Design and Analysis of Bike Frame using Ansys Software

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Abstract: **The frame is an important part in a Two Wheeler and it carries the load acting on the vehicle. So it must be strong enough to resist the shock, twist, vibration and other stresses. In vehicle frame different types of failure occur due to static and dynamic loading conditions. Natural frequency, damping and mode shapes are the inherent structural properties and can be found out by modal analysis. The objective of thesis is to analysis of double cradle frame under rider weight case and engine weight case and comparison of both existing and modified double cradle frame in static structural analysis by using CATIA V5 R20 simulation module. Our goal is to minimize the effect of these vibrations, because while it is undesirable, vibration is unavoidable. The dynamic characteristics of the two wheeler chassis such as the natural frequency and mode shape will determine by using finite element (FEM) method in ANSYS19.2 frequency analysis. Author will be taking ideal procedure for improve strength of chassis with respect to stability and comparison**

result of both existing and modified chassis.

Index Terms – Stress, Rigidity, Bike Chassis, Natural Frequency, Structure.

I. INRODUCTION

The frame is a skeleton upon which parts like gearbox and engine are mounted. So it is very important that the frame should not buckle on uneven road surface. Also it should not be transmitted distortion to the body. Two wheeler frames can be made of steel, aluminium or an alloy. Mostly the frame is consisting of hollow tube. If the natural frequency of two wheeler frame is coincides with excitation frequency then the resonance will occur. Due to resonance the frame will undergo dangerously large oscillation, which may lead excessive deflection and failure. To solve these problems, experimental modal analysis is very essential. Natural frequency, damping and mode shapes are the inherent structural properties and can be found out by experimental modal analysis.

Experimental Modal analysis (EMA) is the process of determining the modal parameters of a structure for all modes in the frequency range of interest. The main purpose of this thesis is to find out natural frequency, damping and mode shape of two wheeler frame using experimental modal analysis. A chassis consists of an internal framework that supports a man-made object. It is analogous to an animal's skeleton. An example of a chassis is the under part of a motor vehicle. That mass or weight reduction is an important issue in automotive industry. Chassis is a prominent structure for a moped body, which takes the loads during serious accidents, costly recalls; chassis also has an impact on product image.

II.CAD MODELING OF MODIFIED DOUBLE CRADLE FRAME FOR STRENGTH

As shown in Figure 2.1, there are different orientations of TVS bike Cradle Frame **as** isometric view, front view, top view and side view.

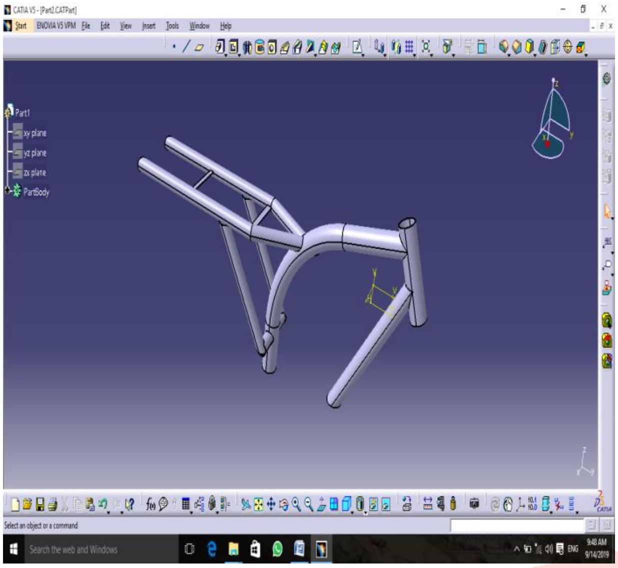

Fig.2.1 Bike chassis CATIA modeling

III. BASIC STEPS OF FEA ANALYSIS FOR MODIFY DOUBLE CRADLE FRAME

(1) Preprocessing: defining the problem

The major steps in preprocessing are

(i) define key points/lines/areas/volumes,

(ii) define element type and material/geometric properties,

(iii) Mesh lines/areas/ volumes as required. The amount of detail required will depend on the dimensionality of the analysis, i.e., 1D, 2D, ax symmetric, and 3D.

(2) Solution: assigning loads, constraints, and solving

Here, it is necessary to specify the loads (point or pressure), constraints (translational and rotational), and finally solve the resulting set of equations.

