Structural Analysis of Motor Cycle Handle Assembly

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Abstract : Designing the handle bar assembly of a two wheeler holds many challenges together with valuation of the structural strength of the mating components. Handle bar is subjected to bending or buckling (mostly) stress. The situations during braking and the forces generated due to road bumps and pot holes can increases the problem. The Finite element analysis outcomes are also well allied by the experimental results in which failure site and pattern is accurately matched. Shape optimization is done on mounting block to reduce weight of component. Further modifications have been made in design to come across the strength requirement.

Index Terms **- Handle bar, Housing, Frame, Finite element analysis, Bending stress, Displacement, shape optimization etc.**

Introduction

Two wheeler handle-bar assemblies is user's first touch point to the vehicle and it is very complex in construction and important in functionality and safety point of view. As handle-bar assembly consists of head lamp, mirrors, clutch and brake levers, speedometer with plastic coverings which are meant to be for aesthetic appeal as shown in figure 1. Whole handle bar assembly is more susceptible to the failures as it experience numerous forces such as bumps, braking, engine vibrations, rider force, road excitations etc. To simulate vehicle operating condition, modal frequency response analysis enables to analyze the strength of structural mountings within assembly for the excitation frequency range on the vehicle. Growing competition in automotive market makes it more and more necessary to reduce the development time and cost of the product development process. One of the most costly phases in the vehicle development process is the field durability test. High expenses for this phase can be attributed to the number of prototypes used and time/efforts needed for its execution. Also, multiple iterations during designing, building and prototype testing are no longer affordable against the time and cost constraints for developing a competitive product. Today, analytical tools in the form of computer

The other areas attracting compliance are the warranty claims received from the customer during usage over the field or the report filed by the concerned field Engineer observing the field test for the vehicle. The breakage and/or damage to the component could be highlighted during the time the vehicle is put to actual use. The scope of this dissertation work falls in this area where the design of the component or the sub-assembly needs to be reviewed for the sake of failure during use.

The performances observed on the bicycles with high-rise and standard handlebar Configurations indicated they were not significantly different from each other. On the circle, figure-eight and performance with both the high-rise and standard handlebars was significantly better than with the race handlebars. The high-rise showed a slight performance edge on tasks requiring the greatest amount of maneuverability, while the standard handlebars offered more control at slower speeds and on tasks requiring stability in tracking. Since the handling characteristics of bicycles can affect their safety.

In designing and manufacturing of any component or part initially we have to analyze the prototype to avoid failure of part or component during operation or working. To approve the component or part or assembly the analysis to be done so the component should work under specified operating condition and environmental condition for required amount of time without failure. This process include need for function, selection of appropriate mechanism, selection of material to sustain applied load without failure, design of part, manufacturing of prototype of part, analysis of part, finally on the basis of result if necessary redesign of part and finally full proof drawing is to be send to production. So stress analysis is very important phase of part development for its efficient, safely working under specified condition without failure and customer satisfaction. Here the concepts of stress analysis will be stated in a finite element context. That means that the primary unknown will be the (generalized) displacements. All other items of interest will mainly depend on the gradient of the displacements and therefore will be less accurate than the displacements. Stress analysis covers several common special cases to be mentioned later. Here only two formulations will be considered initially. They are the solid continuum form and the shell form. Both are offered in SW Simulation. They differ in that the continuum form utilizes only displacement vectors, while the shell form utilizes displacement vectors and infinitesimal rotation vectors at the element nodes.

For our case, the housing of the handle bar is met with failure near the accelerator end of the handle. A study is being initiated by the sponsoring company for identifying the source of this failure and addressing the same with modified or improved design feature/s for reducing the incidence of failure.

Objective

- Identify the inputs, specification, and required parameter for Test conditions.
- Collection of required data, material selection.

