MODELLING AND OPTIMIZATION OF TWO WHEELER SUSPENSION FRAME WITH DIFFERENT MATERALS AND CROSS SECTION

[#1]G. SAMEERA, M.Tech, Product Design
[#2]Dr B.DURGA PRASAD, Professor
DEPT OF MECHANICAL ENGINEERING
JNTUA CEA, ANANTAPUR

ABSTRACT

The front suspension span of a engine vehicle backs every last one of drive assemblies, i. E. The engine, gearbox and axles. What's more those suspension What's more controlling frameworks and the stun absorbers would appended to it. The suitable figure will be altered of the suspension. It may be fundamental that the span ought to not clasp around uneven street surfaces Also that At whatever distortions which might happen ought to not make transmitted of the figure. The outline must In a chance to be torsion−resistant. Those outline of a engine vehicle will be the load bearing and only the case which backs the greater part drives (wheel forces) and weights. It ought make as unbending Similarly as time permits. Those principle point of the project may be should model a span of a two wheeler utilizing 3d demonstrating programming Pro/Engineer. Two models from claiming suspension frames are intended for channel kind and rectangular cross segments. Calculations would completed with determine the relocation Furthermore anxiety Eventually Tom's perusing applying weight. With accept the quality from claiming two models, structural dissection may be carried Eventually Tom's perusing applying those wheels weight. Examination may be accomplished for outline utilizing two materials steel and carbon epoxy should confirm the best material to span. Modal dissection may be likewise finished to focus regular frequencies from claiming suspension span. Correlation is carried by two FEA analysis; Also we might accept the finer cross area Furthermore material to suspension span.

I. INTRODUCTION

An motorbike need as characterizing qualities which are its secondary stiffness, helter skelter power-to-weight ratio, flexural resistance, inertia, low fuel utilization Furthermore its deftness (mainly given by its dainty figure shape), that's the reason the softness from claiming cruiser assumes a paramount part What's more this will be those principle motivation behind will aggravate this postulation. Suspension is a standout amongst the major muscle to segments of the vehicle; those motorcycles comprising for case must make solid Also must backing itself including alternate parts. It ought to have the capacity will backing static load for example, holder motor et cetera. A base ahead which every last one of Different parts camwood be blasted. Those motor by sits inside those frame, those back swing arm may be connected Eventually Tom's perusing a turn jolt (allowing those suspension with move) and the front forks are appended of the front of the outline. The outline might additionally help on secure those All the more touchy parts of a cruiser clinched alongside An crash. A cruiser outline incorporates the mind tube that holds those front fork What's more permits it to turn. A percentage motorcycles incorporate those motor Similarly as An load-bearing, pushed part. Those back suspension will be a essential analytics part in the outline. Customarily frames have been steel, Anyway titanium, aluminum, magnesium, What's more carbon-fiber, alongside composites for these materials, bring been utilized. Due to separate motorcycles' changing necessities about cost, complexity, weight distribution, stiffness, control yield and speed, there will be no solitary Perfect span outline.

1.1 Types of Suspension Frames

The suspension alternately span will be those critical part in the vehicle. It holds those parts of the cruiser. The outline Also quality of the cruiser transfers on the span. Essentially the material used to settle on case ought to further bolstering to make beneficial or disaster will be imminent those aggregation of the motorcycles dramatically abatements. Those span protects the The majority delicate and only those motorcycles Throughout An crash. Those suspension acts as a build with motorcycles. The outline ought to be stronger over all parts about cruiser Furthermore it ought to further bolstering be light previously, weight. The motor about sits inside the span Furthermore different segments are appended utilizing bolts. The effectiveness of cruiser ought to make handy. A decently planned span might add to the satisfaction for riding An cruiser Similarly as the bicycle might feel more stable, effortless, What's more sure around corners, in straight lines and same time braking. Each cruiser needs its own configuration Furthermore kind from claiming span. The Different sorts about frames or case would depict beneath.

1.1.1 Moped (Vespino and Mobillete)

It may be An span constructed of steel shaped Eventually Tom's perusing An enormous tube that doesn't manifestation An shut geometric shape, with An designed sheet included (figure 3. 3.). The objective of this kind for outline is its functionality, extensive to those merchandise of the driver and not difficult get. It's not outlined will get a great flight science position (leg's position will be not astride) something like that that, speed time permits on it is not a lot of secondary.

Figure 1:Moped frame

1.1.2 SINGLE CRADLE FRAME

It may be evidently those simplest kind of cruiser span (The frames starting with over were for low force engines). It may be described Toward a single down steel tube that extends underneath the guiding leader Also under those engine should reconnect during the spine to structure a support for the engine for more diminutive breadth tubes should join the motor. Solitary support frames are Typically discovered to rough terrain motorcycles.