(3) Post processing: further processing and viewing of the results

In this stage one may wish to see

(i) lists of nodal displacements,

(ii) element forces and moments,

(iii) deflection plots, and

(iv) Stress contour diagrams or temperature maps.

IV. METHODOLOGY

This chapter will describe all the processes that involved in the dynamic analysis structure of motorcycles chassis. For structural analysis, it consist two methods which are finite element analysis and modal analysis testing for motorcycles chassis structure. while the finite element analysis used ANSYS software. It is necessary to select a proper methodology for any research work. Computational Experimental approach along with numerical approach gives verified results. In this proposed work the experimental analysis is done and results are verified using the advanced numerical method called as finite element analysis.

Design of motorcycles chassis using CATIA software

The motorcycles chassis structure was modeling in CATIA software. This chassis is modeling according to the measurement of the chassis motorcycles TVS bike. The material of the mountain bike is steel. Below is the figure 4.1 motorcycles modenas TVS bike 125cc, figure 4.2 chassis motorcycles TVS bike 125 cc and figure 4.2 motorcycles chassis design using CATIA.

Figure 4.1 Motorcycles TVS 125 CC

Figure 4.2 Chassis Motorcycles TVS 125 CC

V. RESULT & DISCUSSION

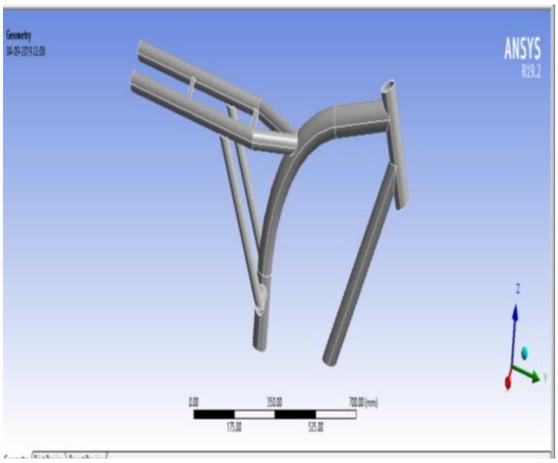

Figure 5.1 TVS Bike frame import to ANSYS

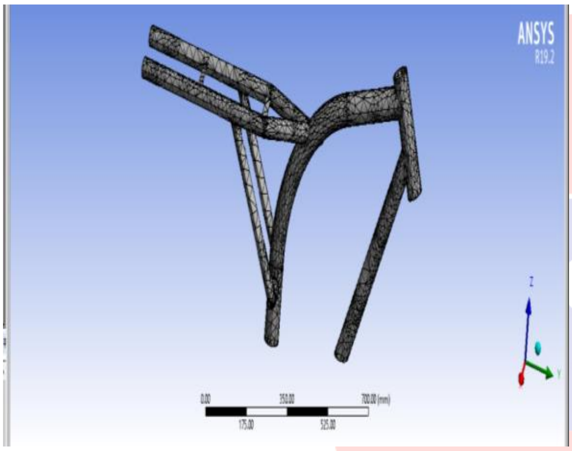

Figure 5.2 TVS Bike frame meshing ANSYS

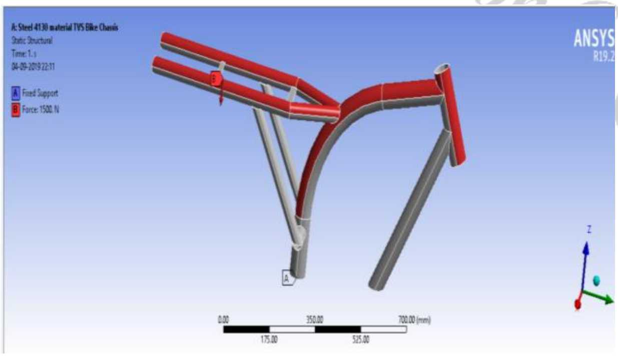

Figure 5.3 TVS Bike frame boundary conditions

