bar.
- To draw CAD model in CatiaV5

- Study boundary conditions and loadings acting on the handle bar.
- Carryout analysis & Optimization
- Conclusion

III. PROPOSED METHODOLOGY

- CAD Model Generation
- Input parameters will be getting through reverse engineering. Reverse engineering will follow a method of hand calculation
- Model creation in from input parameters.
- Determination of loading and forces
- FEA analysis of handle bar discretized model by applying the required boundary conditions and for the various loadings and carrying out static analysis and modal analysis
- Material will be removed from low stressed region or material is changed to optimize the model
- Modal analysis will be done on the model
- Testing will be carried to validate analysis results.
- Validation

3.1 Design Parameters & Materials

Specification	Values
Engine type	4-Stroke,DTS-I, Air cooled, Single Cylinder
Displacement	149 cc
Max. power	15.06 @ 9000 (Ps @ RPM)
Max .torque	12.5 @ 6500 (Nm @ RPM)
Suspension front	Telescopic, with anti-friction bush
Suspension Rear	5 way adjustable, Nitrox shock absorber
Rake Angle	27Degree
BrakeFront	240 mm Disc
Brakes Rear	130 mm Drum
Tyre Front	2.75 – 17
Tyre Rear	100 / 90 – 17
Dimensions Length X Width X Height	2055 X 755 X1060
Ground Clearance	165 mm
Wheelbase	1320 mm
Kerb Weight	144 Kg
Performance	
Acceleration(0-60 kmph)	5.60 seconds
Braking(100-0 kmph)	16.50 meters
Weight considered	
Rider weight (W)	70kg
Pillion rider weight	70kg
Total weight (Wt)	144+70+70= 284 kg

Table 3.1 Bajaj Pulsar 150 Specification

➢ **Existing Material of Handlebar:**

At present handle bar is made of mild steel material. So, first analysis is done using MS as material.
Steel is the traditional material for handle bar. Steel is easy to get. Machinery to manipulate steel is easy to get. Steel is easy and it's also cheap. This is the main reason that 99% of the handle bar are made from steel. Steel is stiff but dense (heavy). Steel rates well in terms of both yield strength and ultimate strength, particularly if it's carefully alloyed and processed. Steel also resists fatigue failure well which is extremely useful - even if the handle bar flexes under load, such flexing need not lead to a critical failure.
The limitation with steel is its weight, or more accurately its density. Steel is made from iron, and its density is high. Light frames of adequate stiffness and strength are made with relatively small-diameter tubes, but steel isn't the right material for light frames or large strong riders. Mild (inexpensive) steel frames need thick walls to be strong enough, and they are heavy. Stronger steel allow thin tube walls, but then frame stiffness goes down.

3.2 Static Force Calculations

In Static Condition the rider sitting position is such that it makes an angle of 30 degree with the horizontal imaginary line from the handle bar gripper parallel to the ground as shown in below picture.Therefore the weight(force) of the rider will be taken into account for the static loading,