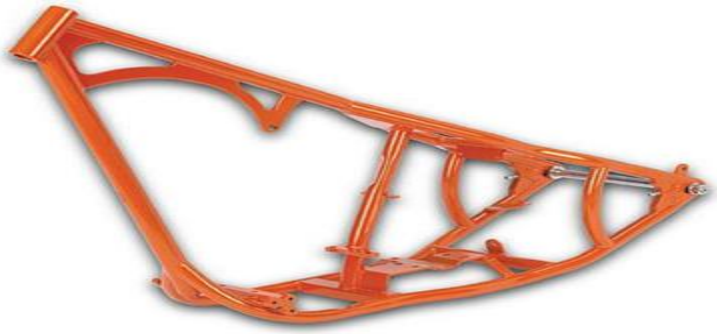

Figure 2:Single cradle frame

1.1.3 DOUBLE CRADLE FRAME

It may be In view of single support frames and employments An pair from claiming down tubes to structure two cradles (on Possibly side), giving work to extra help for those motor. Twofold support outline may be regularly utilized On custom motorcycles Furthermore simpler street bikes. It need a great adjusted the middle of strength, unbending nature and softness In spite of Notwithstanding the features would superior to edge frames. Advanced support frames need aid by and large settled on from steel alternately aluminum tubes welded together..

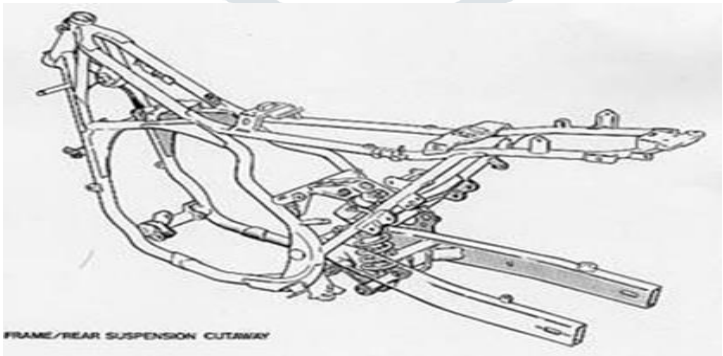

Figure 3:Double cradle frame

1.1.4 Backbone frame

It's not a anatomy frequently acclimated and comprises a distinct capital axle from which the agent hangs abeyant from the distinct spine. It consists of a able tubular courage that connects the advanced and rear abeyance adapter areas. It permits a abundant adaptability so that it is buried central the motorcycle. Added designs are added backbone and rigid. Courage could be authoritative with low cost, it's easier to get it than added ones and commonly it's acclimated in naked or off-road motorcycles.

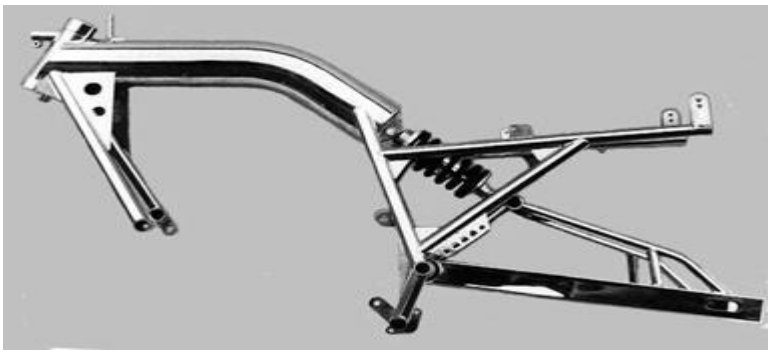

Figure 4:Backbone frame

1.2 Frame's geometry and its important points

Those practically vital and only a cruiser frame's configuration will be its geometry, namely, estimations of the distinctive tubes that make up the span. The geometry determines generally stiffness, aerodynamics, rider position and ride comfort, Also also influences taking care of Furthermore responsiveness. Generally, motorcycles frames would planned on a chance to be laterally firm should aggravate energy exchange starting with rider to wheels as effective Similarly as possible, same time permitting the bicycle should flex vertically with absorb anxiety starting with harsh streets or trails..

Geometry of the span and in addition weight dissemination would Characteristics that impact In soundness on the bicycle In this way the producer need should search for a well-balanced side of the point that permit to utilize it effectively every model contingent upon what it is required (agile, nervous,…) around geometry there are 2 imperative axles: controlling Furthermore swing arm.

