A PROJECT REPORT

ON

"ANTI-DRAG SYSTEM"

Submitted by

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In partial fulfillment for the award of the Degree

Of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

UNDER THE GUIDANCE

Of

Dr. Imamdin Patwegar

DEPARTMENT OF MECHANICAL ENGINEERING

ANJUMAN-I-ISLAM

KALSEKAR TECHNICAL CAMPUS NEW PANVEL,

NAVI MUMBAI – 410206

UNIVERSITY OF MUMBAI

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ANJUMAN-I-ISLAM

KALSEKAR TECHNICAL CAMPUS NEW PANVEL

(Approved by AICTE, recg. By Maharashtra Govt. DTE,

Affiliated to Mumbai University)

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CERTIFICATE

This is to certify that the project entitled

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To the Kalsekar Technical Campus, New Panvel is a record of bonafide work carried out by him under our supervision and guidance, for partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in Mechanical Engineering as prescribed by **University Of Mumbai**, is approved.

Project co-guide	**Internal Examiner**	**External Examiner**
(None)	(Dr. Imamdin Patwegar)	

Head of Department	**Principal**
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APPROVAL OF DISSERTATION

This is to certify that the thesis entitled

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(Internal Examiner)	**(External Examiner)**
Dr. Imamdin Patwegar	___________________

Date: ___________

Abstract

Important features

- Two were used in conjunction with two hubs.
- The locks have one flat face & one curved face.
- The mechanism enables the vehicle to move in forward direction simultaneously prevents reverse slips on a positive slope.
- It is a purely mechanical device.
- No electricity is required.

Chapter-wise description

- Chapter 1. Introduction
- This chapter gives a brief introduction of project.it states the project's need, aim & scope.
- Chapter 2. Review of literature
- This chapter gives information about Nissan hill start assistance. It is Nissan own invention.
- Chapter 3. Report on present investigation.
- This chapter has schedule, construction, working and design analysis of the device.
- Chapter 4. Results and discussion.
- The chapter shows stress analysis, information about the material selected etc.
- Chapter 5. Conclusion.
- This chapter concludes the project, it also shows future modification.

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Nomenclature & abbreviations

m = weight of vehicle (kg)

α = inclination of slope (º) degree

Fr = resultant force (N)

A_L = area of lock (mm)

E = modulus of elasticity (N/mm^2)

G = modulus of rigidity (N/mm^2)

ρ = density (kg/m^3)

W = weight acting on spring (N)

d = wire diameter (mm)

D = mean coil diameter (mm)

δ = deflection of spring (mm)

N= No. of Active Coils

Nt= Total no. of coils

C= Spring index

τ = Shear stress (N/mm^2)

Te= Torque of engine (N-mm)

Tw= Torque due to weight of vehicle (N-mm)

Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Date:

Chapter 1

Introduction

1.1 Need

1.2 Aim

1.3 Scope

1.1 Need

To prevent reversing of vehicles on slopes when brakes of the vehicle are released so as to accelerate the vehicle upwards on the slope without having to operate the accelerator, brake, clutch and handbrake at the same time

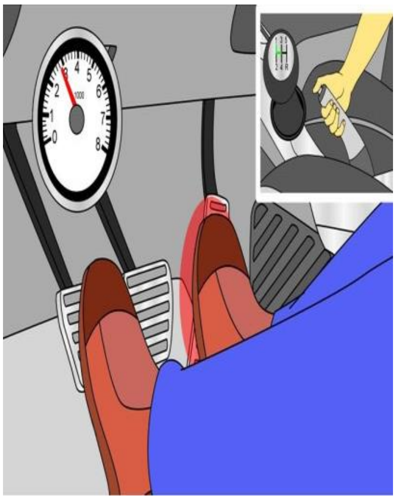


Figure 1:Normal operating condition on the slope

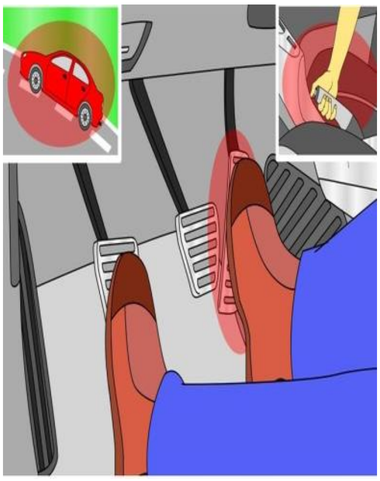


Figure 2:Normal Acceleration on slope

1.2 Aim

To prevent vehicles from reversing while accelerating the vehicle from rest position on a positive Slope.

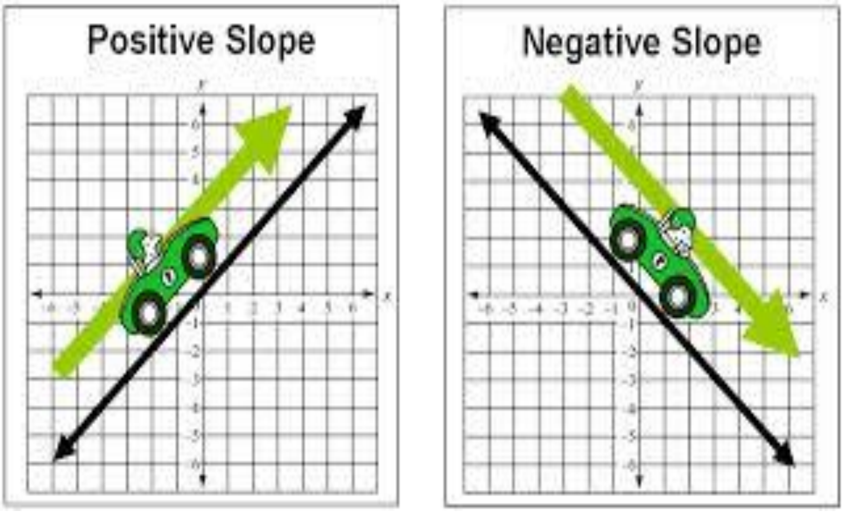


Figure 3: Type of slope

1.3 Scope

This system can be incorporated in commercial vehicles. It can be used in vehicles with more than two wheels. Increases the safety of the vehicle and its passengers as well as other vehicles and pedestrians around it. It can also be used to park the vehicle on slope without engaging the handbrake.

Chapter 2

Review of Literature

2.1 Hill start assistance developed by Nissan

2.1 Hill start assistance developed by Nissan

2.1.1 Hill-start Control Explained

There are several ways in which a hill-start control system can be designed. Each has its advantages, each has its disadvantages. The techniques most commonly used to implement hill-start control are: incline detection, backward motion detection, clutch detection, accelerator detection, brake detection and engine torque detection.

Clutch detection: One of the most obvious applications of hill-start control is in cars with a manual transmission or stick shift. To start a car with a manual transmission, it's necessary to step on a clutch, which disengages the engine from the transmission. While the engine is disengaged, the car is no longer held in place by the engine's braking power, and if the brakes are also disengaged, which is usually the case while accelerating, the car can roll freely, especially if it's on an incline.

Incline detection: If a car is stopped on an incline while the motor is still running, there's a good chance that some kind of hill-start control will be needed. A sensor that detects an incline of more than a certain amount -- say, three degrees or more -- can send a signal to the hill-start control indicating that the vehicle has the potential to start rolling. The disadvantage of incline detection is that sometimes a car maybe on an incline without needing the hill-start control -- for instance, when a tire slips into a pothole.

Engine torque detection:This simply detects whether the engine is producing sufficient torque to accelerate the car forward. If it is, then the car is no longer in danger of rolling backward and the hill-start control is turned off.

Brake detection: This detects whether the brakes are in use and whether there is sufficient braking force to hold the car in place.

Backward motion detection: Although it isn't strictly necessary, some systems may include a means of detecting the fact that the car is rolling backward.

2.1.2 Hill-start Control Components

The hill-start control system consists of a number of different sensors (though the specific sensors may vary according to the implementation), an electronic control unit (ECU) and a brake actuator under the control of the ECU that can apply the brakes as needed to prevent the car from rolling backward. We'll look at these safety and regulatory devices individually; bear in mind those specific hill-start control systems may not necessarily require every one of the following components:

Angle sensors: These detect the angle of the car on an incline, which corresponds to the slope of the hill the car is on.

Pressure sensors: These are part of the suspension system of the car and can detect the vehicle's weight, including the weight of passengers and cargo. This can also be done by piezoelectric sensors or strain gauges. These sensors produce an electrical signal proportional to the weight of the vehicle.

Torque sensor: Torque is the rotational force from the engine that eventually accelerates the vehicle from a complete stop. The torque sensor can detect how much torque is being transmitted to the wheels via the drivetrain.

Wheel-speed sensors: These detectors, usually placed on the axles, can determine the speed and direction the wheels are turning.

Electronic Control Unit (ECU): This is the vehicle's embedded computer system that receives signals from the various sensors. The ECU decides when the brakes need to be applied based on that input. The ECU can also calculate the traveling resistance, which is a function of the car's weight (determined by the pressure sensors) and the slope of the hill that the car is on (determined by the angle sensors). Traveling resistance is used to calculate how much engine torque will be necessary to move the vehicle uphill.

Brake actuator: An actuator is a device that converts an electrical signal into a physical movement. The brake actuator receives a signal from the ECU telling it to trigger the brakes. It then activates brake valves, sending brake fluid to the brakes to hold the vehicle in place, which keeps it from rolling back down the hill. In the case of a hybrid vehicle, the electric motor may be used in place of the brake to apply sufficient forward motion to the vehicle to keep it from rolling backward.

Once the driver starts to accelerate, the torque sensors help the ECU to determine if the engine's torque is sufficient to overcome the traveling resistance (already calculated by the ECU). If it is, then the ECU sends a signal to the brake actuator telling it to turn off the brakes and let the car move.

2.1.3Benefits of Hill-start Control

The major benefits of hill-start control should be obvious. It makes driving easier in certain situations and it can promote driving safety, too. After all, nobody wants his or her car to roll backwards down a hill. There are just too many possibilities for damage in that scenario.

But hill-start control isn't just for the benefit of the driver of the car that that's equipped with the hill-start system. It's also for the benefit of the traffic behind it. For that reason, there may eventually come a day when all cars come with hill-start control and similar safety and regulatory devices as standard equipment simply as a matter of public safety. Driving safety is important to everyone.

Another way that hill-start control helps out is that it means less wear and tear on other parts of the car, such as the handbrake, that you might use to do the same job manually. And in a manual transmission-equipped car you don't have to ride the clutch when starting out on a hill, meaning there's less wear on the clutch. And by preventing the car from rolling backwards, hill-start control puts less strain on the engine and drive train, which would otherwise have to counteract the backward momentum of the car in order to bring it up to speed.