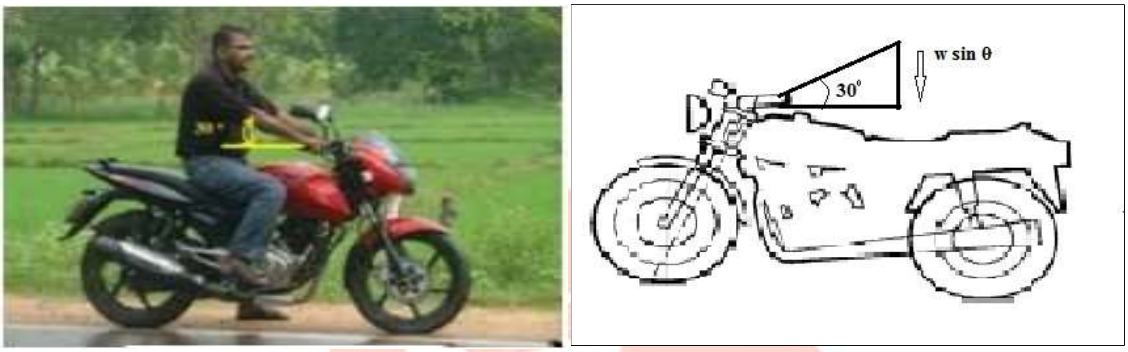


Fig. 3.1 Sitting posture &Vertical force on Handle bar

Vertical force on handle bar
VF = W sin ………… (1)
Put Value ɵ in Equation (1)
VF = 70 sin(30)
VF = 70 x 0.5
VF = 35 x g
VF = 343.5 N ………… (2)

3.3 Braking force calculation

Under heavy breaking the front portion of the vehicle experiences heavy load due to the weight transfer. Directly the forces are transferred from the front fork suspension to the handle bar of the vehicle .Hence the force on the forks from the wheel is calculated.

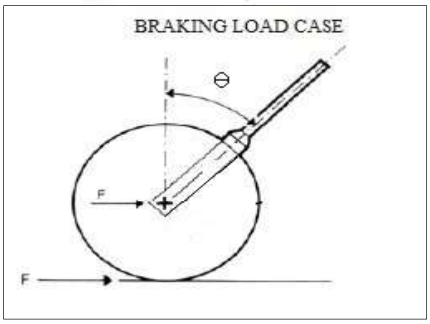


Fig. 3.2 Braking Load Case

Under breaking the rake angle causes some of the braking force to be reacted to the front forks. Therefore the spring compression and dive are increased over that due to weight transfer alone.
Given Data
Rake Angle - 27 °
Initial velocity (U) – 0 kmph
Final velocity (V) – 60 kmph (16.6 mps)

Time (t) – 5.9 sec
Mass (M) – 284 kg
Therefore,
F = M x a x cos ………………. (3)
Now,
To know acceleration (a), we use the below formula
V = U + a x t ………………. (4)
Put all value in above Equation
16.6 = 0 +(a x 5.6)
a = 2.9 m/s
Put Value Of M, ɵ and a in equation (3)
F = 284 x 2.9 x Cos (27°)
F = 752.81 N

The braking force on the front tyre can be split into two components when fed into the forks, one in line with the sliders which tends to compress the springs (this force is approximately 42% of the braking force. at 25 deg. rake), the second component at right angles to the forks which tries to bend the fork legs (roughly 91% of the braking force).

Therefore,
42 % of F
F = 752.81 x 0.42
F = 436.62 N ………………. (5)

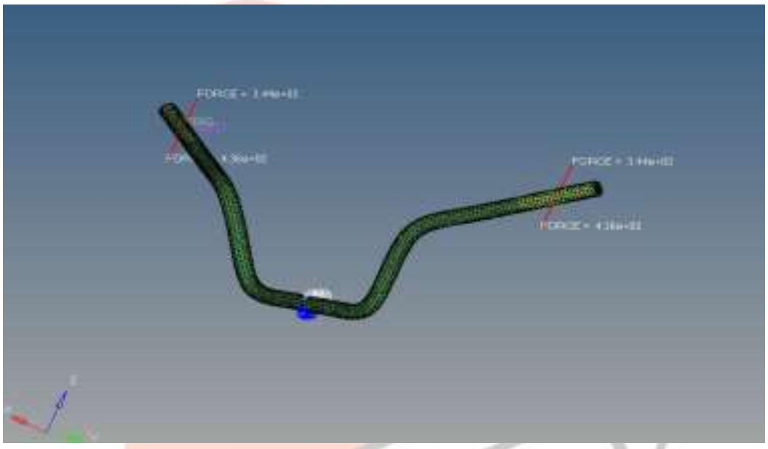
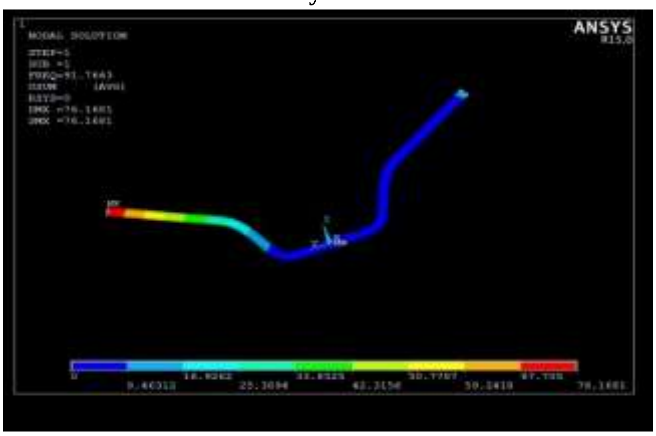