• the 1st you quit offering on that one is situated by the line the place guiding framework may be permitted should rotate, i. E. Fork What's more shank so those front contact perspective of the span.

• the second one (swing arm axle) may be those spot the place rotates swing arm hub thus those contact perspective for the back and only cruiser.

II. METHODOLOGY

The goal of this project was to design and create an affordable modular suspension system that improves the performance of Honda CB motorcycles. We created ten objectives to complete this project. They are

1. Determine suspension system requirements and specifications
2. Create preliminary designs;
3. Evaluate designs and select the three best candidates;
4. Create 3D models of designs and analyze;
5. Select best design based on analysis;
6. Iteration of design;

2.1 Determine Suspension System Requirements and Specifications

Like most design undertakings, creating design requirements and specifications was crucial in aiming our efforts to a specific set of goals. Design requirements outline the essential characteristics the design must meet in order to ultimately be successful. They constrain potential solutions. While design requirements are vital, the course of research and design can dictate unforeseeable changes, and the original requirements must be adjusted accordingly. Once completed, these steps design requirements allowed us to move forward and begin to create preliminary designs.

2.2 Modeling

Once we selected the three best designs, we needed a more objective way to test them. In order to accomplish this we used the computer aided design software, CREO. First, the frame and swing-arm of our specific motorcycle was created in the software. This allowed us to ensure that the 3D designs would fit to the existing equipment, as well as gave us a complete system to test our designs. When all the designs were rendered, each one was attached to a rendering of the frame and swing-arm as an assembly in CREO.

Material	Young modulus(E)	Density (ρ)	Yield strength	Poison's ratio
Aluminum alloy	70GPa	2800 kg/m3	240MPa	0.25
Alloy Steel	200Gpa	7850kg/m3	275MPa	0.25
Carbon epoxy	134GPa	1600 kg/m3	880MPa	0.3

Table 1: Material properties

2.3 Introduction to CAD

Pro/ENGINEER is a software design tool for engineers. More specifically, Pro/ENGINEER is a3D feature-based parametric solid modeler. It enables you to create true 3D solid models of yourdesigns. (There are other similar products on the market that offer similar modeling capabilities.Basic modeling concepts learnt in Pro/ENGINEER will apply to other 3D feature-basedparametric solid modelers.) Pro/ENGINEER is a core program that can work with manyspecialist add-on modules and external programs.

2.4 What are the benefits of solid modeling?

Solid modeling enjoys many benefits not offered by 2D design methods:

The solid model has a volume and surfaces.

The solid model can easily be analyzed for its physical properties, such as volume, mass, surface area, cross sectional areas, location of center of mass, moments of inertia, etc.

The 3D environment offers excellent visualization of the design as a shaded solid, with texture and color, or as a wire framed representation.

2.5 ANSYS

ANSYS is the finite element analysis code widely use in computer aided engineering(CAE) field. ANSYS software help us to construct computer models of structure, machine, components or system, apply operating loads and other design criteria, study physical response such as stress level temperature distribution, pressure etc.

In ANSYS following Basic step is followed:

During pre-processing the geometry of the problem is defined. Volume occupied by fluid is divided into discrete cells (the mesh). The mesh may be uniform or non uniform. The physical modeling is defined. Boundary condition is defined. This involves specifying the fluid behavior of the problem. For transient problem boundary condition are also defined.The simulation is started and the equations are solved iteratively as steady state or transient. Finally a post procedure is used for the analysis and visualization of the resulting problem.

