DESIGN AND ANALYSIS OF TWO WHEELER (BIKE CHASSIS)

K.Sivaramakrishnan,S. Poovarasan,S. Sakthivel,K. Ranjith Kumar

Associate Professor, Student, Student, Student

Mechanical Engineering,
Prathyusha Engineering College, Thiruvallur, India

ABSTRACT

The chassis frame forms the backbone of a vehicle, its principle function is to safely carry the maximum load for all designed operating conditions. Automotive chassis is the main carriage system of a vehicle. The chassis serves as a skeleton upon which parts like gearbox and engine are mounted. The two-wheeler chassis consists of a frame, suspension, wheels and brakes. The chassis is what truly sets the overall style of the two wheeler. Commonly used material for two-wheeler chassis is steel which is heavy in weight or more accurately in density. There are various alternate materials like aluminium alloys, titanium, carbon fiber, magnesium, etc. which are lesser in weight and provide high strength and thus can be used for chassis. This paper deals with design of two wheeler chassis frame and its weight optimization. The static loading was carried out on the chassis and the design is improving the mechanical behavior of the chassis by using alternate material while maintaining the strength. The modeling work was carried out by the CATIA V5 and analysis was done by ANSYS software. The modeling would consider the geometry characteristics and analysis would consider the geometry import, meshing, loading condition, result evaluation. Where geometry import IGS file format was followed.

Key word: static loading, meshing.

1. INTRODUCTION

Whenever to build a motorcycle, the frame determines the basic look of the bike. Of course motorcycle frames affect not only the appearance of the bike but the handling and safety of the finished machine. Frames are the basic skeleton to which other components are attached. They hold the motorcycle tanks and engine and provide support to the whole bike. Motorcycle frames are usually made from welded aluminium, steel or alloy, carbon-fiber is used in some expensive or custom frames. The purpose of a motorcycles frame is to act as a base on which all the various components can be bolted. The engine generally sits inside the frame, the rear swingarm is attached by a pivot bolt (allowing the suspension to move) and the front forks are attached to the front of the frame. The frame can also help to protect the more sensitive parts of a motorcycle in a crash. A motorcycle frame includes the head tube that holds the front fork and allows it to pivot. Some motorcycles include the engine as a load-bearing, stressed member. The rear suspension is an integral component in the design. Traditionally frames have been steel, but titanium, aluminium, magnesium, and carbon-fiber, along with composites of these materials, have been used. Because of different motorcycles' varying needs of cost, complexity,weight distribution, stiffness, power output and speed, there is no single ideal frame design.

2. LITERATURE SURVEY

Prakash Katdare et all “Design Optimization of Two Wheeler (Bike) Chassis”[1] design of two wheeler chassis frame and its weight optimization. Various loading conditions like static and dynamic loadings were carried out on the chassis and the design is optimized by reducing the weight of the chassis by using alternate material while maintaining the strength. Optimization process involves preparation of a CAD model of existing component with help of 3D modelling software like CATIA V5, Pro-E. Analysis is done on this model with the help of analysis software like ANSYS which helps in determining the maximum stress, and displacement values of existing model. Further the analysis is done with alternate materials to verify the best material.

C. H. Neeraja et all “Structural Analysis of Two Wheeler Suspension Frame” [2] 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.

Yaşar Kahraman et all [3], 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.

3. SELEECTION OF FRAME TYPE:

Motorcycle frames affect not only the appearance of the bike but the handling and safety of the finished machine. Frames are the basic skeleton to which other components are attached. They hold the motorcycle tanks and engine and provide support to the whole bike.

Double cradle frames are descended from single cradle frames. They consist of two cradles that support the engine one either side. Double cradle frames are commonly used in custom motorcycles and simpler road bikes.

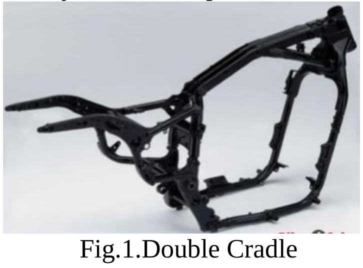
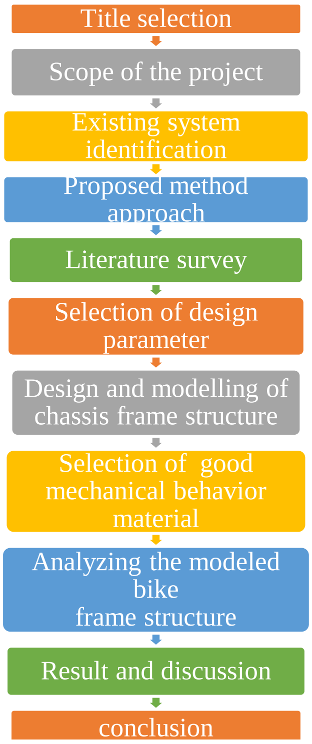