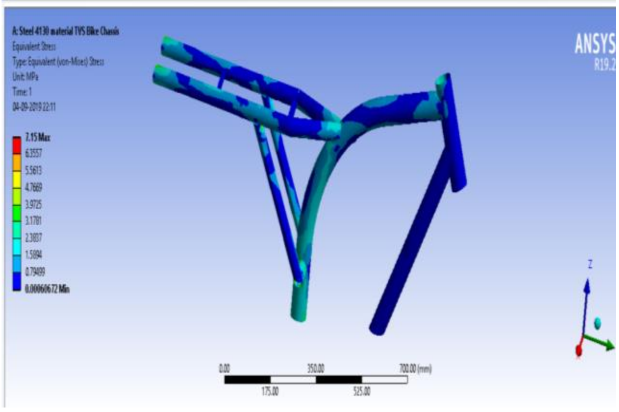

Figure 5.4 Bike frame Steel 4130 material stresses

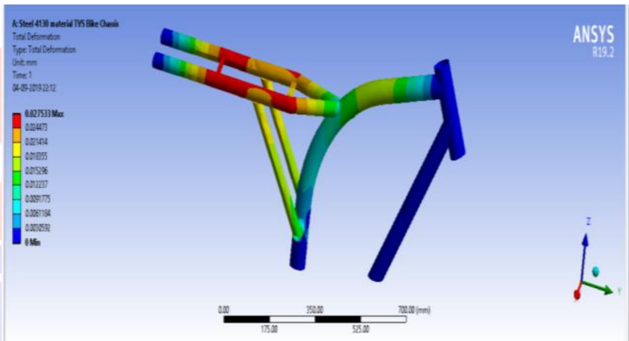

Figure 5.5 Bike frame Steel 4130 material deformation

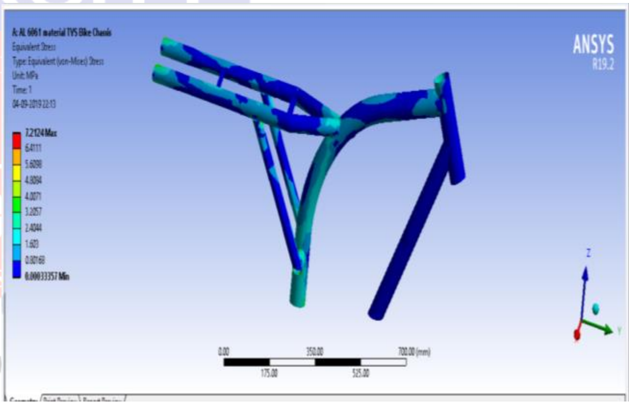

Figure 5.6 TVS Bike frame AL 6061 material stresses

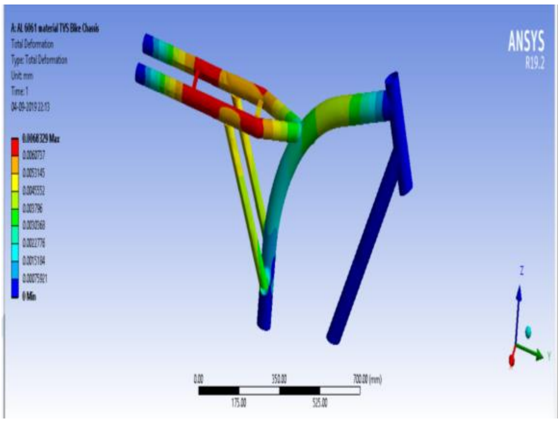

Figure 5.7 Bike frame AL 6061 material deformation

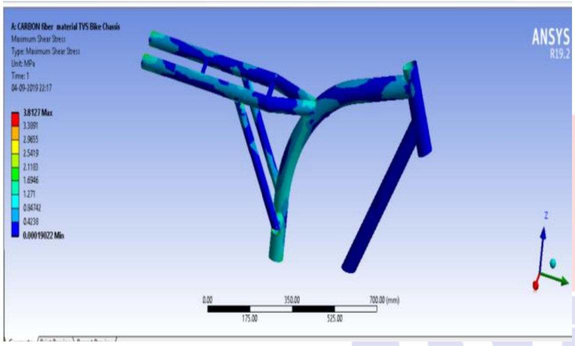

Figure 5.8 Bike frame AL 6061 material stresses

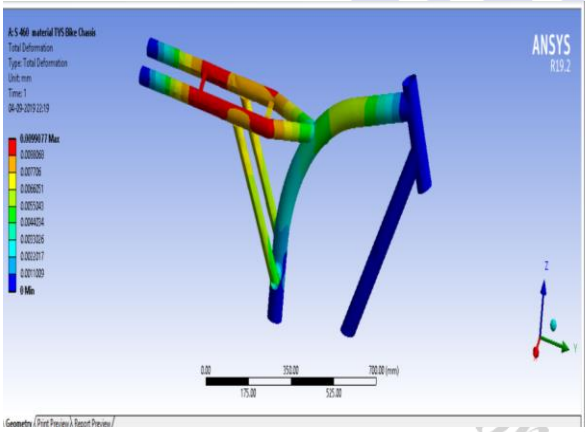

Figure 5.9 Bike frame S 460 material deformation

VI. RESULT & DISCUSSION

In the present work using the finite element analysis method and the assistance of ANSYS 19.2 Workbench software, static structural analysis has been done and we conclude following below points.

From the ANSYS software we able to analyze bike frame for Equivalent stresses and shear stress , total deformation.

In this analysis we tried to simulate real condition by notice to all of effective forces on bike frame on four different materials namely Aluminum alloy 6061 & Steel 4130, and S-460 .

From the analysis results we observe the equivalent stress in Steel 4130 bike frame to be 7.15 mpa and Aluminum alloy 6061 bike frame to be 7.2124mpa , Carbon fiber bike frame 7.2124 mpa and S-460 bike frame 7.214mpa.

From the analysis results we observe the equivalent Shear stress in Steel 4130 bike frame to be 3.7683 mpa and Aluminum alloy 6061 bike frame to be 3.8127 mpa , Carbon fiber bike frame 3.8127 mpa and S-460 bike frame 3.8127 mpa.

From the analysis results we observe the deformations in Steel 4130 bike frame to be 0.027 mm and Aluminum alloy 6061 bike frame to be 0.0068 mm , Carbon fiber bike frame 0.00477 mm and S-460 bike frame 0.0099 mm.