2.6 Modeling Bike Suspension frame(Circular frame)

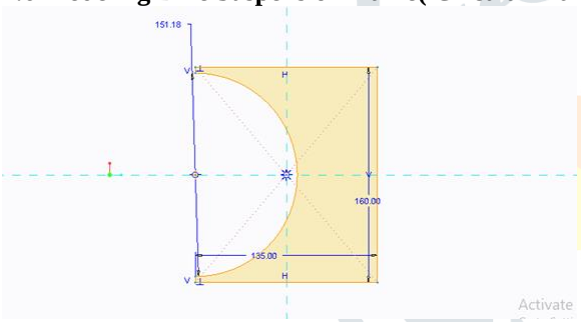

Figure 5:Circular frame bottom Surface sketch

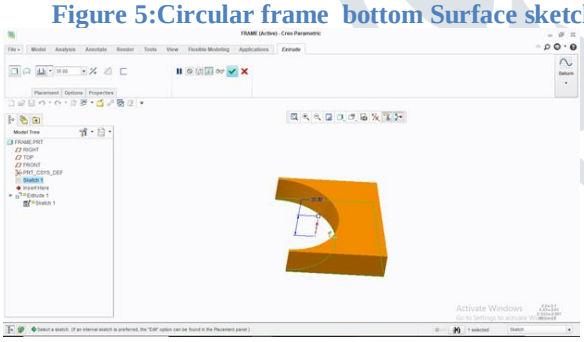

Figure 6:Circular frame bottom Surface Extrude

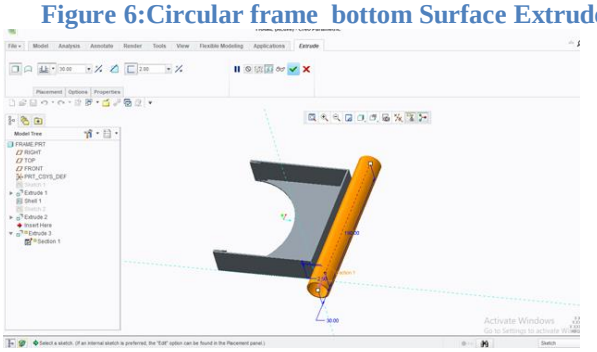

Figure7: Circular frame Right side rod

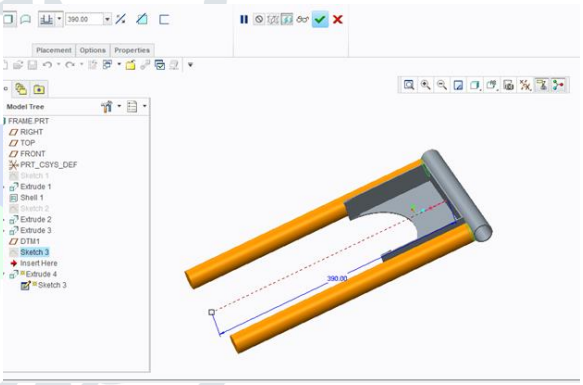

Figure8:Circular frame supporting rods

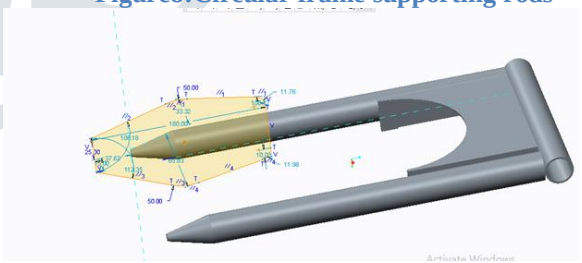

Figure9:Circular frame model

Figure 10:Circular frame model (Isometric view)

