A PROJECT REPORT

ON

"Design and Analysis of All Terrain Vehicle"

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

Prof. Zia Momin

DEPARTMENT OF MECHANICAL ENGINEERING

ANJUMAN-I-ISLAM

KALSEKAR TECHNICAL CAMPUSNEW PANVEL,

NAVI MUMBAI – 410206

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ANJUMAN-I-ISLAM

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CERTIFICATE

This is to certify that the project entitled

"Design and Analysis of All Terrain Vehicle"

Submitted by

Shaikh Rahil Nisar (11ME63)
Mapari Saad Sajjad (12ME76)
Shaikh Mohammed Ijaz (11ME54)

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.

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(Prof. Zakir Ansari)	(Dr. Abdul Razzak Honnutagi)

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APPROVAL OF DISSERTATION

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(Internal Examiner) **(External Examiner)**

___________________ ___________________

Date: ___________

ACKNOWLEDGEMENT

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ABSTRACT

Our project is to design and analyze the ATV that would help to automotive and transportation sector in India to flourish by introducing of low cost automation and effective design and usage of machinery.

We have made an ALL TERRAIN VEHICLE with individual suspension system having the power high enough to carry out transportation in rough terrains.

Following are the objectives of the project:

- Design of a low cost machine taking into consideration the power output that is required for its working.
- Calculation of stresses acting on the chassis of the vehicle under different loading conditions.
- Deciding the cost efficiency of such product in terms of large scale manufacturing i.e. final product.

The product can prove to be very efficient product in its all aspect such as cost, durability, maintenance, easy usage, better transportation medium in rough terrains etc.

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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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Chapter 1

Introduction

1.1 Introduction

An All Terrain Vehicle as known as ATV is a recreational vehicle with large Wheels, and Wide tires, designed for use on sand dunes or beaches. The design is usually a modified vehicle and engine mounted on an open chassis. The modifications usually attempt to increase the power to weight ratio by either lightening the vehicle or increasing engine power or both. Dune buggies designed specifically for operation on open sand are called sand rails.

FIG 1: ATV

A similar, more recent generation of off-road vehicle, often similar in appearance to a sand rail but designed for different use, is the "off road go-kart". The difference may be little more than fitting all-terrain tires instead of sand tires.

1.2 History

Suzuki was a leader in the development of 4-wheeled ATVs. It sold the first ATV, the 1982 Quad Runner LT125, which was a recreational machine for beginners.

Suzuki sold the first 4-wheeled mini ATV, the LT50, from 1984 to 1987. After the LT50, Suzuki sold the first ATV with a CVT transmission, the LT80, from 1987 to 2006.

In 1985 Suzuki introduced to the industry the first high performance 4-wheel ATV, the Suzuki LT250R Quad Racer. This machine was in production for the 1985-1992 model years. During its production run it underwent three major engineering makeovers. However, the core features were retained. These were: a sophisticated long-travel suspension, a liquid-cooled two-stroke motor and a fully manual 5 speed transmission for 85-86 models and a 6-speed transmission for the 87-92 models. It was a machine exclusively designed for racing by highly skilled riders.

Honda responded a year later with the FourTrax TRX250R a machine that has not been replicated until recently. It currently remains a trophy winner and competitor to big-bore ATVs. Kawasaki Heavy Industries responded with its Tecate-4 250.

In 1987, Yamaha Motor Company introduced a different type of high performance machine, the BANSHEE 350, which featured a twin-cylinder, liquid cooled, two stroke motor the RD350LC street motorcycle. Heavier and more difficult to ride in the dirt than the 250s, the Banshee became a popular machine with sand dune riders thanks to its unique power delivery. The Banshee remains popular, but 2006 is the last year available in the U.S. (due to EPA emissions regulations).

Shortly after the introduction of the Banshee in 1987, Suzuki released the L T500R QuadRacer. This unique quad was powered by a 500 cc liquid cooled two stroke engine with a 5-speed transmission. This ATV earned the nickname "Quadzilla" with its remarkable amount of speed and size. While there are claims of 100+ mph stock Quadzillas, it was officially recorded by 3&4 Wheel Action magazine as reaching a top speed of over 79 mph (127 krn/h) in a high speed shootout in its 1988 June issue, making it the fastest production ATV ever produced. Suzuki discontinued the production of the L T500R in 1990 after just 4 years.

At the same time, development of utility ATVs was rapidly escalating. The 1986 Honda FourTrax TRX350 4x4 ushered in the era of four wheel drive ATVs. Other manufacture quickly followed suit, and 4x4s have remained the most popular type of ATV ever since. These machines are popular with hunters, farmers, ranchers’ workers at construction sites.

Chapter 2

Review of Literature

"Optimization of Chassis of an All Terrain Vehicle" by Junaid Mohammed Farooq, A.S.N. Saiteja et. al. studied chassis of ATV. The paper deals with design of chassis frame for an All Terrain Vehicle and its Optimization. Various loading tests like Front Impact, Rear Impact, Side Impact, and Roll over test etc have been conducted on the chassis and the design has been optimized by reducing the weight of the chassis.