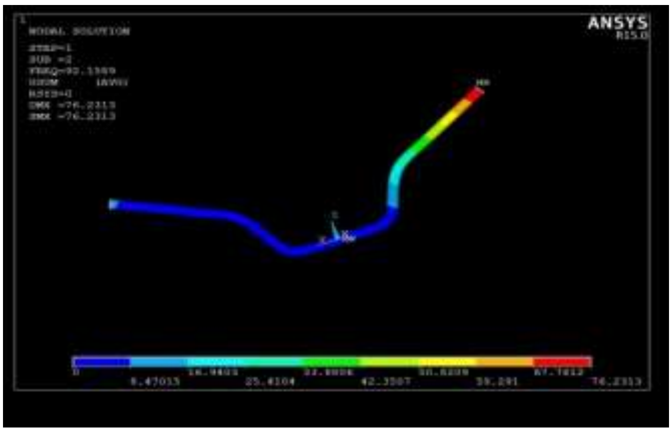
Fig. 3.3 Boundary conditions applied on handle bar

IV. FEA MODAL ANALYSIS

Modal analysis is the study of the dynamic properties of structures under vibrational excitation. Modal analysis uses the overall mass and stiffness of a structure to find the various periods at which it will naturally resonate. These periods of vibration are very important to note in vibration of any machine, as it is imperative that a components or nearby system's natural frequency does not match the frequency of machine. If a structure's natural frequency matches a component's frequency, the structure may continue to resonate and experience structural damage.