Chapter 3

Report On Present Investigation

3.1 Gantt chart

3.2 Material selection

3.3 Construction

3.4 Working

3.5 Design of ADS

3.6 Snap shorts

3.1 Gantt chart

			Days	
Tasks	Start Date	Duration	Complete	Incomplete
Review of literature	4-Aug-14	20	20	0
Marketing and Analysis	24-Aug-14	15	15	0
Designing	8-Sep-14	7	7	0
Material Procurement	15-Sep-14	15	15	0
Fabrication	1-Oct-14	12	12	0
Testing	13-Oct-14	20	20	0
Submission of Repot	12-Nov-14	18	18	0
Redesigning	1-Jan-15	14	14	0
Refabrication	15-Feb-15	16	16	0
Material Procurement and Testing	3-Mar-15	12	12	0
Final Report	15-Mar-15	20	20	0

Table 1:Gantt Chart

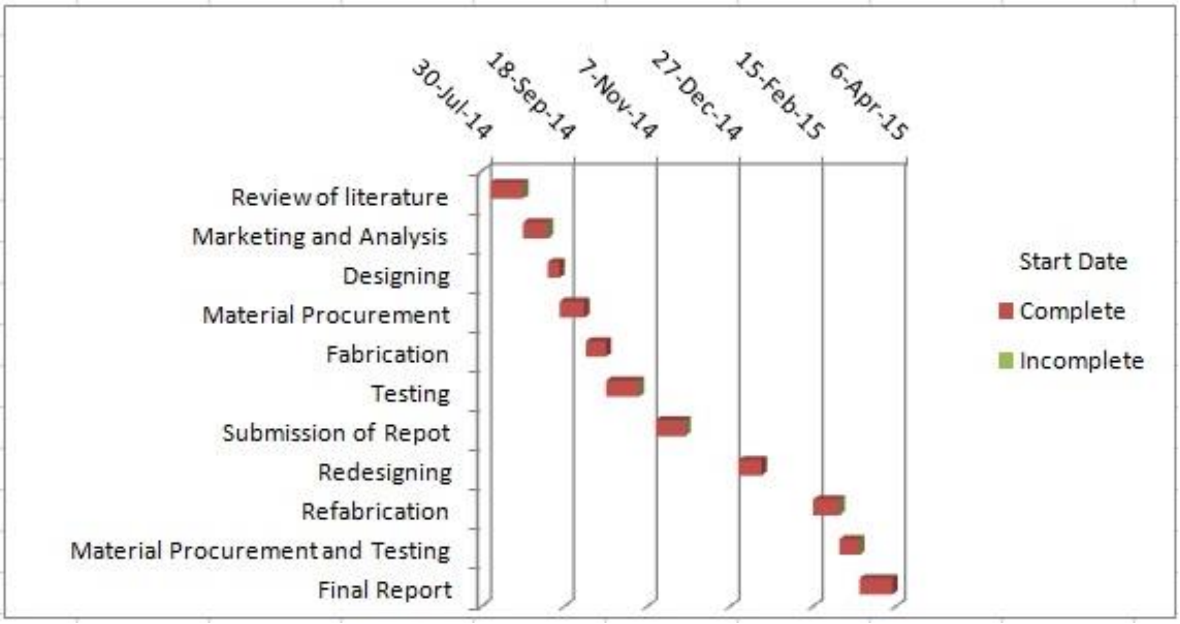


Figure 4: Gantt Chart

3.2 Material, Application and Properties

3.2.1 Lock: Medium Leaded Brass UNS C35000

Introduction

Brass includes a broad range of copper-zinc alloys having a variety of properties such as ductility, wear-resistance, color, machinability, strength, hardness, antimicrobial, corrosion-resistance, and electrical and thermal conductivity. UNS C35000 medium leaded brass alloys are one of the types of brass, which have 62% free-machining brass coupled with good formability.

The following datasheet will provide more details about UNS C35000 medium leaded brass alloys.

Chemical Composition

The following table shows the chemical composition of UNS C35000 medium leaded brass alloys.

Element	Content (%)
Cu	62.5
Pb	1.1
Zn	36.4

Physical Properties

The physical properties of UNS C35000 medium leaded brass alloys are outlined in the following table.

Properties	Metric	Imperial
Density	8.47 g/cm³	0.306 lb/in³

Mechanical Properties

The mechanical properties UNS C35000 medium leaded brass alloys are tabulated below.

Properties	Metric	Imperial
Tensile strength	310-655 MPa	45000-95000 psi
Yield strength (depending on temper)	90.0-483 MPa	13100-70100 psi
Elongation at break (in 25.4 mm)	66%	66%
Elastic modulus	117 GPa	17000 ksi
Poisson's ratio	0.34	0.34
Machinability (UNS C36000 (free-cutting brass) = 100)	70	70
Shear modulus	39.0 GPa	5660 ksi

Thermal Properties

The thermal properties UNS C35000 medium leaded brass alloys are tabulated below.

Properties	Metric	Imperial
Thermal conductivity (@20°C/ 68°F)	115 W/mK	798 BTU in/hr.ft².°F

Other Designations

Equivalent materials to UNS C35000 medium leaded brass alloys are:

ASTM B121

ASTM B453

SAE J461

SAE J463

Fabrication and Heat Treatment

Machinability:

The machinability rate of UNS C35000 medium leaded brass alloys are 70.

Welding:

Soldering, brazing, and butt welding are considered as suitable welding processes, whereas processes such as oxyacetylene welding, gas shielded arc welding, coated metal arc welding spot welding, seam welding are not recommended for UNS C35000 alloys.

Forging:

UNS C35000 alloys have a hot forgeability rating of 50 with the recommended hot working temperature ranging between 760 and 816°C (1400 and 1500°F).

Hot Working:

The hot working capacity of UNS C35000 medium leaded brass alloys is rated as fair.

Cold Working:

The cold working capacity of UNS C35000 is rated as fair.

Annealing:

The annealing temperature of UNS C35000 medium leaded brass alloys is between 427 and 593°C (800 and 1100°F).

Applications

UNS C35000 medium leaded brass alloys are primarily used for screw machine products that need limited cold formability, knurling, crimping, peening, and thread rolling.

The other uses of UNS C35000 are as follows:

- Watch
- Clock and lock parts
- Door Locks
- Hose fittings

- Plumbing valve components
- Bicycle spoke nipples

3.2.2 Hub: AISI 1018 Mild/Low Carbon Steel

Introduction

AISI 1018 mild/low carbon steel has excellent weldability and produces a uniform and harder case and it is considered as the best steel for carburized parts. AISI 1018 mild/low carbon steel offers a good balance of toughness, strength and ductility. Provided with higher mechanical properties, AISI 1018 hot rolled steel also includes improved machining characteristics and Brinell hardness.

Specific manufacturing controls are used for surface preparation, chemical composition, rolling and heating processes. All these processes develop a supreme quality product that are suited to fabrication processes such as welding, forging, drilling, machining, cold drawing and heat treating.

Chemical Composition

Element	Content
Carbon, C	0.14 - 0.20 %
Iron, Fe	98.81 - 99.26 % (as remainder)
Manganese, Mn	0.60 - 0.90 %
Phosphorous, P	≤ 0.040 %
Sulfur, S	≤ 0.050 %

Physical Properties

Physical Properties	Metric	Imperial
Density	7.87 g/cc	0.284 lb/in^3

Mechanical Properties

Mechanical Properties	Metric	Imperial
Hardness, Brinell	126	126
Hardness, Knoop (Converted from Brinell hardness)	145	145
Hardness, Rockwell B (Converted from Brinell hardness)	71	71
Hardness, Vickers (Converted from Brinell hardness)	131	131
Tensile Strength, Ultimate	440 MPa	63800 psi
Tensile Strength, Yield	370 MPa	53700 psi
Elongation at Break (In 50 mm)	15.0 %	15.0 %
Reduction of Area	40.0 %	40.0 %
Modulus of Elasticity (Typical for steel)	205 GPa	29700 ksi
Bulk Modulus (Typical for steel)	140 GPa	20300 ksi
Poissons Ratio (Typical For Steel)	0.290	0.290
Machinability (Based on AISI 1212 steel. as 100% machinability)	70 %	70 %
Shear Modulus (Typical for steel)	80.0 GPa	11600 ksi

Electrical Properties

Electrical Properties	Metric	English	Comments
Electrical resistivity @0°C (32°F)	0.0000159 Ω-cm	0.0000159 Ω-cm	annealed condition
@100 °C/ 212 °F	0.0000219 Ω-cm	0.0000219 Ω-cm	annealed condition
@ 200 °C/392 °F	0.0000293 Ω-cm	0.0000293 Ω-cm	annealed condition

Machining

The machinability of AISI 1018 mild/low carbon steel is graded at 78% of B1112.

Weldability

AISI 1018 mild/low carbon steel can be instantly welded by all the conventional welding processes. Welding is not recommended for AISI 1018 mild/low carbon steel when it is carbonitrided and carburized.

Low carbon welding electrodes are to be used in the welding procedure, and post-heating and pre-heating are not necessary. Pre-heating can be performed for sections over 50 mm. Post-weld stress relieving also has its own beneficial aspects like the pre-heating process.

Heat Treatment

The heat treatment for AISI 1018 mild/low carbon steel consists of the following processes:

Normalizing

AISI 1018 mild/low carbon steel should be heated at 890°C – 940°C and then cooled in still air.

Forging

This process requires heating between 1150°C – 1280°C and AISI 1018 mild/low carbon steel is held until the temperature becomes constant.

900°C is the minimum temperature required for the forging process.

The steel is then cooled in air after this process.

Tempering

AISI 1018 mild/low carbon steel is tempered at between 150°C – 200°C for improvement of case toughness. This process has little or no effect on hardness.

The occurrence of grinding cracks is reduced when AISI 1018 mild/low carbon steel is tempered at the above mentioned temperature.

Annealing

The AISI 1018 mild/low carbon steel is heated at 870°C – 910°C and allowed to cool in a furnace

Stress Relieving

500°C – 700°C is required to relieve stress in AISI 1018 mild/low carbon steel that is later cooled down in still air.

Case Hardening

This process requires heating to be carried out between 780°C – 820°C. AISI 1018 mild/low carbon steel is then quenched in water.

Core Refining

This is an optional process that requires heating at 880°C – 920°C.

AISI 1018 mild/low carbon steel after being heated is moistened in oil or water.

Carburizing

Carburizing takes place at 880°C – 920°C.

Applications of AISI 1018 Mild/Low Carbon Steel

- It is used in bending, crimping and swaging processes.
- Carburized parts that include worms, gears, pins, dowels, non-critical components of tool and die sets, tool holders, pinions, machine parts, ratchets, dowels and chain pins use AISI 1018 mild/low carbon steel.
- It is widely used for fixtures, mounting plates and spacers.
- It is suitably used in applications that do not need high strength of alloy steels and high carbon.
- It provides high surface hardness and a soft core to parts that include worms, dogs, pins, liners, machinery parts, special bolts, ratchets, chain pins, oil tool slips, tie rods, anchor pins, studs etc.
- It is used to improve drilling, machining, threading and punching processes.
- It is used to prevent cracking in severe bends.

3.3 Construction

3.3.1 Lock

Figure 5:lock

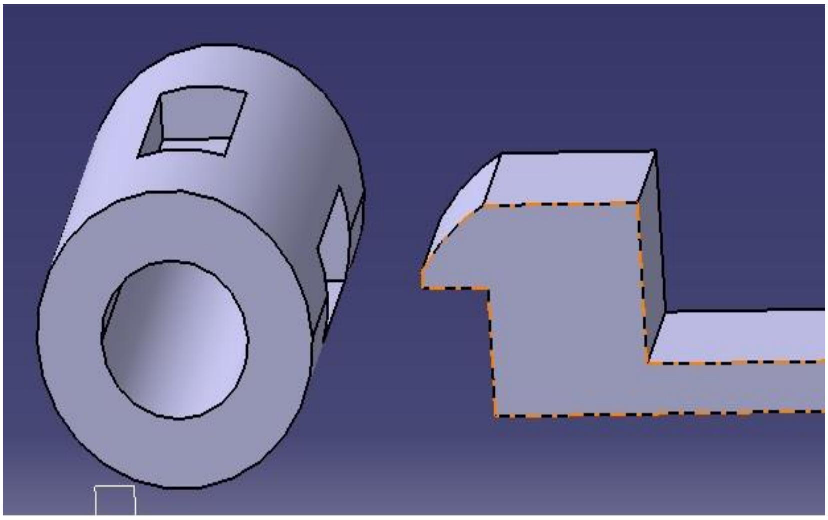


Figure 6:Locking operation

- It has two faces a flat one and a curved one.
- The flat face prevents the vehicle from reversing down a slope.
- The curved surface allows the hub to slip allowing forward motion.