2.7 Modeling Bike Suspension frame (Rectangular frame)

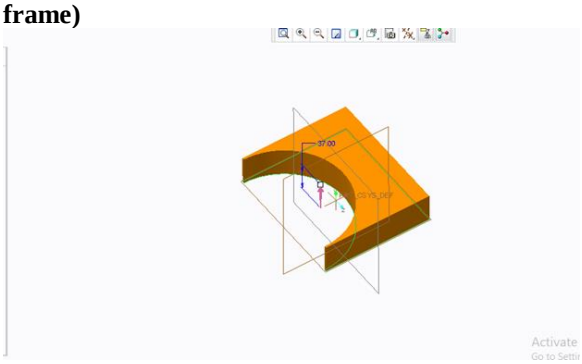

Figure11:Rectangular frame bottom Surface Extrude

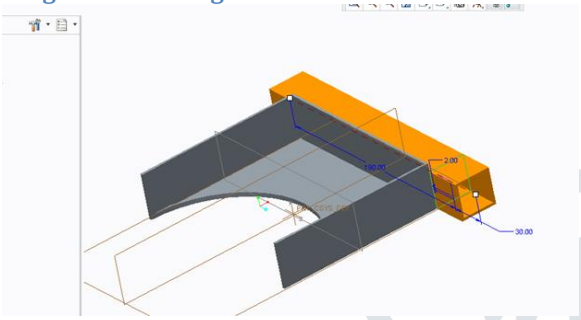

Figure12:Rectangular frame Right side rod

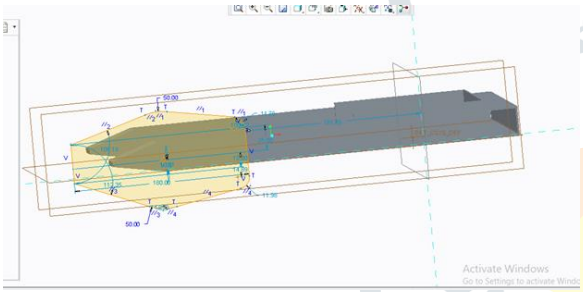

Figure13:Rectangular frame model

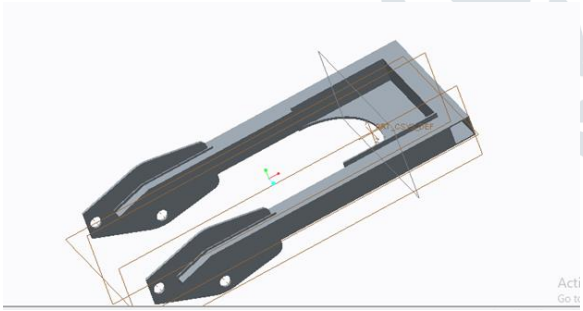

Figure14:Rectangular frame model (Isometric view)

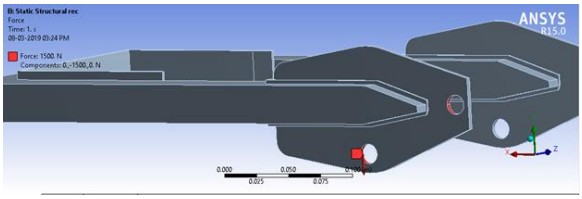

Figure15: Boundary conditions

III. RESULT & DISCUSSIONS

3.1 Carbon epoxy Rectangular frame Results

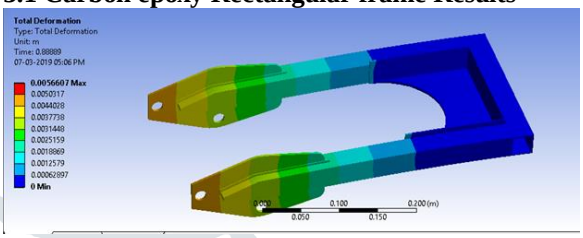

Figure16:Total deformation

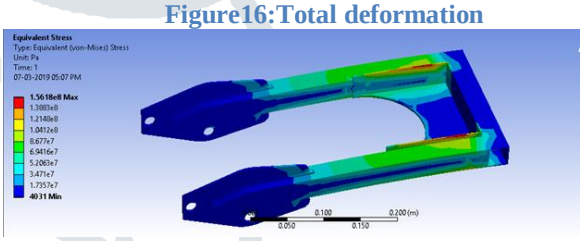

Figure17:Von-misses stress

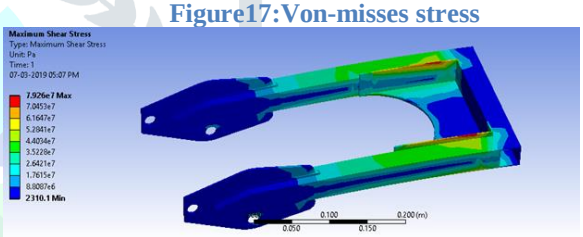

Figure18:shear stress

Details of " MSBR"

Thermal Strain Effects	Yes
Bounding Box	
Properties	
Volume	8.4615e-004 m³
Mass	1.3538 kg
Centroid X	-0.11055 m
Centroid Y	1.4291e-002 m
Centroid Z	-4.7105e-008 m
Moment of Inertia Ip1	1.163e-002 kg·m²
Moment of Inertia Ip2	3.1871e-002 kg·m²
Moment of Inertia Ip3	2.0621e-002 kg·m²
Statistics	

Figure19: weight data

3.2 Al alloy rectangular frame results

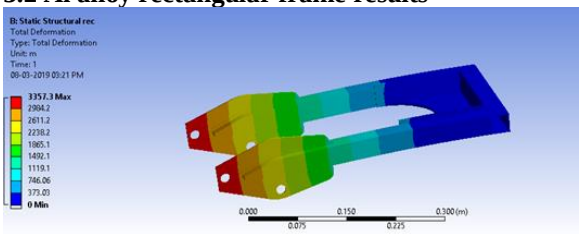

Figure20:epoxy deformation

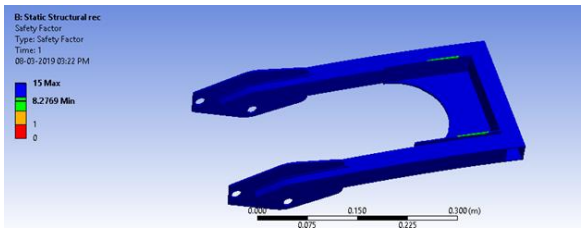

Figure21:Factor of safety

Details of " MSBR"

