

Design and Analysis of Optimised Loop Wheel

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Abstract—A Loop wheel is a wheel with integral suspension, designed for higher shock-absorbing performance and better comfort. Loop wheels offer you a smoother ride. they're more comfortable than usual wheels: the carbon springs absorb exhausting vibration, in addition to the bumps and the shocks. They're extraordinarily robust and durable.

Loop wheel springs are made up of a composite material, carefully developed to offer optimum compression and lateral stability as well as strength and durability. Hydraulic cylinders attach the springs to the hub and rim. The three loops in every wheel work along as a self-correcting system. This spring system between the hub and the rim of the wheel provides suspension that continuously adjusts to uneven terrain cushioning the rider from abnormalities in the road. In effect, the hub floats inside the rim, adjusting continuously as shocks from the uneven road hit the rim of the wheel. The spring configuration permits the torque to be transferred smoothly between the hub and the rim.

Keywords— Loop wheel, Comfort, Suspension, Analysis, Hydraulic Cylinder

I. INTRODUCTION

A wheel is a circular part that's meant to rotate on an axle bearing. The wheel is one of the essential parts of the wheel and axle which is one of the six simple machines. Wheels, in conjunction with axles, enable heavy objects to be moved simply facilitating movement or transportation while supporting a load, or performing labour in machines. Wheels are also used for various alternative functions, such as a ship's wheel, steering wheel, potter's wheel and flywheel.

Common examples are found in transport applications. A wheel greatly reduces friction by facilitating motion by rolling along with the use of axles. For the for wheels to rotate, a moment has to be applied to the wheel about its axis, either by means of gravity, or by applying another external force or torsion.

A loopwheel is a wheel with integral suspension, designed for better shock-absorbing performance and greater comfort. Loopwheels give you a smoother ride. They are more comfortable than standard wheels: the carbon springs absorb tiring vibration, as well as bumps and shocks. They're designed for everyday use and are strong and durable. The loopwheels for wheelchairs help people push over uneven streets, rough tracks and gravel paths, with less effort, and the carbon springs give you extra power to get up or down kerbs. They reduce jolting and vibration, by as much as two thirds compared with a spoked wheel. They made the decision to focus just on wheelchair wheels because the demand for these was really strong, and but it is very small company. A loopwheel for bikes is an awesome ride. As we know because we've tried them a lot. The loop wheels concept is found which has become a very beneficial to the world which reduces the wear and tear of bearing that makes novice after completion its specific life which increases the cost and maintenance of a bicycle. In this case the loop wheels gives a better results and reduces this all the bad impacts created by the normal cycles and gives a one new morning to the innovation.



Fig 1: Loop Wheel

Loopwheel springs are made from a carbon composite material, carefully developed and tested to give optimum compression and lateral stability as well as strength and durability. Specially-designed connectors attach the springs to the hub and rim. The three loops in each wheel work together as a self-correcting system. This spring system between the hub and the rim of the wheel provides suspension that constantly adjusts to uneven terrain, cushioning the rider from bumps and potholes in the road. In effect, the hub floats within the rim, adjusting constantly as shocks from an uneven road hit the rim of the wheel.

II. PROBLEM STATEMENT

In the conventional bicycles there no any type of suspension system. The spokes attached to rim has less load bearing capacity for special purpose cycles. The aim of the project is to design new type of wheel with hub, rim and tyre to provide suspension as well as to support rim and provide better bearing capacity.

III. OBJECTIVES

- To design better shock-absorbing performance.
- To give smoother ride.
- To increase load bearing capacity

IV. SCOPE

In this project we will design and fabricate a loop-wheel bicycle which will be able to have extra feature of shock absorption and also the better load bearing capacity. The project will contain a bicycle with an improved wheel.

The wheel will be replaced from conventional spoked-rim system to leaf spring or loop spring. The wheel will consist Axle, Hub, Rim, Tyre and Leaf/loop springs. All parts will be mounted in wheel so as to maintain its centre of gravity.

V.METHODOLOGY

1 Literature study:

We started are literature study by referring different research papers, magazines and journals. The basic aim was to understand the previous work done in the loop wheel bicycle. The use of different materials for leaf springs and its results were studied. We made the comparative study between composite and steel leaf spring with respect to weight, cost and strength.

1.2 Project identification:

After the detailed study we came to the conclusion that the suspension system is very much essential in the bicycle. Suspension system is not present in the conventional bicycle and due to this high amount of shocks are received by the rider. So we decided to work on this problem by using suspension system along with leaf springs. For reducing the efforts we decided to make the use of hydraulic cylinders.

1.3 Design stage:

Firstly we selected standard chain used in the cycle as chain – 06 B. Then we selected the standard sprocket and wheel. The design of leaf spring along with the maximum stress and maximum deflection was calculated.