3.3.2 Hub

Figure 8:Hub

Figure 7:Hub

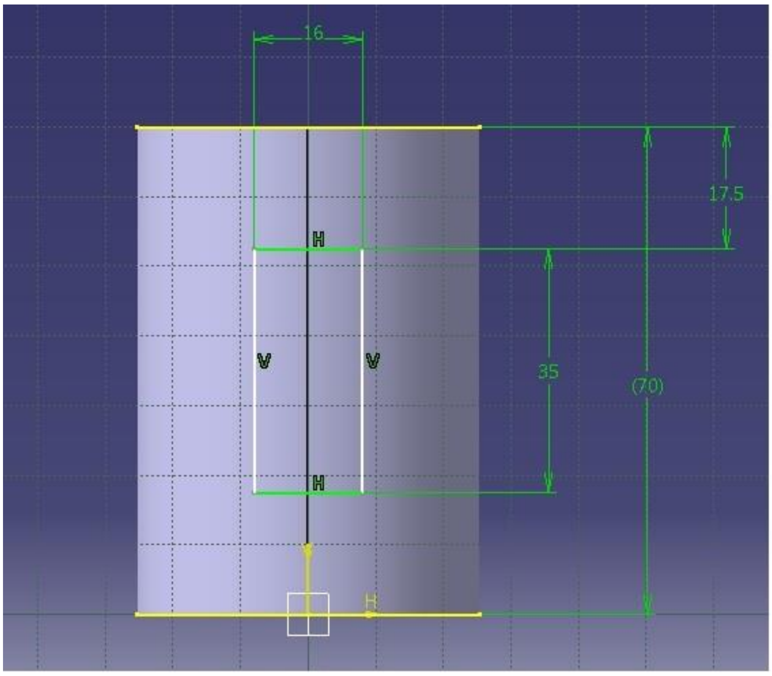


Figure 9:Hub Dimensions

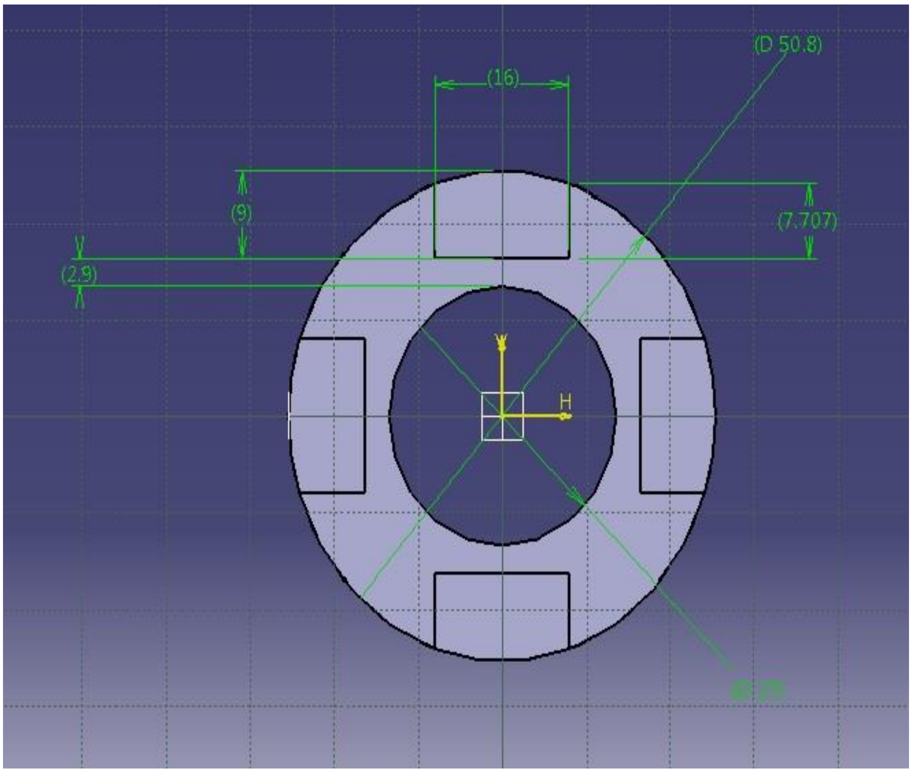


Figure 10:Front View of Hub

- Hub has four slots at 90 degrees as shown in the figure.
- It is co-axially mounted on the rear axle.
- Two hubs are used.
- The hubs are made of AISI 1018.
- The hubs are designed such that failure first occurs in the lock so that one does not have to replace the hub as replacing the hub in more difficult than the lock.

3.3.3 Slider

Figure 11:Slider

- The device has two sliders with stoppers.
- They are welded to the chassis of the vehicle.
- The primary function of the slider is to allow smooth sliding of the lock.
- It also helps in supporting the lock when in disengaged position.

3.3.4 Actuating Mechanism

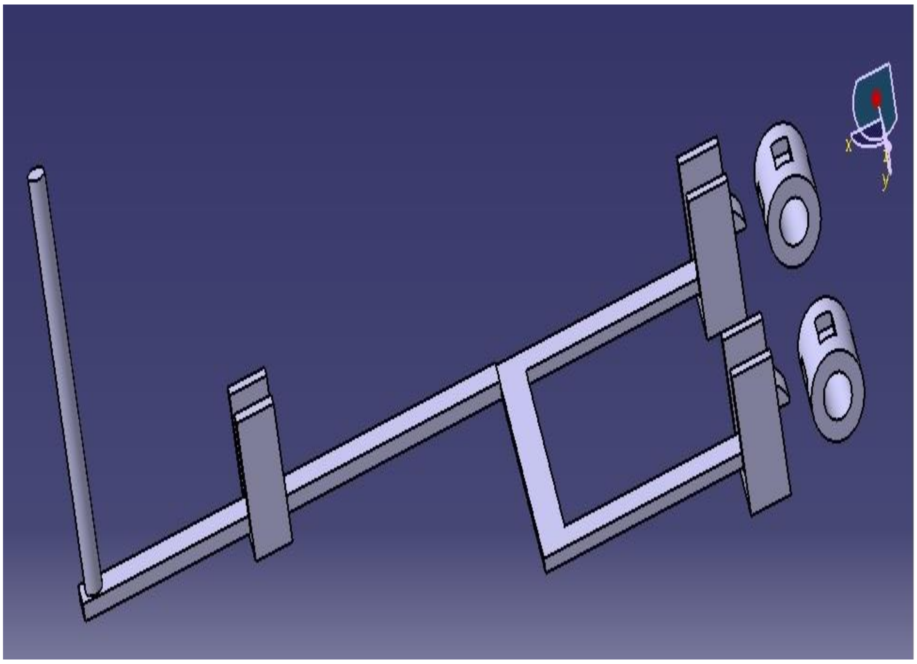


Figure 12:Actuator Links

- The actuating mechanism consists of a Tie rod and M.S. rods.
- The function of tie rod is to give both lateral and longitudinal motion

3.3.5 M.S. Rod

Figure 13:Rod

3.3.6 Rod and bearing

Figure 14:Rod & Bearing

3.3.7 Supports

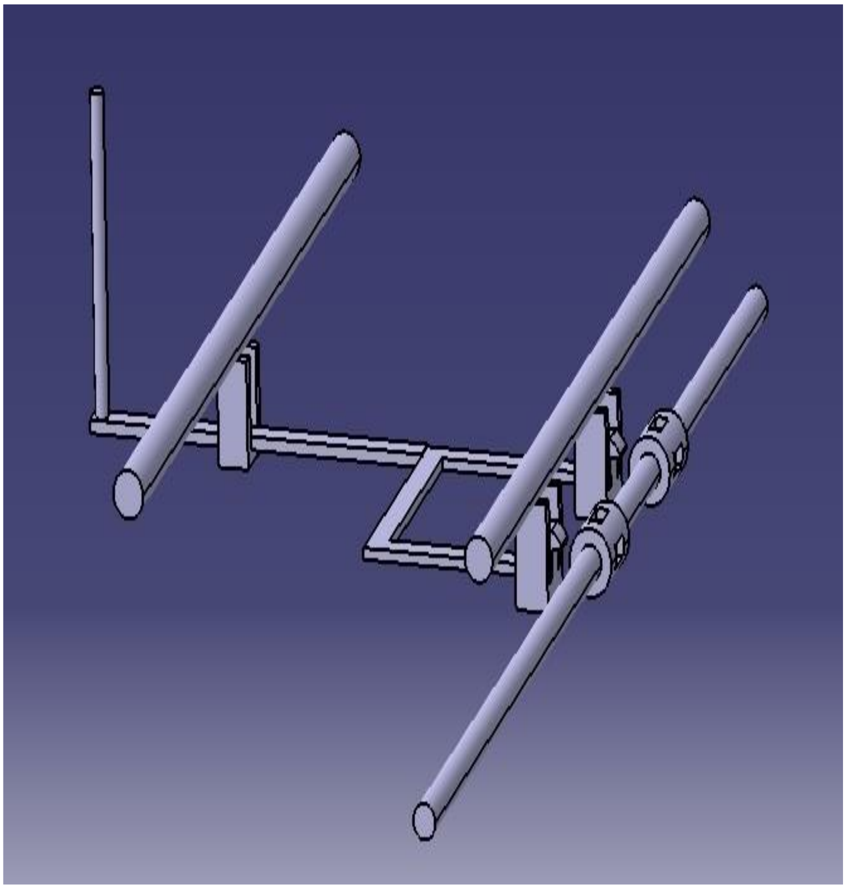


Figure 15:Supports

- There are 3 supports at specific positions which support the motion of M.S. rods.
- The supports are welded to the chassis.

3.4 Working

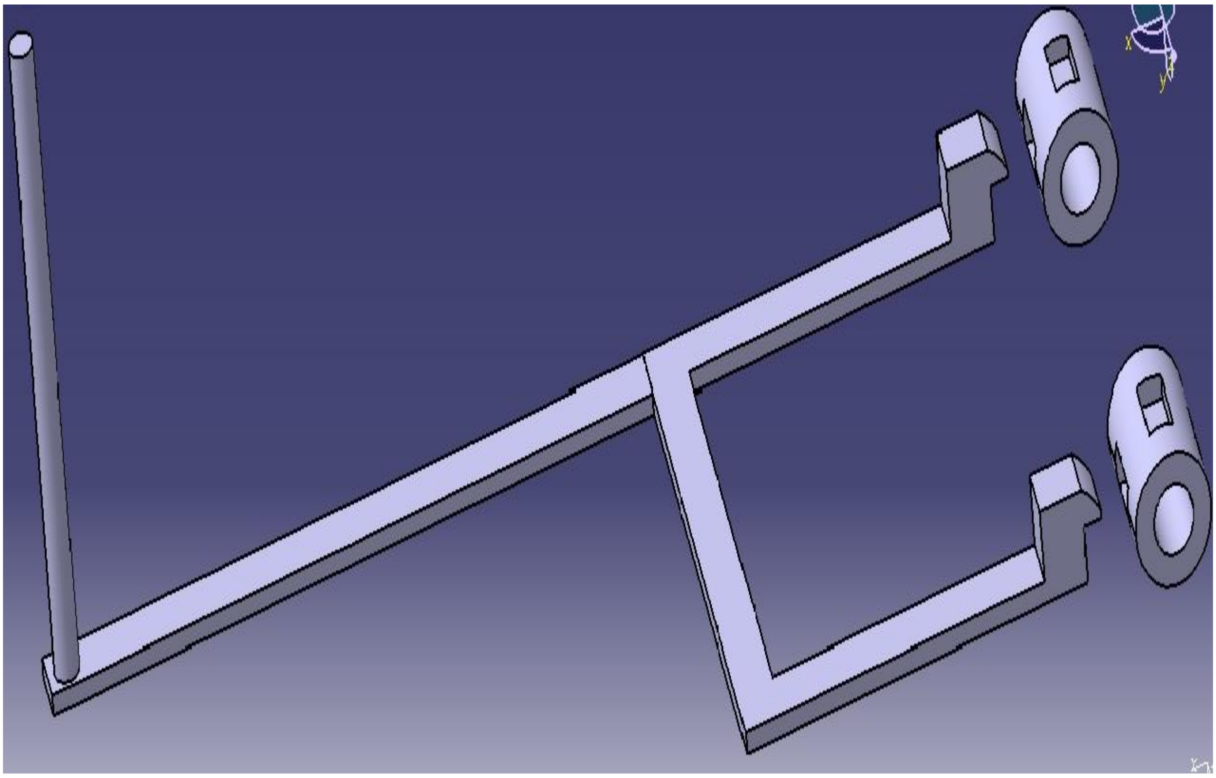


Figure 16:Working of ADS

When the lever is actuated the locks slide in the slot of the hubs on the axle.