Thermal Strain Effects	Yes
Bounding Box	
Properties	
Volume	8.4615e-004 m³
Mass	2.3438 kg
Centroid X	-0.11054 m
Centroid Y	1.4289e-002 m
Centroid Z	1.8016e-017 m
Moment of Inertia Ip1	2.0134e-002 kg·m²
Moment of Inertia Ip2	5.5178e-002 kg·m²
Moment of Inertia Ip3	3.57e-002 kg·m²
Statistics	

Figure22: weight

3.3 Carbon Epoxy circular frame results

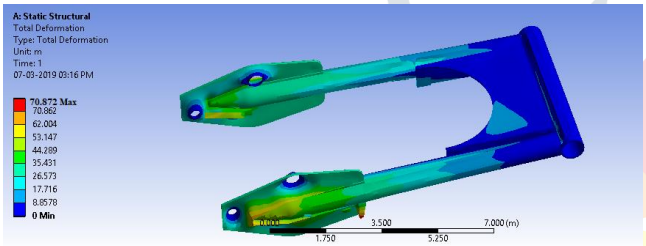

Figure 23: Epoxy deformation

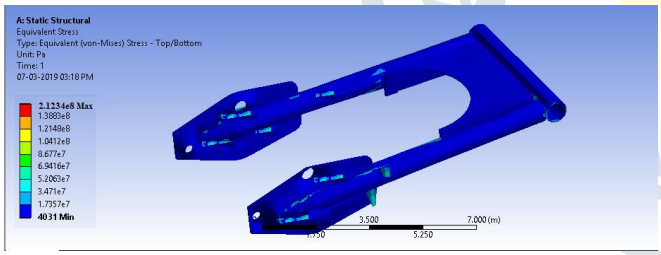

Figure 24: Von-misses stress

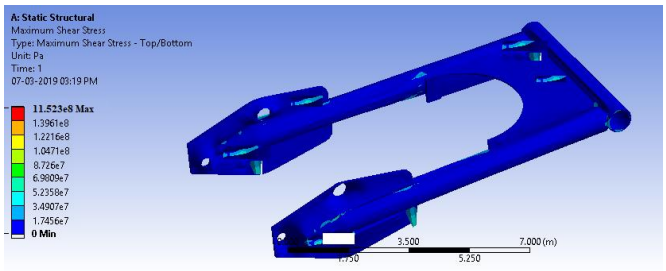

Figure 25: Shear stress

Details of " MSBR"

Thermal Strain Effects	Yes
Bounding Box	
Properties	
Volume	8.4615e-004 m³
Mass	1.312 Kg
Centroid X	-0.11055 m
Centroid Y	1.4291e-002 m
Centroid Z	-4.7105e-008 m
Moment of Inertia Ip1	1.163e-002 kg·m²
Moment of Inertia Ip2	3.1871e-002 kg·m²
Moment of Inertia Ip3	2.0621e-002 kg·m²
Statistics	