1.4 System drawing: Firstly a rough 2 D Sketch was prepared and then the 3 D model of the bicycle was done by using CATIA V5 software.

1.5 Material procurement:

According to our design and calculations we purchased the metal strip, hub plate and hydraulic cylinder from the market.

1.6 Manufacturing stage: Three elliptical loop along with the triangular hub were assembled together. The three loops are mounted on triangular hub at 120 degree each.

1.7 Testing: In testing we are evaluating deflection and maximum stress of the loop wheel on different road surfaces and rough terrains.

CALCULATIONS

Materials Used

cold-rolled carbon steel
Ultimate tensile strength = 310 Mpa
Yield strength = 185 Mpa
Elongation = 25 percent

Leaf Spring

Calculation of maximum stress

We used C20 material
Tensile strength=560N/mm²
 σ_{\max} of C20 material=560/2=280 N/mm²
Given data:

F=360N
Major Axis of loop spring=L=300mm
Minor axis of loop spring=h=200mm
E= 200MPa
Width of spring=b=25mm
Thickness of spring=t=5mm

$$\sigma_{\max} = \frac{3FL}{2nbt^2} = \frac{3 \times 360 \times 300}{2 \times 1 \times 25 \times 5^2} = 259.2 \text{ N/mm}^2 < 280 \text{ N/mm}^2$$

Hence design safe.

II. Calculation of max. Deflection:

$$\delta_{\max} = \frac{3FL^3}{8Enbt^3} = \frac{2 \times 360 \times 300^3}{8 \times 2 \times 10^5 \times 1 \times 25 \times 5^3} = 3.88 \text{ mm}$$

HYDRAULIC CYLINDER:

Hydraulic cylinder
Calculating load bearing capacity of piston rod,
Size of cylinder=25*50
Material- mild steel
Shear stress(σ)=407.7

Calculation

$$\sigma = \frac{F}{A}$$

$$\text{Area of cylinder} = \frac{\pi}{4} D^2 = \frac{\pi}{4} 25^2 = 490.87 \text{ mm}^2$$

$$407.7 = \frac{F}{490.87}$$

$$F = 200.129 \times 10^3 \text{ N}$$

Required pressure calculation:

Required force=12kg=12*9.81=117.72N

$$\text{Area of cylinder} = \frac{\pi}{4} D^2 = \frac{\pi}{4} 25^2 = 490.87 \text{ mm}^2$$

VLCATIA MODEL

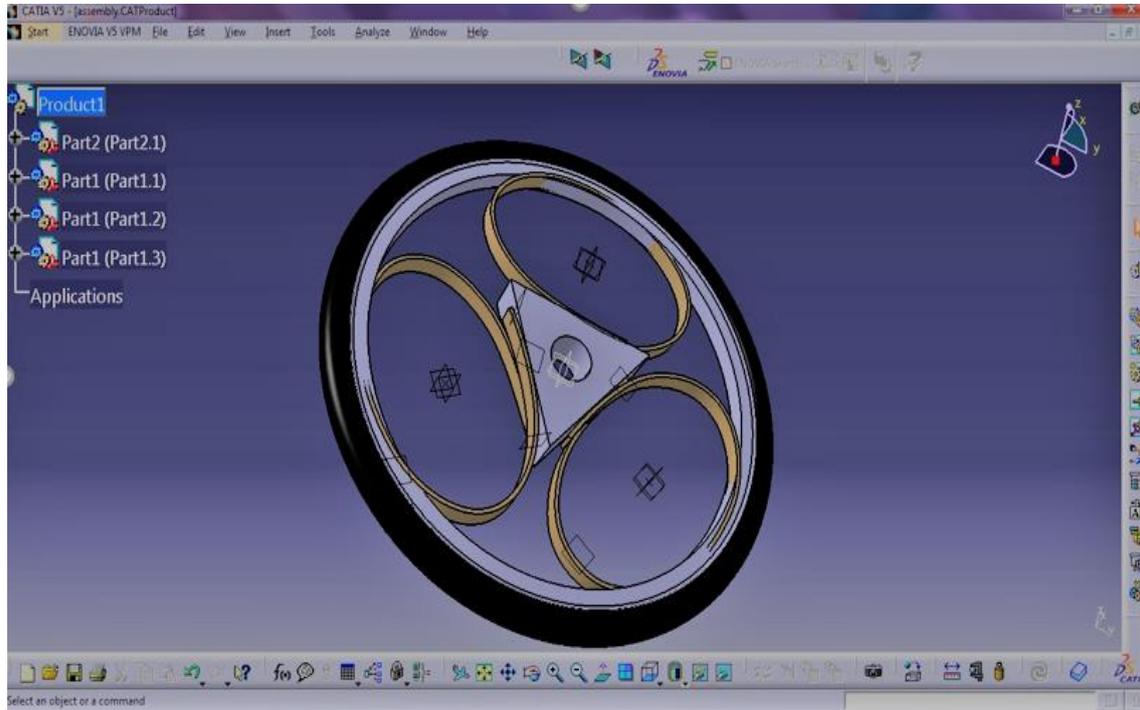


Fig. 2 CATIA Model of Loop Wheel

VII. ANALYSIS RESULTS

The software used for determining the maximum deformation and for analysis is ANSYS Workbench 14.5.

