

Design and Development of Loop Wheel Bicycle

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Abstract - A Loop wheel is a wheel with integral suspension, designed for better shock-absorbing performance and greater comfort. Loop wheels 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 extremely strong and durable. Loop wheel springs are made from a composite material, carefully developed 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. The spring configuration allows the torque to be transferred smoothly between the hub and the rim.

Key Words: Leaf spring, Loop Wheel, Triangular Hub, ANSYS Workbench

1. 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.

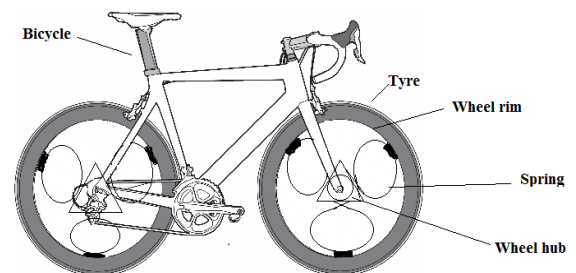
1.1 Loop-wheels

Loop-wheels fit the vast majority of manual wheelchairs. They make 24" and 25" Loop-wheels for wheelchairs. Their wheels have ½ inch bearings to fit standard ½ inch quick release axle pins. This is the most common size on most wheelchairs. Some wheelchairs take 12mm axles, and they can make Loop-wheels with this size axle bearing

too. When you first put the Loop-wheels on the chair, you just need to check that there aren't any bolts sticking out from the side of your chair that could rub against the wheels. This is not usually the case, but it does happen with some chairs and is not a unique problem to Loop-wheels. You should be able to prevent any rubbing by adding some washers to your axle, which will move the wheels out just enough to ensure there is clearance.

There are 3 important factors as to whether Loop-wheels are suitable for your bike. 1: Wheel size. 2: Width of the Drop-out centre The "drop out centre" : on a bike is the distance between the forks where the hub fits. 3: Clearance space above the wheel. This is to allow space for the loop-wheel's suspension to function. As the wheel hits a bump, the wheel moves up towards the frame. You need a minimum of 35mm from the top of the tyre to the underside of the fork (or any other part of the bike frame). If there is less than this 35mm space, your wheel could hit the frame causing it to brake. This is important, If you decide the fit thicker tyres to your Loop-wheels, reduce this clearance gap, If your bike already matches these criteria, you're good to go.

1.2 Model Diagram



1.3 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.

1.4 Objective

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 stability. Our objectives

behind it are to design better shock-absorbing performance, to give smoother ride, to increase load bearing capacity.

1.4 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 center of gravity.

1.5 Advantages

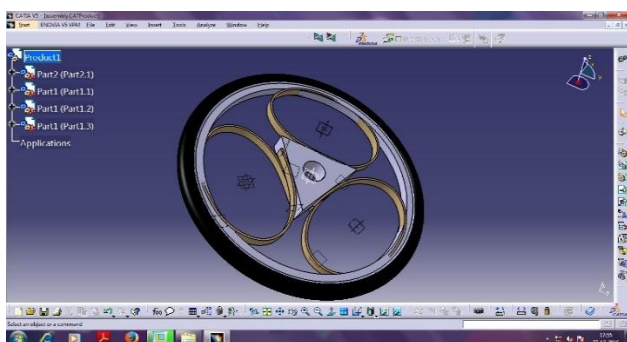
Better shock-absorbing performance, Greater comfort, Smoother ride, More comfortable than standard wheels, They are extremely strong as compared to other wheels.

2. METHODOLOGY

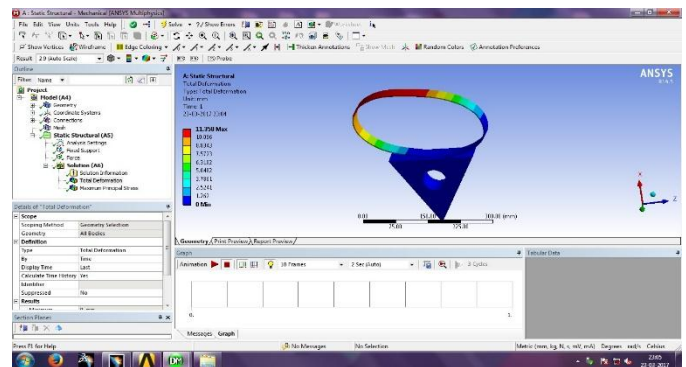
We started our work with literature survey. Search many research papers from various articles and published journal papers. Worked on different mechanisms that can be useful for our project. We have done a rough 2D sketch of model in Auto-CAD. After getting rough model we started calculation of some components. We selected standard components. Simultaneously we have done work of report for semester I.