Fig.1.Double Cradle

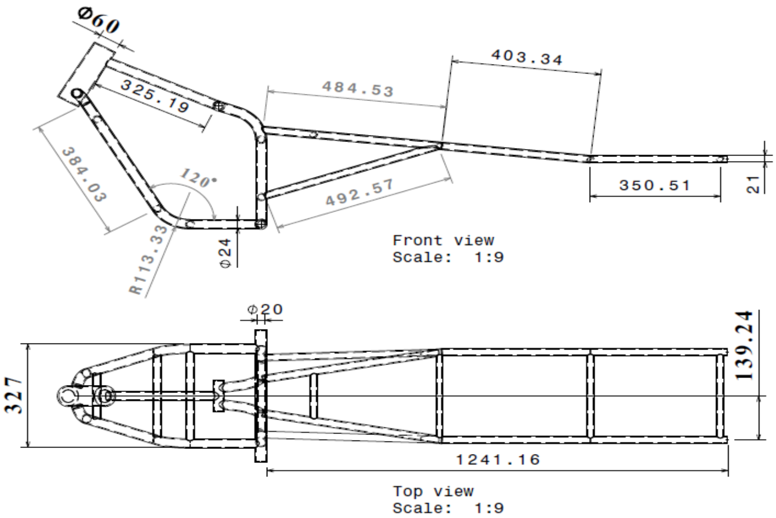
3.1 METHODOLOGY



4. CAD MODEL:

CAD model of existing chassis has been prepared in CATIA V5 as shown in fig.the dimensions were measured from existing chassis by reverse engineering.

2-D DRAFTING



3D-MODELLING

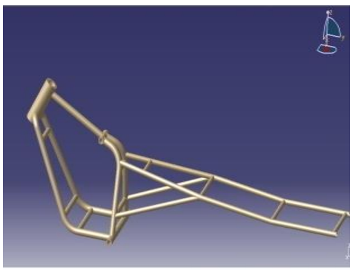


Fig.2 Isometric view

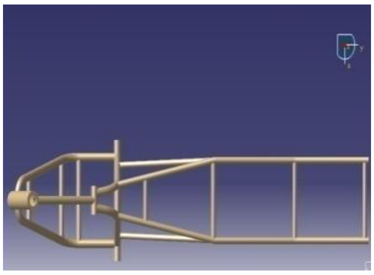


Fig.3 Top view

4.1 STRUCTURAL ANALYSIS OF BIKE CHASSIS:

A general-purpose commercial finite element code, Hyper-Mesh and ANSYS is applied to conduct the static simulations. A full 3-D solid model is constructed for the static test simulation. Mixed type of elements which contain quadrilateral as well as triangular elements, have been used in analysis. These 2D elements are converted into 3D tetra elements. The sensitive regions have been re-meshed manually considering the shape and size of the parts. From the analysis the maximum principle stress ana total deformation were determined and are shown. Table 1 shows the Material properties of steel and other three materials.

Mesh Type:Tetrahedral

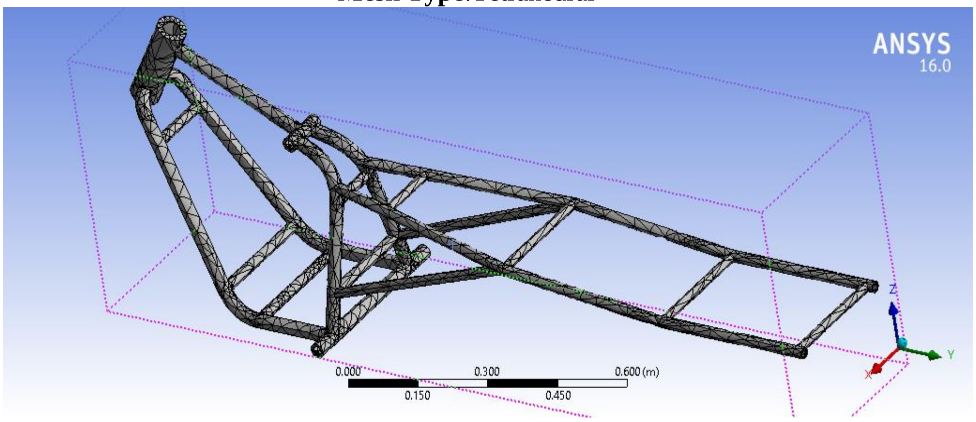


Fig.4 Meshed model

4.2 MATERIAL PROPERTIES

TABLE 1

material	Young's modulus (Mpa)	Poisson ratio	Density (t/mm3)
Stainless steel	200*E3	0.29	8E-9
Aluminium alloy	68.9*E3	0.33	2.70E-9
Carbon steel	200*E3	0.29	7.87E-9
taitanium	116*E3	0.32	4.506E-9