According to the results obtained from ANSYS software, it can be concluded that the weight of Carbon fiber is lighter and maximum stress also predicted when compare to bike frame with structural steel S-460 & Steel 4130 material and Aluminum alloy 6061 . The results clearly indicate that the new design (bike frame with carbon fiber) much lighter and has more strength than initial design of bike frame (structural steel). Hence Carbon fiber is the best replacement material in place of steel and aluminium alloy for present generation bike frames. Material optimization approach will be considered for future research.

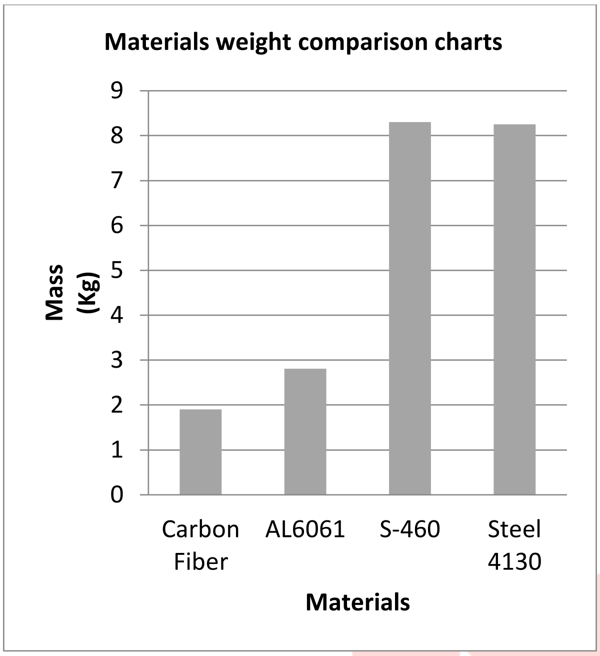

Figure 6.1Materials weight comparison charts

here we can see that the weight of bike frame we observe the deformations in Steel 4130 bike frame to be 8.25 kg and Aluminum alloy 6061 bike frame to be 2.81 kg , Carbon fiber bike frame 1.9 kg and S-460 bike frame 8.3 kg.

VII. CONCLUSION

According to the results obtained from ANSYS software, it can be concluded that the weight of Carbon fiber is lighter and maximum stress also predicted when compare to bike frame with structural steel S-460 & Steel 4130 material and Aluminum alloy 6061 . The results clearly indicate that the new design (bike frame with carbon fiber) much lighter and has more strength than initial design of bike frame (structural steel). Hence Carbon fiber is the best replacement material in place of steel and aluminium alloy for present generation bike frames. Material optimization approach will be considered for future research.

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