Design, Analysis & Increasing Strength of TVS JIVE Bike Handle

Mr. Pandurang B. Bhise[1] Prof. Y. A. Kharche[2] Dr. C. R. Patil[3]
[1]PG Student [2]Assistant Professor [3]Professor
[1,2,3]Department of Mechanical Engineering
[1,2]VBKCOE Malkapur, India [3]PRMIT Badnera, India

Abstract— In day today life we frequently come across some minor incidents occurring in case of two wheeler. This includes problems like damage to various two wheeler parts because of vehicle slipping, collapsing and minor dash or due to impact of heavy weight. In such cases the handle of vehicle deforms or undergoes bending. This dissertation aims at studding the deformation taking place due to bending by analyzing the stresses and reducing this stresses by making modification in dimensions or by changing material properties of handlebar. The stresses include were calculated out by making use of numerical methods. By analysis of the total deformation occurring in handle was estimated and comparison of obtained results was checked experimentally. Increase in thickness and changing the material properties of handle makes it safer.

Key words: Structural Analysis, Modal Analysis, Optimization, ANSYS

I. METHODOLOGY

The outputs of a vibrating system generally, depend upon the geometry, boundary conditions, material properties and external excitations. The main Objective of this paper is to analyze the handle bar of motor-cycle for performance enhancement to increase safety and comfort and reduce accidents. When handle bar exposed to load applied by rider hands, that varies accidentally in both magnitude and direction.

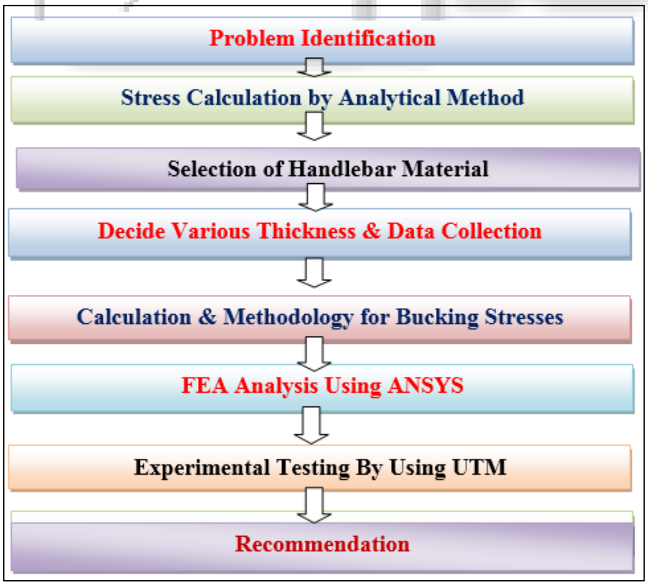

Fig. 1: Methodology/ Flow Chart

II. SELECTION OF MATERIAL

Handlebars are created from hollow metal tube, typically from aluminium alloys, mild steel, chrome plated steel and Stainless steel however additionally of carbon fibre and Ti, shaped to the required contour, out of which we are selected aluminium alloys, mild steel & Stainless steel. Holes may be drilled for the internal routing of control cables for brake, clutch, and throttle.

1) Stainless steel
2) Mild steel
3) Aluminium alloys

A. Dimensions of Handle Selected

As per the availability of standard material size in market we have selected the handle dimensions as follows:

Sr. No.	Internal diameter(mm)	Thickness (mm)	External Diameter(mm)
1	18.2	2.4	23.0
2	18.2	2.5	23.2
3	18.2	2.6	23.4
4	18.2	2.7	23.6
5	18.2	2.8	23.8
6	18.2	2.9	24

Table 2.1:

III. RESULT AND DISCUSSIONS

A. Structural Analysis

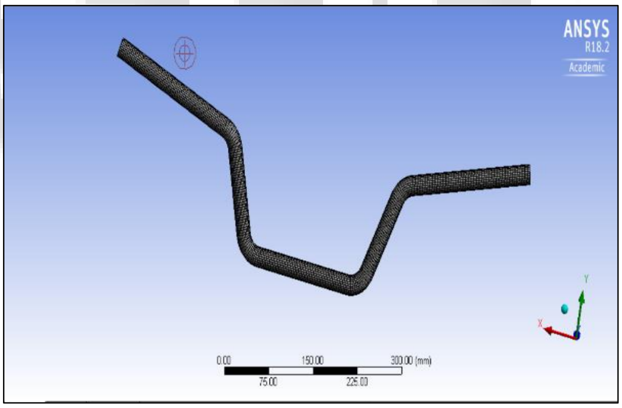

Fig. 3.1.1: Meshing of Handlebar

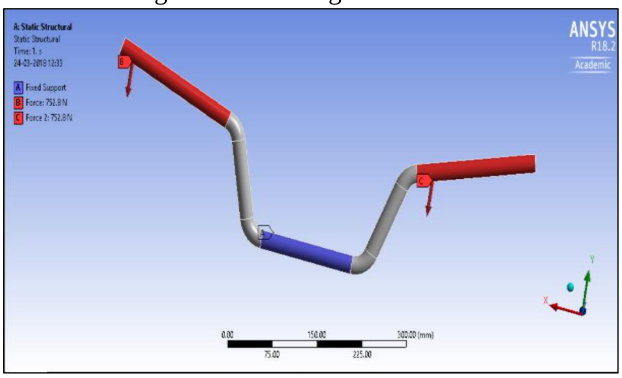

Fig. 3.1.2: Boundary Condition

EXPERIMENTS

1) Analysis of handle bar with Stainless Steel Material for 23 mm diameter:

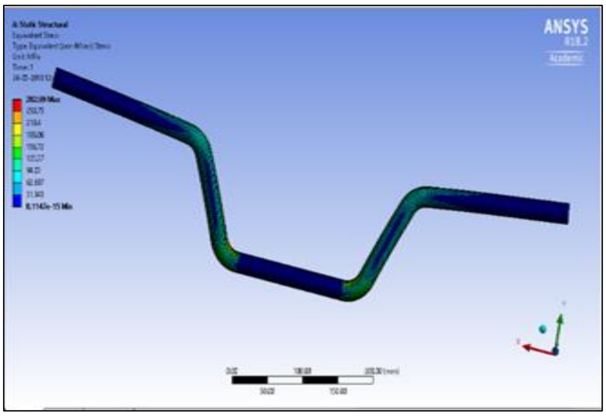

Fig. 3.1.3: Equivalent Stress (SS)

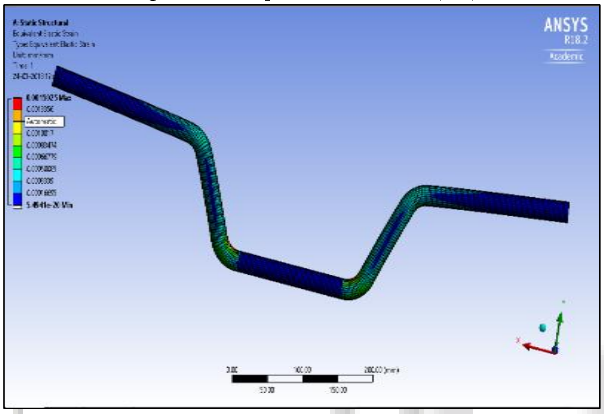

Fig. 3.1.4: Total Deformation (SS)

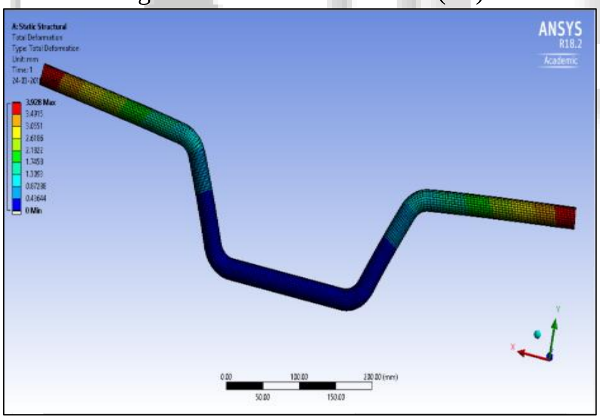

Fig. 3.1.5: Eq. Elastic strain (SS)