Rahul Dev Gupta, Rakesh Kumar Phanden and other in their paper "Design and Development for Roll Cage of All-Terrain Vehicle" studied aims to give an introduction to the material selection procedure, pipe size selection and various tests that need to be done before finalizing the design. Various factors such as impact force determination, loading points, the mesh size dependence of generated stress, Von-Misses Stress, Deformation and Factor of Safety (FOS) are studied.

"Modal and Static Analysis of a Standard All-Terrain Vehicle Chassis" by Shaik khajamoinuddin, B.Balaji did chassis analysis using software and comparing it with theoretical calculations.

"Design & Manufacturing of All Terrain Vehicle (ATV) - Selection, Modification, Static & Dynamic Analysis of ATV Vehicle" in the journal presented by Upendra S. Gupta, Sumit Chandak, Devashish Dixit provided detail description of the design considerations, static & dynamic analysis and mathematical data involved in the design of a ATV Vehicle.

Denish S. Mevawala et. al. in their paper "Stress Analysis of Roll Cage for an All Terrain Vehicle" discussed about the roll cage of ATV. The paper deals with design of roll cage for an ATV and Various loading tests like Front Impact, Side Impact and rear impact have been conducted. The modeling and stress analysis is done by ANSYS software.

The paper "Simulation of Roll cage of an All-Terrain Vehicle considering inertia, using Transient Multi-body analysis" by A.V.S. Abhinav have developed an approximate model using different elements in ANSYS APDL and a transient multi-body analysis is carried out to check for failure in the roll cage due to inertia of major components. The paper thus provides the method to study the effect of inertia of individual components on the roll cage during an impact and helps in designing a safer vehicle.

"Simulation Aspects of a Full-Car ATV Model Semi-Active Suspension" written by Kasi Kamalakkannan et. al. studied the design, modeling, and simulation and testing procedure of All Terrain Vehicle (ATV) fitted with SAS, which is used in BAJA SAEINDIA standards. They have focusd on suspension and in corporate in front SLA wishbone and rear McPherson Strut are fixed. Primary important of the paper has been to show a direction, of an easy way to implement ATV's behavior to the simulation software, in particular for SAS.

Designing of All Terrain Vehicle (ATV) by Deep Shrivastava concentrated on the chassis, drive-train, and suspension. The design process included using Solid Works, CATIA and ANSYS software packages to model, simulate, and assist in the analysis of the completed vehicle.

Amrit Om Nayak et. al. tried to design an all terrain vehicle that meets international standards and is also cost effective at the same time in their paper "Complete Design and Finite Element Analysis of an all Terrain Vehicle". The key parameters ranging from most critical to least critical are safety, reliability, low cost, ease of operation and maintenance, and overall performance.

Chapter 3

Components of ATV

In this chapter we shall have a detail look on the various components that will be required for the ATV.

3.1 Engine

The engine used for this project is a FOUR STROKE 3-CYLINDER ENGINE. The reason for using his engine is for better power output. Such engine is used for delivering good amount of power which is essential for such sort of vehicle.

FIG 2: Engine

The specification for this engine is as follows:
Displacement: 798cc
Stroke: 4 Strokes
Fuel: Petrol
Cylinder: 3 Cylinders
Number of Valve: 6 valves
Power output: 37 bhp @ 5000 rpm
Bore x Stroke (mm): 68.5x72.0
Compression Ratio: 8.8:1

3.2 Air Filter

An air filter is an important part of a car's intake system, because it is through the air filter that the engine "breathes." An engine needs an exact mixture of fuel and air in order to run, and all of the air enters the system first through the air filter. The air filter's purpose is to filter out dirt and other foreign particles in the air, preventing them from entering the system and possibly damaging the engine.

FIG 3: AIR FILTER

Keeping this in mind our filter has been specially designed to give maximum air intake possible for better combustion.

3.3 Carburetor

a) OPERATION:

Variable-venturi, in which the fuel jet opening is varied by the slide (which simultaneously alters air flow). In "constant depression" carburetors, this is done by a vacuum operated piston connected to a tapered needle which slides inside the fuel jet. A simpler version exists, most commonly found on small motorcycles and dirt bikes, where the slide and needle is directly controlled by the throttle position. The most common variable venturi (constant depression) type carburetor is the sidedraft SU carburetor and similar models from Hitachi, Zenith-Stromberg and other makers. The UK location of the SU and Zenith-Stromberg companies helped these carburetors rise to a position of domination in the UK market, though such carburetors were also very widely used on Volvos and other non-UK makes. Other similar designs have been used on some European and few Japanese automobiles. These carburetors are also referred to as “constant velocity” or “constant Vacuum” carburetors, which was essentially a fixed venturi carburetor with one side of the venturi hinged and movable to give narrow throat at low rpm and a wider throat at high rpm. This was designed to provide good mixing and airflow over a range of engine speeds, through the VV carburetor proved problematic in service.