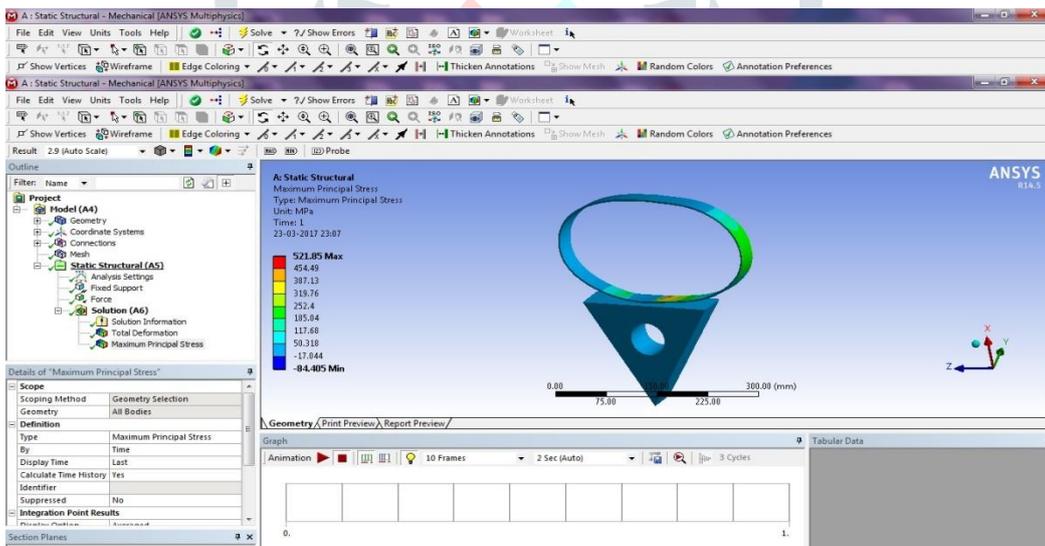


Fig. 3 Analysis of Loop Wheel

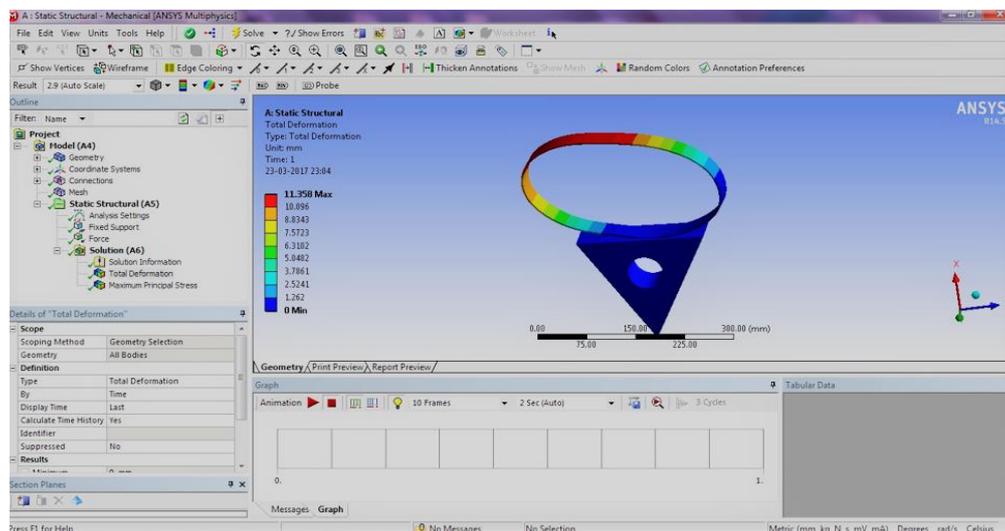


Fig.4 Analysis of Loop Wheel

RESULTS:

Sr.No.	PARAMETERS	MAXIMUM VALUE	MINIMUM VALUE
1.	STRESS	521.85	-84.405
2.	DEFORMATION	11.358	0

CONCLUSION:

Loopwheel bicycle provide a smoother and comfortable ride as compared to the conventional bicycle. Shock-absorbing capacity is also higher than the conventional bicycle. This type of bicycles are very much useful in mountain areas as well as rough terrain areas. Due to the use of hydraulic cylinder less efforts are required for riding as compared to the conventional bicycle.

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