B. Analysis of handle bar with Aluminium Alloy Material for 23 mm diameter

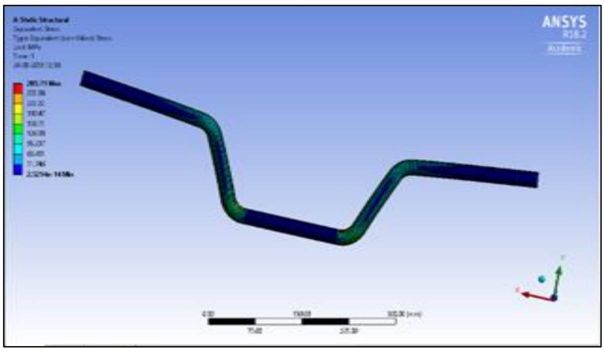

Fig. 3.1.6: Equivalent Stress (SS)

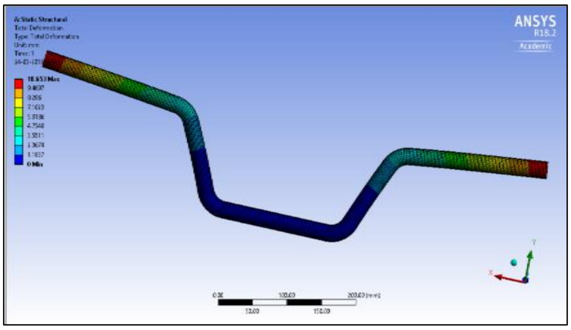

Fig. 3.1.7: Total Deformation (SS)

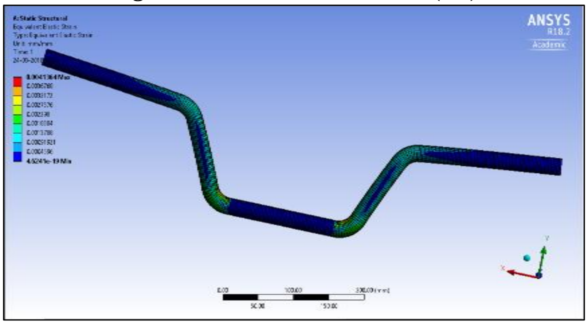

Fig. 3.1.8: Eq. Elastic strain (SS)

C. Analysis of handle bar with Mild Steel Material for 23 mm diameter

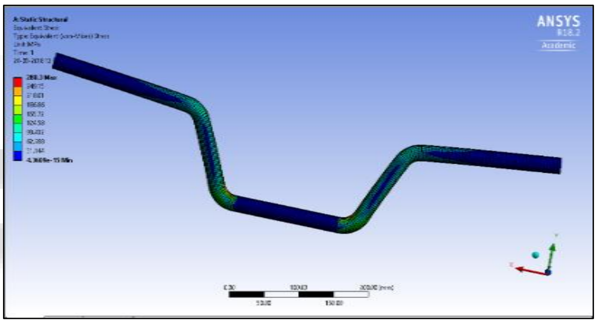

Fig. 3.1.9: Equivalent Stress(SS)

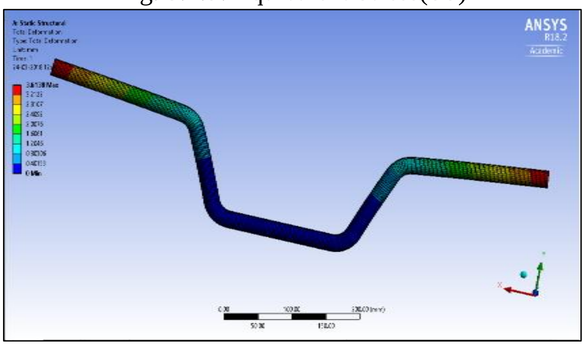

Fig. 3.1.10: Total Deformation(SS)

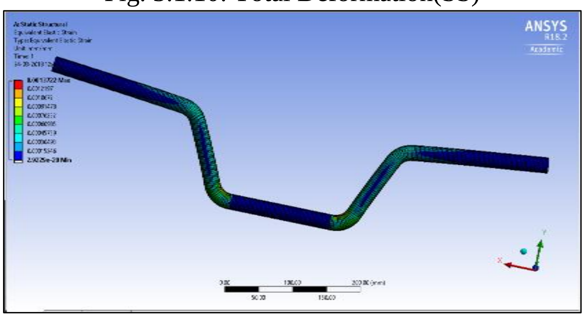

Fig. 3.1.11: Eq. Elastic strain(SS)