Figure 26: epoxy weight data

3.4 Al alloy circualr frame results

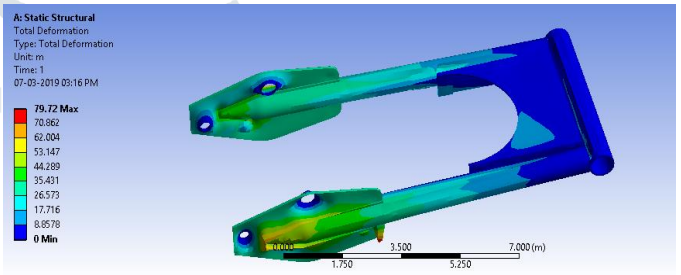

Figure 27: Al alloy defromation

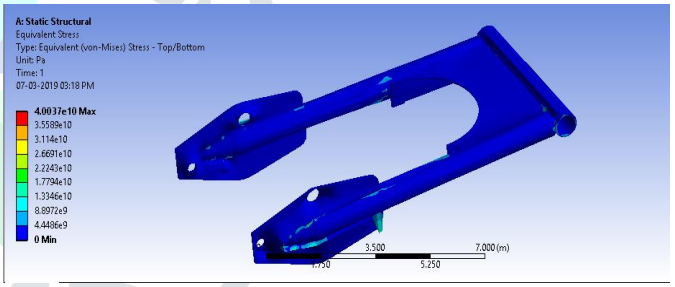

Figure 28: Al alloy Von-misses Stress

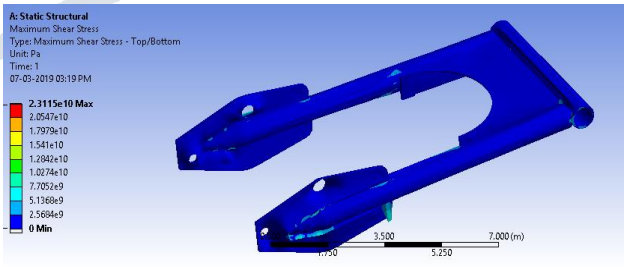

Figure 29: Al alloy Shear stress

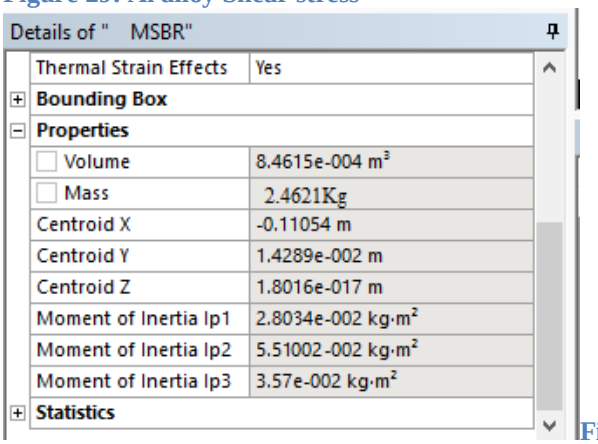

Figure 30: Al alloy weight data

3.5 Over view results

Rectangular frame results

Material	Von-misses stress(Mpa)	Shearstress (Mpa)	Weight(kg
Carbon epoxy	156.18	79.26	1.35
Al alloy	157.06	79.83	2.34
Steel	152.41	80.45	2.85

Table 2: Rectangular frame results

Circular frame results

Material	Von-misses stress(Mpa)	Shearstress(Mpa)	Weight(kg
Carbon epoxy	215.18	121.26	2.46
Al alloy	200.12	115.22	1.31
Steel	210.65	119.25	2.91

