International Journal of Scientific Research and Management Studies (IJSRMS)
ISSN: 23493771 **Volume 1 Issue 11, pg: 346-351**

DETERMINATION OF NATURAL FREQUENCIES OF AN HANDLE BAR USING FINITE ELEMENT METHODS TO ENHANCE THE STRENGTH

[1]Amol H. Parihar, [2]Pravin P.Huzare,[3]Swapnil S. Kulkarni
[1]ME-Mech/Design Engg, Sinhgad Academy of Engineering, Kondhwa, Pune, India
[2]Asst. Prof. Sinhgad Academy of Engineering, Kondhwa, Pune, India
[3]Director-Able Technologies India Pvt. Ltd., Pune, India

ABSTRACT

The handle bar vibrations can be contained within the prescribed limits using computational methodology for problem solving. CAE software such as Hypermesh as a pre-processor, MSC Nastran or Radioss as a solver and Hyperview as a post-processor are considered for this dissertation work. Using this methodology, nature, amplitude, and frequency of the vibrations can be predicted during the design phase. Material properties, thickness for the handle bar and the associated boundary conditions with the adjacent parts are fed into the computing interface while input and output conditions are assigned in the appropriate dialogue box of the software interface. Mathematical modeling shall provide as a preliminary tool for investigation. Physical experimentation shall offer as a source for validation being used as an alternative methodology for finding solution. The physical setup for the existing case shall be used for experimental investigation and validation.

KEY WORDS: *Handle Bar, Vibration Analysis, FEA, Nastran*

I. INTRODUCTION

Two wheeler handle-bar assembly is user's first touch point to the vehicle, also 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. 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 simulation have been developed to such a level that they reliably predict performance.

Fig. 1: Typical Two wheeler Handle bar Assembly

II. PROBLEM DEFINITION

The ride comfort and handling is dictated, besides other factors, by the nature and intensity of the vibrations perceived by the rider. The human fatigue or the depreciation in human performance is linked to the vibrations in the system, especially the area in contact with the maneuvering subsystems or controls on the vehicle. For a two-wheeler/ motorcycle, the handle bar offers a means for steering the vehicle while in motion. The problem for this work is to minimize the adverse effects of vibrations magnified with the occurrence of resonance in the maneuvering elements of the system i.e. the handle bar and the base. The existing methodology involving extensive experimentation is time consuming and proves to be expensive. Alternative means of assessment needs to be explored.

III. SCOPE

The scope of this work is to study the existing design and analysis to find out the natural frequencies. Analytical method shall be used for the work. Preliminary stress calculations shall be evaluated using mathematical model for benchmarking case. The validation shall be completed by conducting the experimentation over the existing system. FFT analyzer shall be used for measurement of natural frequencies.

IV. LITERATURE REVIEW

Harale Shivraj. N Gyanendra Roy [1] describe in this analysis the handle bar assembly is excited with acceleration derived from road load data over an operational frequency range to evaluate the strength of mountings on handle-bar in vibration. Frequency response analysis on handle bar assembly is carried out using Altair solver code Radioss Bulk data. In this analysis the handle bar assembly is excited with acceleration derived from road load data over an operational frequency range to evaluate the strength of mountings on handle-bar in vibration. Model is prepared using Hyper Mesh and Post processing is done using Hyper View and Hyper Graph. The simulation results are also well correlated by the experimental results in which failure location and pattern is exactly matched. Further modifications have been incorporated in design to meet the strength requirement.

S. Agostoni, A. Barbera, E. Leo, M. Pezzola, M. Vanali [2] In this paper it is shows that how to reduce driver vibration exposure acting on modal response of structures physically in Contact with driver, as handlebar, footpad and saddle.

Figure 2: Handlebar; (1) fixed beam, (2) insertion of steering balance into extremity of handlebar.

Mohsen Fereydooni1, Ali Nejat Lorestani, Hekmat Rabbani, Payam Javadikia [3] In this study, object is to compare effect of change engine rotation and ground type on operator of tractors and implements that utilized. In other words, the goal is to measurement and analysis of transmitted vibration on different parts of human body. In this investigation universal tractor and ferguson285 &299 tractors with moldboard plough and disk are used. Hand-Arm vibration's operator in 1300, 1500 and 1700 rpm and in ploughing field and unploughing field with hand-arm vibration meter are measured. After statistical analysis, appeared that effective vibration difference on hand and arm's operator in examined tractors is significant and engine rotation is significant too. Based on the results of statistical analysis, we can conclude that at the same terms the lowest vibration occurs respectively working with Massey Ferguson 285, 299 and Universal 650 tractors. Disking operator exposure to less vibration than he worked with moldboard plough and operator exposure to less vibration on plough ground than he worked on unplough ground. However increasing the engine rotation will increase vibrations on operator.