D. FEA Observations of Handlebar (Static Structural)

Material	Diameter	Total Deformation	Equivalent Stress (MPa)		Equivalent Strain	
		Max (mm)	Max	Min	Max	Min
Stainless steel	23.0	3.9245	282.09	8.11e-15	0.0015025	5.4941e-20
	23.2	3.7183	252.17	1.4395e-11	0.0013836	9.1967e-19
	23.4	3.4941	236.16	3.0029e-11	0.0012947	2.46e-16
	23.6	3.2832	224.7	2.4096-13	0.00124	4.800e-18
	23.8	3.1258	218.93	1.0891e-12	0.0011917	9.56e-18
	24.0	2.9549	220.54	4.0573e-12	0.001172	4.65e-17

Table 3.1.1: Stainless steel

Aluminium Alloy	23.0	10.653	285.71	2.5214e-14	0.0041364	4.6261e-13
	23.2	10.083	254.26	3.8602e-13	0.0037907	6.6025e-18
	23.4	9.4743	238.01	5.1246e-11	0.0035435	1.2627e-15
	23.6	8.9021	226.6	3.4134e-13	0.0033911	3.59e-17
	23.8	8.4773	220.52	2.763e-12	0.0032627	6.196e-17
	24.0	8.04	222.98	7.5052e-12	0.003221	2.8921e-17

Table 3.1.2: Aluminium Alloy

Material	Diameter	Total deformation	Equivalent Stress (MPa)		Equivalent Strain	
		Max (mm)	(max)	(min)	(max)	(min)
Mild Steel	23	3.6138	280.3	4.3609e^-15	0.0013722	2.9229e^-20
	23.2	3.4211	251.14	8.7218e^-14	0.0012667	5.1615e^-19
	23.4	3.215	235.28	2.3022e^-11	0.0011858	1.6384e^-16
	23.6	3.0211	223.73	2.2163e^-13	0.0011362	2.6612e^-18
	23.8	2.8759	218.13	6.7936e^-13	0.0010914	5.7205e^-18
	24	2.7186	219.32	2.9398e^-12	0.0010711	2.8826e^-17

Table 3.1.3: Mild Steel

IV. MODAL ANALYSIS

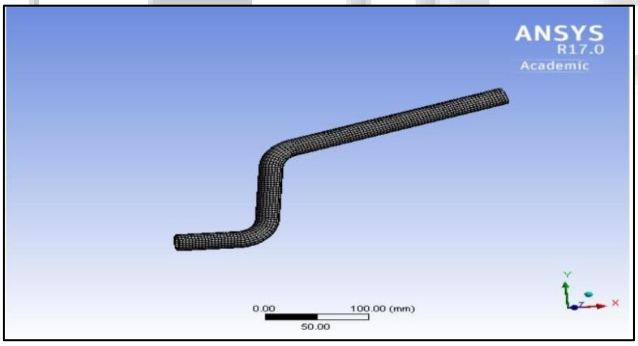

Fig. 3.2.1: Meshing of Handlebar

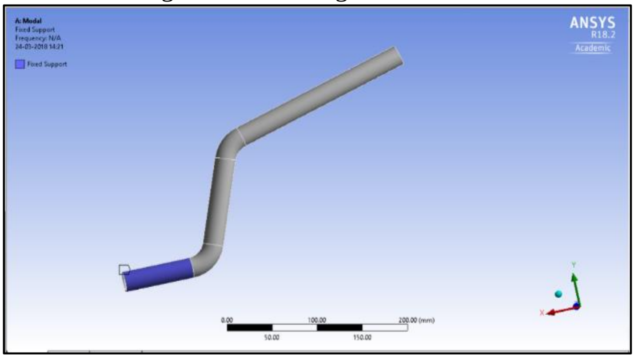

Fig. 3.2.2: Boundary Condition

1) NATURAL FREQUENCIES OF HANDLEBAR BY FEM:

Tabular Data

	Mode	Frequency [Hz]
1	1.	146.1
2	2.	148.57
3	3.	652.07
4	4.	669.91

Fig. 3.2.3: Stainless Steel

	Mode	Frequency [Hz]
1	1.	148.1
2	2.	150.91
3	3.	662.33
4	4.	677.49

Fig. 3.2.4: Aluminium Alloy

Tabular Data

	Mode	Frequency [Hz]
1	1.	151.49
2	2.	153.9
3	3.	675.45
4	4.	695.43

Fig. 3.2.5: Mild Steel

2) Total Deformation of Stainless Steel Material for 23 mm Diameter.

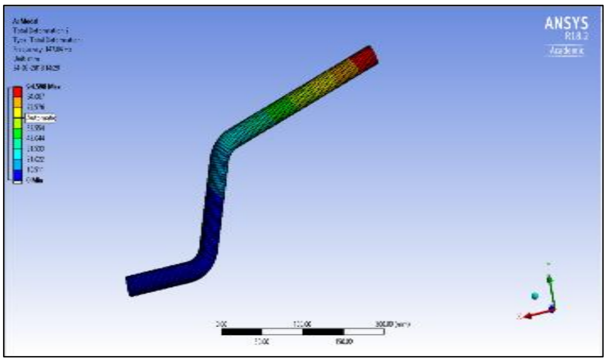

Fig. 3.2.6: Mode I

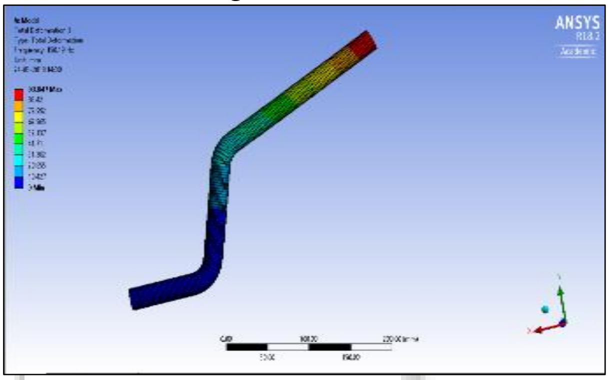

Fig. 3.2.7: Mode II

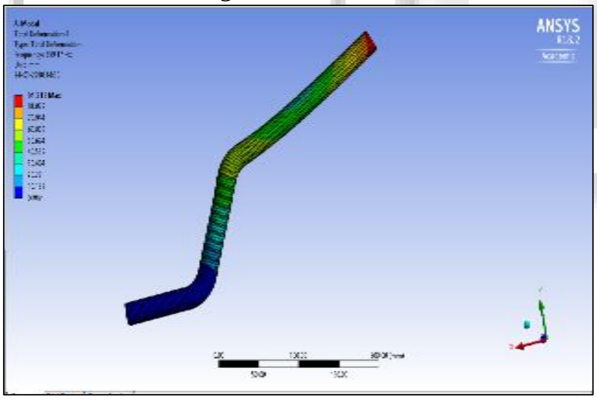

Fig. 3.2.8: Mode III

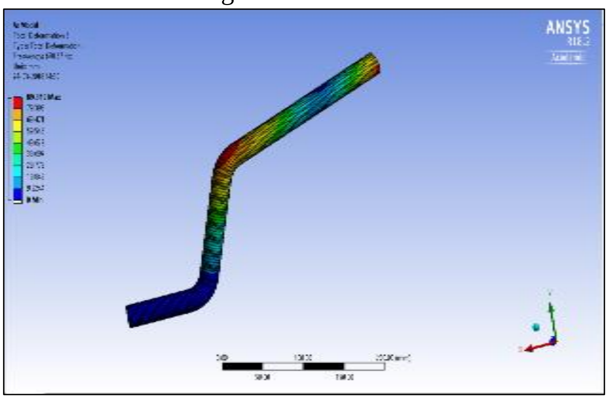

Fig. 3.2.9: Mode IV

3) Total Deformation of Aluminium Alloy Material for 23 mm Diameter

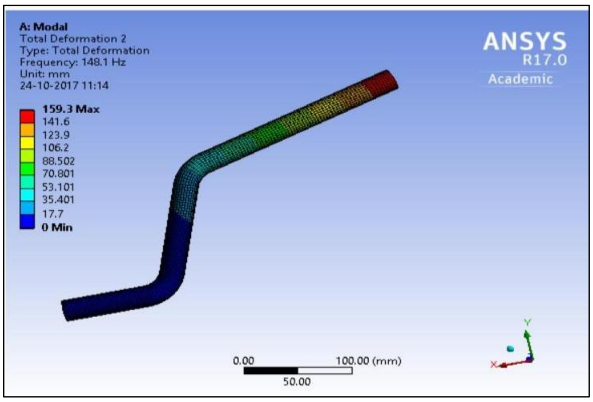

Fig. 3.2.10: Mode I

