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SHAPE OPTIMIZATION OF A TWO WHEELER SUSPENSION WITH DIFFERENT CROSS SECTIONS

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ABSTRACT

The two-wheeler chassis consists of the frame, suspension, wheels and brakes. The chassis is what truly sets the overall style of the two-wheeler. Automotive chassis is the main carriage systems of a vehicle. The frame serves as a skeleton upon which parts like gearbox and engine are mounted. It can be made of steel, aluminum or an alloy. It keeps the wheels in line to maintain the handling of the two-wheeler.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 Pro/Engineer. 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.

1.1.INTRODUCTION

In a vehicle, it reduces the effect of traveling over rough ground, leading to improved ride quality, and increase in comfort due to substantially reduced amplitude of disturbances. Without shock absorbers, the vehicle would have a bouncing ride, as energy is stored in the spring and then released to the vehicle, possibly exceeding the allowed range of suspension movement. Control of excessive suspension movement without shock absorption requires stiffer (higher

rate) springs, which would in turn give a harsh ride. Shock absorbers allow the use of soft (lower

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rate) springs while controlling the rate of suspension movement in response to bumps. They also, along with hysteresis in the tire itself, damp the motion of the unstrung weight up and down on the springiness of the tire. Since the tire is not as soft as the springs, effective wheel bounce damping may require stiffer shocks than would be ideal for the vehicle motion alone.

Spring-based shock absorbers commonly use coil springs or leaf springs, though torsion bars can be used in tensional shocks as well. Ideal springs alone, however, are not shock absorbers as springs only store and do not dissipate or absorb energy. Vehicles typically employ springs or torsion bars as well as hydraulic shock absorbers. In this combination, "shock absorber" is reserved specifically for the hydraulic piston that absorbs and dissipates vibration.

INTRODUCTION TO SUSPENSION FRAMES

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. 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 aluminum, 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 swing arm 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.

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- fibre, 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.

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CARBON FIBER MOTORCYCLE FRAMES VS. STEEL MOTORCYCLE FRAMES

Motorcycle frames are built from a range of materials such as steel, aluminum, titanium and carbon fiber. Carbon fiber is a thread-like material with a diameter of approximately 0.0002 to 0.0004 inches. A carbon fiber composite is created by mixing thousands of these threads with epoxy.

Literature survey

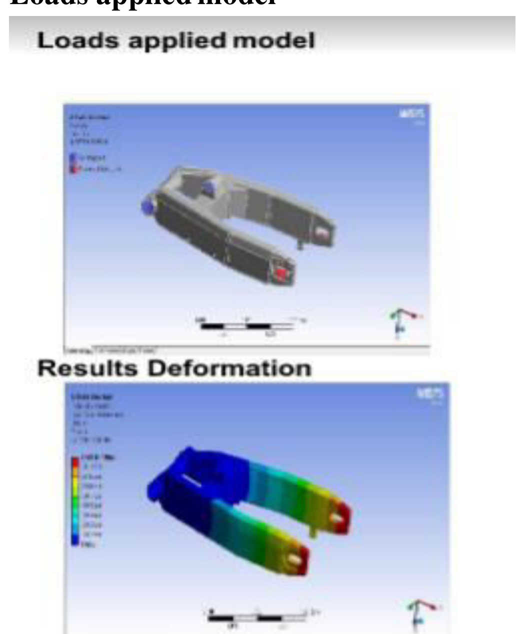
1. Miner (1945) explained fatigue damage during the crack initiation phase. Damage during the initiation phase can be related to dislocations, slip bands, micro cracks, etc. Since these phenomena can only be measured in a highly controlled laboratory environment, most damage summation approaches for the initiation phase are empirical in nature. These methods relate damage to the expended life for a small laboratory specimen. For this purpose, life is defined as the separation of a specimen, which is equivalent to the formation of a small crack in a large component or structure.

2.Gurney (1976) studied about the analyses carried out in this work were restricted to results which had been obtained for K butt joints under axial loading and transverse non-load-carrying fillet welds under both axial and bending loads. However, by far the greatest amount of data examined was that relating to as-welded transverse fillet welds under axial loading. In all cases the thickness range considered did not extend beyond 10-26mm.