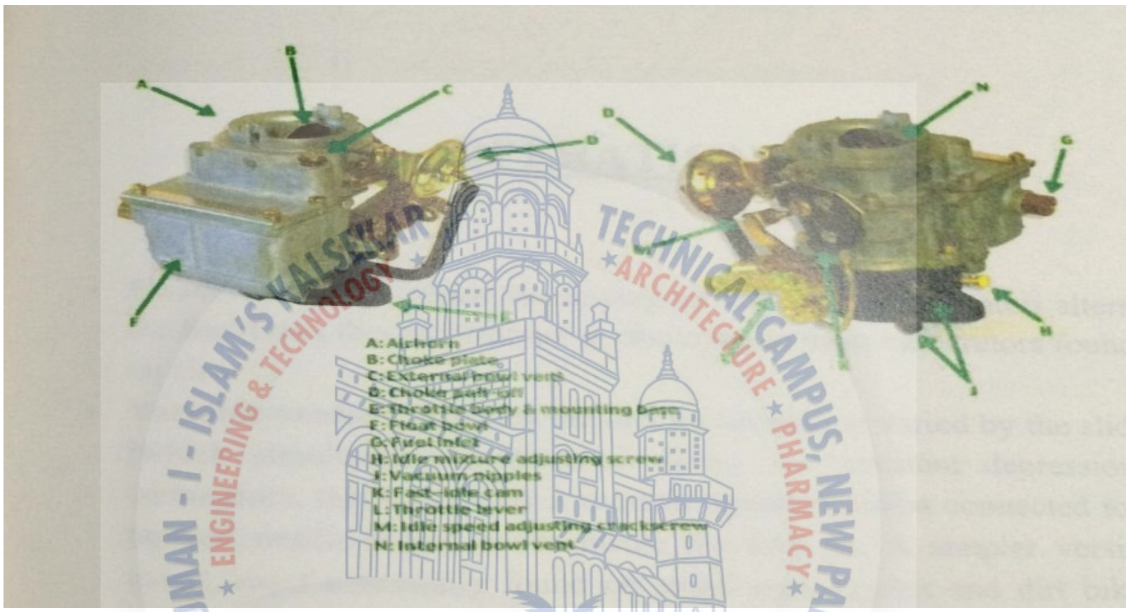

FIG 4: CARBURETOR

3.4 Transmission

Automobile or automotive transmission system consists of various devices that help in transmitting power from the engine through the drive shaft to the live axle of an automobile. Gears, brakes, clutch, fluid drive and other auto transmission parts work together for transforming the speed ration between the engine and wheels of a vehicle. The auto transmission system incorporates various components, which are attached to the back of the engine, and used for distributing the power from the engine to the drive wheel.

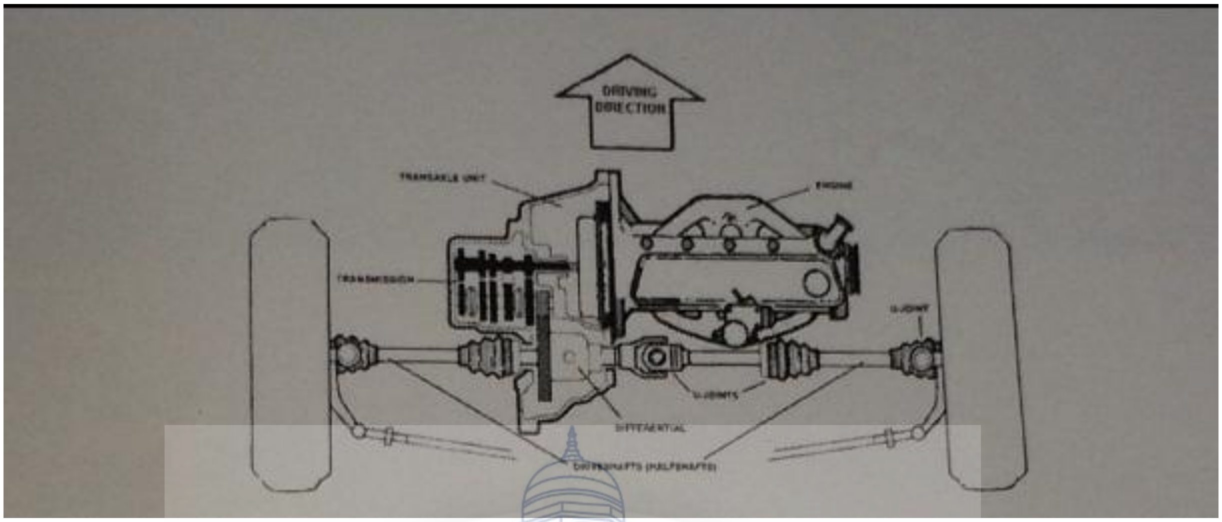

FIG 5: TRANSMISSION SYSTEM

The main components of transmission system consist of a gearbox, clutch, differential, drive shaft, propeller shaft and the coupling used.

