REDUCTION GEARBOX WITH INBOARD BRAKING SYSTEM FOR AN ATV

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ABSTRACT

The ATV has higher torque requirements due to the terrains it has to traverse on and also special circumstances and necessities. Hence the assembly of rear braking system is complicated and costlier too. It has to also take into consideration the rear transmission system for a rear wheel drive vehicle which is the case in most ATVs available in the market. Use of 2 Disc brakes, 2 Calipers and mounting of both on the hub assembly becomes costly. Also, the use of 2 calipers requires 2 separate fluid lines for hydraulic brakes for proper application of brakes which makes the linings assembly more complex and tedious, and may also entangle. The Brake Disc and Calipers are moderately heavy in the rear assembly and hence increase the sprung weight of the vehicle.

The Main objective of my project is to provide the reduction in gear ratio which meets the torque requirements for the ATV and also implement inboard braking system for the rear compartment. This will enable the ATV to perform better as per its necessity by utilizing the engine brake power more efficiently. Also using inboard braking system in the rear due to spool drive, i.e. a common axle connecting both the wheel assembly for power transmission from the drive train.

Keywords- ATV, Torque, Braking, Inboard braking, Calipers, Brake disc, sprung weight, Spool drive.

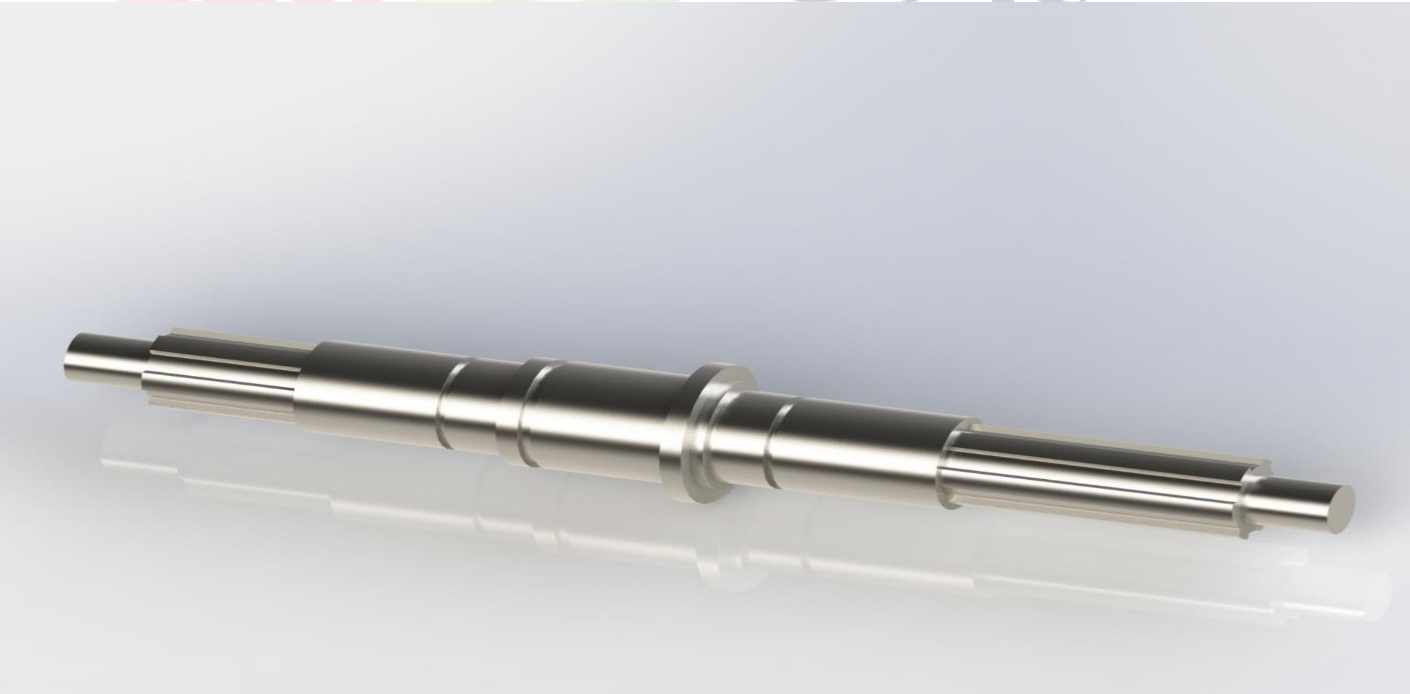
INTRODUCTION

GEARBOX CASING

The gear housing is the casing that surrounds the mechanical components of a gear box. It provides mechanical support for the moving components, a mechanical protection from the outside world for those internal components, and a fluid-tight container to hold the lubricant that bathes those components. Traditionally, it is made from cast iron or cast aluminium, using methods of permanent mold casting or shell molding. Experimentally, though, composite materials have also been used.