LOAD APPLIED:

Engine load- 300 N
- Total Weight- 1200 N
- Fuel Tank- 150 N
- Driver – 750 N
- Pillion- 750 N

SEAT AND PASSENGER LOADING:

PASSENGER WEIGHT

200 KG = 200*9.81 = 1962 N

4.3 LOADING CONDITIONS

The portion of handle in front is made fixed (as shown in figure 5 by whitish portion) and then various loads are applied and the analysis was done.

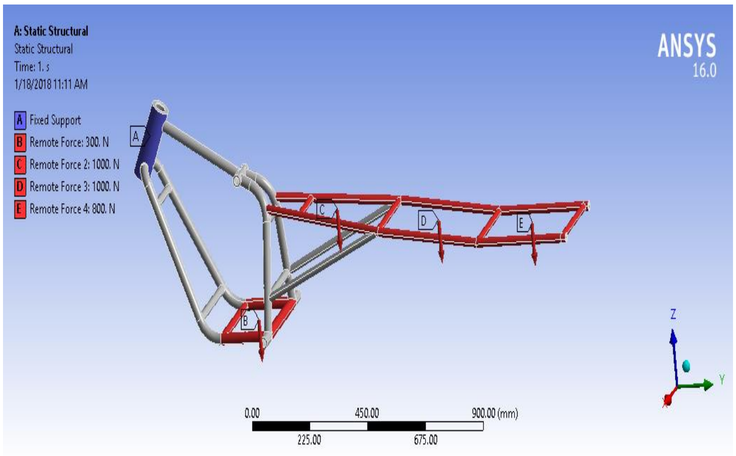


Fig.5 Loading Conditions

5. ANALYSIS RESULTS:

5.1 stainless steel

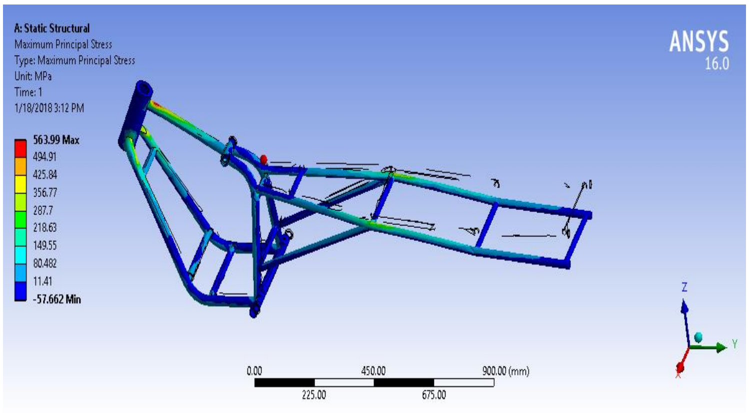


Fig.6 Max Principle stress

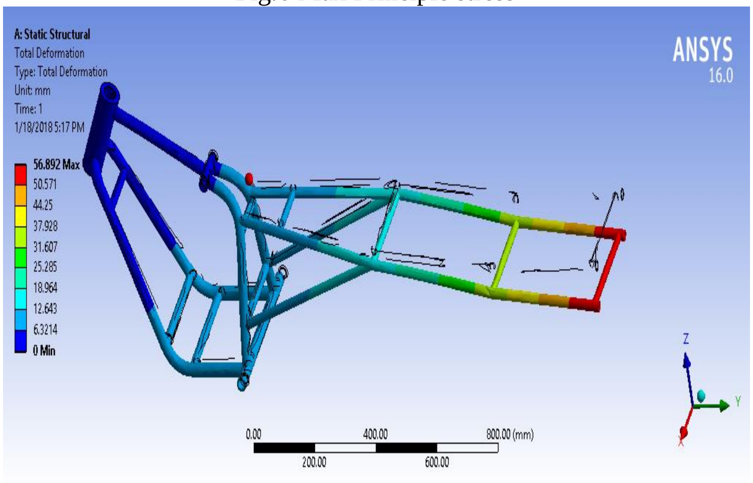


Fig.7 Total Deformation

5.2 Aluminium alloy

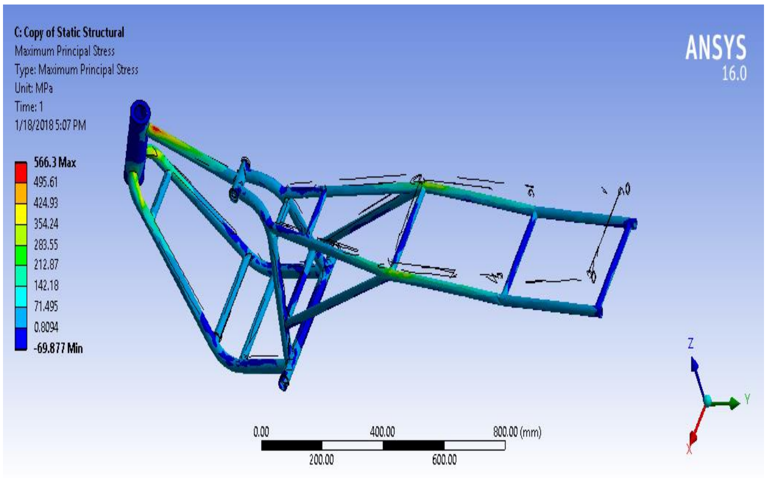


Fig.8 Max principle stress

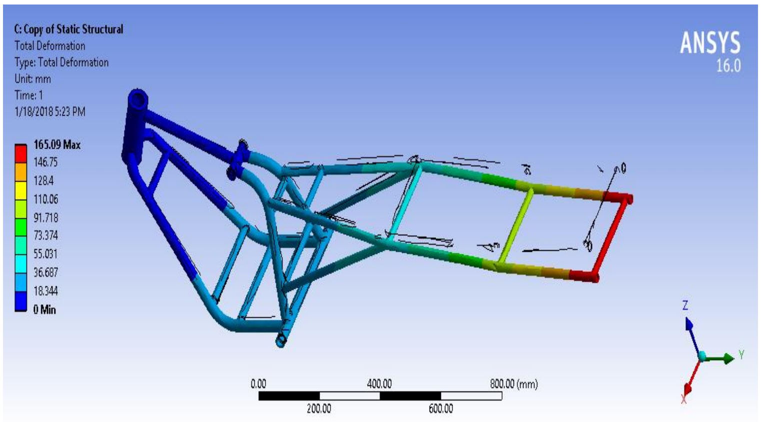


Fig.9 Total Deformation

5.3 Carbon Steel

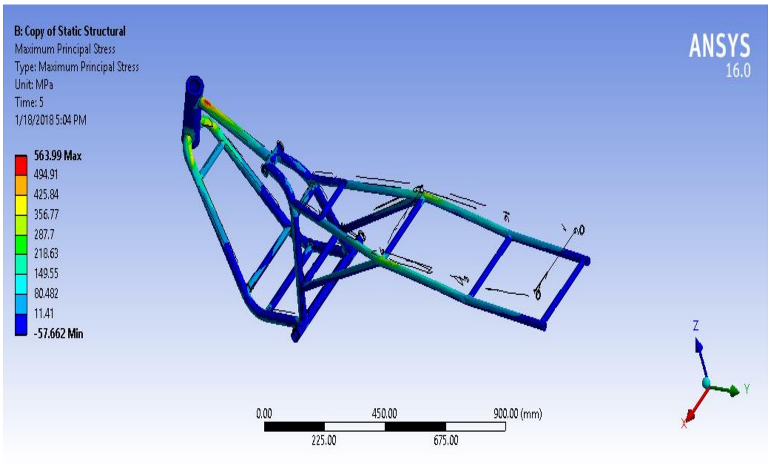


Fig.10 Max Principle stress

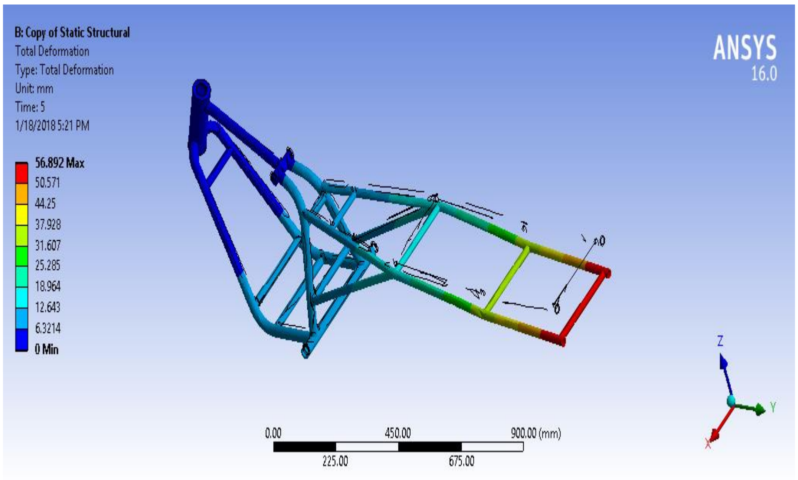


Fig.11 Total deformation

5.4 Titanium

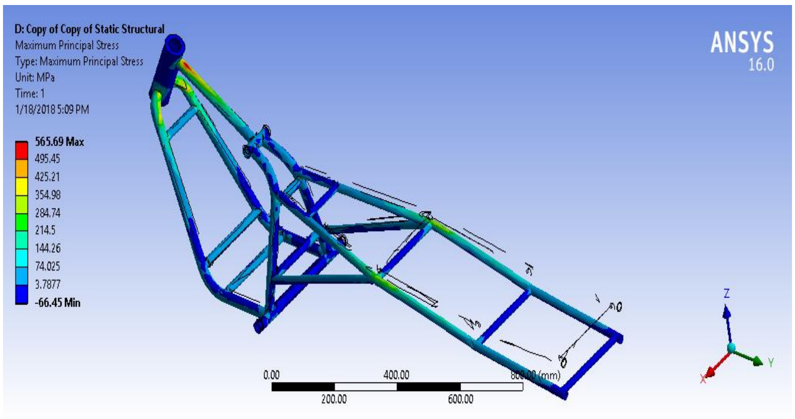