It stops the axle in its place preventing the vehicle from going in reverse.

When the lever is retracted, the vehicle is free to move in both forward and reverse directions.

This helps the driver to easily drive the vehicle in forward direction from rest position when the vehicle is on a slope.

3.5 Design analysis

Considering:

α=30°

Weight of the vehicle (W)=200kg

Torque of engine (Te) =10.8 N.m

For safe design considering F.O.S=4.5

Torque due to weight of vehicle (Tw) = mgSinα×radius of wheel

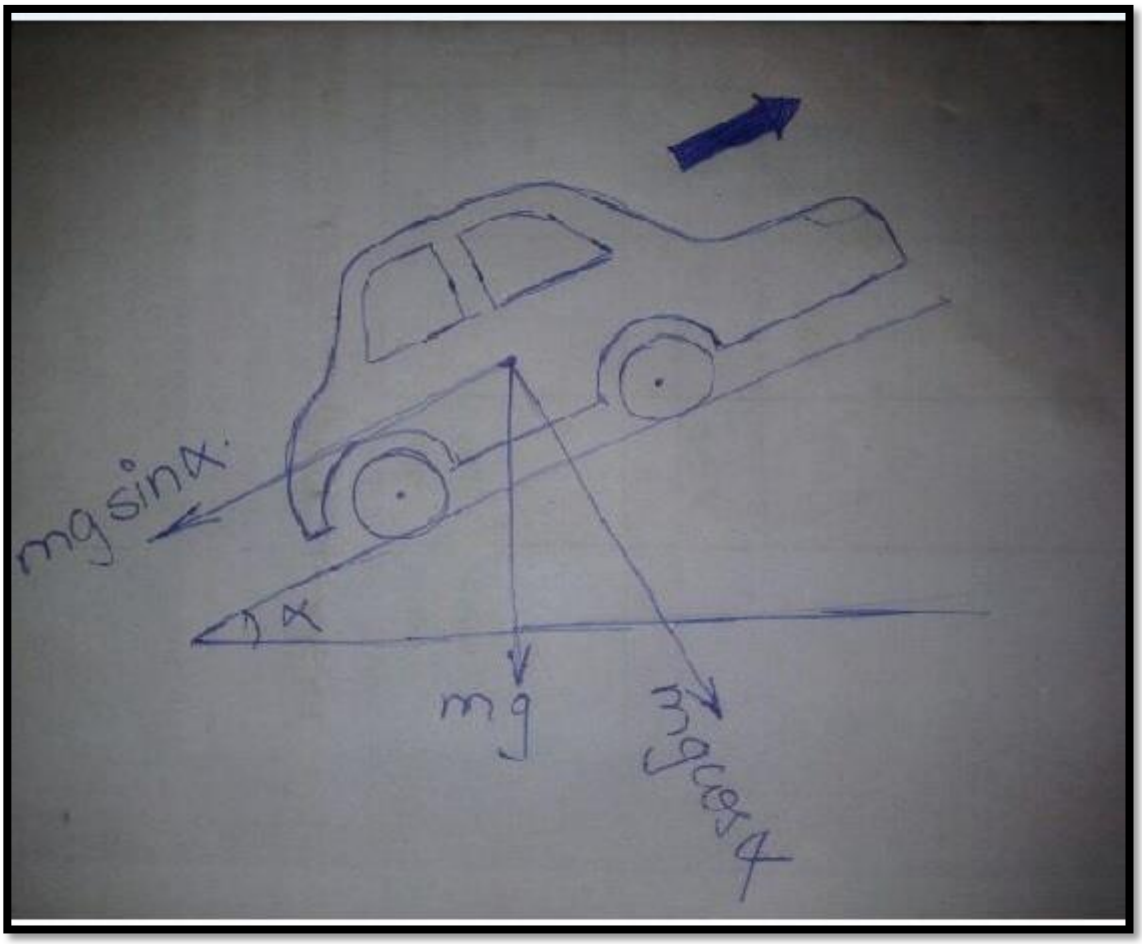


Figure 17:Resultant force analysis

Calculation of Resultant Force

Resultant Torque Acting (T) = Tw-Te

Considering Tangential Forces acting due to Torque

Tangential force due to weight of the vehicle (Fw)

Tangential force due to torque of engine (Fe)

Resultant Force = Fw-Fe

Te = Fe × perpendicular distance of sproket

10.8 = Fe × 0.075

Fe = 144 N

Fw = mgSinα=200×10×Sin30°=1000N

Calculation of Resultant Force:

Resultant Force = 856 N

By considering F.O.S =4.5

F =3856 N

The above force is total force acting the lock. Therefore each lock F/2=3865/2=1928N

Design of Lock

Material :- Brass

Shear Strength :- 100 N/mm²

Bending Strenght :- 200 N/mm²

3.5.1 Design of Lock

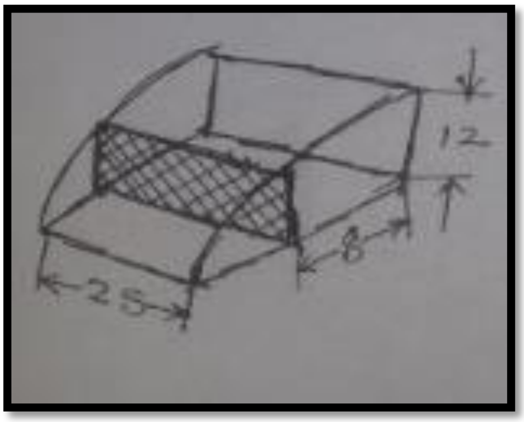


Figure 19:Lock dimensions

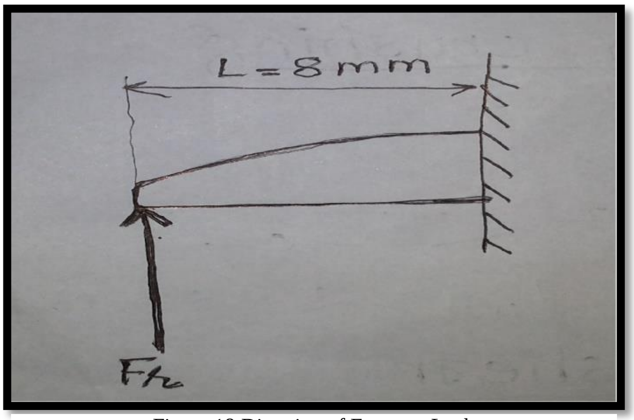


Figure 18:Direction of Force on Lock

<u>Failure of lock in bending</u>

Bending stress=M×y/I

M= 15424 N.mm

I=1066 mm4

Bending stress= 57.87 N/mm² < 200 N/mm²

<u>Failure of lock in shearing</u>

Shear Stress = F/A= 1928/200

Shear Stress = 9.24 N/mm²<100 N/mm²

Hence safe.

3.5.2 Design of Hub

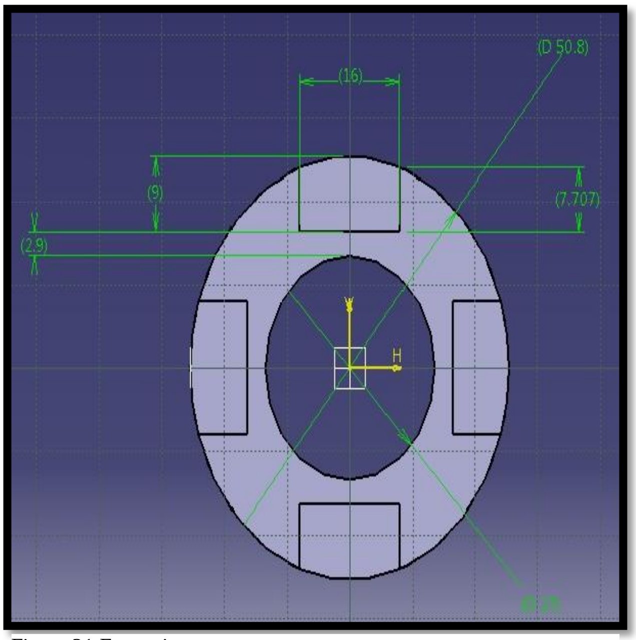


Figure 21:Front view

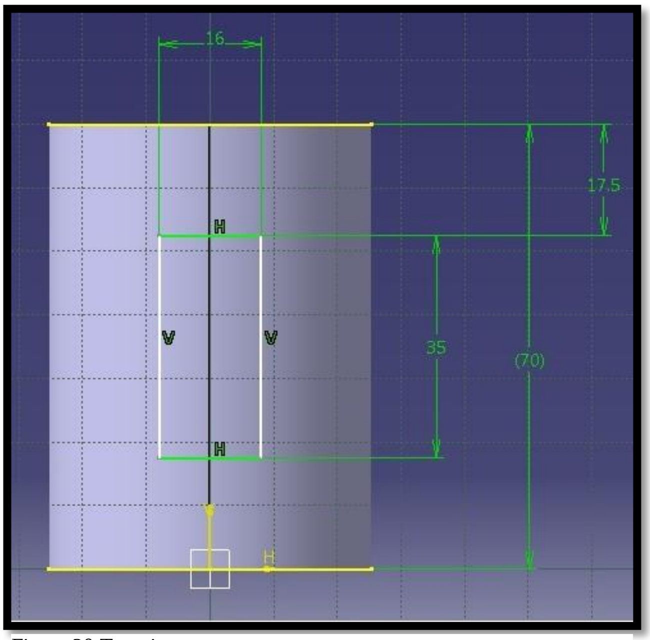


Figure 20:Top view

Material :- AISI 1018

Shear Strength :- 185 N/mm^2

Crushing Strength :- 370 N/mm^2

<u>Failure of hub in crushing</u>

Crushing Stress = F/Ah = 1928/25×9

Crushing Stress =8.565 N/mm^2 <370 N/mm^2

<u>Failure of hub in Shear</u>

Shear Stress = F/A= 1928/35×9

Shear Stress =6.12 N/mm^2 <185 N/mm^2

Hence safe.