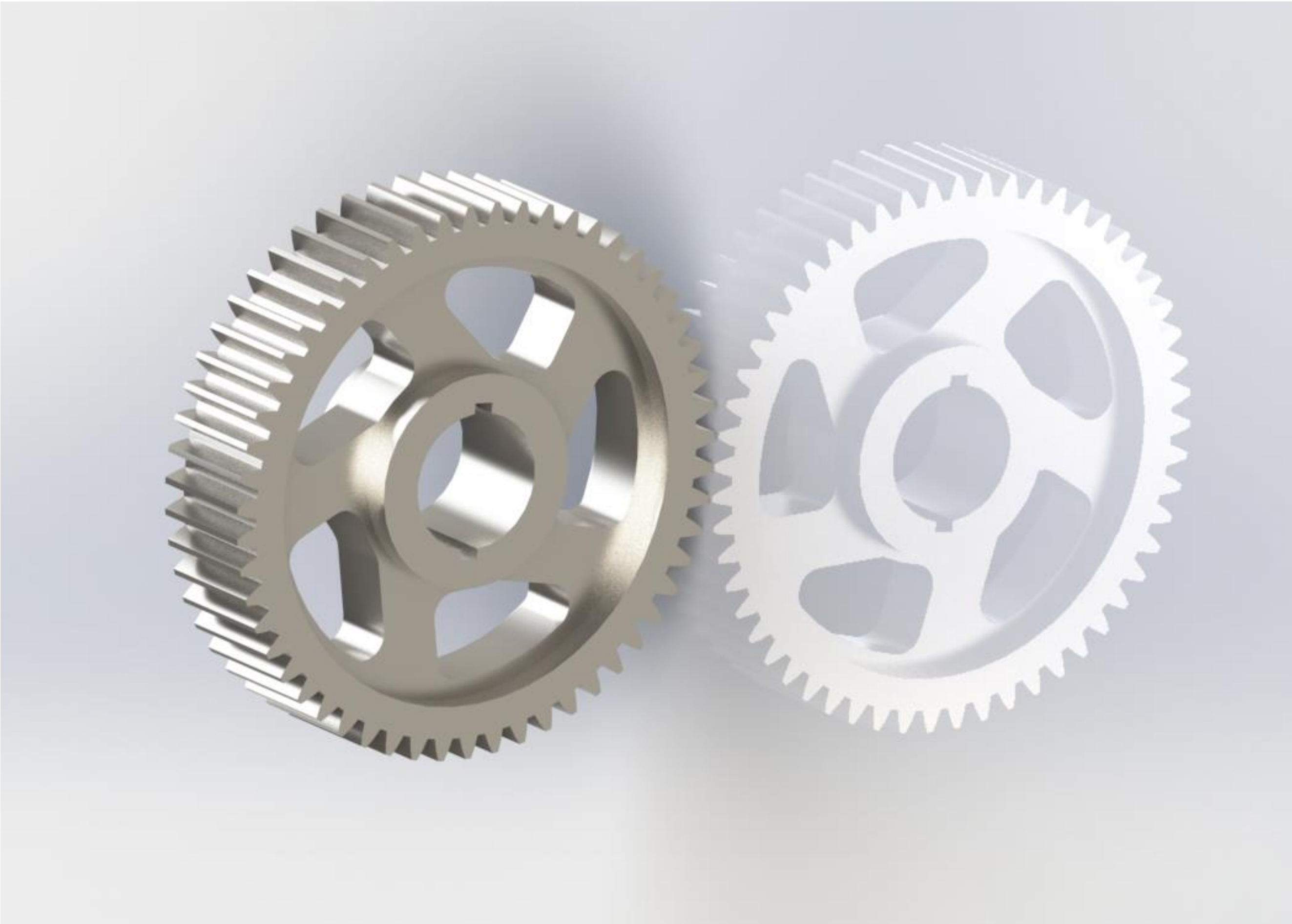
SHAFTS /SPOOL SHAFT

Shaft Design has been done taking into considerations from the Machine Design Data Book. Optimum shaft diameter for my design is 33mm approx. which i get by calculating the bending stresses acting on the shaft at maximum torque.