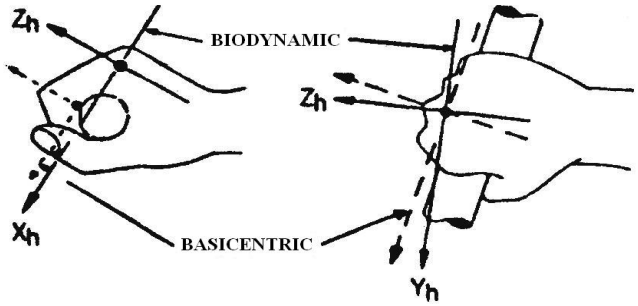


Figure 3. Presentation of Biodynamic system axis and Basicentric system

L.X. Penga, S. Kitipornchaib, K.M. Liewb [4] In this paper, a mesh free Galerkin method that is based on the first-order shear deformation theory (FSDT) will be introduced to analyse the elastic bending problem of stiffened and un-stiffened folded plates under different loadings and boundary conditions. Folded plates are regarded as assemblies of plates that lie in different planes. The stiffness matrices of the plates are given by the mesh free method. Employing the element concept, which is borrowed from the finite element method, and treating every plate as a big element, the global stiffness matrix of the whole folded plate is obtained by superposing the stiffness matrices of the plates. This is about the same for the analysis of stiffened folded plates. They are considered as assemblies of stiffened plates. The stiffness matrices of the stiffened plates are also given by the mesh free method. Superior to the finite element methods, no mesh is required in determining the stiffness matrices for the plates and the stiffened plates in this paper, which means time-consuming and accuracy-suffering re-meshing is entirely avoided for problems such as large deformation or crack propagation in folded plates or stiffener position changes of stiffened folded plates.

M. Elchalakani, X.L. Zhao, R. Grzebieta [5] In this paper an attempt is made to establish more accurate slenderness limits for cold-formed circular hollow sections. This paper describes a series of bending tests to examine the influence of section slenderness on the inelastic bending properties of cold-formed CHS. Twelve bending tests were performed up to failure on different sizes of CHS with diameter-to-thickness ratio d/t ranging from 37 to 122. This range of d/t was obtained by machining as-received cold formed circular hollow sections grade C350L0. The test results are compared with other experimental data and the design rules given in various steel specifications. The slenderness limits were established to define Class 1 (compact), 2, 3 (non-compact) and 4 (slender). These limits were based on modifications of criteria for rotation capacity commonly used for steel structures.

Ernest W. Lau [6] The mathematical modeling of column buckling or beam bending under an axial or transverse load is well established. However, the existent models generally assume a high degree of symmetry in the structure of the column and minor longitudinal and transverse displacements. The situation when the column is made of several components with different mechanical properties asymmetrically distributed in the transverse section, semi-rigid, and subjected to multiple axial loads with significant longitudinal and transverse displacements through compression and bending has not been well characterized. A more comprehensive theoretical model allowing for these possibilities and

assuming a circular arc contour for the bend is developed, and used to establish the bending axes, balance between compression and bending, and equivalent stiffness of the column. In certain situations, such as with pull cable catheters commonly used for minimally invasive surgical procedures, the compression loads are applied via cables running through channels inside a semi-rigid column. The model predicts the mathematical relationships between the radius of curvature of the bend and the tension in and normal force exerted by such cables. Conjugate extension with reciprocal compression–bending is a special structural arrangement for a semi-rigid column such that extension of one segment is linked to compression–bending of another by inextensible cables running between them. Leads are cords containing insulated electrical conductor coil and cables between the heart muscle and cardiac implantable electronic devices.

Objectives:

- Study the existing system
- Mathematical Model for the existing System
- Benchmarking Analysis for the existing system
- Identify design alternative/s for improvement
- Validation through physical experimentation over the existing

V. METHODOLOGY

1. Analytical Method:

In this method, stresses and displacement for the given system shall be calculated using numerical techniques.

2. Computational Method:

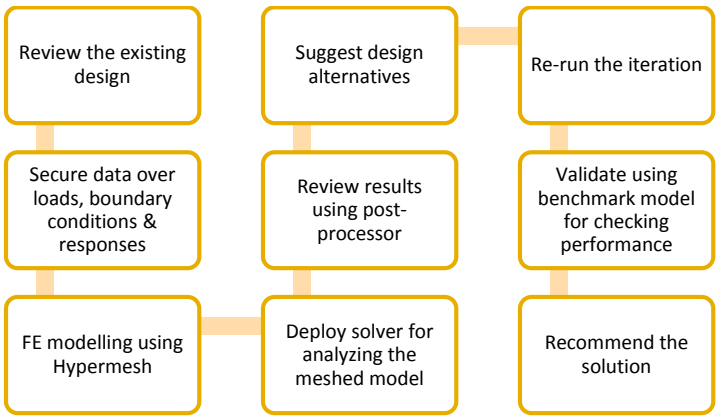
For the analysis purpose the 3D model is secured from sponsoring company. The analysis could be completed using following steps:

1. Pre-processor: Hypermesh is used for the pre-processing purpose. Generally shell elements would be used for the meshing the component. Material Properties and boundary conditions would be applied in this interface.