Fig.12 Max principle stress

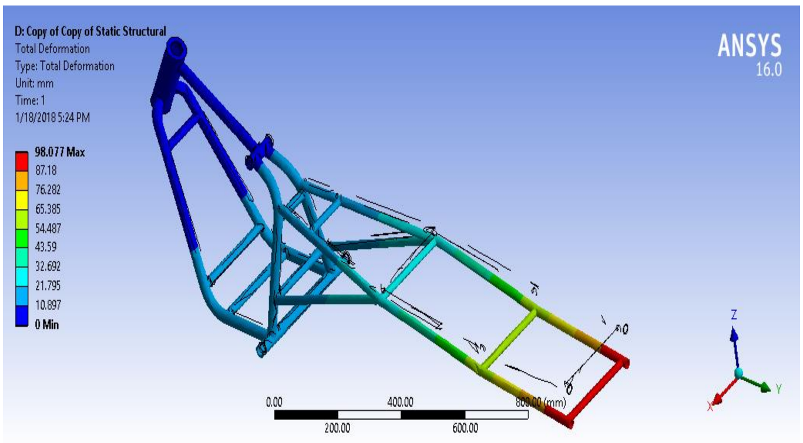


Fig.13 Total deformation

COMPARISON TABLE:

MATERIALS	Max principle stress(mpa)		Total deformation (mm)	
	Min	Max	Min	Max
Structural steel	-57.662	563.99	0	56.892
Aluminium alloy	-69.877	566.3	0	165.09
Carbon steel	-57.662	563.99	0	56.892
Titanium	-66.45	565.69	0	98.077

6. CONCLUSION:

Hence structural analysis of the different materials has be done by using stainless steel, aluminium alloy, carbon steel, titanium must be done using **ANSYS** software.

From the result it is observed that the stresses are maximum at the joint location and also for all the materials the stress value values are less that their permissible yields stress values. So the design is safe. While comparing the all four material steel and aluminium are cheapest in cost but as for our result the stress and deformation must be lesser in stainless steel and carbon steel.

By using carbon steel it has less density compared to stainless steel materials and also cheap in cost, so this is the best suitable material for chassis frame and is expected to perform better with satisfying amount of weight reduction.

7. REFERENCES:

1.Prakash katdare, S.C.Shilwant “design optimization of two wheeler (bike) chassis” international engineering research journal (IERJ) special issue2 page 4273-4277, 2015, ISSN 2395-1621

2.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.

3.Kutay yilmazçoban, yaşar kahraman, sakarya university, mech. Eng. Dept., 54187 serdivan-sakarya, turkey, july2011 ss

4.Mrs. Bagal Nilesh N., Mrs. Kadam Ganesh S., Mrs.Ghuge Tukaram S. Mrs.Bedade Anil N. Design & Analysis of two wheeler chassis to reduce weight & cost by using Bamboo International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 04 Issue: 04 Apr -2017

5.Http://www.Streetdirectory.Com/travel_guide/60151/motorcycles/types_of_motorcycleframes.Html

6.https://www.ezlok.com/carbon-steel-properties

7.https://en.wikipedia.org/wiki/6061 aluminium alloy.