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Design and Analysis of Mono Wheel

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Abstract: Mono wheel as the name indicates consists of a single wheel .Driver of the wheel sits inside the wheel and the main principle involved is application of GYROSCOPE. The main aim of Mono wheel is that it reduces the space occupied when a single occupied vehicle is necessary and environment friendly. The main discipline of engineering that is applied is mechanical engineering where we find applications of topics like stress calculation, trusses, gyroscopic couple, and concepts of a circle etc .It can be both human powered or motor driven type

Keywords: Mono wheel, gyroscopic couple, Carbon steel, Compound Gear

1. INTRODUCTION

A Monowheel is a one-wheeled single-track vehicle similar to a unicycle. However, instead of sitting above the wheel, the rider sits either within it or next to it. The wheel is a ring, usually driven by smaller wheels pressing against its inner rim. Most are single-passenger vehicles, though multi- passenger models have been built. Hand-cranked and pedal-powered mono wheels were patented and built in the late 19th century; most built in the 20th century have been motorized. Some modern builders refer to these vehicles as monocycles, though that term is also sometimes used to describe motorized unicycles. Today, mono wheels are generally built and used for fun and entertainment purposes, though from the 1860s through .to the 1930s, they were proposed for use as serious transportation In view of the efficiency of bicycles, it is natural to ask if a one-wheeled vehicle provides any advantages. A one-wheeled vehicle is potentially more efficient than a two-wheeled vehicle since frictional losses at the wheels and in the drive train is reduced. However, just as a bicycle is dynamically more challenging to ride than a tricycle, a vehicle with a single wheel poses yet more challenges to stability and control there are two main types of single- wheeled vehicles. In a unicycle, the rider sits above the wheel. These vehicles are recognizable by most people. Less well known is the monocycle, where the rider sits inside the wheel. Like the bicycle, the unicycle and monocycle are statically unstable. Since the center of gravity (cg) is lower for the monocycle, this vehicle is potentially easier to ride than the unicycle. Nevertheless, piloting a monocycle is a challenging task. In this article, we discuss the history of the monocycle. Although many potential problems were inherent in their design, monocycles were adapted to accept motors. Garavaglia is credited with motorizing the first monocycle in 1904. Inventors and entrepreneurs soon began to promote the anticipated benefits of one-wheeled conveyances in contemporary publications and promotional materials

2. DESIGN

2.1 Design of Mono Wheel

Then mono wheel with an effective power transmission system has to be designed such that it can be handled and controlled by a single person even in the rest position. The main and basic constraints that are being taken into consideration are

1 Height of the person riding the vehicle
2 Maximum weights that the vehicle can withstand
3 Power Transmissions

2.2 Height of the person riding the vehicle

According to the survey conducted an independent research organization average height of the person in India is 1.67m.This includes the people from both the genders .So the vehicle has been designed for people whose height lies in the range of 1.6m (5’ 2”)-1.8m (5’ 9”).The average length of a leg person is 1.0m and the height variation is mainly due to the variation in the growth of upper part of the body. So the vehicle accounts to a mean diameter of 1.9m of which 0.8m consists of the transmission system and the lower part of the body i.e. the legs and the lower abdomen manage this area of the vehicle and the upper part of the body occupy the rest of the area. The key advantage of this design is that the rider can easily balance the entire vehicle with the help of his legs and the person can feel comfortable while riding the vehicle.

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2.3 Maximum Weight the vehicle canwithstand

The vehicle that is fabricated should be able have a specification of the weight that it can bear .This is the Maximum weight bearing capacity of the vehicle. So, we have taken into consideration that the maximum weight of the rider to be 80Kgs. By fixing the weight of the rider static structural stress analysis is done to check the strength of the design and determining the maximum stresses acting thereby deciding material that is to be used for fabrication has been determining by considering a factor of safety of 4.76 At end of this step the material that would withstand the load of 80kgs with a factor of safety of 4.76 is ASTM A106 GRADE B.

TABLE 1: Material properties

MECHANICAL PROPERTIES	GRADE B
Tensile strength, min, (MPa)	415
Yield strength ,min (MPa)	240
Elongation.min,(%)L/T	30/16.5

Table2: Chemical Composition

	Grade B
Carbon, max	0.30
Manganese	0.29-1.06
Phosphorous, Sulphur, max	0.035
Silicon, min	0.10
Chrome, Copper, Nickel, max	0.40
Molybdenum, max	0.15
Vanadium, max	0.08

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3. APPLICATIONS

Carbon steel is used in the most critical engineering applications and also in certain applications in the automotive sector. In addition, some of the value-added carbon steel products include steel for lpg cylinders, api grade, corrosion resistant steel, critical structural application steel, boiler quality, auto grades, precision tubes and medium/high carbon grades, among others.