GEARS

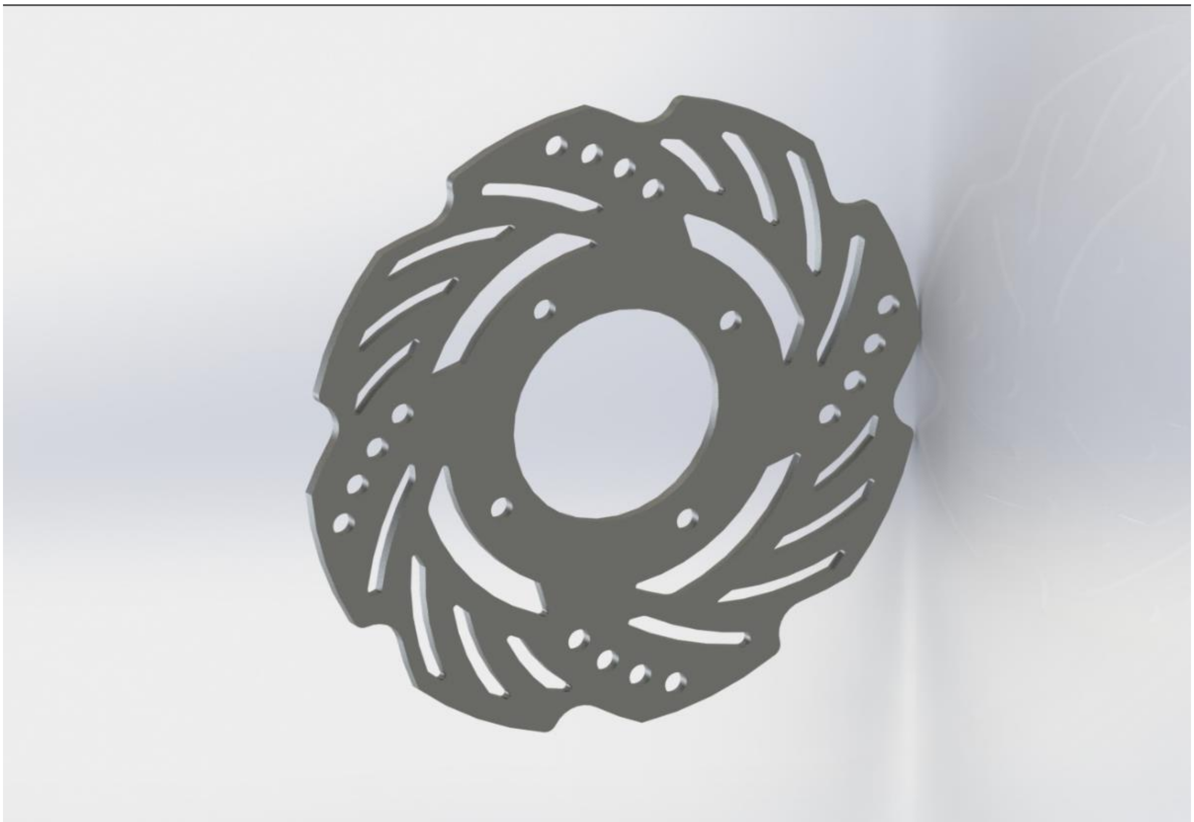
A gear or cogwheel is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The teeth on the two meshing gears all have the same shape. Two or more meshing gears, working in a sequence, are called a gear train or a transmission. A gear can mesh with a linear toothed part, called a rack, thereby producing translation instead of rotation. The gears in a transmission are analogous to the wheels in a crossed, belt pulley system. An advantage of gears is that the teeth of a gear prevent slippage. When two gears mesh, if one gear is bigger than the other, a mechanical advantage is produced, with the rotational speeds, and the torques, of the two gears differing in proportion to their diameters. The term describes similar devices, even when the gear ratio is continuous rather than discrete, or when the device does not actually contain gears, as in a continuously variable transmission.



GEARTRAIN ASSEMBLY

BRAKE DISC

A disc brake is a type of brake that uses calipers to squeeze pairs of pads against a rotor (or "disc") in order to create friction that retards the rotation of a shaft, such as a vehicle axle, either to reduce its rotational speed or to hold it stationary. The energy of motion is converted into waste heat which must be dispersed. Hydraulic disc brakes are the most commonly used form of brake for motor vehicles but the principles of a disc brake are applicable to almost any rotating shaft. Compared to drum brakes, disc brakes offer better stopping performance because the disc is more readily cooled. As a consequence, discs are less prone to the brake fade caused when brake components overheat. Disc brakes also recover more quickly from immersion (wet brakes are less effective than dry ones).Most drum brake designs have at least one leading shoe, which gives a servo-effect. By contrast, a disc brake has no self-servo effect and its braking force is always proportional to the pressure placed on the brake pad by the braking system via any brake servo, braking pedal, or lever. The rotor is usually made of cast iron, but may in some cases be made of composites such as reinforced carbon–carbon or ceramic matrix composites. This is connected to the wheel and/or the axle. To retard the wheel, friction material in the form of brake pads, mounted on the brake caliper, is forced mechanically, hydraulically, pneumatically or electromagnetically against both sides of the rotor. Friction causes the rotor and attached wheel to slow or stop.