3.5 Gearbox

It is the gearbox which provides with all the torque and speed variations. Often, a gearbox will have multiple gear ratios (or simply "Gears"), with the ability to switch between them as speed varies. This switching may be done manually (by the operator), or automatically. Directional (forward and reverse) control may also be provided. Many typical automobile transmissions include the ability to select one of several different gears ratios. In this case, most of the gear ratios (often simply called "gears") are used to slow down the output speed of the engine and increase torque. However, the highest gears may be "overdrive" types that increase the output speed.

Requirements for transmission for our vehicle

- It should transmit more torque at lower RPM as it's an ATV.
- Gears should be strong enough to take the load.
- Gear shifting mechanism should be simple.
- Transmission should not be heavy otherwise it will affect the load of the vehicle.
- Gears are appropriate and suitable for the engine.
- Shifting of gears should be smooth.

3.6 Clutch

Clutch is a mechanism which enables the rotary motion of one shaft to be transmitted, when desired, to a second shaft the axis of which is coincident with that of the other. Clutches are useful in devices that have two rotating shafts. In these devices, one shaft is typically attached to a motor or other power unit (the driving member), and the other shaft (the driven member) provides output power for work to be done. The clutch connects the two shafts so that they can either be locked together and spin at the same speed (engaged), or be decoupled and spin at different speeds (disengaged).

3.7 Brakes

Brakes - what do they do? The simple answer: they slow you down.

DISC BRAKES

The disc brake or disk brake is a device for slowing or stopping the rotation of a wheel while it is in motion.

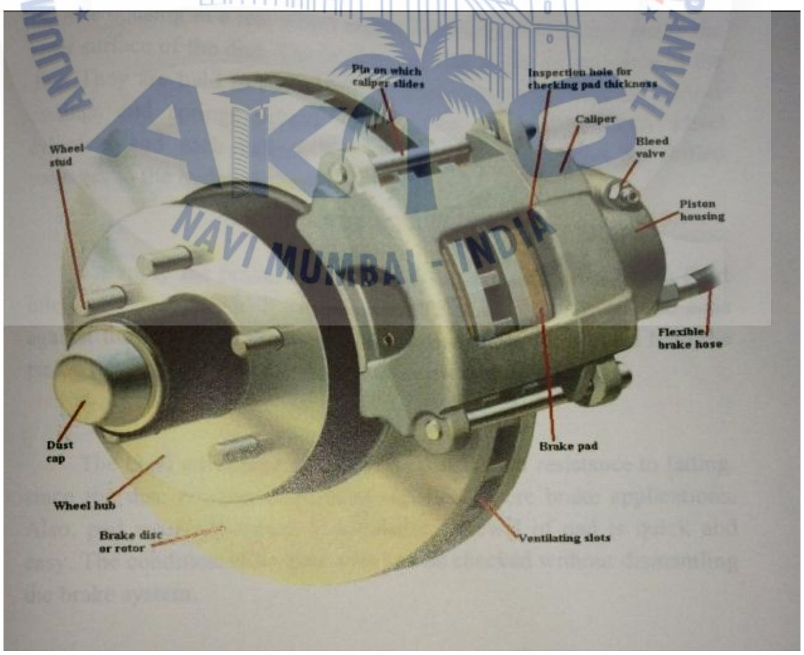

FIG 6: DISC BRAKE

The motor vehicles are now being fitted with disc brakes instead of the conventional tire drum brakes which are generally used on some cars. A disc brake consists of a rotating disc and two friction pads which are actuated by four hydraulics wheel pistons contained of a rotating disc and two friction pads which are actuated by four hydraulic wheel pistons contained in two halves of an assembly called a *caliper*. The caliper assembly is secured to the steering knuckle in front wheel brake and to the axle housing in a rear wheel brake. The road wheel is fastened to the outer surface of the disc. The friction pas ride freely on each side of the disc. They are held in position by machined surface inside the caliper castings and springs behind and hydraulic pistons. The two wheel cylinders and each caliper half are connected in series by drilled passages to the hydraulic brake lines and to the bleeder screw.

To apply the brake, the hydraulic pressure is applied to the fluid inlet tube, due to which wheel cylinder pistons force the friction pads against the rotating discs. In the released position, the springs hold the piston pads so that they maintain contact with the disc surface.

The chief advantage of the disc brakes is their resistance to fading, since the disc remains cool under repeated severe brake applications. Also, pad wear adjustment is automatic; renewal of pad is quick and easy. The condition of the pad wear can be checked without dismantling the brake system.

3.8 Suspension

The conventional buggies had a MONO suspension at the REAR wheels that will make both the wheels up or down as per the terrain conditions.

This makes one of the wheels to leave the ground contact unnecessarily. When the buggy bounces on the rough terrain one transmission wheel should be on ground so as to gain control over vehicle.