4.1. Results of Modal Analysis:





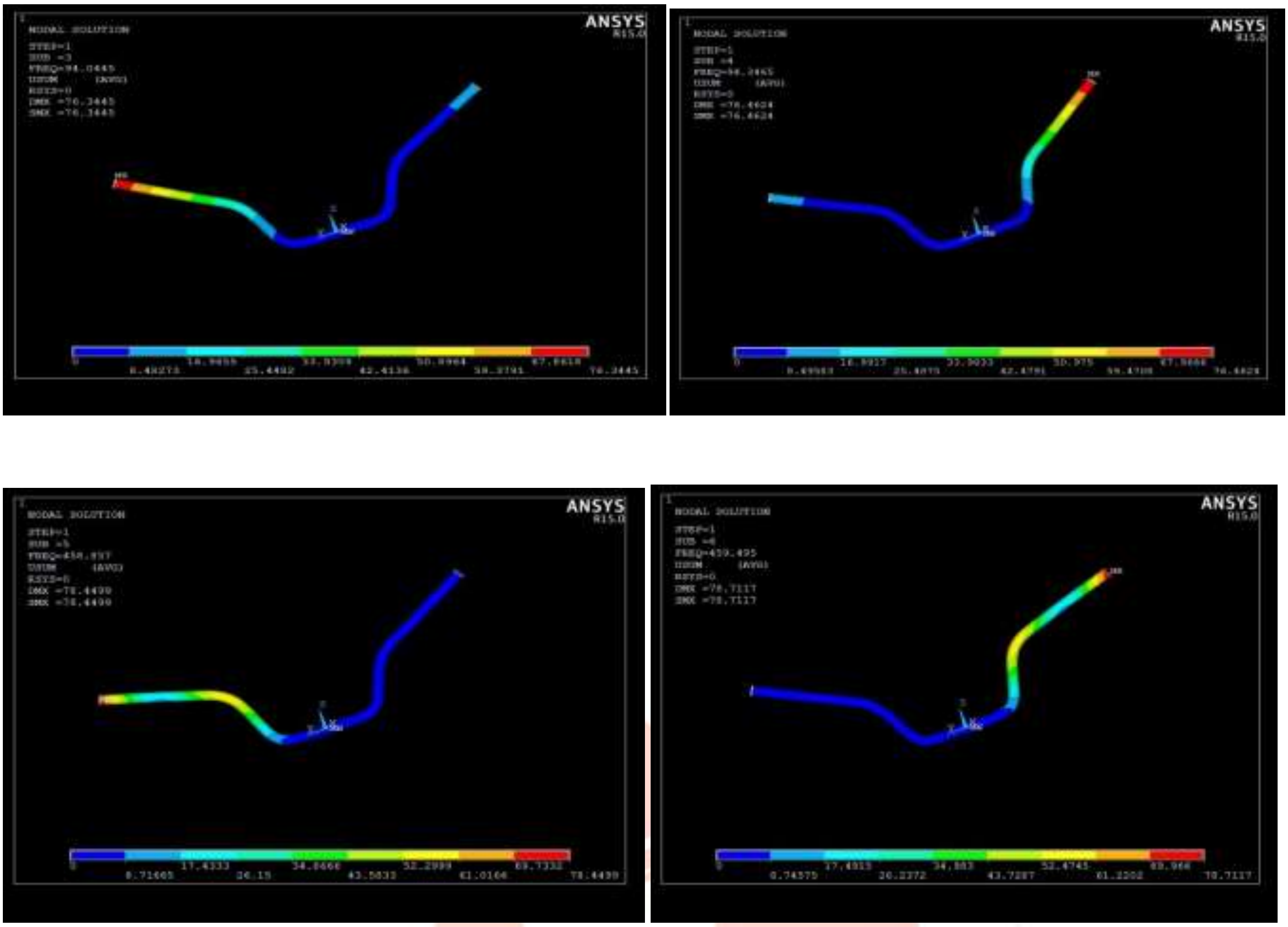


Fig 4.1 Modal Frequency of mode shapes

- The frequency of 1st mode is **91.76**hz.
- The frequency of 2nd mode is **92.16**hz.
- The frequency of 3rd mode is **94.04**hz.
- The frequency of 4th mode is **94.34**hz.
- The frequency of 5th mode is **458.8**hz.
- The frequency of 6th mode is **459.49**hz.

V. ITERATIONS WITH ALTERNATE MATERIAL

This chapter iteration with alternate materials of the dissertation includes finite element based weight optimization of handle bar using alternate materials. The chapter discuss about the selection of various alternate materials with different properties. It includes structural analysis of a handle bar with alternate materials. Also it includes the comparative study of properties of these materials with conventional mild steel.

- **ALUMINUM ALLOY 6063**

Aluminum is a nonferrous material with very high corrosion resistance and very light material compared to steels. Aluminum cannot match the strength of steel but its strength-to-weight ratio can make it competitive with steel. The density of aluminum is in the region of 35% of that of steel.

Composition of aluminum alloy 6063 is listed below:

Chemical Element	% Present
Manganese (Mn)	0.0 - 0.10
Iron (Fe)	0.0 - 0.35

Magnesium (Mg)	0.45 - 0.90
Silicon (Si)	0.20 - 0.60
Zinc (Zn)	0.0 - 0.10
Titanium (Ti)	0.0 - 0.10
Chromium (Cr)	0.0 - 0.10
Copper (Cu)	0.0 - 0.10
Aluminium (Al)	Balance

Table 4.1 Typical composition of Aluminum Alloy 6063

- **GLASS FIBER**

It has relatively low stiffness, high elongation, and moderate strength and weight, and generally lower cost relative to other composites. It has been used extensively where corrosion resistance is important, such as in piping for the chemical industry and in marine applications.Glass fibers are also available in woven form, such as woven roving and woving cloth. Woven roving is coarse, dropable fabric in which continues ravings are woven in two mutually perpendicular directions.