BRAKE CALIPER

The most common arrangement of hydraulic brakes for passenger vehicles, motorcycles, scooters, and mopeds, consists of the following:

- Brake pedal or lever
- A pushrod (also called an actuating rod)
- A master cylinder assembly containing a piston assembly (made up of either one or two pistons, a return spring, a series of gaskets/ O-rings and a fluid reservoir)
- Reinforced hydraulic lines
- Brake caliper assembly usually consisting of one or two hollow aluminium or chrome-plated steel pistons (called caliper pistons), a set of thermally conductive brake pads and a rotor (also called a brake disc) or drum attached to an axle.

The system is usually filled with a glycol-ether based brake fluid (other fluids may also be used).

At one time, passenger vehicles commonly employed drum brakes on all four wheels. Later, disc brakes were used for the front and drum brakes for the rear. However disc brakes have shown better heat dissipation and greater resistance to 'fading' and are therefore generally safer than drum brakes. So four-wheel disc brakes have become increasingly popular, replacing drums on all but the most basic vehicles. Many two-wheel vehicle designs, however, continue to employ a drum brake for the rear wheel.

DESIGN OF COMPONENTS

DESIGN OF GEARS

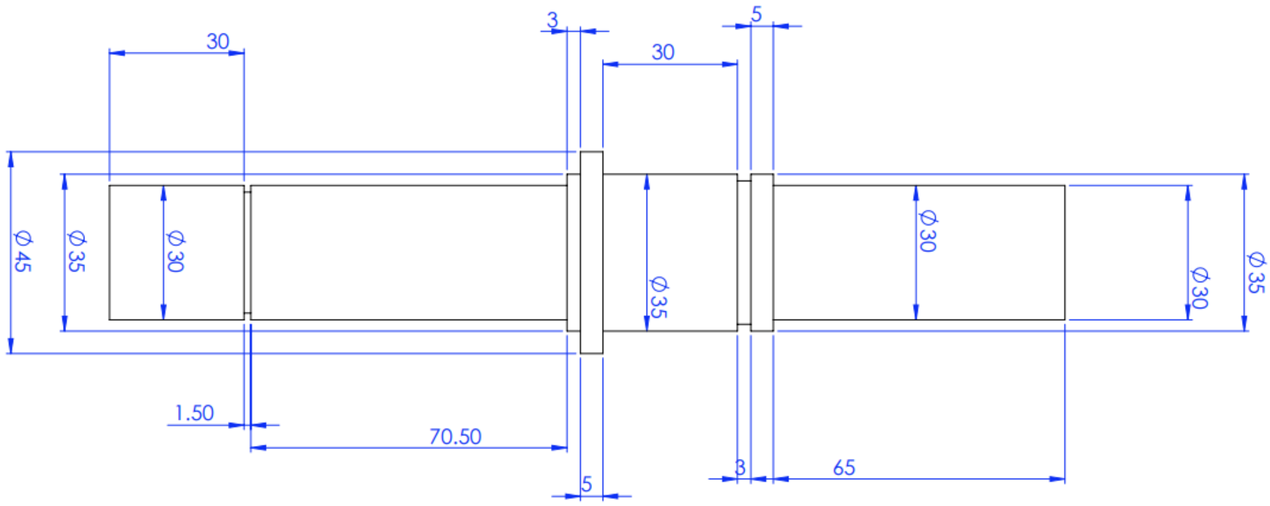
Continuous Variable Transmission							
RPM	**CVT Ratio**	**Total Ratio**	**T_e**	**T_w(N.m)**	**T.F(N)**	**a(m/s^2)**	**V(m/s)**
1800	**2.8**	**27.9**	**39.7**	**888.3**	**3331.04**	**13.32**	**6.53**
2400	**2.03**	**20.2**	**29.8**	**483.1**	**1811.56**	**7.24**	**11.96**
3200	**1.01**	**10.0**	**22.3**	**180.8**	**677.96**	**2.71**	**31.87**
3600	**0.5**	**4.98**	**19.9**	**79.32**	**297.41**	**1.18**	**72.69**

Gear 1 Module:2 No. of Teeth:18 Face Width:12M+2mm=26mm	**Gear 3** Module:2.5 No. of Teeth:20 Face Width:12M+2mm=32mm
Gear 2 Module:2 No. of Teeth:49 Face Width:12M+2mm=26mm	**Gear 4** Module:2.5 No. of Teeth:55 Face Width:12M+2mm=32mm

DESIGN OF SHAFT

Shaft has been designed according to the directions given in the design data book.

Optimum shaft diameter for our design is 33mm approx. which we get by calculating the bending stresses acting on the shaft at maximum torque.