3.5.3 Calculation of stresses for hub and lock for different angle of slopes

α	Fr(N)	M(N.mm)	LOCK		HUB	
			Bending(N/mm²)	Shear(N/mm²)	Crushing(N/mm²)	Shear(N/mm²)
15°	840.67	6725.34	25.235	4.2	3.735	2.67
20°	1215.09	9720.72	36.47	6.075	5.43	3.86
25°	1577.76	12622.12	47.36	7.89	7.01	5.01
30°	1926	15424	57.815	9.64	8.565	6.12

Table 2:Calculation of stresses for different slope

3.5.4 Design of spring:

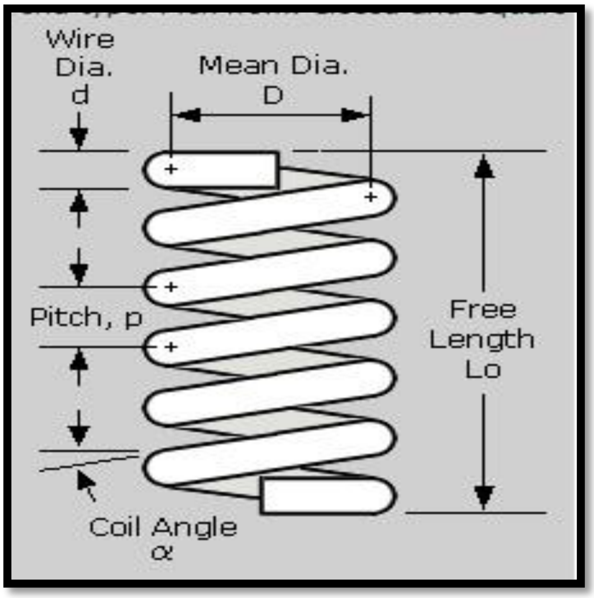


Figure 22:Nomenclature of spring

<u>Material selected for wire:</u>

EN10270-1-SH

E=208500 N/mm²

G=80400 N/mm²

ρ = 7.85 Kg/m³

size range wire (0.1-12mm)

For practical design C is selected in range of [4-12]

Spring index=C=5

Load acting=P=1928N

Deflection of spring=δ max=16mm

$$K = \frac{4C-1}{4C-4}$$

$$= \frac{4(5) - 1}{4(5) - 4}$$

K=1.3105

For load =P=1928N

<u>Selecting material</u>: Music spring [EN10270-1-SH]

Size:-SWG (8.299mm)

Allowable shear stress=490N/mm² (for average service)

$$\tau = \frac{8PC}{\pi d^2}$$

$$\tau = \frac{8 \times 1928 \times 5}{\pi \times 8.229^2}$$

=474.89N/mm^2< [τ]

Design is safe.

<u>Mean coil diameter</u>

D=C*d

=5*11.785

D=41.14mm

<u>No. of active coils</u>

$$\delta = \frac{8PD^3N}{Gd\text{^}4}$$

$$16 = \frac{8 * 1928 * 41.4^3 * N}{80400 * 8.229\text{^}4}$$

N=6

Nt =6+2

Total no. of coils=8

Solid length= Nt*d

=8*8.229

=65.83mm

Assuming 2mm of gap

Total axil gap=2*(8-1) =14

Free length=solid length + total axial gap + deflection

=66+14+16

=96mm

$$\text{Pitch of coil} = \frac{\text{free length}}{(Nt-1)}$$

$$= \frac{96}{(8-1)} = 13.71mm$$

$$\text{Stiffness of spring} = \frac{P}{\delta}$$

$$= \frac{1928}{16} = 120.5\text{N/mm}$$

Strain energy stored in spring =1/2*P*δ

=0.5*1928*16

= 15424 N.mm

3.6 Snap shorts

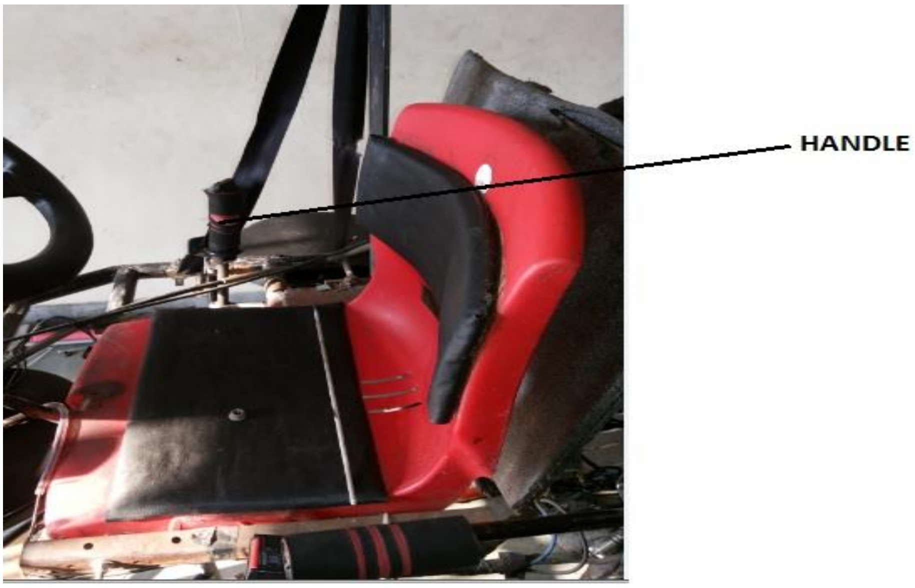


Figure 24:Actuating Handle

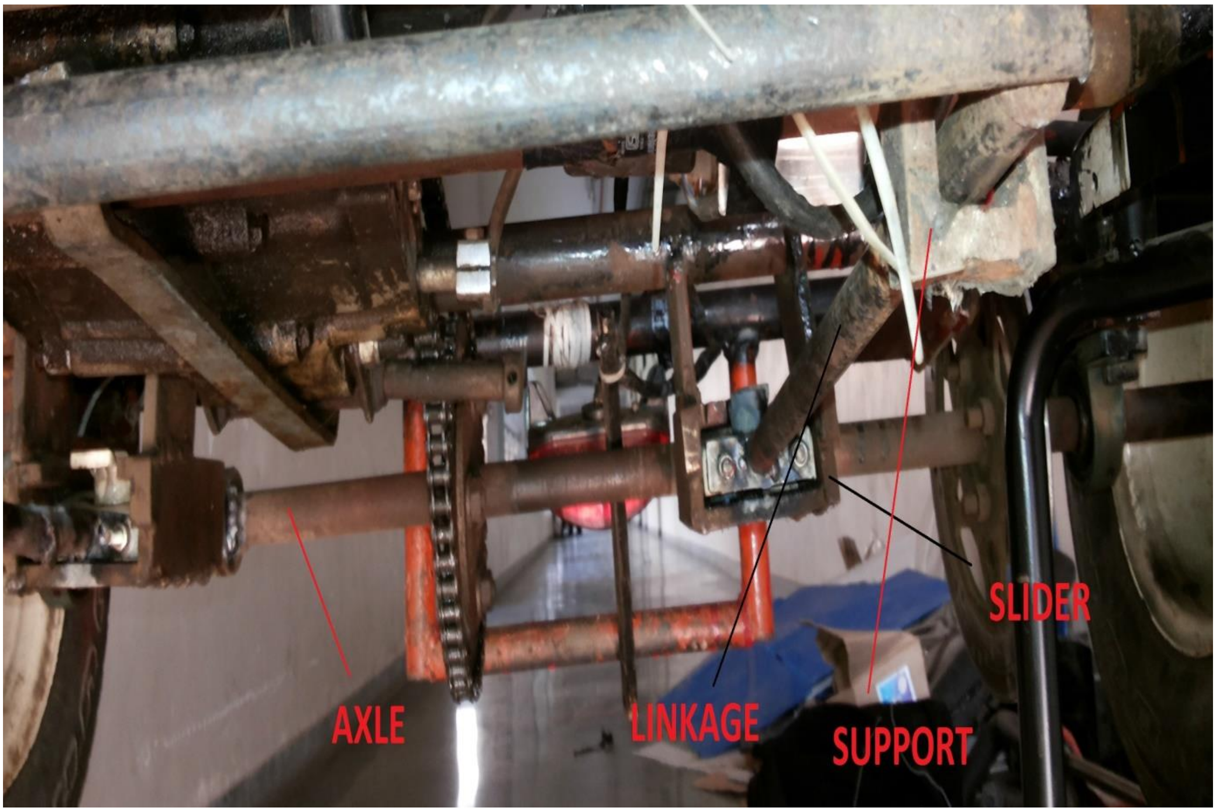


Figure 23:Components of ADS

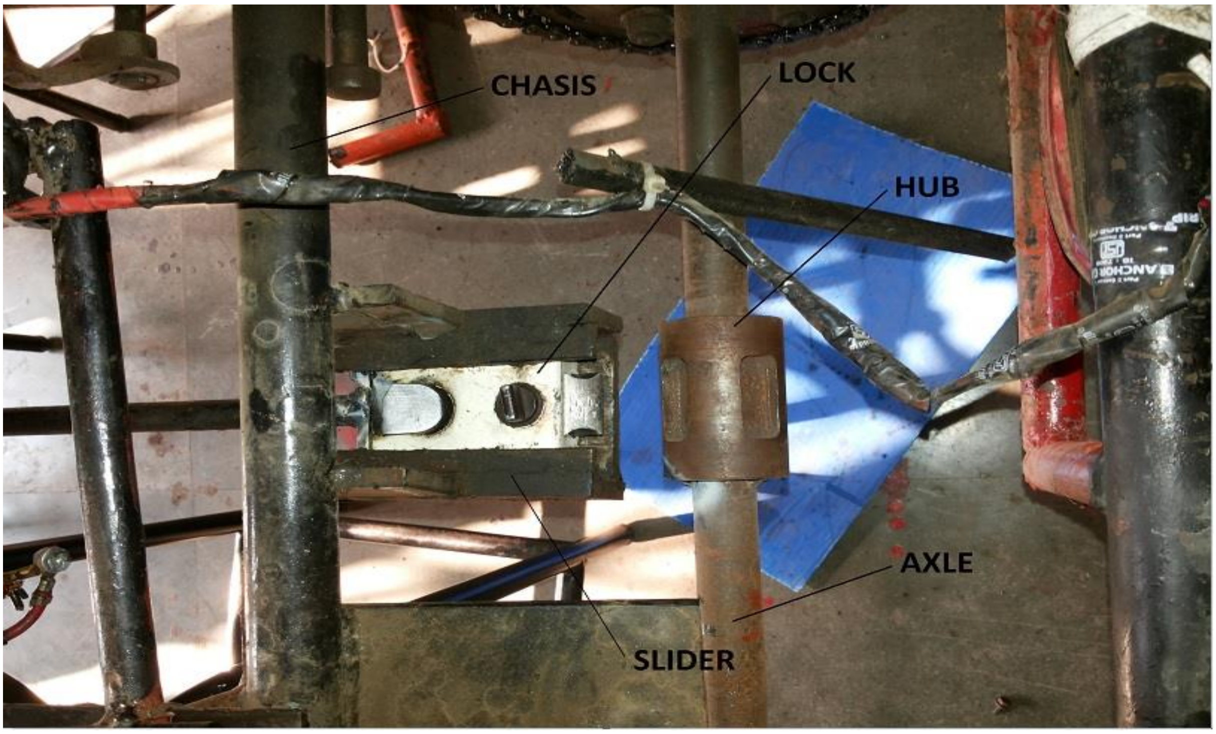


Figure 25:Lock and Hub

Chapter 4

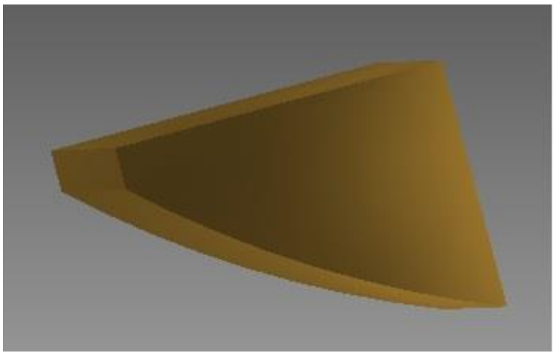
Results

4.1 Stress analysis of lock

4.2 Stress analysis of hub

4.1 Stress analysis of lock

Analyzed File:	lock.ipt
Autodesk Inventor Version:	2013 (Build 170138000, 138)
Creation Date:	3/31/2015, 9:25 PM
Simulation Author:	User
Summary:	



4.1.1 Simulation

Physical

Material	Brass
Density	8.49 g/cm^3
Mass	0.0261048 kg
Area	1470.36 mm^2
Volume	3074.77 mm^3
Center of Gravity	x=12.5 mm y=-1.16252 mm z=4.44255 mm

Table 3: Physical Properties of Lock Material

Note: Physical values could be different from Physical values used by FEA reported below.