The individual suspension system would release the load of the other wheel i.e. on the ground and that the wheel experiencing rough road would continue to work as per the terrain condition.

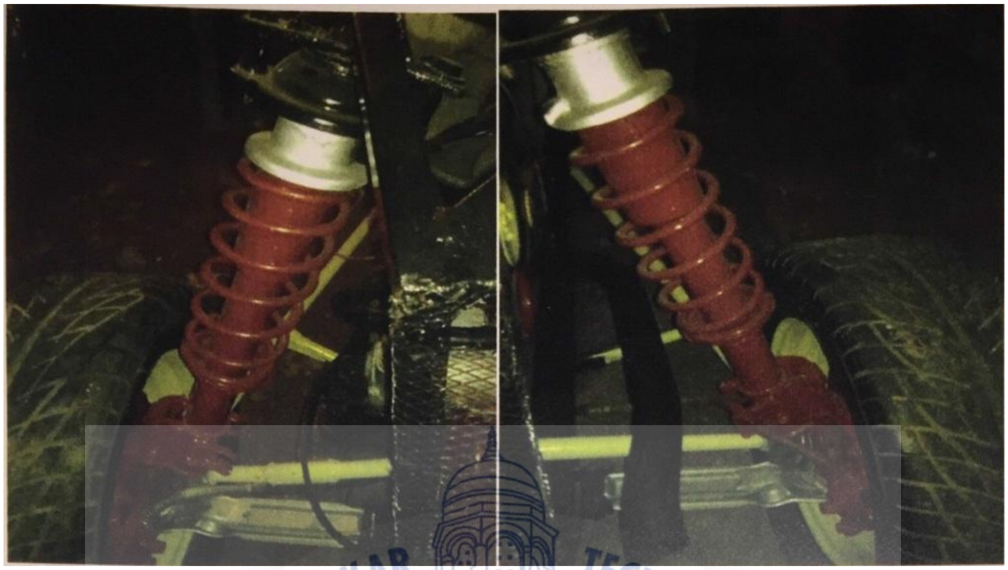

FIG 7: MCPHERSON SUSPENSION AT REAR

FIG 8: TELESCOPIC SHOCK ABSORBER AT FRONT

3.9 Battery

The automotive battery, also known as a lead-acid storage battery, is an electrochemical device that produces voltage and delivers current. In an automotive battery we can reverse the electrochemical action, thereby recharging the battery, which will then give us many years of service. The purpose of the battery is to supply current to the starter motor, provide current to the ignition system while cranking, to supply additional current when the demand is higher than the alternator can supply and to act as an electrical reservoir. The battery that used was 12V, 30Ah

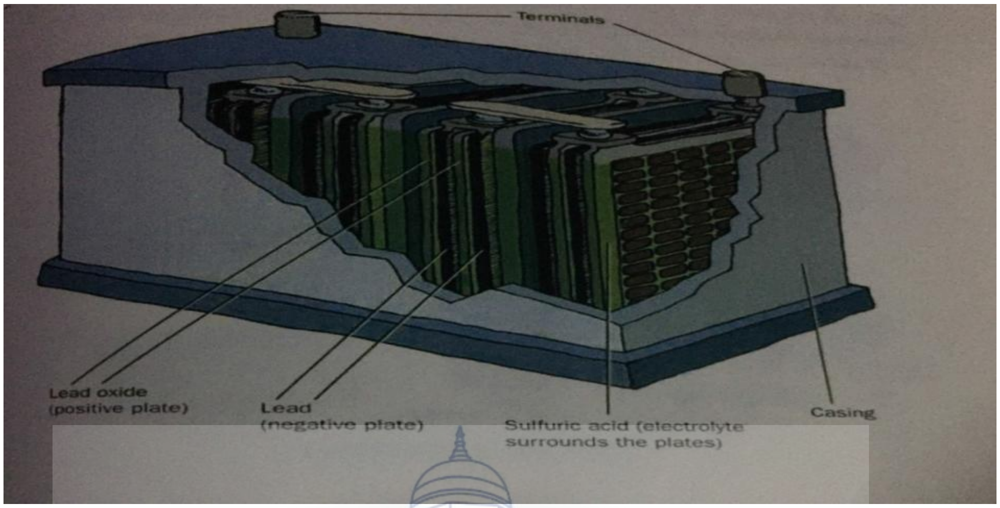

FIG 9: BATTERY

3.10 Ignition System

Working of the basic distributor type electronic system is similar to the conventional electrical system, in that both are inductive type system that is the energy of the system is stored in the coil. In this electronic system, ignition system timer is employed in the distributor instead of contact breaker. This timer may be a pulse generator or a Hall Effect switch or an optical switch which triggers the ignition module, also called the electronic ignition control unit. This control unit primary contains transistor circuit whose base current is triggered off and ON by the timer which results in the stopping and timing of the primary current. Other than this, the electronic ignition system works similar to the conventional electrical point type system.