DESIGN OF GEAR HOUSING

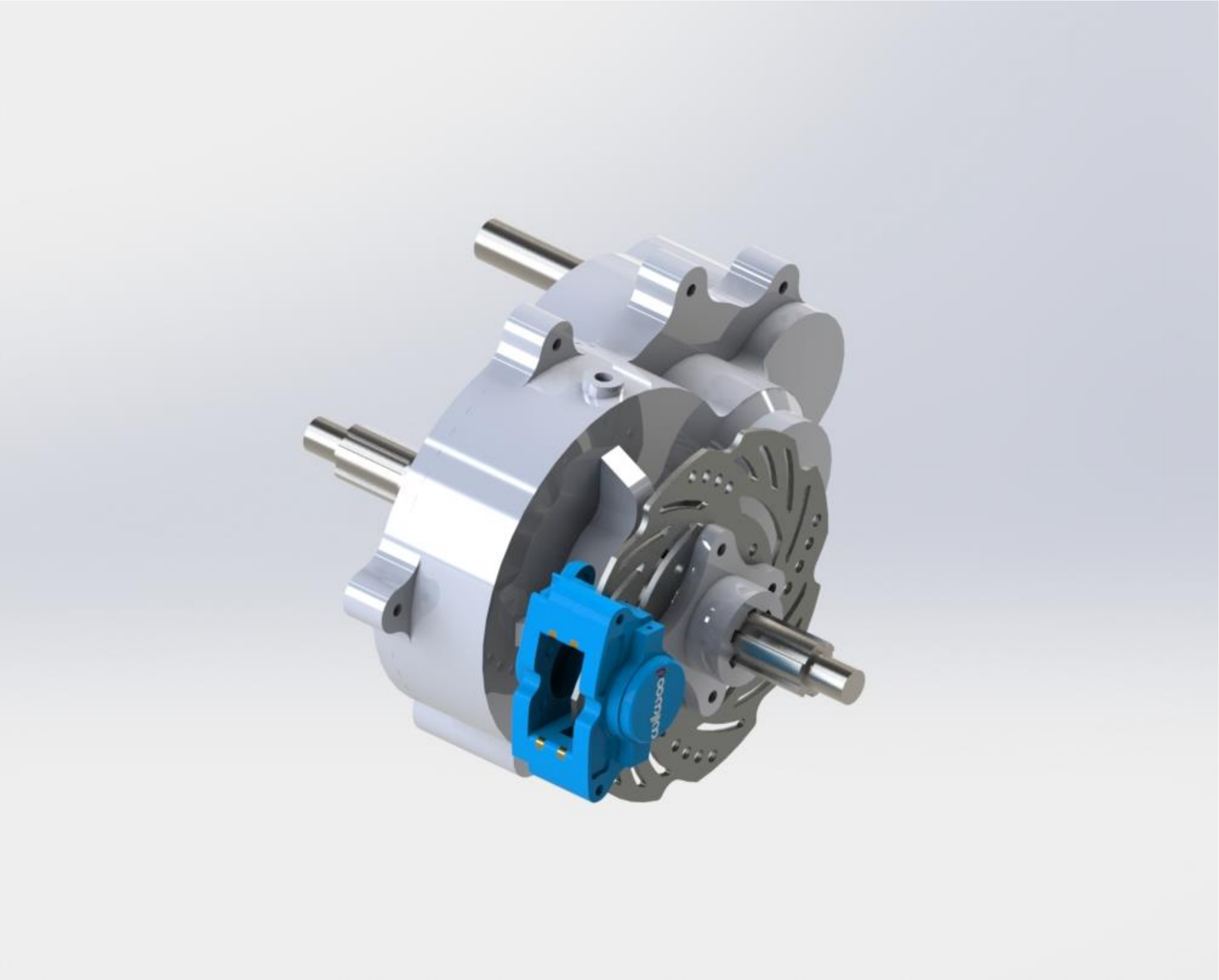
Design of the Gear housing has been done by taking wall thickness from design data book and keeping marginal clearances for safety. The radial clearances between gears and housing have been kept according to CFD of the oil used. Same has been considered while taking lateral clearances. Lateral clearances between 2 gears or between gear and housing is 8 mm while radial clearance between gear and housing is 8mm.

SELECTION OF MATERIAL

Material selection is one of the foremost functions of effective engineering design as it determines the reliability of the design in terms of industrial and economical aspects. A great design may fail to be a profitable product if unable to find the most appropriate material combinations. So it is vital to know what the best materials for a particular design are.

