A Review on Design and Analysis of Two Wheeler Chassis

Gaurav Vasantrao Bhunte[1] and Dr. Tushar R. Deshmukh[2]

[1]M.E. (CAD/CAM) Pursuing, Mechanical Engineering Department, Professor Ram Meghe Institute of Institute of Technology & Reasearch Badnera, Amravati, India.
[1]gaurav_bhunte@rediffmail.com
[2]Professor, Mechanical Engineering Department, Professor Ram Meghe Institute of Technology & Reasearch Badnera, Amravati, India.
[2]tushar.d69@gmail.com

ABSTRACT

In this paper an effort is made to review the investigations that have been made on the different analysis techniques of automobile frames. That analysis may be, static analysis or dynamic analysis. A number of analytical and experimental techniques are available for the analysis of the automobile frames. Determination of the different analysis around different conditions in an automobile frames has been reported in literature. An attempt has been made in the article to present an overview of various techniques developed for the analysis of automobile frames and results of that analysis due to which further study on the chassis will become easy.

Keywords — Fatigue life prediction, Automotive Vehicles, Static Analysis, Dynamic Analysis

1. INTRODUCTION

The motorcycle chassis consists of the frame, suspension, wheels and brakes. Each of these components is described briefly below. Frame Motorcycles have a frame made of steel, aluminum or an alloy. The frame consists mostly of hollow tubes and serves as a skeleton on which components like the gearbox and engine are mounted.

The frame also serves as a support for the suspension system, a collection of springs and shock absorbers that helps keep the wheels in contact with the road and cushions the rider from bumps and jolts. Wheels Motorcycle wheels are generally aluminum or steel rims with spokes, although some models introduced since the 1970s offer cast wheels. Cast wheels allow the bikes to use tubeless tires, which, unlike traditional pneumatic tires, don't have an inner tube to hold the compressed air. The front and rear wheels on a motorcycle each have a brake. The rider activates the front brake with a hand lever

on the right grip, the rear brake with the right foot pedal. Drum brakes were common until the 1970s, but most motorcycles today rely on the superior performance of disc brake.

2. LITERATURE REVIEW

C. H. Neeraja a C. R. Sireesha and D. Jawaharlal [1] have modelled a suspension frame used in two-wheeler. Modelling is done in Pro/Engineer. They have done structural and modal analysis on suspension frame using four materials Steel, Aluminium Alloy A360, Magnesium and carbon fiber reinforced polymer to validate our design.

By observing the results, for all the materials the stress values are less than their respective permissible yield stress values. So the design was safe, by conclusion.

By comparing the results for four materials, stress obtained is same and displacement is less for carbon fiber reinforced polymer than other three materials. So for design considered, CFRP is better material for suspension frame.

Cicek Karaoglu and N. Sefa Kuralay [2] did the finite element analysis of a truck chassis. The analysis showed that

 COPYRIGHT © 2015 IJREST, ALL RIGHT RESERVED

increasing the side member thickness can reduce stresses on the joint areas, but it is important to realize that the overall weight of the chassis frame increases. Using local plates only in the joint area can also increase side member thickness. Therefore, excessive weight of the chassis frame is prevented.

In November 2008 **Mohamad Tarmizi Bin Arbain** uses 3D model for finite element analysis issues regarding the experimental analysis of car chassis is addressed. The modeling approach is investigated extensively using both of computational and compared it to experimental modal analysis.

A comparison of the modal parameters from both experiment and simulation shows the validity of the proposed approach. Then perform the computational stress analysis with linear material type analysis to find the stress concentration point in the car chassis.

Karaoglu and Kuralay[3] investigated stress analysis of a truck chassis with riveted joints using FEM. Numerical results showed that stresses on the side member can be reduced by increasing the side member thickness locally.

Fermer et al investigated the fatigue life of Volvo S80 Bi-Fuel using MSC/Fatigue **Conle and Chu [4]** did research about fatigue analysis and the local stress –strain approach in complex vehicular structures.

Structural optimization of automotive components applied to durability problems has been investigated by **Ferreira et al Filho Et. al. [5]** have investigated and optimized a chassis design for an off road vehicle with the appropriate dynamic and structural behavior.

In July 2011 **Kutay Yilmazçoban, Yaşar Kahraman [6]**, put some works on the chassis optimization by using the finite analysis, his main focus was on the reduced the weight of the chassis for that he used three thickness 4 mm, 5 mm & 6 mm and after analysis he conclude that the 4 mm thickness is better because the stress and the displacement in that is better than other two thickness.

