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SHAPE OPTIMIZATION OF A TWO WHEELER SUSPENSION FOR PIPE TYPE AND RECTANGULAR CROSS SECTIONS

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A B S T R A C T

The frame of a motor vehicle supports all the drive assemblies, i.e. the engine, gearbox and axles (front and rear). In addition the suspension and steering systems and the shock absorbers are attached to it. The appropriate body is fixed to the chassis. It is essential that the frame should not buckle on uneven road surfaces and that any distortions which may occur should not be transmitted to the body. The frame must therefore be torsion−resistant. The frame of a motor vehicle is the load bearing part of the chassis which supports all forces (wheel forces) and weights. It should be as rigid as possible.The main aim of the project is to model a frame of a two wheeler using 3D modeling software CREO. Two models of suspension are designed for pipe type and rectangular cross sections.Considering the frame as a beam, calculations are done to determine the displacement and stress by applying loads.To validate the strength of two models, Structural analysis is done by applying the wheel forces. In this analysis ultimate stress limit for the model is determined. Analysis is done for frame using two materials steel and aluminum to verify the best material for frame. Modal analysis is also done to determine natural frequencies of suspension frame. Analysis is done in ANSYS software.Comparison is done mathematically and by FEA analysis. And also we can validate the better cross section and material for suspension frame.

Key words: Two wheeler suspension system, Aluminium Alloy, Forged Steel, Ansys Workbench, etc.

I INTRODUCTION

INTRODUCTION TO SUSPENSION FRAMES

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If you are going 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.Framesare 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-fibre is used in some expensive or custom frames. The purpose of a motorcycles frame is to act as a base onto which all the various components can be bolted to. 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.Buell, one of the motorcycling world's greatest innovators, uses the frame as a fuel tank on many of it's models like the XB12S Lightning.One of the earliest decisions to make is which of these motorcycle frames is right for your bike. Many of your other decisions will depend on the type of frame you choose so consider the options and choose wisely.

TYPES OF FRAMES

Single cradle frame - The single cradle is the simplest type of motorcycle frame, and looks similar to the first ever motorcycle frames. It is made from steel tubes that surround the engine with a main tube above and other, smaller diameter tubes beneath. If a single cradle becomes double at the exhaust, as frequently occurs, it is referred to as a split single cradle frame. Single cradle frames are usually found in off-road motorcycles.

Double cradle frame - 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. They offer a good compromise between rigidity, strength and lightness, though they have now been technically surpassed by perimeter frames.

Backbone frame - Far from the most desirable frame around, the backbone frame comprises a single, wide main beam from which the engine is suspended. The backbone frame allows for great flexibility in design, since it is concealed inside the finished motorcycle. The engine just seems to hang in mid air. It is simple and cheap to make, and is used mainly on naked and off-road motorcycles.

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Monocoque frame - The monocoque frame is used nearly exclusively on competition bikes and is very rarely found on road-going bikes. Monocoque frames act as a single piece unit that functions as seat mounting, tank and tail section. Though they offer certain advantages in terms of rigidity

LITERATURE REVIEW

DESIGN AND ANALYSIS OF SUSPENSION SYSTEM FOR AN ALL TERRAIN VEHICLE

In this paper our work was to study the static and dynamic parameter of the suspension system of an ATV by determining and analyzing the dynamics of the vehicle when driving on an off road racetrack. Though, there are many parameters which affect the performance of the ATV, the scope of this paper work is limited to optimization, determination, design and analysis of suspension systems and to integrate them into whole vehicle systems for best results. The goals were to identify and optimize the parameters affecting the dynamic performance suspension systems within limitations of time, equipment and data from manufacturer. In this paper we will also come across the following aspects

ADVANTAGES OF CREO PARAMETRIC SOFTWARE

1. Optimized for model-based enterprises

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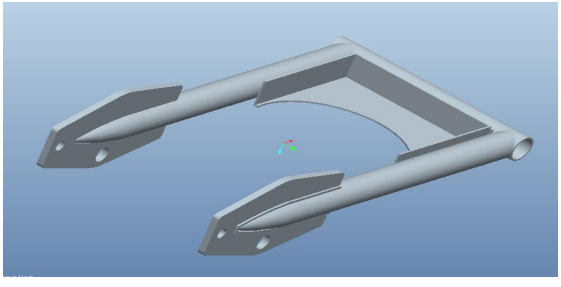
2. Increased engineer productivity
3. Better enabled concept design
4. Increased engineering capabilities
5. Increased manufacturing capabilities
6. Better simulation
7. Design capabilities for additive manufacturing

CREO parametric modules:

- Sketcher
- Part modeling
- Assembly
- Drafting

MODEL OF SUSPENSION FRAME



2d drawing

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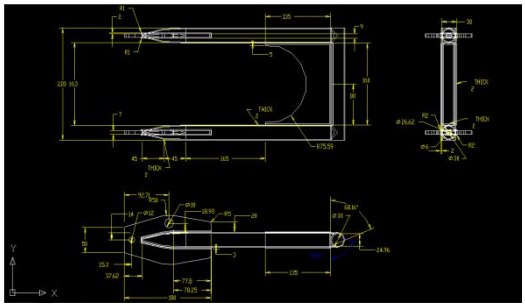
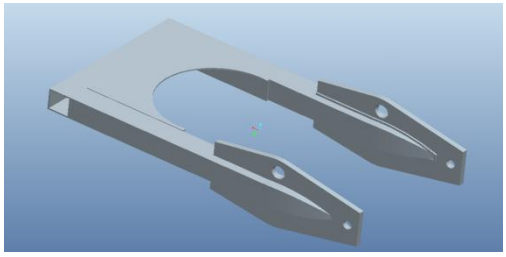
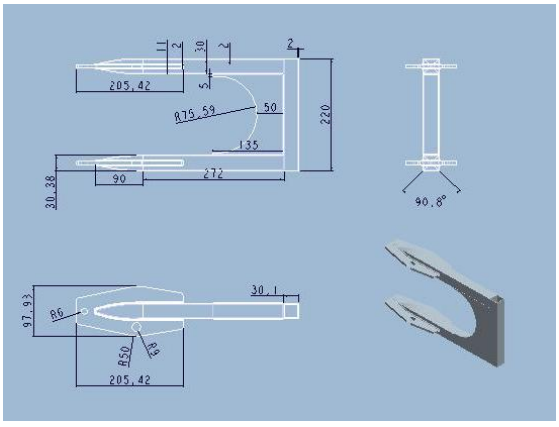


Rectangular frame





STRUCTURAL ANALYSIS OF ORIGINAL MODEL OF SUSPENSION FRAME STEEL

Imported Model from Pro/Engineer

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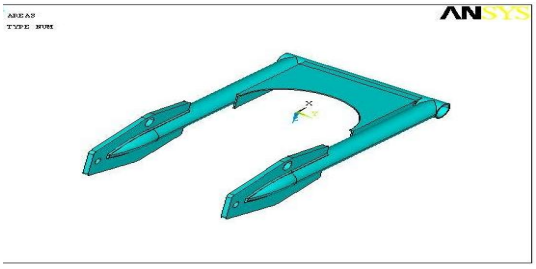
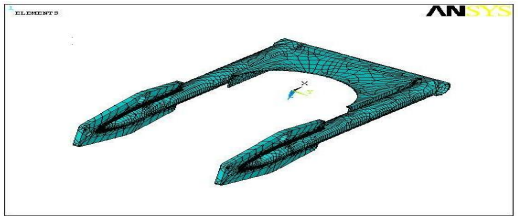
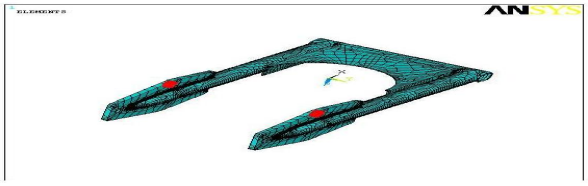


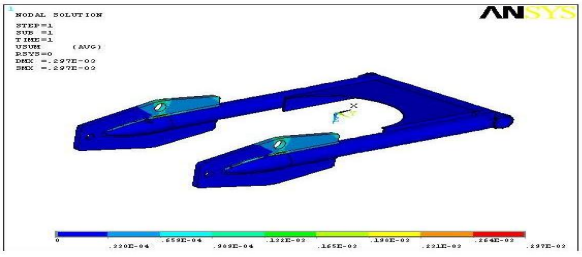
Meshing



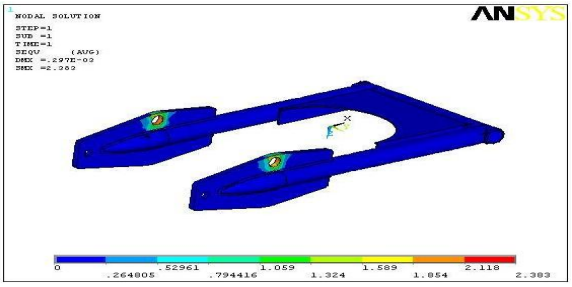
Boundary conditions



Total deformation



Stress



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DEFINITIONS OF RESULTS OBTAINED

Displacement - A vector quantity which refers to the distance which an object has moved in a given direction. It is measured as the length of a straight line between the initial and final positions of a body.

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

RESULTS TABLE

ORIGINAL MODEL

Steel

	RESULTS	**PERMISSABLE**
DISPLACEMENT (mm)	$0.297e^{-3}$	
VONMISES STRESS (N/mm^2)	2.383	325
	Frequency (Hz)	**Displacement (mm)**
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

Carbon Epoxy

	RESULTS	**PERMISSABLE**
DISPLACEMENT (mm)	$0.848\ e^{-3}$	
VONMISES STRESS (N/mm^2)	5.995	600
	Frequency (Hz)	**Displacement (mm)**
MODE 01	0.04726	0.00167

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MODE 02	0.014729	0.00167
MODE 03	0.021785	0.001547
MODE 04	0.021795	0.001547
MODE 05	0.023324	0.002075

CONCLUSION

In our project we have modeled a suspension frame used in two wheeler. The original cross section is circular we are changing the model to rectangular cross section. Modeling is done in CREO

We have done structural and modal analysis on both models of suspension frame using materials Steel and Carbon Epoxy.Present used material for suspension frame is steel. We are replacing with Carbon Epoxy. The density of Carbon Epoxy is less than that of Steel, so the weight of the frame reduces when Carbon Epoxy is used.By observing the results, for both the materials the stress values are less than their respective permissible yield stress values. So our design is safe. Using rectangular cross section is also safe.By comparing the results for both the cross sections, the displacement and stress values are less for rectangular cross section than circular cross section.By comparing the results for steel and carbon epoxy, the stress values are less for carbon epoxy than steel.So we can conclude that using rectangular cross section and material Carbon Epoxy is better for suspension frame.

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