Material	Tensile Strength	Yield Strength	Density
Aluminium 6351 HE 30	250 N/mm^2	150 N/mm^2	2.6-2.8 g/cc
Aluminium 7075 T6	580 N/mm^2	510 N/mm^2	2.8 g/cc
Grey Cast Iron FCD 500-7	520 N/mm^2	360 N/mm^2	7.14 g/cc

FULL ASSEMBLY



ADVANTAGES OF THE PROJECT

- In our project the raw engine power is controlled and by reduction gearbox optimum torque and speed are attained, with less strain on the power transmitting system.
- There is no need to lock both sides of the wheel separately because the spool drive in an ATV would connect the two and stopping and locking either side should be enough to lock both tires simultaneously.
- We can lower the cost of calipers, brake disc, fluid line and brake pads by half.
- The fluid line assembly for the brake system is made much simpler.
- We can shift the brake system from the rear onto the vehicle chassis which reduces the sprung weight of the vehicle for better vehicle dynamics.
- Also the CVT load is reduced due to the use of reduction gearbox in the drive train.
- Also the Brake system components become easier to manufacture.

- Similarly the components of the rear suspension system become simpler with more space to work on by elimination of the brake caliper mounting and brake disc mounting points on the hub assembly.

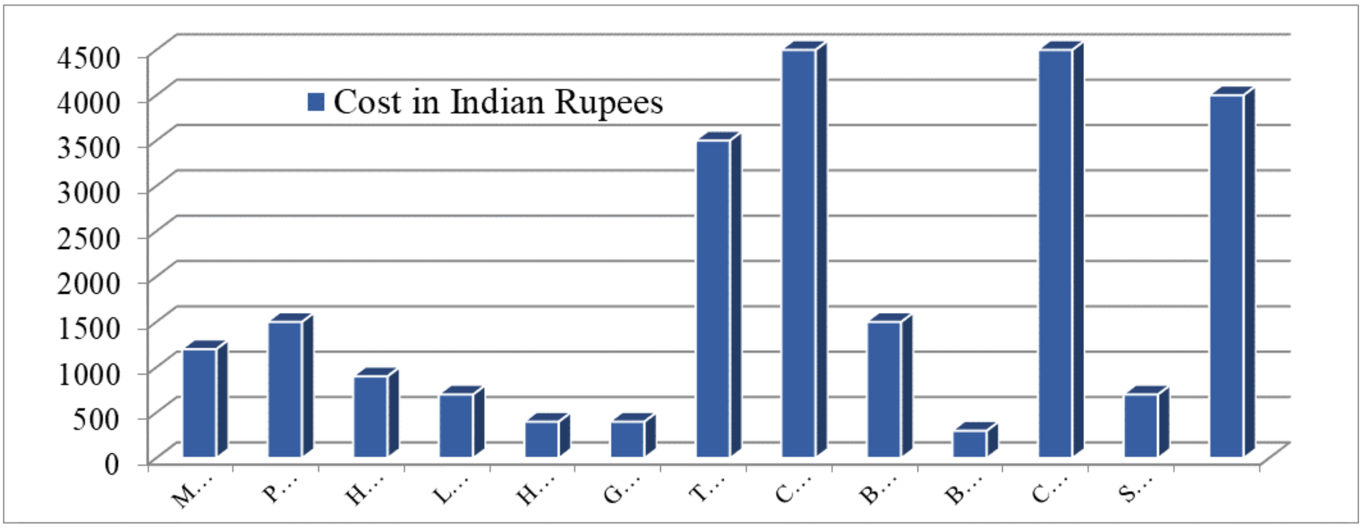
LIMITATIONS AND DIFFICULTIES OF THE PROJECT

- It is difficult to assemble the brake disc and caliper on the vehicle chassis.
- Failure of the caliper would result in failure of braking of both the tyres of the rear compartment.
- For best use of our product the person should must be aware of the effect of the driving positions of vehicle.
- As a single caliper would be taking the load of stopping the vehicle, the caliper needs to have more bore dia. and would hence be more costly and bulkier.
- The Gear Box casing possesses the threat of failure in extreme cases due to lower wall thickness