Teo Han Fui, Roslan Abd. Rahman [7], in December 2007, works on the Statics and Dynamics, Structural Analysis of a 4.5 Ton Truck Chassis, he determined the dynamic characteristic, of the truck chassis, investigating the mounting locations of components on the truck chassis and observing the response of the truck chassis under static loading conditions. The local bending vibration occurs at the top hat cross member where the gearbox is mounted on it.

And hence, the mounting location of the engine and transmission system is along the symmetrical axis of the chassis's first torsion mode where the effect of the first mode is less. However, the mounting of the suspension system on the truck chassis is slightly away from the nodal point of the first vertical bending mode. This might due to the configuration of the static loading on the truck chassis. For the linear static analysis, the stress distribution and deformation profile of the truck chassis subjected to two loading conditions: truck components loading and asymmetrical loading had been determined. Maximum stress occurred at the mounting brackets of the suspension system while the maximum translation occurred at the location where the symmetry and asymmetry load is acting. The maximum stress of the truck chassis is 490 MPa while the maximum translation is 33.6 mm. These values are acceptable as compared to the yield strength of the chassis material and the tolerance allowed for the chassis.

O Kurdi, R Abd- Rahman, M N Tamin [8], works on the, Stress Analysis Of Heavy Duty Truck Chassis Using Finite Element Method, he mainly focus on the important steps in development of a new truck chassis is the prediction of fatigue life span and durability loading of the chassis frame. Fatigue study and life prediction on the chassis is necessary in order to verify the safety of this chassis during its operation. Stress analysis using Finite Element Method (FEM) can be used to locate the critical point which has the highest stress. This critical point is one of the factors that may cause the fatigue failure.

In June 2012 **Haval Kamal Asker1, Thaker Salih Dawood1 and Arkan Fawzi [9]**, put some works on the Stress Analysis of Standard Truck Chassis during Ramping on Block Using Finite Element Method and he focused on the intensity and the strength of the frame play a big role in the truck's design.

 COPYRIGHT © 2015 IJREST, ALL RIGHT RESERVED

A frame of 6 wheels, standard dump truck has been studied and analyzed using Ansys package software.

Fig: 2.1 Back bone Frame

The static intensity of the frame has been analyzed when exposed to pure bending and torsion stress, within two cases. First case is when the rear wheels zigzag gets over block (only one side of the chassis steps the block), and the second case is when both wheels gets over the block. The results show important differences between the two case studies, especially in the torsion and deformations results obtained from the chassis model.

Also, vibration modes have been analyzed during the loading conditions. The more damping ratio Used, the more stabilizing of the stresses with respect to time

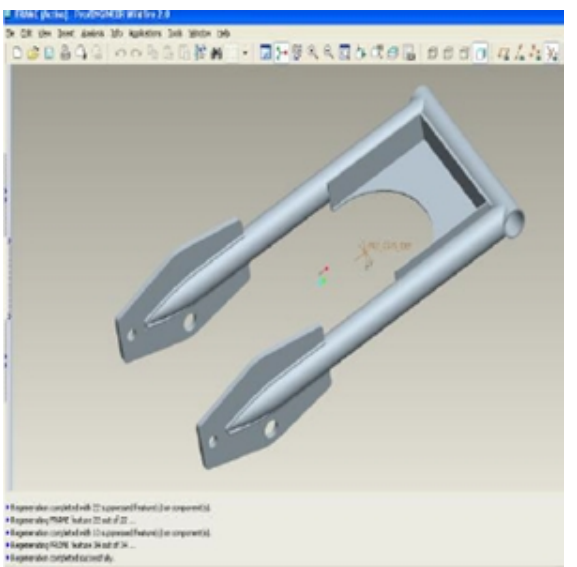

Fig: 2.2 Pro/Engineer model of suspension frame

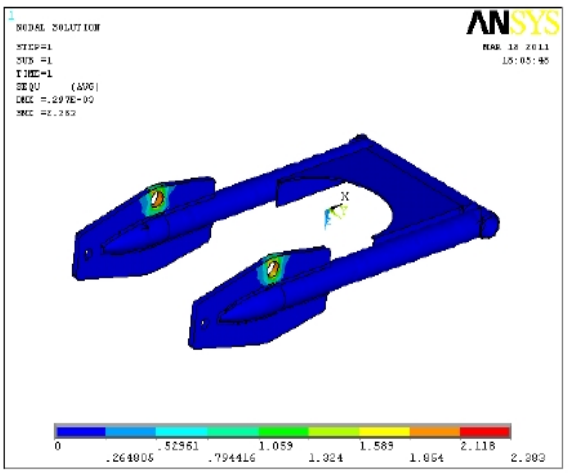

Fig. 2.3 Structural analysis of suspension frame using aluminium alloy a360

Table 2.1For Alloy Steel:

	Results	Permissable
Displacement	0.297e-3	
Vonmises stress	2.383	325
	Frequency	Displacement
Mode 01	0.024473	0.922 e-3
Mode 02	0.025756	.001876
Mode 03	0.026079	0.001991
Mode 04	0.02613	0.925 e-3
Mode 05	0.032796	0.004175

Table 2.2 For Magnesium alloy:

	Results	Permissible
Displacement	0.848 e-3	
Vonmises stress	5.995	165
	Frequency	Displacement
Mode 01	0.04726	0.00167
Mode 02	0.014729	0.00167
Mode 03	0.021785	0.001547
Mode 04	0.021795	0.001547
Mode 05	0.023324	0.002075

 COPYRIGHT © 2015 IJREST, ALL RIGHT RESERVED

Table 2.3 For Aluminum Alloy A360:

	Results	Permissible
Displacement	0.551 e-3	
Vonmises stress	2.381	520
	Frequency	Displacement
Mode 01	0.023455	0.001676
Mode 02	0.02448	0.001906
Mode 03	0.02958	0.001593
Mode 04	0.02967	0.001768
Mode 05	0.030221	0.00211

Table 2.4 For Carbon fiber reinforced polymer:

	Results	Permissible
Displacement	0.002413	
Vonmises stress	2.658	83
	Frequency	Displacement
Mode 01	0.01383	0.001667
Mode 02	0.014074	0.001666
Mode 03	0.014399	0.002029
Mode 04	0.014559	0.002031
Mode 05	0.021519	0.001549

Here the Von Misses Stress - The Von Misses criteria is a formula for combining these 3 stresses into an equivalent stress, which is then compared to the tensile stress of the material.

By using the carbon fiber reinforced polymer we can suitably prepare the model. As the material has less density compared to the another materials used for manufacturing of chassis and frame, this is the best suited for our process of manufacturing, and can with stand very high loads Using carbon fiber reinforced polymer frequently in the upcoming days we can reduce the cost of manufacturing of frame. Carbon fiber-reinforced polymers (CFRPs) have an almost infinite service lifetime when protected from the sun, and, unlike steel alloys, have no endurance limit when exposed to cyclic loading.

3. CONCLUSIONS

- In the review most of cases are under study and the work carried out do not provide sustainable progress in analysis of the chassis and differentiation between load analysis results to predict life of it.
- So it is necessary to continue further study in the analysis and evaluation of the chassis to provide the pathfinder a way.
- To predict life of a chassis there is need to have the results which are based on the load variation and impact in static as well as in dynamic.

REFERENCES

[1] CH.Neeraja, C.R.Sireesha and D. Jawaharlal, “Structural Analysis of Two Wheeler Suspension Frame”, International Journal of Engineering Reasearch & Technology,Vol.1 Issue 6,August -2012.

[2] Cicek Karaoglu, N. Sefa Kuralay ,”Stress analysis of a truck chassis with riveted joints” , Journal of Finite Elements in Analysis and Design 38 (2002), Elsevier Science, page no- 1115–1130.

[3] Karaoglu, C. and Kuralay, N.S., 2000, “ Stress Analysis of a Truck Chassis with Riveted Joints”, Elsevier Science Publishers B.V. Amsterdam, the Netherlands, Vol. 38, 1115-1130.

[4] Conle, F.A. and Chu, C.C., 1997, “Fatigue Analysis and the Local Stress-strain Approach in Complex Vehicular Structures”,International Journal of Fatigue.

[5] Filho, R.R.P., Rezende, J.C.C., Leal, M. de F., Borges, J.A.F., 2003. “Automotive Frame Optimization” 12th international Mobility

[6] Kutay Yilmazçoban, Yaşar Kahraman, Sakarya University, Mech. Eng. Dept., 54187 Serdivan-Sakarya, Turkey, July2011

[7] Teo Han Fui, Roslan Abd. Rahman, Faculty of Mechanical Engineering, University Teknologi Malaysia, “STATICS and Dynamics Structural Analysis of a 4.5 Ton Truck Chassis” December,2007

[8] O Kurdi, R Abd- Rahman, M N Tamin, Faculty of Mechanical Engineering University Teknologi Malaysia 81310 UTM Skudai, Johor, Stress Analysis Of Heavy Duty Truck Chassis Using Finite Element Method

[9] Haval Kamal Asker1, Thaker Salih Dawood1 And Arkan Fawzi, “Stress Analysis Of Standard Truck Chassis During Ramping On Block Using Finite Element Method”, JUNE 2012.

 COPYRIGHT © 2015 IJREST, ALL RIGHT RESERVED