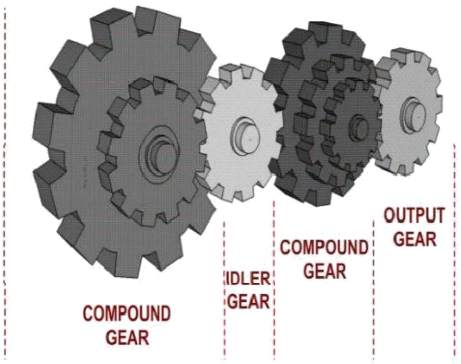

Figure 1: Compound Gear

In this system two types of sprockets and a bigger wheel has been used for power transmission. They are

Sprocket 219mm outer diameter

Sprocket 116mm outer diameter

Power transmitting friction wheel whose outer diameter is 610mm

3.1 THE POWER TRANSMISSION ARRANGEMENT

1 Pedaling shaft
2 Intermediate shaft
3 Transmission shaft

On the pedaling shaft is the sprocket with 0.219m OD which is considered as the bigger sprocket in this discussion and

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on the intermediate shaft there are two bigger sprockets and a sprocket with 0.116m OD which is considered as the smaller sprocket in this discussion. The transmission shaft houses two smaller sprockets and a friction wheel that would transmit power to the outer wheel. Initially when the pedaling shaft is being pedaled the bigger sprocket rotates relative to the shaft as it is mounted on it and this acts as the driver for the smaller sprocket on the intermediate shaft.

Let the pedaling shaft rotates at a speed of X rpm→N1 = X rpm. Rotational speed of the intermediate shaft

N2 = X = 1.8879X $\frac{219}{116}$

On the intermediate shaft two bigger sprockets are mounted at equal distance from the smaller shaft on the either sides and these act as the driver for the smaller sprockets on the transmitting shaft .As they are on the same shaft they also rotate with the same speed as the smaller sprocket. Thus here we can achieve a mechanical advantage of 188.9%.Finally, on the transmission shaft there are two smaller sprockets that are driven by the bigger sprockets on the intermediate shaft Rotational speed of the transmission shaft

N3 = 116^{219} (1.8879X)= 1.8879*1.8879

X= 3.564 X rpm

Thus when the pedaling shaft is pedaled for 1 revolution the transmission shaft revolves 3.564 times which means a theoretical mechanical advantage of 356.4%is achieved. The transmission shaft also houses the friction wheel that transmits the power to the outer wheel
The final power transmission ratio is as follows

The speed of rotation of the outer wheel when the vehicle is pedaled at X rpm is

N4 = N3= $0_{1}.^{610}900$ (3.564 X)

= 0.3211*3.564 X= 1.14 X

By this we can deduce that for every for pedaling cycle the outer wheel revolves 1.14 times which means a linear displacement of 6.8m which is almost 10 times effective than the design we have discussed earlier. If the above power transmission is being implemented there would a theoretical effectiveness of 114%.