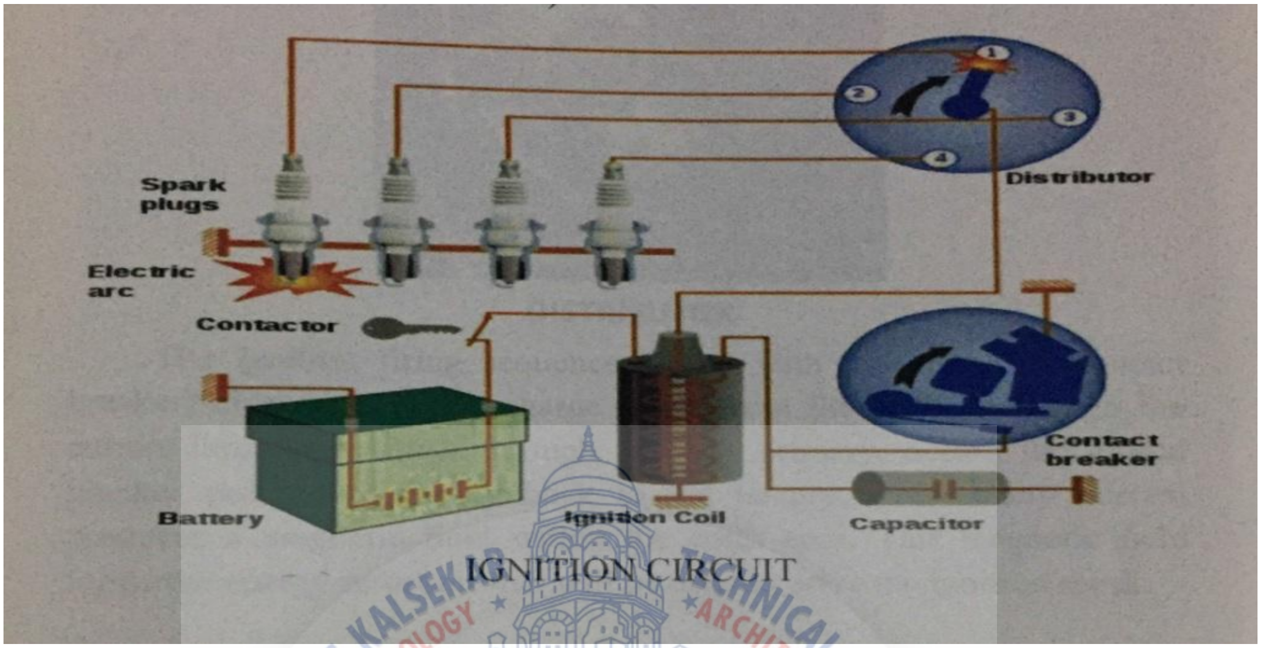

FIG 10: IGNITION SYSTEM

3.11 Starter Motor

The starter motor is a powerful electric motor, with a small gear (pinion) attached to the end. When activated, the gear is meshed with a larger gear (ring), which is attached to the engine. The starter motor then spins the engine over so that the piston can draw in a fuel/air mixture; this is then ignited to start the engine. When the engine starts to spin faster than the starter, a device called an overrunning clutch (bendix drive) automatically disengages the starter gear from the engine gear. It has 6 terminals. 2 are connected to alternator. 1 to battery and other is to charging indicator and 2 on ignition key.