Actual preparation of project: We completed calculations of remaining parts. We purchased standard components from market. We will be done a rough 3D model of our project manufacturing will be done. Assembly was completely done. Testing of set up was done. Representation of actual theoretical report was presented.

3.1 CATIA MODEL



3.2 ANSYS RESULTS



4. LEAF SPRING CALCULATIONS

Distribution of body weight for average weight of 60 kg per person

Now calculation for total load on each wheel

As we know that the total weight if get distributed on two wheels

And total approximate weight of cycle = 14 Kg

Hence load on each wheel, $w = 30 \text{ kg} + 7 \text{ kg} = 37 \times 9.81 = 362.97 \text{ N}$

Load due to tractive force, $f = \mu * w = 0.02 * 362.97 = 7.2594 \text{ N}$

Total load on each wheel, $F = w + f = 362.97 + 7.2594 = 370.2294 \text{ N}$

Wheel Specification

All data from BIS IS: 624:2003 Fourth Revision ICS 43.150 October 2003

Bicycles Sectional Committee, TED 16

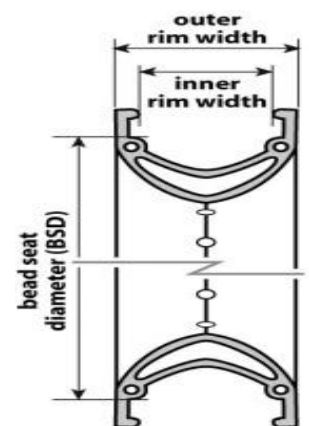
Rim Diameter = 530 mm

Rim bead seat diameter = 540 mm

Rim outer width = 25 mm

Rim Circumference = 1665 mm

Type = Beaded Edged (BE)



Materials Used

cold-rolled carbon steel

Ultimate tensile strength = 310 Mpa

Yield strength = 185 Mpa

Elongation = 25 percent

Leaf Spring

Calculate maximum stress

We used C20 material

Tensile strength=560N/mm²

σ_{\max} of C20 material=560/2=280 N/mm²

Given data:

F=370.22N

Major Axis of loop spring=L=300mm

Minor axis of loop spring=h=200mm

E= 200MPa

Width of spring=b=25.4mm

Thickness of spring=t=5mm

$$\sigma_{\max} = \frac{3FL}{2nbt^2}$$

$$= \frac{3 \times 370.22 \times 300}{2 \times 1 \times 25.4 \times 5^2}$$

$$= 262.36 \text{ N/mm}^2 < 280 \text{ N/mm}^2$$

Hence design safe.

II. Calculation of max. Deflection:

$$\delta_{\max} = \frac{3FL^3}{8Enbt^3}$$

$$= \frac{2 \times 370.22 \times 300^3}{8 \times 2 \times 10^5 \times 1 \times 25.4 \times 5^3}$$

$$= 5.90 \text{ mm}$$

5. CONCLUSION

Bicycle with loop wheel suspension system provides smoother ride, high shock absorption capacity, avoids the necessity of additional suspension system. Also this loop wheels can find their applications in wheel chairs, mountain bikes because of their capacity to adjust to uneven terrain, cushioning the rider from abnormalities in the road. Analysis on deformation has been done which shows that the calculated and the values obtained using ANSYS are in accordance with each other which suggests that the design is safe.

6. ACKNOWLEDGEMENT

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7. REFERENCES

- 1] Gulur Siddaramanna, Shiva Shankar and Sambagam Vijayarangan, "Mono Composite Leaf Spring for Light Weight Vehicle – Design, End Joint Analysis and Testing", MATERIALS SCIENCE (MEDŽIAGOTYRA), ISSN 1392–1320, Vol. 12, Issue No. 3. 2006, PP 220-225.
- 2] Pankaj Saini, Ashish Goel and Dushyant Kumar, "Design and Analysis of Composite Leaf Spring for Light Vehicles", International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753, Vol. 2, Issue 5, May 2013, PP 1-10.
- 3] Baviskar A. C., Bhamre V. G. and Sarode S. S., "Design and Analysis of a Leaf Spring for automobile suspension system- A Review", International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, Volume 3, Issue 6, June 2013, PP 406-410.
- 4] Mr. Tharigonda Niranjana Babu, Mr P. Bhaskar and Mr. S. Moulali, "Design and Analysis of Leaf Spring with Composite materials", INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY, ISSN: 2277-9655, Babu, 3(8): August, 2014, PP 759-756.
- 5] Holfgang Trauthein, "Loop-wheel suspension system development status", Engineering Consultant, D-7758 Meersburg, Federal Republic of Germany.