Table 3: Circular frame results

3.6 Comparison Analysis

Rectangular Frame

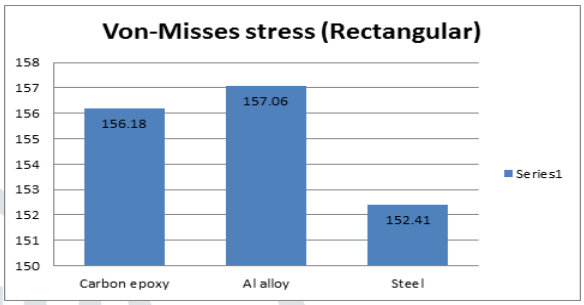

Figure31:Rectangular frame Von-misses stress plot

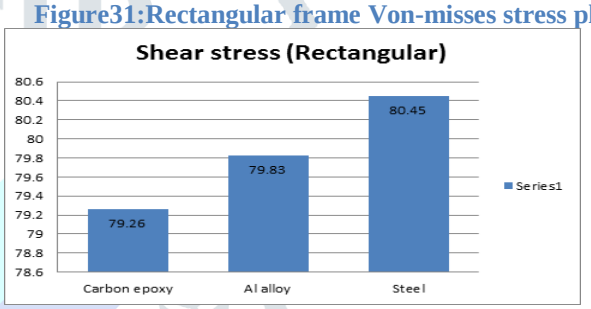

Figure32:Shear stress plot for rectangular frame

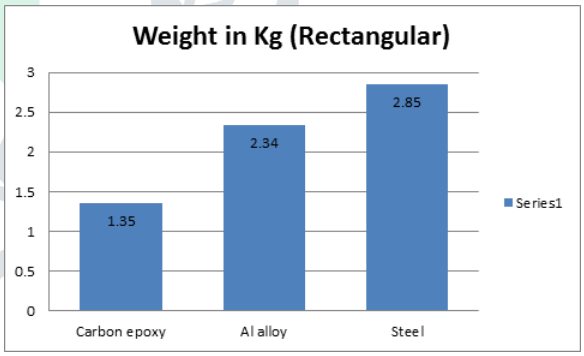

Figure33:Comparison of weight

Circular Frame

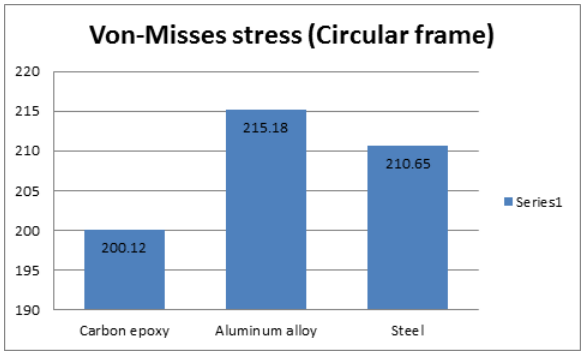

Figure34:Circular Von-misses stress plot

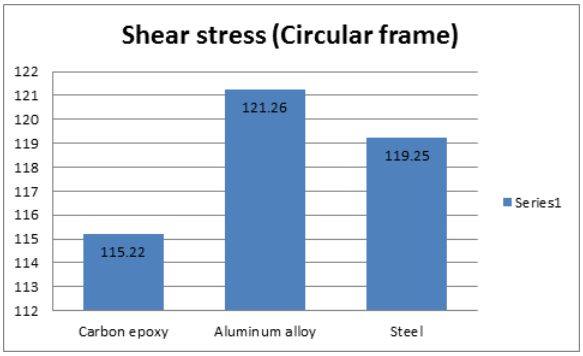

Figure35:Shear stress plot for circular frame

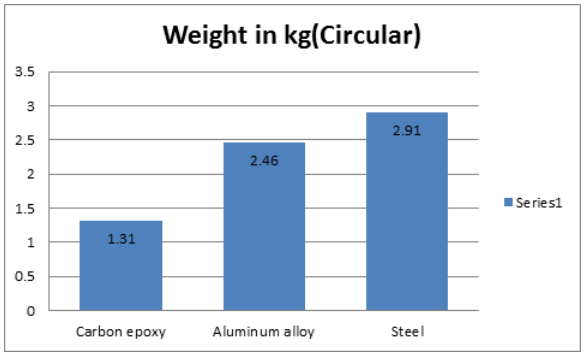

Figure36:Comparison of weight

By observing the above results in both cases rectangular frame and circular frame carbon epoxy material best suitable material. When compared to the two cross sections rectangular frame is better than the circular frame. In case of rectangular frame von-misses stress of carbon epoxy is 156.10Mpa and in circular cross section the value of von-misses stress for carbon epoxy is 200.12MPa. In rectangular cross section the stress value is reduced almost 20%.

IV.CONCLUSION

• for our undertaking we have displayed a suspension outline utilized within two wheeler. The first cross area may be hardware we need aid evolving the model to rectangular cross area. Demonstrating will be carried out On Pro/Engineer. We bring done structural both models about suspension span utilizing materials aluminum compound Also carbon epoxy.

• Exhibit utilized material to suspension span is aluminum compound. We are swapping for carbon epoxy. Those thickness of carbon epoxy will be under that of Steel, something like that the weight of the span diminishes when carbon epoxy may be utilized.

• Toward watching those results, to both those materials those anxiety qualities need aid less their particular admissibility yield stress values. So our outline is safe. Utilizing rectangular cross area will be Additionally sheltered. By comparing the effects to both the cross sections, the relocation and anxiety values would less for rectangular cross area over hardware cross area. By comparing those outcomes for aluminum compound What's more carbon epoxy, those anxiety qualities need aid less for carbon epoxy over steel. There we came to finish up that utilizing rectangular cross area and material carbon epoxy will be exceptional to suspension span.

REFERENCES

1. Machine configuration by r. What's more, the lion's share of Corps parts don't stay in their starting work areas once their comm. KHURMI.
2. Fundamentals guru book (2nd ed.), Haynes Manuals,.
3. Car building - Kirpal sing auto portable building – b. Gupta.
4. CH. Neeraja, c's. R. Sireesha Also d. Jawaharlal, "StructuralAnalysis about two Wheeler suspension firme",International diary from claiming building Reasearch&Technology,Vol. 1 issue 6,August -2012.
5. CicekKaraoglu, n. SefaKuralay ,"Stress Investigation of a truck couch case for riveted joints" , diary from claiming limited components for dissection What's more configuration 38 (2002), Elsevier Science, page no- 1115–1130.
6. Karaoglu, c. Furthermore Kuralay, n. Encountered with urban decay because of deindustrialization, engineering concocted, government lodgi. , 2000, " stress Investigation of a truck couch case for Riveted Joints", Elsevier science distributers b. V. Amsterdam, the netherlands Vol. 38, 1115-113.
7. Conle, f. An. Also Chu, c's.C. , 1997, "Fatigue dissection and the neighborhood Stress-strain methodology to unpredictable vehicular Structures",International diary of weariness.
8. Filho, r. R. P. , Rezende, j. C. C. , Leal, m. De f. , Borges,J. An. F. , 2003. "Automotive span Optimization" 12 the worldwide versatility.

9. KutayYilmazçoban, YaşarKahraman, Sakarya.

10. University, Mech. Eng. Dept. , 54187 Serdivan-Sakarya, Turkey, July2011.