- Explore the existing 3D models / drawings for components.
- Review the existing assembly for the given application.
- Perform analysis using suitable CAE software.
- Study the results of analysis.
- Generate a revised layout for the component/s.
- Review the Design for the Case/ Housing.
- Finalize the specifications.

Drafting of Handle Assembly

Drawings and documentation are the true products of design because they guide the manufacture of a mechanical device. CATIA automatically generate associative drafting from 3D mechanical designers and assemblies. Associability of the drawings to the 3D master representation enables to work concurrently on designs and drawings. CATIA enriches generative Drafting with both integrated 2D interactive functionality and a productive environment for drawings dress-up and annotation.

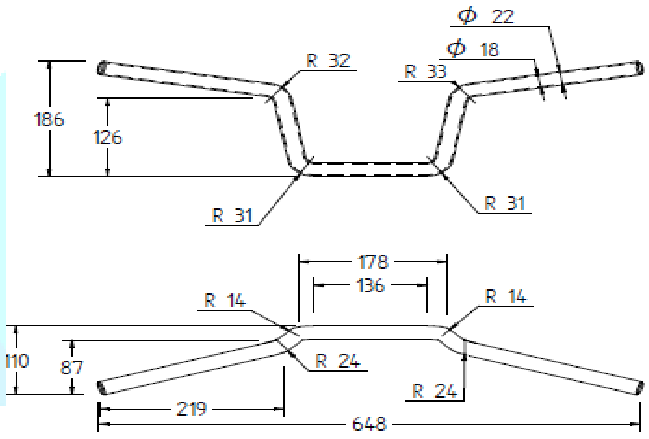

FIG.1DESIGN INPUTS FOR HANDLE BAR

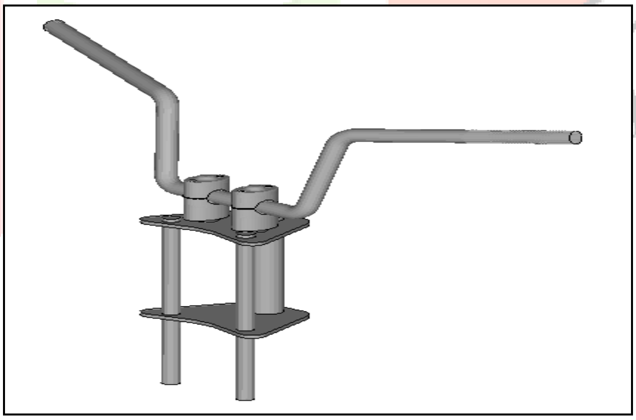

FIG.2 DRAFTING OF HANDLE BAR ASSEMBLY

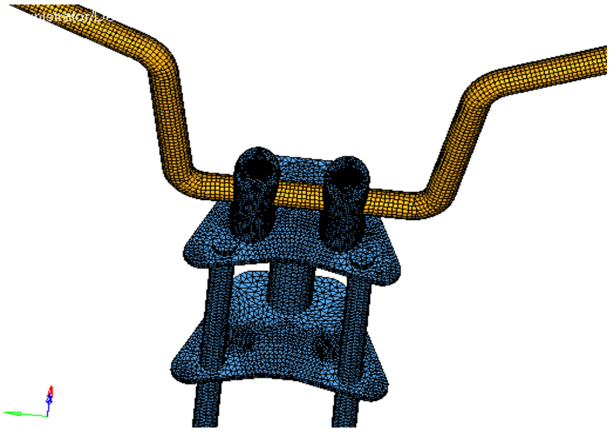

FIG.3 MESHING OF HANDLE BAR ASSEMBLY

Material selection

According to loading condition defined, study of previous data and type of stress act on handle bar material selected is ASTM A-36 with following composition.