4. EXPERIENTIAL ANALYSIS

PARTS MODELLED IN CATIA

1. Outer wheel
2. Sprocket
3. Friction wheel
4. Supporting Wheel
5. Chain
6. Pedaling Rod
7. Frame

4.1 Outer Wheel

Specifications: Diameter:-2000mm, Pipe diameter:-3 inches

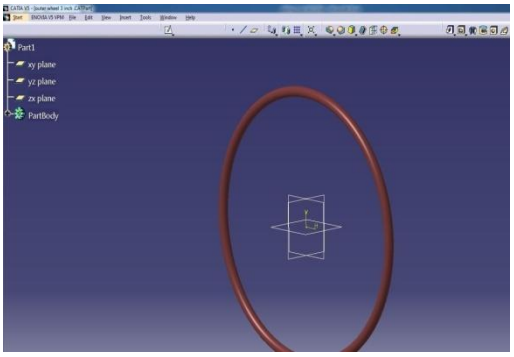

Figure 2 Outer wheel

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4.2 Sprocket

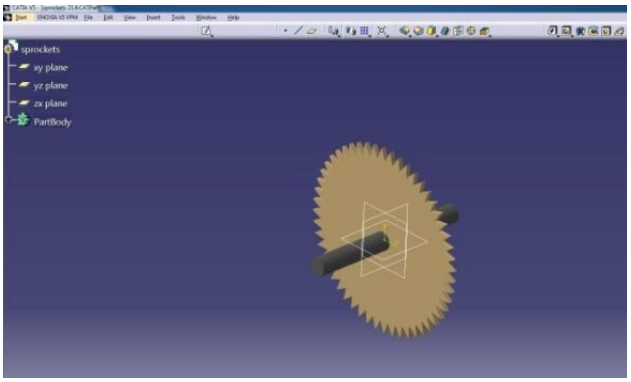

Figure 3 Sprocket

4.3 Friction Wheel

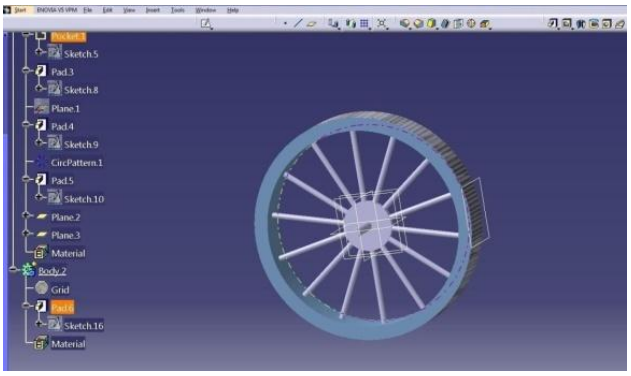

Figure 4 Frication wheel

4.4 Supporting Wheel

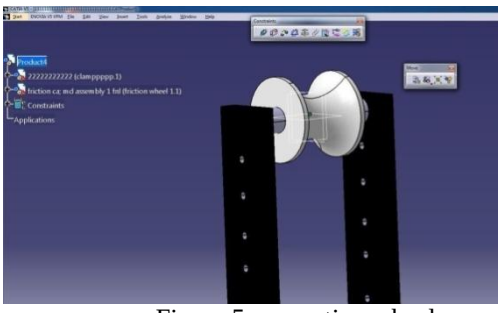

Figure 5 supporting wheel

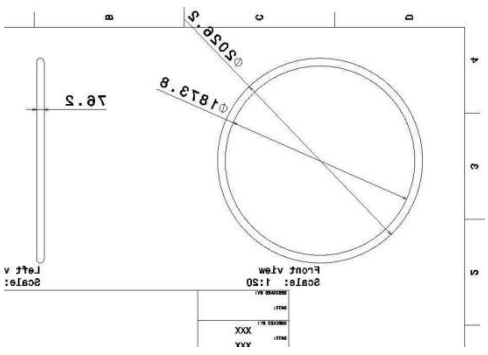

Figure 6 Drafting of outer wheel

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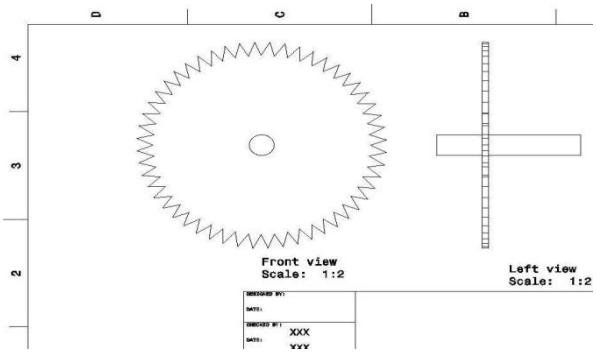