COMPARISON OF MATERIAL PROPERTIES

The analysis of handle bar has been done for all the three materials viz. steel, aluminum alloy 6063, glass fiber. The comparison of properties and analysis results is shown in table A and B respectively.

S.No.	Material	Young's Modulus E	Poisson's Ratio υ	Density ρ	Yield Stress σ_{yield}	Ultimate Tensile Stress σ_{uts}
1.	**Steel**	210 GPa	0.3	7850 kg/m^3	250 MPa	390 MPa
2.	**Aluminum Alloy 6063**	68.9 GPa	0.33	2700 kg/m^3	214 MPa	241 MPa
3.	**Glass Fiber**	E1-40GPa E2-6 Gpa	0.3	2000 kg/m^3	1850 MPa	2000 MPa

Table 4.2 Comparison of material properties

VI. CONCLUSION

- Metals are mostly of medium to high density. So, it became important to find out suitable low density material for handle bar which has good structural strength, easily available, cheap, easy to machine etc. Glass fiber material fulfills these requirements.
- From properties of different materials it is observed that all materials have stress values less than their permissible yield limit. So the design is safe. But if we compare the density of MS and glass fiber, glass fiber has much lesser density than any other.
- Ultimate strength for MS material is 390Mpa, whereas for glass fiber is 2000Mpa. So, a handle bar would be safe even if stresses are high enough.

REFERENCES

1. S. V. Jaswandkar, P.N.Deshmukh Prof. P.S.Desle3 Swapnil S Kulkarni4, "Design Enhancement Of The Handle Bar Assembly Of An Automobile Using Fea", International Journal of Advanced Engineering Research and Studies E-ISSN2249–8974
2. Harale Shivraj. N, Gyanendra Roy, "Vibration Analysis of 2 Wheeler Handle-Bar Assembly", HTC 2012.
3. Rajratna M. Kharat, Dr. K. K. Dhande, " Impact of Vibration on Health of Automobile Rider- A Review", International Journal for Scientific Research & Development| Vol. 3, Issue 04, 2015 | ISSN (online): 2321-0613

4. Harshada G. Deshmukh, S. G. Dambhare, M. R. Phate, “Review And Suggested Generalized Approach To Analyze The Impact Of Vibration On Two Wheeler Rider”, International Journal of Science, Engineering and Technology Research (IJSETR), Volume 3, Issue 5, May 2014
5. Jaimon Dennis Quadros, Suhas, Vaishak N.L, Shilpa.B, “study of vibration and it s effects on health of a two wheeler rider”, IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 pISSN: 2321-7308
6. Patil Pruthviraj Devidas , Prof. P. N. Ulhe, “Stress analysis for Handle-Bar Housing at the Accelerator of two Wheeler” SSN-2250-1991, Volume:2,Issue:7,July 2013
7. Amol h. Parihar, Pravin P.huzare,Swapnil S. kulkarni, “Determination of natural frequencies of an handle bar using finite element methods to enhance the strength,” international journal of scientific research and management studies ISSN 23493771 volume 1 issue 11, pg: 346-351
8. Alexandre Callensa, André Bignonnet, “Fatigue design of welded bicycle frames using a multiaxial criterion”, 9th Conference of the International Sports Engineering Association (ISEA) Procedia Engineering 34 (2012) 640 – 645.
9. H. A. Khade and P. A. Narwade, “Structural Analysis of Two Wheeler Handlebar”, International Journal of Advanced Science and Technology Vol.68 (2014), pp.65-76
10. Mukesh Hadpe, Dr.D.S.Deshmukh, P.M.Solanki, “Vibration Analysis of a Two Wheeler (Analytically)”, International Journal of Innovative Research in Science, Engineering and Technology Vol. 3, Issue 11, November 2014