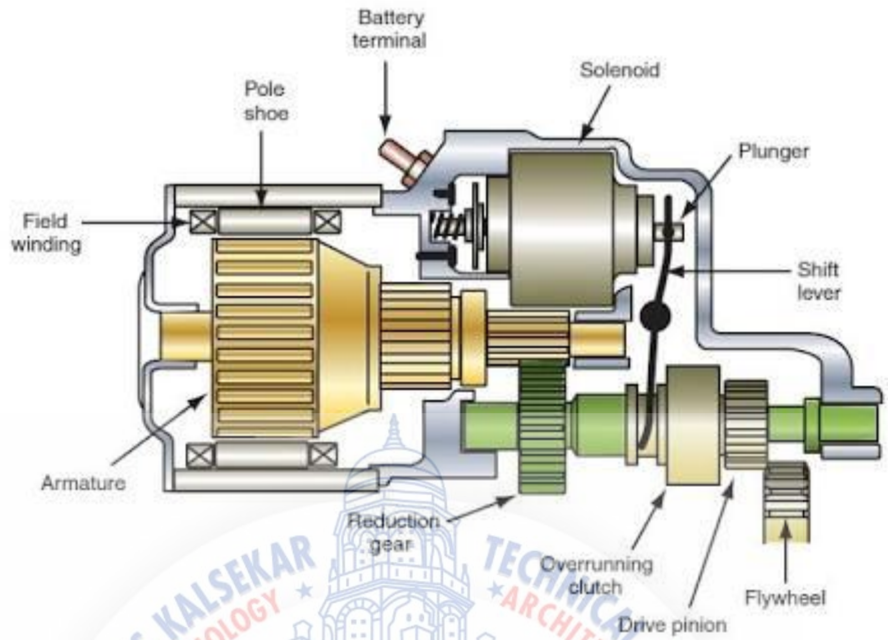

FIG11: STARTER MOTOR

Chapter 4

Design and Analysis of ATV

Dune buggies are usually created using one of two to three different methods. The first involves alteration of an existing vehicle. Most significant is the position of the rear, which with removal of bodywork transfers a high proportion of the weight to the rear driven wheels for extra traction. The engine is air cooled, simplifying engine modification, and the absence of a radiator eliminates a source of failure. The low price; robustness of the front suspension; and the sizable quantity of spare parts are a further advantage.

The second method involves construction of a vehicle frame from formed and welded steel tubing. 'The advantage of this method is that the fabricator can change fundamental parts of the vehicle (usually the suspension and addition of a built-in roll cage). Buggies of this type are called sand rails because of the rail frame. Sand rails, often have the engine located behind the driver. Sizes can vary from a small-engine one-seat size to four-seat vehicles with eight or more cylinders. Sand rails can have panels or custom-shaped body coverings over frame, though many are left bare.

4.1 Technical Parameters

4.1.1 Design and General Layout

The design of the vehicle is made such that:

- It would be simple in design to make it easy to fabricate
- Easy enough to make the engine bolt align on the engine
- It should be appropriate as per the design requirement
- It should take the weight of the engine as well as the rider easily
- There should be proper weight distribution on all the four wheels of the vehicle for better stability
- It should give the rider a comfortable posture while riding the ATV so as to give out better drivability quotient
- The individual suspension during working or loading should not bring stresses on the chassis mounting parts
- The chassis should be fabricated in suc a way that there would be space good enough to carry out routine maintenance work.
- The design and fabrication work should be cost and time efficient.

4.2 Vehicle Specification

a) Dimensions and weight:

Overall length: - 2553mm
Overall Width: - 1461mm
Overall Height: - 1232mm
Wheel Base : - 2083mm
Ground Clearances: - 191mm

b) Capacity:

Seating Capacity: Single Person
Engine: Water Cooled Engine, Three Cylinders
Fuel Type: Petrol

c) Transmission

Transmission Type: Manual
Gearbox: Four Speed

d) Suspension

Rear: McPherson Strut and Coil Spring
Front: Telescopic Suspension

e) Rack and Pinion

Rack and Pinion
Minimum Turning Radius

f) Brakes

Front: Disc
Rear: Disc

g) Wheel & Tires

Tires: Radial R/13

4.3 Design of Chassis

The chassis is a most important aspect of a Buggy. The chassis of such a vehicle is either preferred to be made of hollow pipes or Super Tubular sections so as to make it light weight and shock absorbent.

It should be tensile enough and should have proper suspension mounting points so as to gain balance while handling along with ease in riding.

Chassis design should be such that it should not be subjected to twist during sharp turns.

This is the final layout of the chassis:

❖ Modification in Chassis Design

The Chassis has been modified as per the design constraints put forth in the earlier section.
The chassis that was fabricated along with the bolting point of the engine and other accessories needed a firm base on to which the suspension system has been mounted.
The fabricated chassis along with the mounting points was then mounted on to the base frame and thereby welded firmly to it.
The material used for this frame is Tubular section with cross section of 2” **x** 1”

❖ Base Frame

The section used was hollow so as to take the weight reduction into consideration.
The Shape was given in such a manner so that the power from the engine to wheels would face no obstruction in between.

❖ Design Consideration

We selected to use SOLIDWORKS to design a three dimensional model of the chassis. The design software allowed the team to visualize the design in 3-D space and reduce error in fabrication. The main criterion in chassis design was to achieve perfect balance between a spacious and ergonomic drive area with easy ingress and egress, and compact dimensions to achieve the required weight and torsional rigidity criteria.
After a series of design changes; with consequent finite elemental analysis using ANSYS software, the final chassis design was decided upon.

❖ Design model in SOLIDWORKS

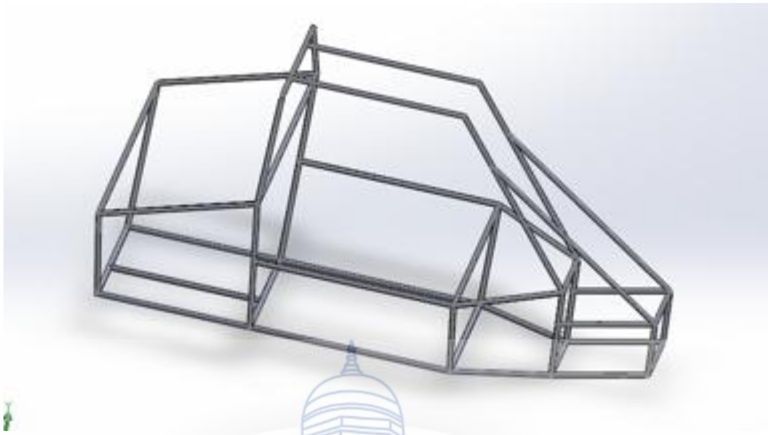

FIG12: DESIGN OF ATV

Although there was added cost associated with out sourcing tube bending, this cost was offset by a reduction in fabrication man hours through decreasing the amount of mitered and welded joints and eliminating man hours and material needed to fabricate for fit-up.