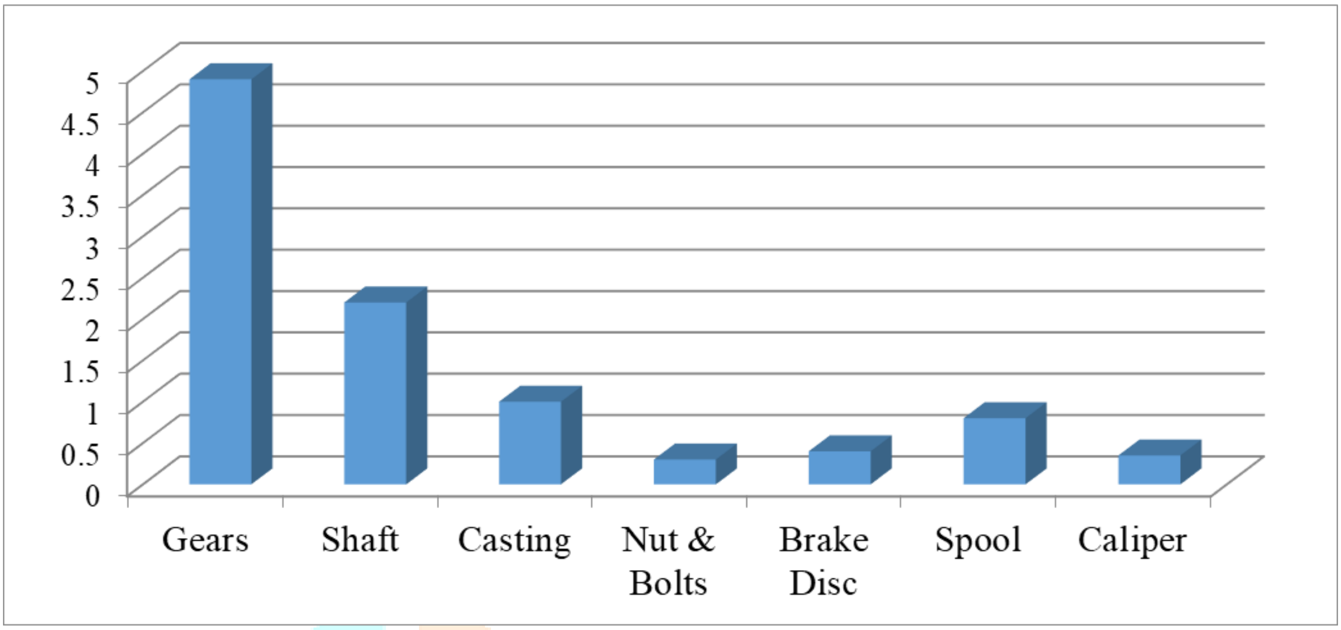
COST AND WEIGHT ANALYSIS

- Our concept works on further developing the idea of inboard brakes being used.
- Alongside this, we have added the reduction gearbox in the same assembly which makes the assembly a bit more complex but more compact and less costly.
- It has great advantage for the drifters in their races so they can also use our product for future.

COST AND WEIGHT ANALYSIS



Approx. Cost of the Assembly is **₹22,600**



Approx. weight **is 9.95 kilo grams**.

CONCLUSION

Here by we conclude that our product will reduce the engine power and provide the necessary torque. We will use aluminium for casting gear housing which will reduce the weight. Also the inboard braking system provides simultaneous locking of the tires and reduce the twisting moment applicable on the rotating shaft of the gear train. Also the spool design enables us to utilize only one caliper and disc rotor which saves cost and makes the suspension assembly simpler and lighter. It also makes the fluid line assembly with least possible linkages. Reduction in unsprang mass also leads to better vehicle dynamics and ride stability.

The above mentioned tests are some of the tests which are to be done to make proper inspection of quality of fabric and its aesthetic properties.

CERT No. (T-0435)

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Phone : 079 - 2289 1013 Tele/Fax : 079 - 2289 2804 Mobile : 922 722 0993
Email : divinelab_nhp@rediffmail.com, divinelab_nhp@yahoo.com

Test Report

Name & Address of Customer
M/s.
L.J.Institute of Engineering & Technology
Near Sarkhej-Sanand Circle,S.G.Highway,Ahmedabad.

Test Report No. S34096

Date : 14/08/2017

Description : 29.2mm OD X 1.65mm Thk Welded Pipe

Nature of Sample : SOLID

Date of Receipt of Sample : 12/08/2017

Test method Used : ASTM E - 415 - 2014(SPECTRO)

Specification : AISI 4130 **Identification :** NIL

TEST RESULT

ELEMENTS	PERCENTAGE (%)	Min	Max
CARBON	0.280	0.280	0.330
SILICON	0.270	0.150	0.350
SULPHUR	0.004		0.040
PHOSPHORUS	0.020		0.040
MANGANESE	0.600	0.400	0.600
NICKEL	0.013		
CHROMIUM	0.960	0.800	1.100
MOLY	0.150	0.150	0.250

N. B. :

Remarks : Above Composition/Elements

CONFORM AISI 4130

Approved by

MD. / Lab Incharge
(N.H.P. / S.K.G.)

P.T.O.