2. Processor: MSC Nastran or Radioss would be used for deploying the natural frequencies of the system.

3. Post-Processor: Hyperview interface would be used for finding the mode shapes and natural frequencies.

Flow Chart for methodology



Experimentation/ Validation

FFT Analyzer info / results

An FFT spectrum analyzer works in an entirely different way. The input signal is digitized at a high sampling rate, similar to a digitizing oscilloscope. The resulting digital time record is then mathematically transformed into a frequency spectrum using an algorithm known as the Fast Fourier Transform or FFT. The FFT is simply a clever set of operations which implements Fourier's basic

theorem. The resulting spectrum shows the frequency components of the input signal. The advantage of this technique is its speed. The entire spectrum takes only 4 ms to measure.

Figure 4: Typical vibration sensor device for FFT analyzer

VI. CONCLUSION

The Literature Review points to the use of Computational techniques as the preferred tool or methodology for assessing the alternatives for design. Being a prime component for styling as well as safety and comfort of the rider, handle bar is considered for compliance for the load cases and its characteristics of vibration. Experimentation shall follow the F.E. Model over its concurrence with the Benchmark geometry.

REFERENCE

[1]. Harale Shivraj N, Gyanendra Roy. Vibration Analysis of 2 Wheeler Handle-Bar Assembly.
[2]. S. Agostoni, A. Barbera, E. Leo, M. Pezzola, M. Vanali Politecnico di Milano. Investigation on motor vehicle structural vibrations caused by engine unbalances. *Proceedings of the SEM Annual Conference June 1-4, 2009 Albuquerque New Mexico USA.*
[3]. Mohsen Fereydooni, Ali Nejat Lorestani, Hekmat Rabbani, Payam Javadikia. Measurement and Analysis of Vibration of Operator in Universal 650, Massey Ferguson 285 & MF 299 Tractors. *International journal of the mechanics and Applications 2012*, 2(5): 88-92 DOI:10.5923/j.mechanics. 20120205.06
[4]. L.X. Penga, S. Kitipornchaib, K.M. Liewb, Bending analysis of folded plates by the FSDT mesh less method, *Thin-Walled Structures* 44 (2006) 1138–1160
[5]. M. Elchalakani, X.L. Zhao, R. Grzebieta, Bending tests to determine slenderness limits for cold-formed circular hollow sections. *Journal of Constructional Steel Research* 58 (2002) 1407–1430
[6]. Ernest W. Lau, Compression–bending of multi-component semi-rigid columns in response to axial loads and conjugate reciprocal extension–prediction of mechanical behaviours and implications for structural design, *journal of the mechanical behaviour of biomedical materials* 17 (2013) 112–125.
[7]. Analysis process of a steering system using a concept model for idle vibration k. C. Kim1) and C. M. KIM2)* 1)Hyundai Motor Co., Jangduk-dong, Hwaseong-si, Gyeonggi 445-706, Korea 2)Graduate School of Automotive Engineering, Kookmin University, Seoul 136-702, Korea *(Received 19 June 2007; Revised 2 February 2008)*
[8]. Irfan Dost, Shoukat Alim Khan, Majid Aziz, "Mechanical Evaluation of Joining Methodologies in Multi Material Car Body", International Journal of Advances in Engineering & Technology, Vol. 5, Issue 1, pp. 259-268, Nov. 2012.
[9]. Analytical solutions for bending and buckling of functionally graded nanobeams based on the nonlocal Timoshenko beam theory M. S_ims_ek a, H.H. Yurtcu b a Yildiz Technical University, Faculty of Civil

Engineering, Department of Civil Engineering, Davutpas_a Campus, 34210 Esenler-Istanbul, Turkey b Yildiz Technical University, Faculty of Chemical and Metallurgical Engineering, Department of Mathematical Engineering, Davutpas_a Campus, 34210 Esenler-Istanbul, Turkey

[10]. Buckling of composite thin walled beams by refined theory S.M. Ibrahim ⇑, E. Carrera, M. Petrolo, E. Zappino Department of Aeronautics and Space Engineering, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy

[11]. Deformation monitoring during removal of the supporting of T-type rigid frame bridge constructed by rotation method Lanchao Jiang*, Ri Gao School of Civil Engineering, Beijing Jiaotong University, Beijing 100044,China Received 14 July 2010; revised 25 July 2010; accepted 30 July 2010

AUTHORS' BIOGRAPHY

Amol H. Parihar working in Samarth College of engineering Belhe, Pune 412410. He is pursuing Masters of .Engineering. Specialisation in Design from Sinhgad Academy of Engineering, kondhwa, Pune.411048

Pravin P. Hujare is working in Dept. of Mechanical Engg. Sinhgad Academy of Engg. Pune-48. He has total Experience of 15 years. His Area of interest are Noise Vibrations and Acoustics, Finite Element Analysis, Composite material.

Swapnil S. Kulkarni, Director, Able Technologies India Pvt. Ltd., Pune. The Company offers Engineering Services and Manufacturing Solutions to Automotive OEM's and Tier I and Tier II Companies. He is a Graduate in Industrial Engineering with PG in Operations Management. With around 20 years of working experience in the domain of R&D, Product Design and Tool Engineering, he has executed projects in the Automotive, Medical and Lighting Industry. His area of interest is Research and Development in the Engineering Industry as well as the emerging sector of Renewable Energy.