Mesh settings

Avg. Element Size (fraction of model diameter)	0.1
Min. Element Size (fraction of avg. size)	0.2
Grading Factor	1.5
Max. Turn Angle	60 deg
Create Curved Mesh Elements	Yes

Table 4: Mesh setting of Lock

Material(s)

Name	Brass	
General	Mass Density	8.47 g/cm^3
	Yield Strength	200 MPa
	Ultimate Tensile Strength	275 MPa
Stress	Young's Modulus	109.6 GPa
	Poisson's Ratio	0.331 ul
	Shear Modulus	41.1721 GPa
Stress Thermal	Expansion Coefficient	0.0000205 ul/c
	Thermal Conductivity	116 W/(m K)
	Specific Heat	369 J/(kg c)

Table 5: Material Properties of Lock

Operating conditions

Force

Load Type	Force
Magnitude	1928.000 N
Vector X	0.000 N
Vector Y	0.000 N
Vector Z	-1928.000 N

Table 6: Force Conditions

Selected Face(s)

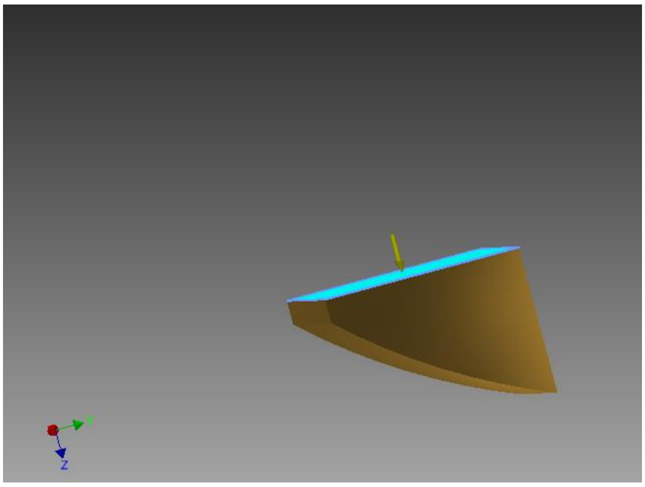


Figure 26: Face with force acting on lock

Fixed Constraint

Constraint Type	Fixed Constraint

Selected Face

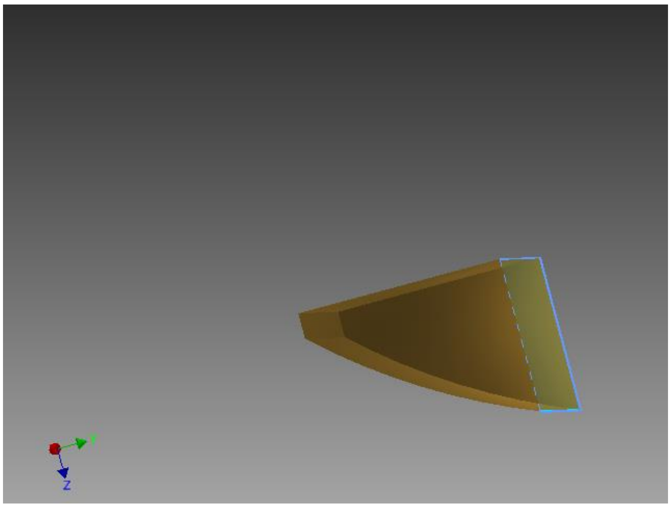


Figure 27: Constraint face of lock

Figures

Von Mises Stress

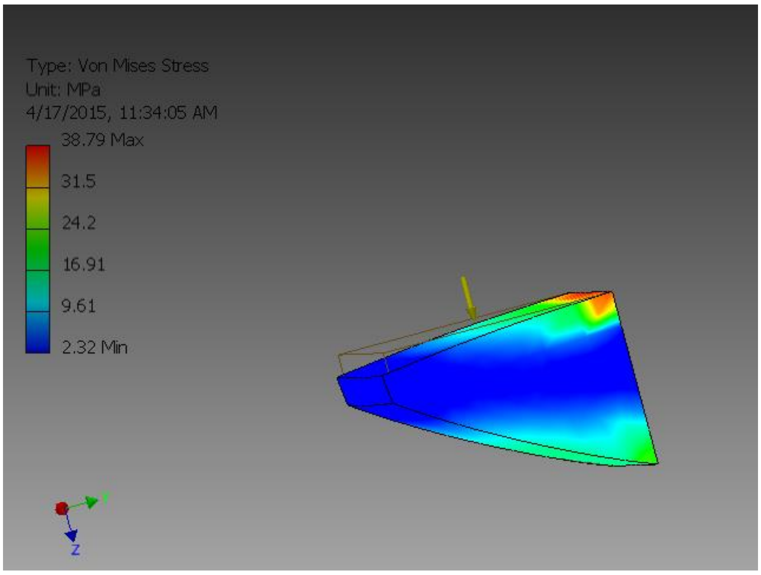


Figure 28: Von mises stress of lock

1st Principal Stress

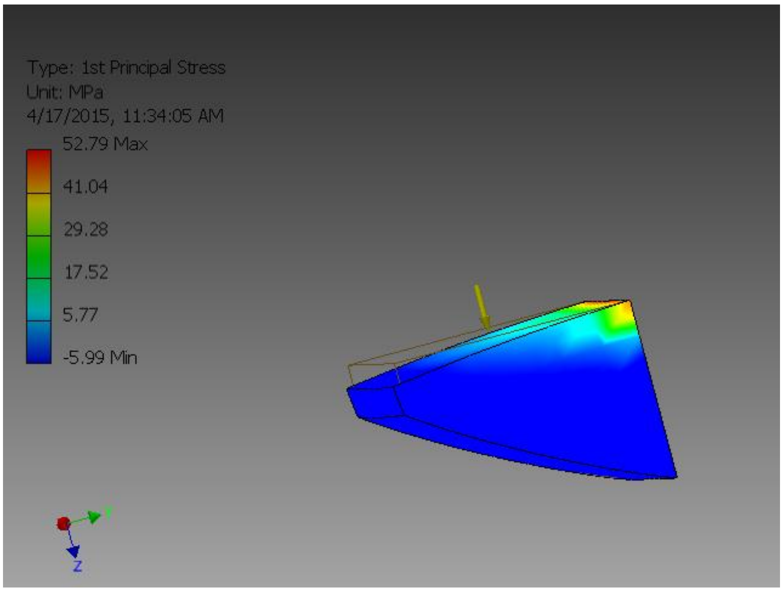


Figure 29:1 Principal stress of lock

3rd Principal Stress

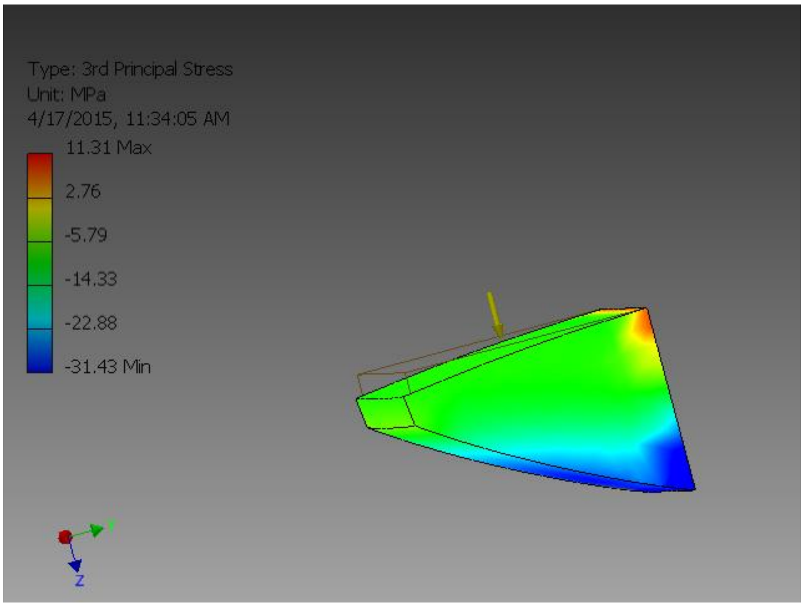


Figure 30:3 Principal stress of lock

Displacement

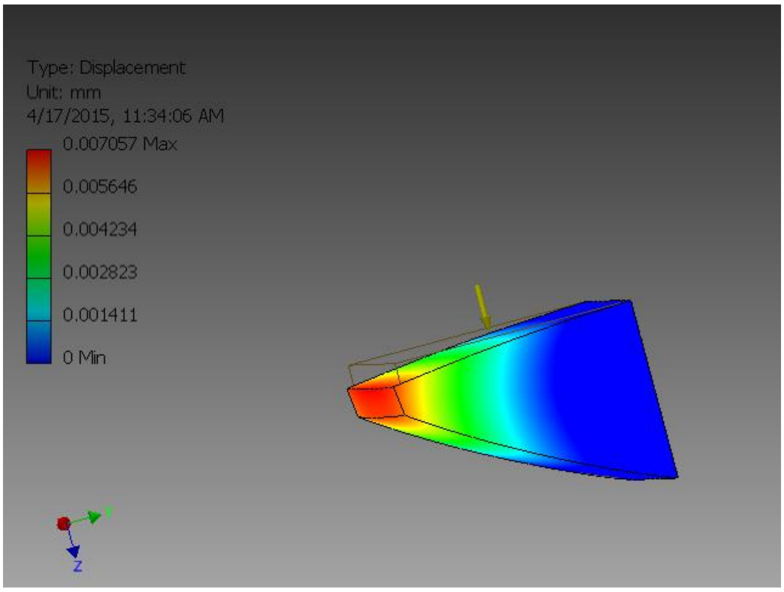


Figure 31:Displacement of lock

Safety Factor

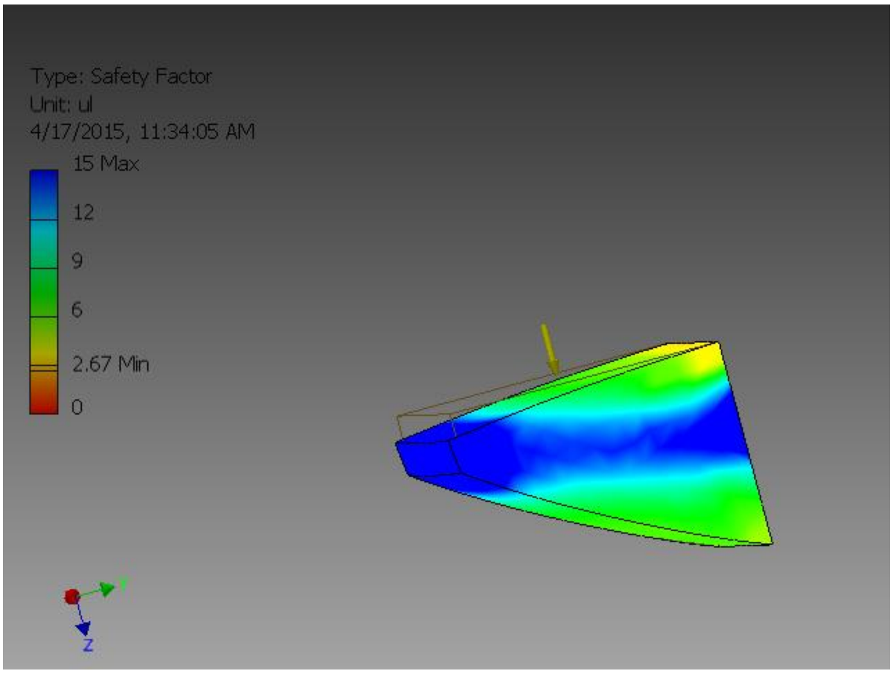


Figure 32:Safety factor of lock

4.1.2 Results

Reaction Force and Moment on Constraints

Constraint Name	Reaction Force		Reaction Moment	
	Magnitude	Component (X,Y,Z)	Magnitude	Component (X,Y,Z)
Fixed Constraint:1	1928 N	0 N	15.424 N m	15.424 N m
		0 N		0 N m
		-1928 N		0 N m