Format No.: F-16/1

SCOLARIAN

Scolarian Bicycles Private Limited
CIN No.: U35921OR2014PTC018136
TIN:33686271398
CST:1175970

COMMERCIAL INVOICE

GSTIN: 33AAUCS7685Q1Z1

DATE: 28-07-2017

INVOICE NO: #836

BILL TO	DELIVERY ADDRESS
L.J INSTITUTE OF ENGINEERING AND TECHNOLOGY AHMEDABAD GUJARAT	HARSH PATEL TEAM BLACKHAWKS L.J INSTITUTE OF ENGINEERING AND TECHNOLOGY L.J CAMPUS SARKHEJ SANAND HIGHWAY BETWEEN SARKHEJ CIRCLE AND KATARIA MOTORS AHMEDABAD GUJARAT 382210 PH: +91-8866116723 EMAIL: ljsaeindia@gmail.com

S.NO	DESCRIPTION	RATE	QUANTITY	AMOUNT (INR)
1	Bicycle Frame-set CrMo AISI 4130 29.20 X 1.65-3048 MM	2,900.00	6	17,400.00
2	Bicycle Frame-set CrMo AISI 4130 25.40 X 1.20-3048 MM	2,800.00	7	19,600.00

SUB TOTAL	37,000.00
DISCOUNT (-)	**4,000.00**
IGST (12%)	3,960.00
PACKAGING & HANDLING	1,500.00
TOTAL	**38,460.00**

AMOUNT: **THIRTY EIGHT THOUSAND, FOUR HUNDRED SIXTY RUPEES ONLY /-**
REMARKS: FREE SHIPPING ALL OVER INDIA

28/7/17

SCOLARIAN RACING

SCOLARIAN BICYCLES PVT LTD COIMBATORE 641 041

If you have any queries about the invoice, please contact support@scolarianracing.com

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TC-5098

Phone : 079-22891013 Mo. : 9227220993
Telefax : 079-22892804
Email : divinelab_nhp@rediffmail.com
Web site : www.divinelaboratory.com

Mechanical Testing

Report No : T34094 Date : 14/08/2017

To,
L.J Institute of Engineering & Technology
Near Sarkhej-Sanand Circle S.G.Highway,Ahmedabad

Test	Tensile
Test Method	ASTM A370 (2015)
Test Performance At:	Divine Metallurgical Services P. Ltd.
Instrument Used :	FIE Make Universal Testing Machine,UTE-60 Due Date of Calibration:08.05.2018
Customer Ref No. :	Letter Dated:12.08.2017
Condition of Sample :	29.2mm OD x 1.65mm Pipe
Nature Of Sample :	Test Piece of Pipe Stamped as : -
Specification :	AISI 4130
Date Of Testing :	14/08/2017 Sample Drawn By : Party

Section Dimension (in mm)	29.10-ODX1.64 thk		
Area (in mm²)	141.537		
Gauge Length (in mm)	50.000		
Final Gauge Length (in mm)	61.420		
Yield Load (in KN)	97.620		
Ultimate Load (in kn)	105.720		
Yield Stress (in N/mm²)	689.715		
UTS (in N/mm²)	746.927		
Elongation (in %)	22.840		
Location of Fracture	W.G.L		
Remarks	---------		
Witnessed By/ N.B. :	---------		

Tested By
(Under NABL)

Authorized Signatory

G.M.

Condition Of Reporting :

1. Sample must be drawn by the party. The result relate only to the sample submitted by the party.
2. Any part or parts of the Test Report shall not be resproduced for this, the written request to DLS is mandatory for the Customer.
3. Samples are store for fifteen days from the date of receipt

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Testing House of Metals & Alloys.
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Opp. Vallabhnagar,
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Phone : 079-22891013 Mo. : 9227220993
Telefax : 079-22892804
Email : divinelab_nhp@rediffmail.com
Web site : www.divinelaboratory.com

Mechanical Testing

Report No : T34093 Date : 14/08/2017

To,
L J Institute of Engineering & Technology
Near Sarkhej-Sanand Circle,S.G.Highway,Ahmedababd.

Test :	Tensile
Test Method	ASTM A370 (2015)
Test Performance At:	Divine Metallurgical Services P. Ltd.
Instrument Used :	FIE Make Universal Testing Machine,UTE-60 Due Date of Calibration:08.05.2018
Customer Ref No. :	Letter Dated:12.08.2017
Condition of Sample :	1" X 1.2mm Pipe
Nature Of Sample :	Test Piece of Pipe Stamped as : -
Specification :	AISI 4130
Date Of Testing :	14/08/2017 Sample Drawn By : Party

Section Dimension (in mm)	25.36-ODX1.24 thk		
Area (in mm²)	93.999		
Gauge Length (in mm)	50.000		
Final Gauge Length (in mm)	59.520		
Yield Load (in KN)	60.240		
Ultimate Load (in kn)	77.940		
Yield Stress (in N/mm²)	640.857		
UTS (in N/mm²)	829.149		
Elongation (in %)	19.040		
Location of Fracture	W.G.L		
Remarks	---------		
Witnessed By/ N.B. :	---------		

Tested By (Under NABL) Umesh

Authorized Signatory

G.M.

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2. Any part or parts of the Test Report shall not be resproduced. for this , the written request to DLS is mandatory for the Customer.
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WEBSITES

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- http://www.andysautosport.com/