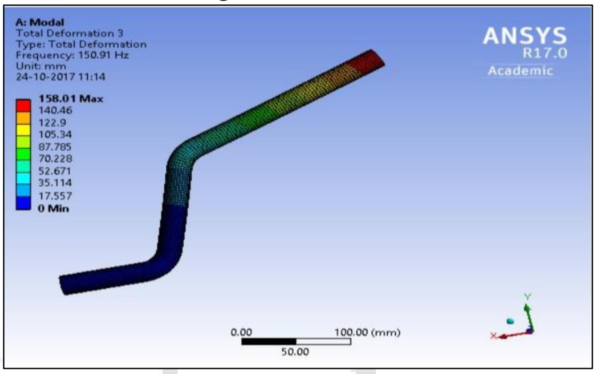

Fig: 3.2.11- Mode II

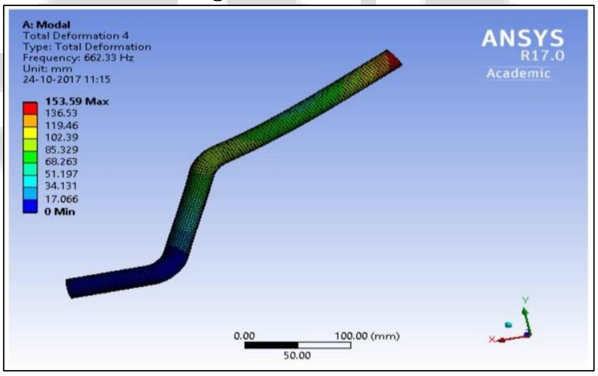

Fig: 3.2.12- Mode III

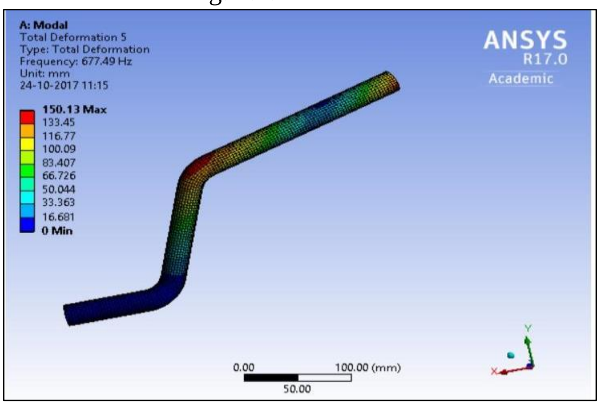

Fig. 3.2.13: Mode IV

4) Total Deformation of Mild Steel Material for 23 mm Diameter

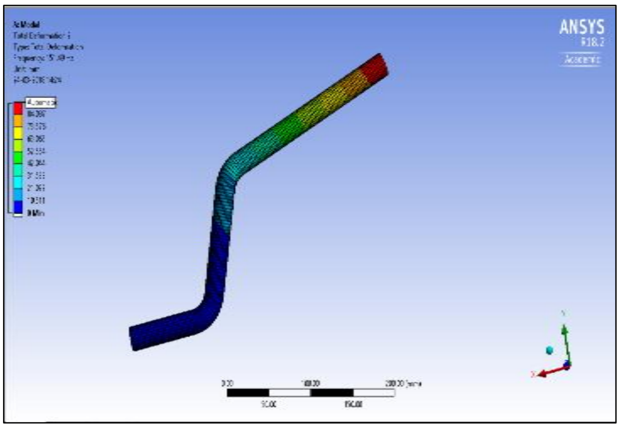

Fig. 3.2.14: Mode I

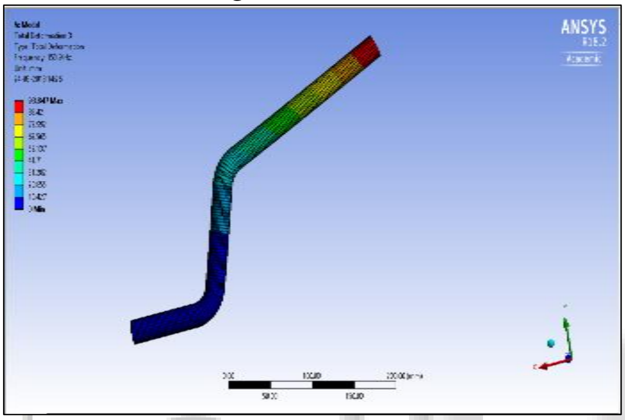

Fig. 3.2.15: Mode II

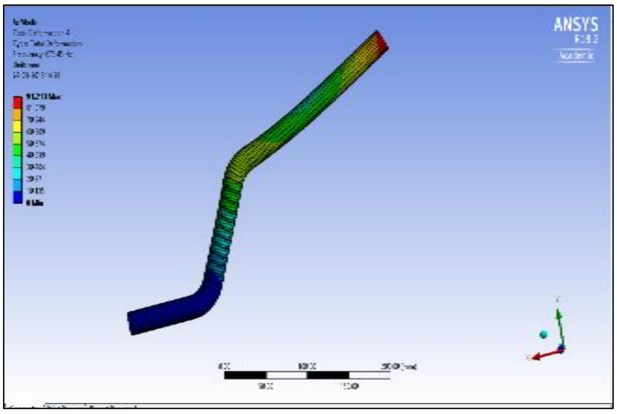

Fig. 3.2.16: Mode III

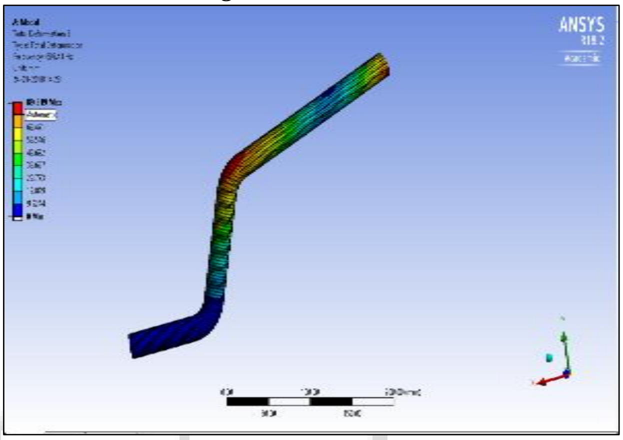

Fig. 3.2.17: Mode IV

V. OPTIMIZATION LEVEL OF HANDLE BAR

Now we have all results of Modal analysis and stress analysis from these results we have to decide the optimize results. According to the company the maximum stress should be 250 MPa and Frequency should be below 155 Hz at 2 modes and weight should be minimum.

A. Arranging the Results We Get Safe Levels As

Sr. No.	Material	Diameter	Equivalent Stress (MPa)	Frequency	Safe/Unsafe
1	Aluminium Alloy	24	222.98	143.13	Safe
2	Stainless Steel	23.4	236.16	151.06	Safe
3	Stainless Steel	23.8	218.93	152.55	Safe
4	Stainless Steel	23.6	224.7	152.95	Safe
5	Aluminium Alloy	23.4	238.01	153.43	Safe
6	Aluminium Alloy	23.8	220.52	154.55	Safe
7	Stainless Steel	24	220.54	154.82	Safe
8	Aluminium Alloy	23.6	226.6	155.35	Unsafe
9	Mild Steel	23.4	235.28	156.48	Unsafe
10	Mild Steel	23.8	218.13	158.03	Unsafe
11	Mild Steel	23.6	224.73	158.43	Unsafe
12	Mild Steel	24	219.32	160.38	Unsafe

Table 3.3.1:

Also we can say that Aluminium handle with 23.8 mm and Stainless steel at 24 mm are on the edge so we can eliminate these two.