Table 7: Resuslts of reaction forces and moments

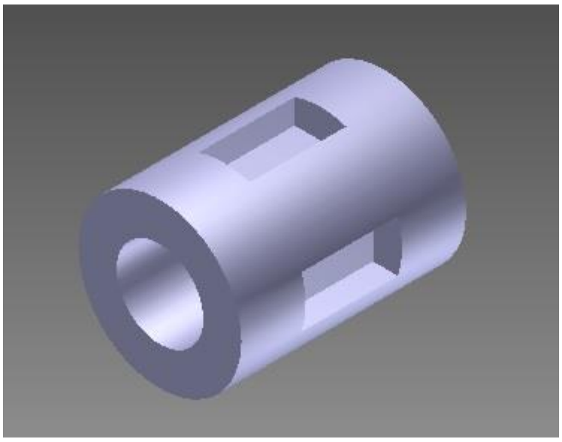
Result Summary

Name	Minimum	Maximum
Volume	3074.78 mm^3	
Mass	0.0260433 kg	
Von Mises Stress	2.31523 MPa	38.7925 MPa
1st Principal Stress	-5.98999 MPa	52.7921 MPa
3rd Principal Stress	-31.4311 MPa	11.3123 MPa
Displacement	0 mm	0.00705714 mm
Safety Factor	2.66547 ul	15 ul

Table 8: Result summary of lock

4.2 Stress Analysis Report of hub

4.2.1 Simulation



Analyzed File:	hub.ipt
Autodesk Inventor Version:	2013 (Build 170138000, 138)
Creation Date:	3/31/2015, 9:48 PM
Simulation Author:	User
Summary:	

⊟ Physical

Material	Steel AISI 1018
Density	0.288766 lbmass/in^3
Mass	1.50379 lbmass
Area	22931.6 mm^2
Volume	85338 mm^3
Center of Gravity	x=-0.00000000132598 mm y=0 mm z=35 mm

Table 9: Physical properties of hub

Note: Physical values could be different from Physical values used by FEA reported below.

Mesh settings:

Avg. Element Size (fraction of model diameter)	0.1
Min. Element Size (fraction of avg. size)	0.2
Grading Factor	1.5
Max. Turn Angle	60 deg
Create Curved Mesh Elements	Yes

Table 10: Mesh settings of hub

Material(s)

Name	Steel AISI 1018	
General	Mass Density	0.288766 lbmass/in^3
	Yield Strength	30020.6 psi
	Ultimate Tensile Strength	75051.4 psi
Stress	Young's Modulus	28319.4 ksi
	Poisson's Ratio	0.3 ul
	Shear Modulus	10892.1 ksi
Stress Thermal	Expansion Coefficient	0.0000288034 ul/f
	Thermal Conductivity	29.9895 btu/(ft hr f)
	Specific Heat	0.386579 btu/(lbmass f)

Table 11: Material properties of hub

Operating conditions

Force:

Load Type	Force
Magnitude	433.430 lbforce
Vector X	433.430 lbforce
Vector Y	0.000 lbforce
Vector Z	0.000 lbforce

Selected Face(s)