Chemical Composition	
Element	Content
Carbon, C	0.25 - 0.290 %
Copper, Cu	0.20%
Iron, Fe	98.00%
Manganese, Mn	1.03%
Phosphorous, P	0.04%
Silicon, Si	0.28%
Sulfur, S	0.05%
Physical Properties	
Physical Properties	Metric
Density	7.85 g/cm3
Mechanical Properties	
Mechanical Properties	Metric
Tensile Strength, Ultimate	400 - 550 MPa
Tensile Strength, Yield	290 MPa
Modulus of Elasticity	210 GPa
Bulk Modulus (typical for steel)	140 GPa
Poisson's Ratio	0.3
Shear Modulus	79.3GPa

Loading Condition for Analysis

In general driving condition when driver applies break slowly total load come on handle bar is total weight of driver and generally weight of human is 80-85 kg, and angle of inclination of hand through driver apply brake is nearly 300. Total weight is equally divided into two sides of handle bar of motorcycle so weight at one side is nearly 40-42kg or 400N.

In another case suppose driver driving motorcycle with another one passenger at backseat and he applies sudden brake. Due to inertia effect sudden load experience by handle bar and driver and passenger get lifted and try to come forward and apply almost vertical load on handle bar. As general weight of human being is 70-80kg, for two persons it is nearly 140kg. Total weight is equally divided into two sides of handle bar of motorcycle so weight at one side is nearly 70-75kg or 700N.

By considering these two cases from past data and personnel experience we define the boundary conditions for analysis purpose. Most of the failures of handle bars are cause due to sudden application of brake. For a given existing design, suitable selected material and defined loading conditions analysis results are as follows.

Modification in Existing Handle Bar

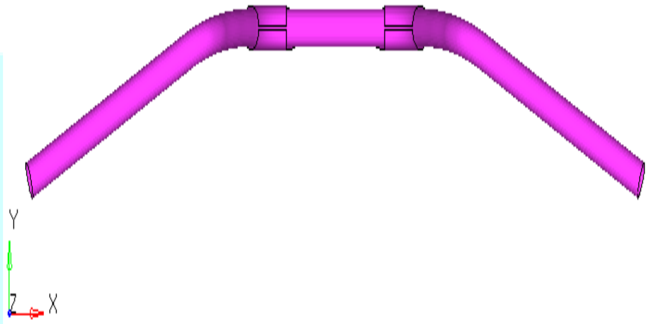

FIG.4 BRACELET WELDED AT STRESSED AREA

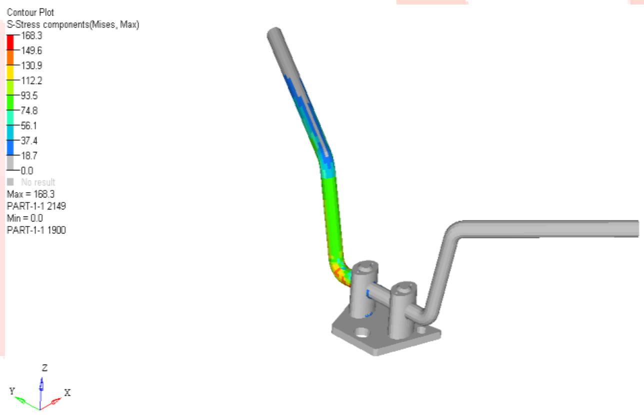

FIG. 5 STRESS ANALYSIS REPORT FOR MODIFIED DESIGN WITH BRACELET OF THICKNESS 1.5MM AT 400N INCLINED LOAD.

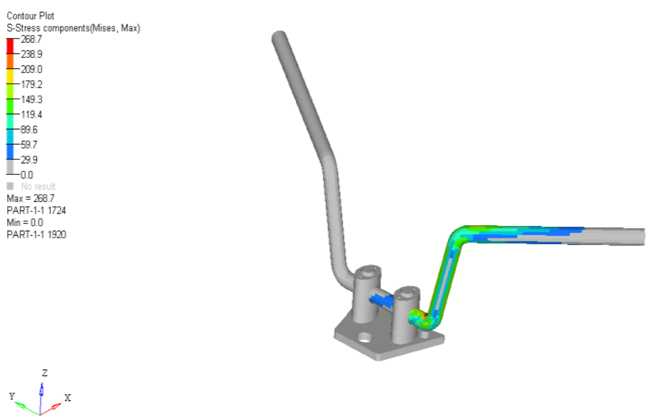

FIG. 6 STRESS ANALYSIS REPORT FOR MODIFIED DESIGN WITH BRACELET OF THICKNESS 1.5MM AT 700N VERTICAL LOAD.