B. From above Five Components we have to Decide Optimize Level, for this we will Consider the Weight or Mass,

Sr. No.	Material.	Diameter	Equivalent Stress (MPa)	Frequency	Mass in Kg
1	Aluminium Alloy	24	222.98	143.13	0.486
2	Stainless Steel	23.4	236.16	151.06	1.201

3	Stainless Steel	23.8	218.93	152.55	1.301
4	Stainless Steel	23.6	224.7	152.95	1.26
5	Aluminium Alloy	23.4	238.01	153.43	0.431

Table 3.3.2:

C. From Mass we get Optimize Levels are as Follows

Sr. No.	Material.	Diameter	Equivalent Stress (MPa)	Frequency	Mass in Kg	Optimized level
1	Aluminium Alloy	24	222.98	143.13	0.486	-
2	Aluminium Alloy	23.4	238.01	153.43	0.431	Optimized level

Table 3.3.3:

So we got aluminium Alloy with 23.4 mm as optimum level.

VI. Conclusion

In this project ANSYS V17 package is used for Modal vibrational analysis and Static structural analysis of the motorcycle Handlebar assembly. In the static structural analysis there were three materials out of six were taken into consideration. The equivalent stress and strain was calculated for each materials whereas in the modal analysis the six different mode shape results are obtained showing different deflections of handlebar assembly. While on the other hand in the experimental investigation strain probes were applied on specific points on the handlebar. And accordingly the following conclusions have been made from the above study:

1) As there is good correlation between the Software (FEM) results and
2) Experimental test results with average error found to be around 8-9 % only.
3) As Software (FEM) method can predict good results and number of iterations can be taken within less time so, there is no need of actual or prototype formulation to conduct experimental test. FEM approach can be used to reduce design cycle time, number of prototypes and more importantly, testing time and its associated costs.

As Aluminium alloy having less cost and fulfils the requirements regarding weight optimization. So it is the best material for two wheeler handlebar if one go for the weight optimization and cost reduction.

References

[1] Pranavdeep A. Borse, Dr. Purushottam S. Desale et al, Design and Vibrational Analysis of Motorcycle Handlebar by FEA Method and correlating it with Test Results, International Advanced Research Journal in Science, Engineering and Technology, ISO 3297:2007 Certified Vol. 4, Issue 7, July 2017.

[2] Atul P. Gund, Dr. F. B. Sayyad et al[2016], Modal Analysis on composite Pulsar Bike Handle Bar using Finite Element Analysis, International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 6, Issue 8, August 2016.

[3] H. A. Khande and P. A. Narwade, et al [2014], Structural Analysis of Two Wheeler Handlebar, International Of Technology Enhancements And Emerging Engineering Research, Vol 2, Issue 7 ,Issn 2347-4289.

[4] Amol h. Parihar, PravinP.Huzare, Swapnil s. Kulkarni et al[2015], Performance Analysis Of A Handle Bar Using Finite Element Methods To Enhance The Strength, International Journal of Advanced Engineering Research and Studies, EISSN2249–8974,April-June,2015/18-21.

[5] HaraleShivraj. N, Gyanendra Roy et al [2012], “Vibration Analysis of 2 Wheeler HandleBar Assembly” Mahindra 2 Wheelers Ltd. Mahindra 2 Wheelers Ltd. 2012, PP. 1-7.

[6] Mr.Chandrakant S. Khemkar, Prof. Ganesh A. Kadam et al [2015], Structural Analysis and Design Optimization for Handle Bar Assembly of Motor-Cycle, International Journal for Scientific Research & Development| Vol. 3, Issue 09, 2015 | ISSN (online): 2321-0613

[7] Harshada G. Deshmukh, S. G. Dambhare, M. R. Phate et al [2014], 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.

[8] Rajratna M. Kharat, Dr. K. K. Dhande et al [2015], 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.