ANALYSISOFSUSPENSIONFRAMEUSING MATERIALSTEEL

STATIC ANALYSIS

Loads applied model



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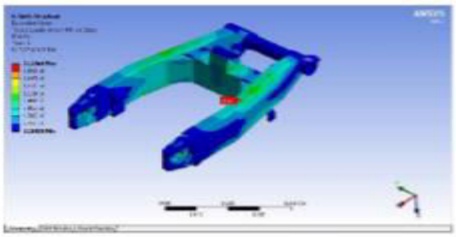
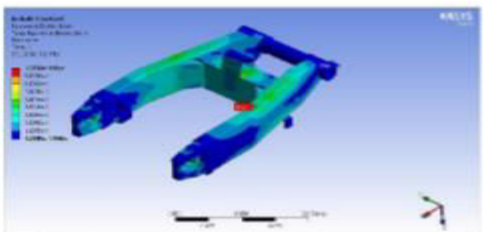
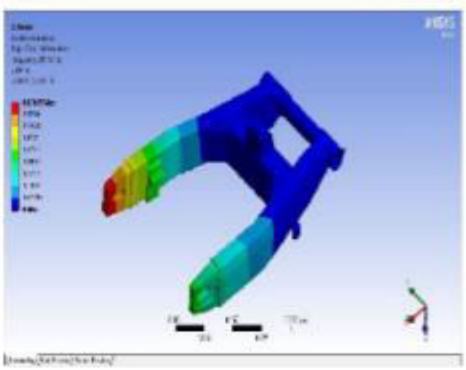
Von-Mises stresses



Strain



Modal analysis

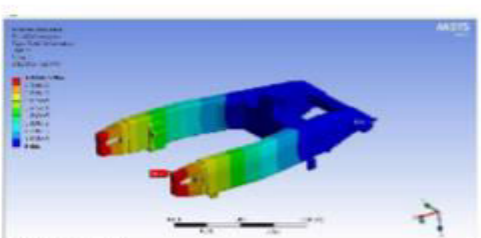


MATERIAL ALUMINUM ALLOY

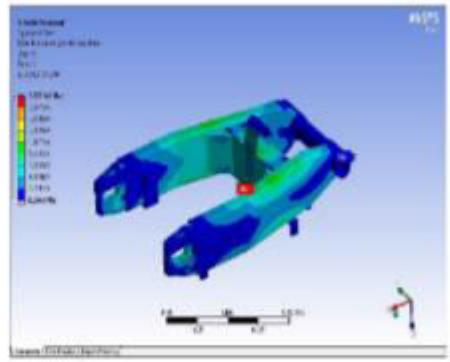
Static analysis Imported model

Results

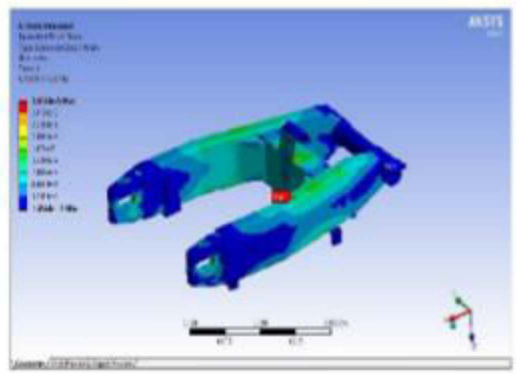
Deformation



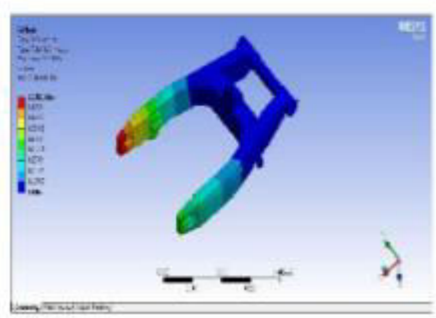
7.2.2.Von-Mises stresses



7.1. Strain



Mode shape 1



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8.1.Static analysis results

	Steel	aluminum
Deformation, mm	1.0813e-2	3.0559e-5
Stress, MPa	2.116	2.1011
strain	1.0759e-5	3.0078e-5

9.1. Modal analysis results

	Steel		Aluminum	
	Frequency	Deformation	Frequency	Deformation
Mode shape 1	295.49	0.67665	296.38	1.1311
Mode shape 2	302.86	0.69878	303.94	1.1695
Mode shape 3	358.6	0.48861	358.99	0.82388
Mode shape 4	410.61	0.47984	411.41	0.80732
Mode shape 5	1152.6	0.59448	1151.1	1.0008

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