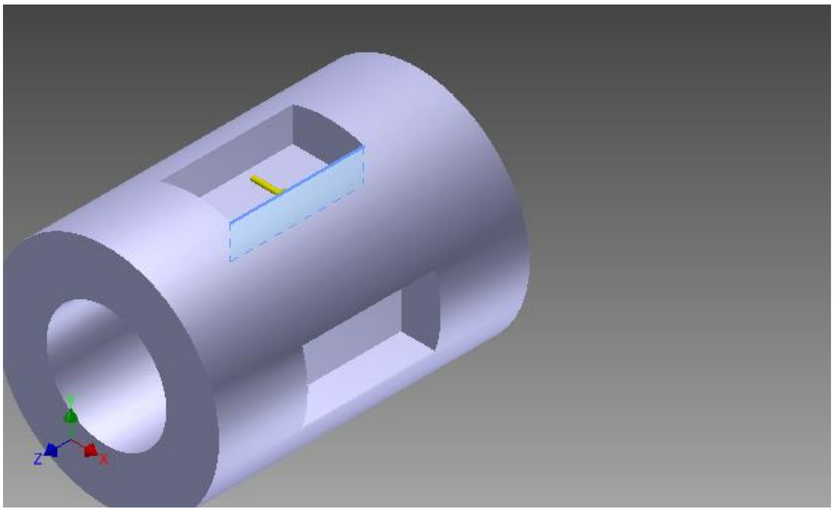


Figure 33: Force on face of hub

Figures

Von Mises Stress

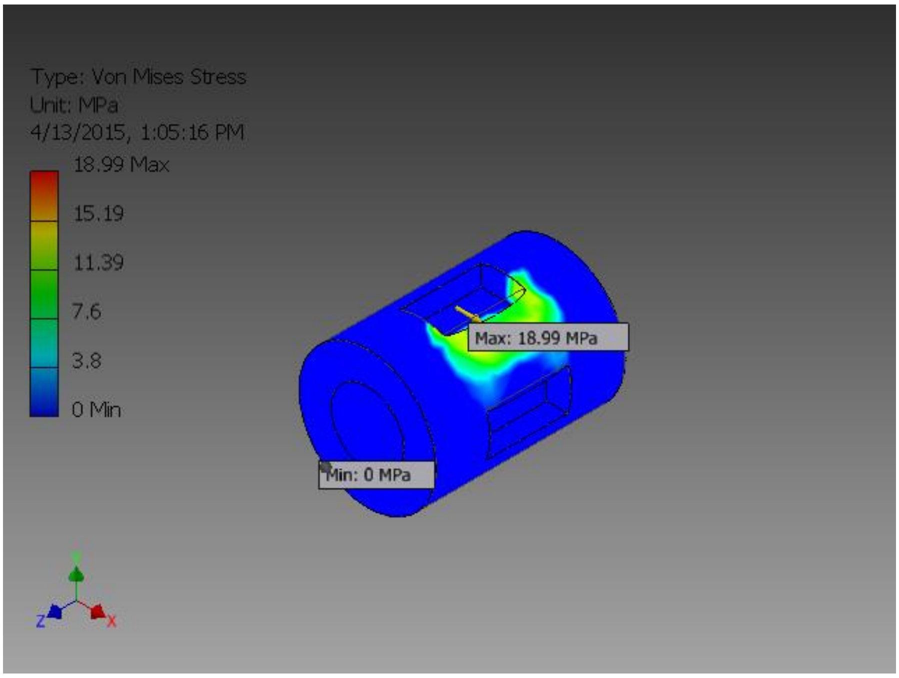


Figure 34: Von mises stress of hub

1st Principal Stress

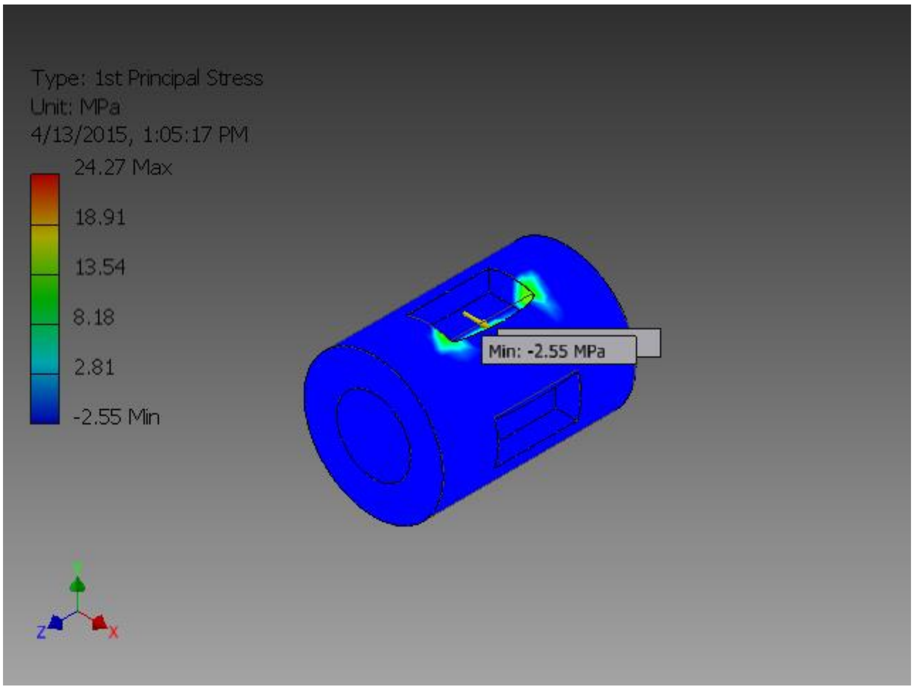


Figure 35: 1 Principal stress of hub

3rd Principal Stress

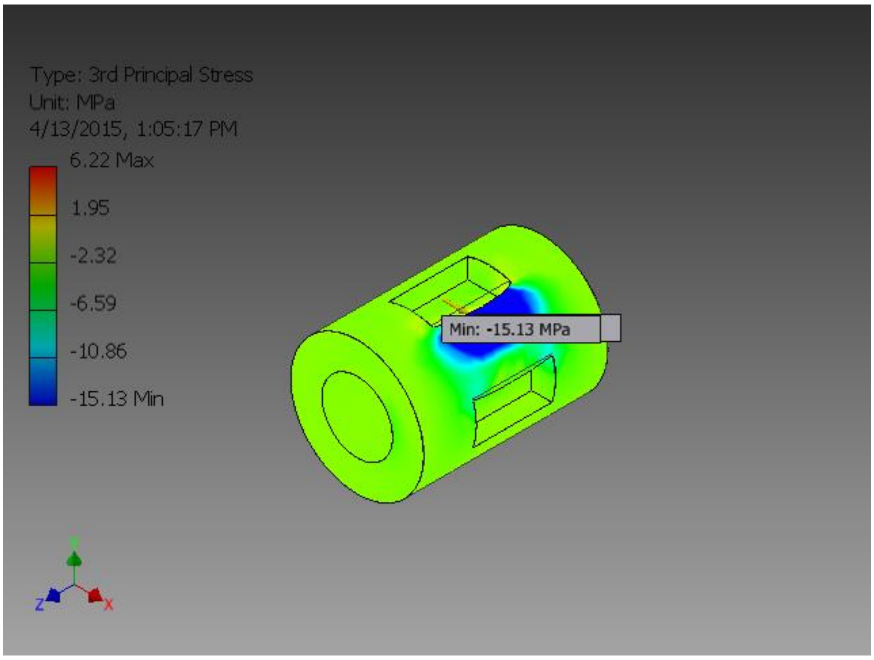


Figure 36: 3 principal stress of hub

Displacement

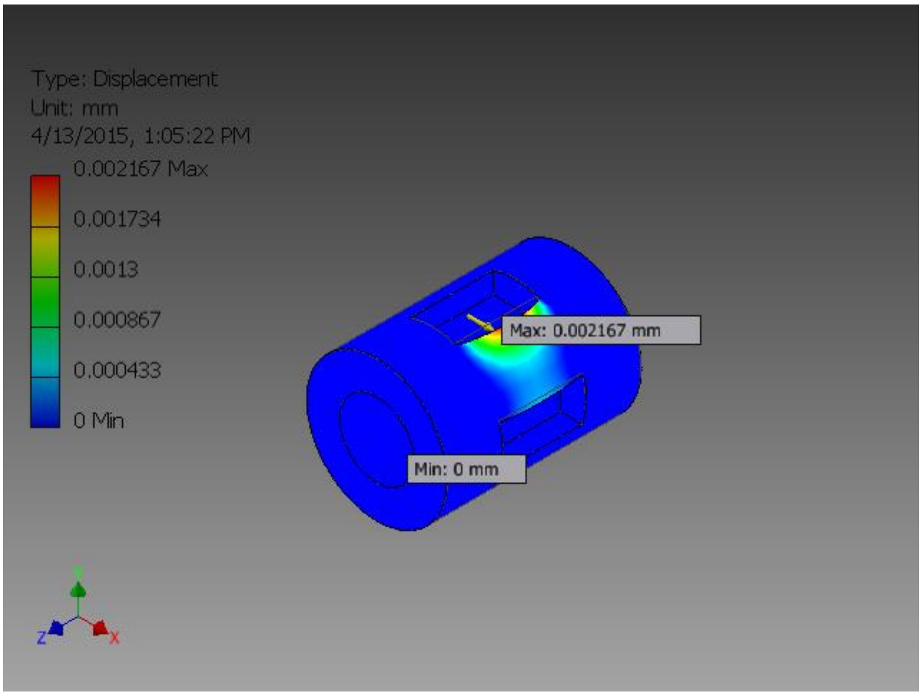


Figure 37: Displacement of hub

Safety Factor

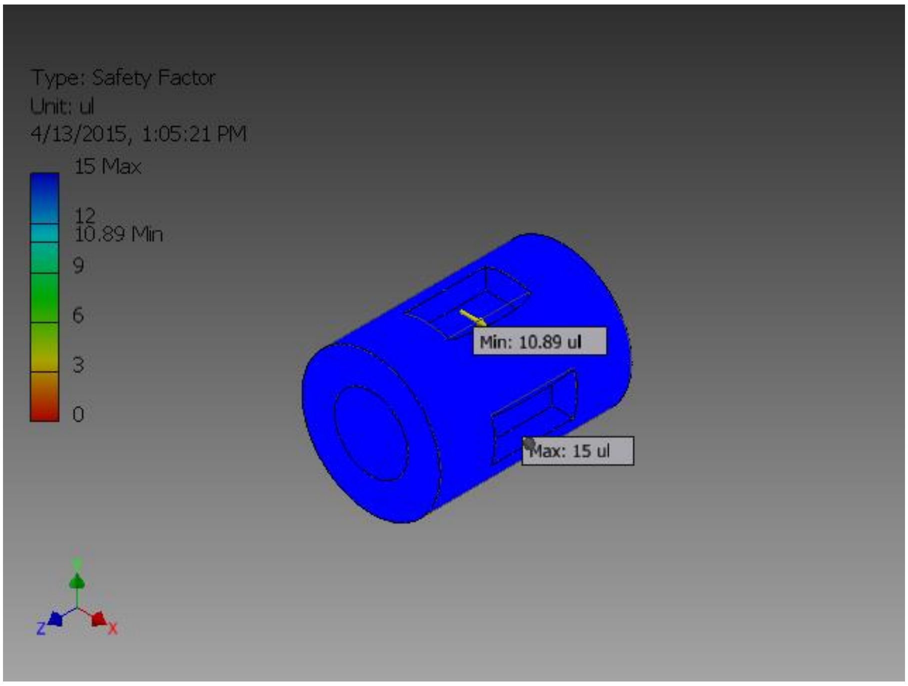


Figure 38: Safety factor

4.2.2 Results

Reaction Force and Moment on Constraints

Constraint Name	Reaction Force		Reaction Moment	
	Magnitude	Component (X,Y,Z)	Magnitude	Component (X,Y,Z)
Fixed Constraint:1	433.43 lbforce	-433.43 lbforce	28.8018 lbforce ft	0 lbforce ft
		0 lbforce		0 lbforce ft
		0 lbforce		28.8018 lbforce ft

Table 12: Reaction force and moment on constraints of hub

Result Summary

Name	Minimum	Maximum
Volume	85338 mm^3	
Mass	1.50379 lbmass	
Von Mises Stress	0.00188823 MPa	18.9852 MPa
1st Principal Stress	-2.55066 MPa	24.2749 MPa
3rd Principal Stress	-15.1295 MPa	6.21794 MPa
Displacement	0 mm	0.00216731 mm
Safety Factor	10.8949 ul	15 ul

Table 13: Result summary of hub

Chapter 5

Conclusion

5.1 Conclusion

- Anti-Drag System was designed, analyzed and manufactured successfully.
- The project work was completed in around 7 months in total.
- Designing and Analysis took about two months each.
- Sourcing materials, manufacturing and testing was carried out in two months.
- The project report required an additional two weeks.
- The Anti-Drag system can be used in any vehicle with more than two wheels.
- It is easy to manufacture, easy to replace if broken.

5.2 Future Scope

5.2.1 Safety System for Conceptual Car Design

The aim of the system is to avoid the backward movement of car when the ADS (anti-drag system) fails when the car is moving on slope.

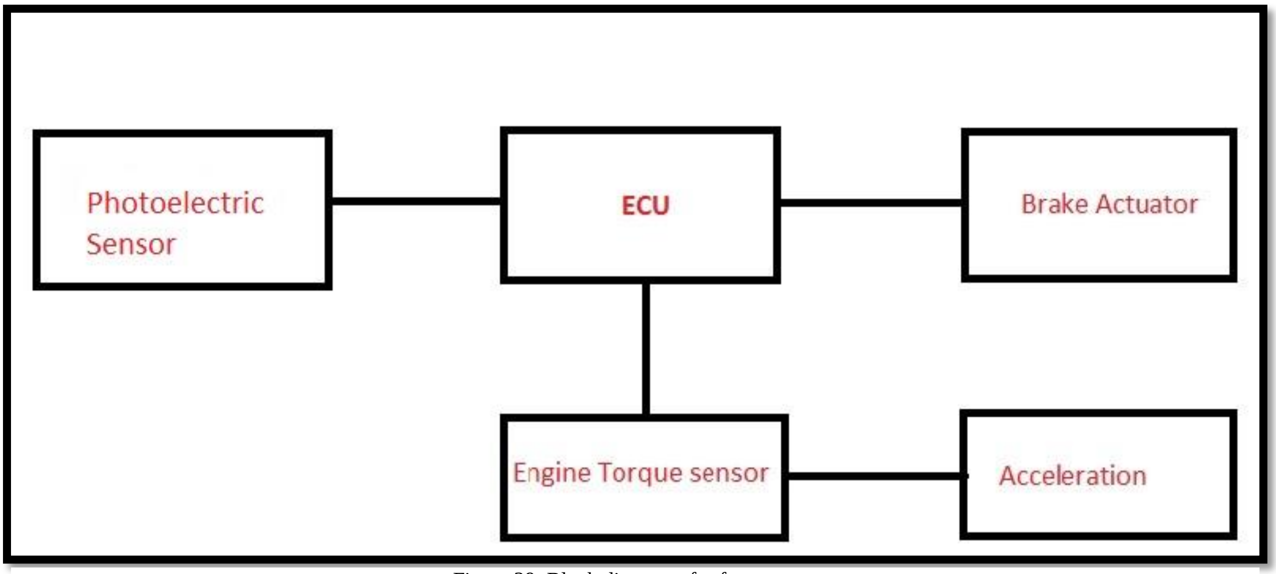


Figure 39: Block diagram of safety system

<u>The safety system consist of:-</u>

1. Protoelectric Sensor

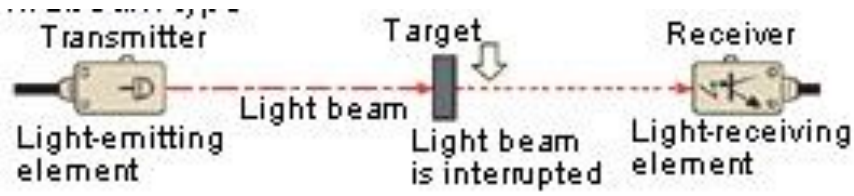


Figure 40: Photoelectric sensor

A **photoelectric sensor**, or photo eye, is a device used to detect the distance, absence, or presence of an object by using a light transmitter, often infrared, and a photoelectric receiver.

There are various sensing modes in photoelectric sensor such as through beam , retro reflective and diffused arrangement. In our case we have used proximity-sensing (diffused) arrangement. A proximity-sensing (diffused) arrangement is one in which it become operational when the receiver "receives" the transmitter. The emitting element is located at one end of lock while the receiving element is located on other end of the lock.

2. ECU

This is the vehicle's embedded computer system that receives signals from the various sensors.

3. Engine Torque Sensor

This simply detects whether the engine is producing sufficient torque to accelerate the car forward.

4. Brake Actuator

An actuator is a device that converts an electrical signal into a physical movement. The brake actuator receives a signal from the ECU telling it to trigger the brakes. It then activates brake valves, sending brake fluid to the brakes to hold the vehicle in place.

5.2.2 Working of Safety System

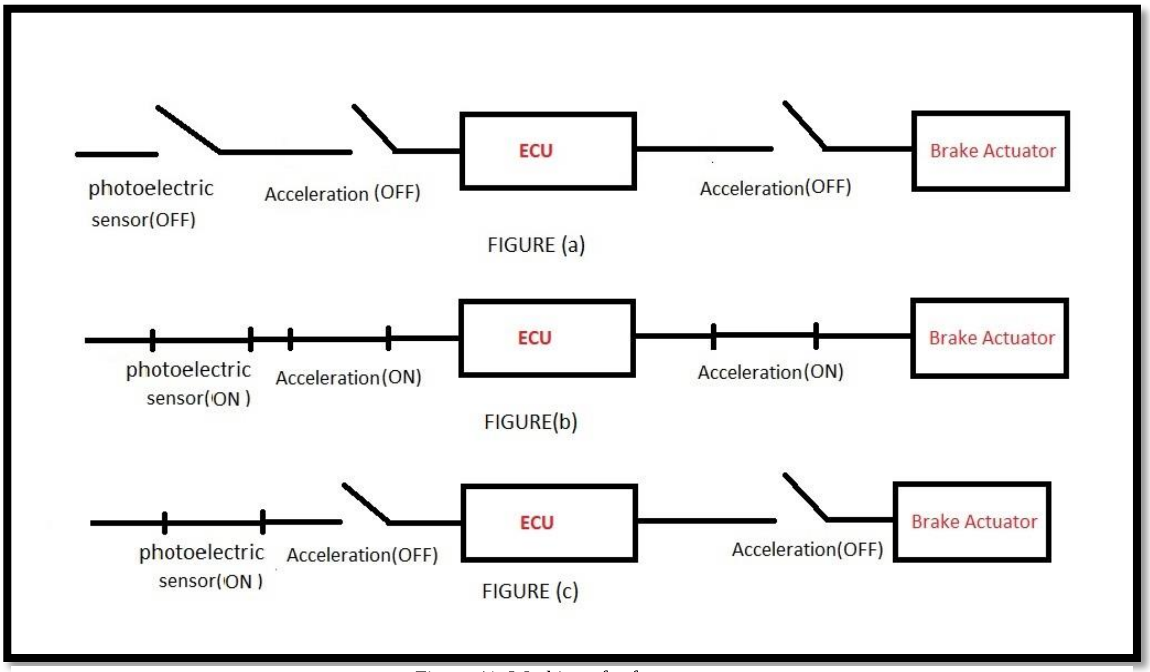


Figure 41: Working of safety system

When the ads is operating normally the photoelectric sensor will in off position as the signal is not received by the receiver. The acceleration switch is in off position as the accelerator pedal is operated, in this case normally closed switch is used. It is Shown in fig(a).

As the lock gets bend due to excessive sudden load the proximity switch gets on and it will send the signal to ECU to operate the brake actuator. Hence the brake is applied which prevent the backward motion of the vehicle. It is shown in fig(b).

The brake will be applied until sufficient engine torque has been produced to move the vehicle forward without allowing it to move backward. As soon as sufficient torque has been developed the ECU will turn the brake actuator off and vehicle will move forward. It is shown in fig (c)

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- http://www.azom.com/article.aspx?ArticleID=6115
- http://www.azom.com/article.aspx?ArticleID=6375
- http://www.nissan.global.com

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Dilawarkhan Sufiyan M
Bade Usama A
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