Figure 7 Drafting of sprocket

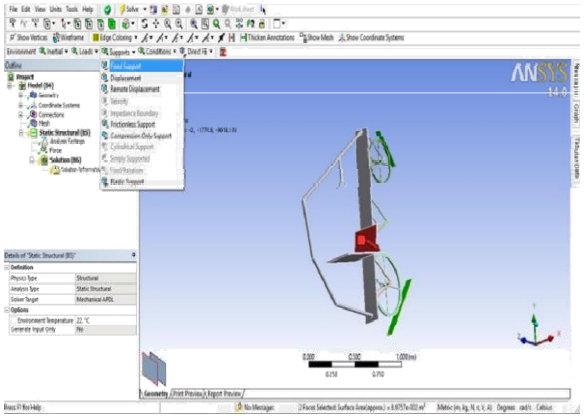

Figure 8 Application of boundary condition 1

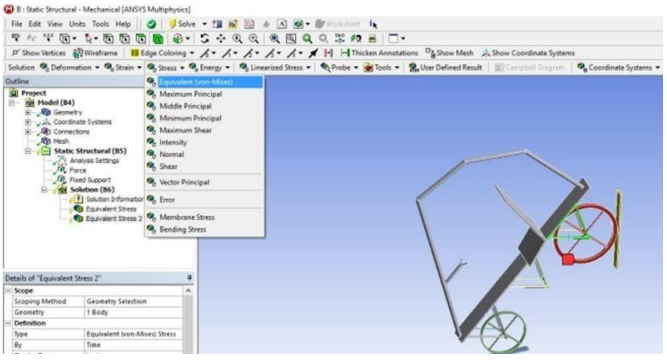

Figure 9 Application of boundary condition 2

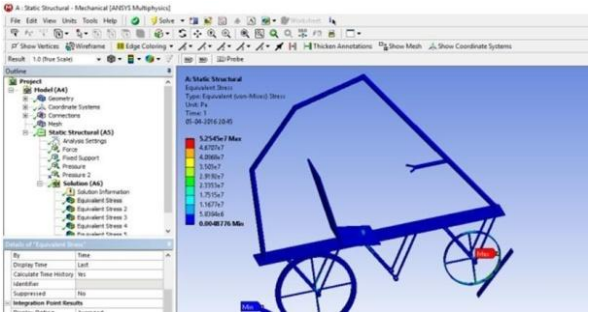

Figure 10 Result of Stress Analysis

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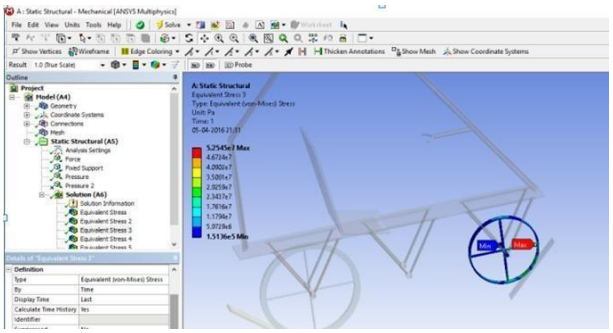

Figure 11 Maximum Stress

The results obtained are

Maximum stress acting = 5.2545e*007 Pa.
Minimum Stress acting = 1.2418e*005 Pa.

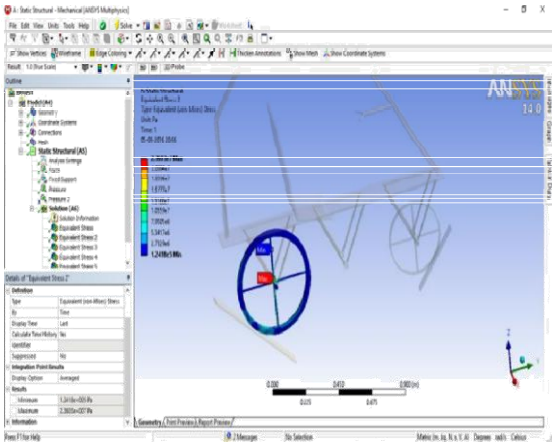

Figure 12 Minimum Stress

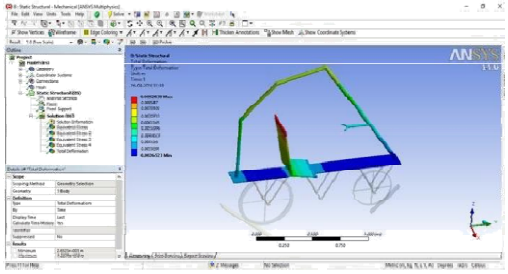

Figure 13 Deflection on force

The maximum deflection =0.0092839 m

Minimum deflection =0.0026523 m

Table 3: Stress Analysis results

Maximum Stress on the frame	52.545 MPa
Minimum Stress on the frame	0.12418 MPa.
Maximum deflection occurring on the frame	0.0092839 m
Minimum deflection occurring on the frame	0.0026523 m
Factor Of Safety	4.766

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CONCLUSION

Considering the feedback we removed the seat so that more than one can ride the mono wheel. From ergonomic study to make it possible for any height of a person ranging from 5’2‖ to 6’2‖ to cycle it we provided long horizontal plate for seating purpose .We have proved the theoretical concept that if one pedaling cycle is done the outer wheel rotates by 0.8 revolutions so that we can travel a distance of 5mWe have realized that the weight of outer wheel is so huge that we cannot pedal for more than quarter revolution. In future Mono wheel is a research project in which continuous study on the existing design in the future helps it to increase its effectiveness to a greater extent. It can be further improved with a motor driven technology and can be extensively used in the transport purposes of the industrial works to a greater extent. When driven with the help of IC engine we can develop a competitive mode of transport.

REFERENCES

[1]. Goddard, J. T. (1869). The velocipede: its history, varieties, and practice .University of Princeton: Hurd and Houghton.
[2]. Jump upUS 325548, J.O. Lose, "One wheeledvehicle"
[3]. The Museum of Retro Technology - The strange story of vehicles with insufficient wheels
[4]. Channel 4's Scrapheap Challenge page on theMono wheel
[5]. Monovelo, the 2008 Beijing Olympic Games Mono wheel Monovelo, the 2008 Beijing Olympic Games Mono wheel
[6]. Wheelsurf, the Dutch/Brazilian motorized Mono wheel
[7]. Ben Wilson's simplified, DIY mono wheel