Result Table

THK for handle bar(mm)	Displacement (mm)	VonMises Stress (MPa)	Major Principal Stress (MPa)
2.0	11.0	444.3	500.4
2.5	5.4	357.2	411.2
3.0	4.3	279. 1	322.2
3.0 (Bracelet added 1.5mm)	**3.6**	**168.3**	188.8

TABLE 1 RESULTS FOR 400N INCLINED LOAD FOR DIFFERENT THICKNESS OF HANDLE BAR

Variant No Th. (mm)	Displace ment (mm)	VonMiss Stress (MPa)	Major Principal Stress (MPa)
2	13.4	780.3	850.7
2.5	8.2	532. 1	596.4
3	6.5	419.3	476
2.0+ (1.5mm Bracelet)	5.2	268.7	286. 1

TABLE 2 RESULTS FOR 700N VERTICAL LOAD FOR DIFFERENT THICKNESS OF HANDLE BAR.

CONCLUSION

As discussed in paper the method of FEA for safe design before manufacturing and Experimentation after prototype manufacturing is very useful for development of new safe products. With the help of FEA we are able to design a product with high reliability and quality which is useful to increase the performance for its optimum cost. It also reduces the chances of failure and cycle time required for the development of new product.

REFERENCES

[1]F. Guarracino, A.C. Walker b, A. Giordano, Effects of boundary conditions on testing of pipes and finite element modeling, International Journal of Pressure Vessels and Piping 86 (2009) PP 196–206.
[2]Harale Shivraj. N, Gyanendra Roy “Vibration Analysis of 2 Wheeler Handle-Bar Assembly” Mahindra 2 Wheelers Ltd. Mahindra 2 Wheelers Ltd. 2012, PP. 1-7.
[3] Javad Marzbanrad n, Mohammad Reza Ebrahimi, Multi-Objective Optimization of aluminum hollow tubes for vehicle crash energy absorption using a genetic algorithm and neural networks, Thin-Walled Structures 49 (2011) PP 1605–1615.
[4] FEA Concepts: SW Simulation Overview J.E. Akin (International Journal of Industrial Ergonomics).
[5] Jia-Hua Lin, Raymond W. McGorry, Chien-Chi Chang, Effects of handle orientation and between-handle distance on bi-manual isometric push strength Liberty Mutual Research Institute for Safety, 71 Frankland Road, Hopkinton, MA 01748, USA, Applied Ergonomics 43 (2012) PP 664-670.

[6] Alexander Janushevskis, Janis Auzins ,Anatoly Melnikovs and Anita Gerina-Ancane, Shape Optimization of Mechanical Components for Measurement Systems, Riga Technical University ,Latvia.
[7] Ko Ying Hao, Zaidi Mohd Ripin, Nodal control of grass trimmer handle vibration, International Journal of Industrial Ergonomics 43 (2013) PP18-30..
[8] Elisabetta M. Zanettia,n, Giordano Franceschinia, Alberto L. Audeninob, Rider–handlebar injury in two-wheel frontal collisions journal of the mechanical behavior of biomedical materials, Department of Industrial Engineering—University of Perugia.
[9] Patil Pruthviraj Devidas, Prof. P. N. Ulhe, "Stress analysis for Handle-Bar Housing at the Accelerator of two Wheeler" Paripex - Indian journal of research. Vol.-2, Issue-7, July 2013, PP. 67-70.