The front and rear of the car features unique an arm mounts which perform the dual purpose of increasing the torsion rigidity of the frame and also providing three mounting options for the upper A-arms. The need for the LFS and SIM members to pass through the mounts also reduced the number of fixtures needed for maintaining dimensional accuracy. After evaluating the preliminary design, it was found that further weight reduction was possible and so members in addition to those deemed necessary were chosen to be of 1.63mm wall thickness; reducing the weight by around five kilograms.

Additional front bulkhead for suspension was eliminated due to packaging constraints and to reduce wheelbase to achieve an optimum balance between straight line stability and cornering agility. All this would be impossible without setting of suspension geometry, and so both the chassis and suspension teams reached a compromise between the optimum conditions for the same.

❖ Frame Analysis

➢ Material Properties

Elastic Modulus 210 GPa
Poisson’s Ratio 0.3
Yield Stress 365 MPa

The Frame needs to withstand any collision that it might be subjected to as part of the testing process or competition. To ensure driver safety, required frame strength, five impact scenarios were analyzed using software to ensure the frame design will not fail.

i. Front impact analysis (THEORETICAL & PRACTICAL)
ii. Rear impact analysis (THEORETICAL & PRACTICAL)
iii. Side impact analysis (THEORETICAL & PRACTICAL)
iv. Roll over analysis (THEORETICAL & PRACTICAL)

i. FRONT IMPACT ANALYSIS (THEORETICAL)

Assumptions:-

1) Maximum Speed of Vehicle V_{max}= 60Kmph = 16.66 *mls.*

2) Weight of vehicle = 350kg

Weight of driver = 75Kg

M_{total}=350 + 75 =425 Kg

M_{total}= 425 Kg.

3) 't' is impact time. (Total time from max speed to full stop)

t = 0.15 sec

- v= u + at

Where, v= V max u=O, t=0.15.

- a = (v-u)/t = (16.66-0)/0.15
  =111.06 m/s^2
- F = M x a = 425 x 111.06
  =47200.5 N

Hence for design purposes force is taken to be 47200.5N. The force of 47200.5 N was divided by four and applied to the four front most points of the car. The rear most points of the car was constrained to prevent movement.

Results,

• Stress

Max Stress= 56.147 MPa

• Factor of Safety

Incorporated Factor of Safety = S_{YT}/S_{max}
= 425 / 56.147
= 7.5

Hence, the chassis will be safe under FRONTAL STRESSES.

ii. REAR IMPACT ANALYSIS (THEORETICAL)

Assumptions: -

1) Maximum Speed of Vehicle V max= 50Kmph = 13.889 *mls.*

2) Weight of vehicle = 350kg

Weight of driver = 75Kg

M=350 + 75 =425 Kg

M_{total}= 425 Kg.

3) 't' is impact time. (Total time from max speed to full stop)

t = 0.15 sec

- y = u + at

where, v = V_{max}; u=0; t=0.15

- a = (v-u)/t = (13.889-0)/0.15
  = 92.59 m/s^2
- F = M x a = 425 x 92.59
  = 39350.7 N

The force of 39350.7 N was divided by four and applied to the four front most points of the car. The rear most points of the car was constrained to prevent movement.

Results,

- Stress
  Max Stress = 66.866 Mpa
- Factor of Safety,
  Incorporated Factor of Safety = S_{YT}/S_{max}
  = 425/66.866
  = 6.35

Hence, the chassis will be safe under rear impact.

iii. Side impact analysis (THEORETICAL)

Assumptions:

1) Maximum speed of the Vehicle, V_{max} = 50 Kmph
   = 13.889 m/s
2) Weight of vehicle = 350 Kg
   Weight of Driver = 75 Kg
   M = 350 + 75
   = 425 Kg
   M_{total} = 425 Kg

3) 't' is impact time. (Total time from max speed to full stop)
   t = 0.15 secs

- y = u + at

where, v = V_{max}; u=0; t=0.15

- a = (v-u)/t = (13.889-0)/0.15
  = 92.59 m/s^2
- F = M x a = 425 x 92.59
  = 39350.7 N

The force of 39350.7 N was divided by four and applied to the four and applied to the right most points of the car (9837.68N). The left most point of the car was constrained to prevent movement.

❖ ANALYSIS from SOLIDWORKS (PRACTICAL)

a. Axial and bending Stress at the FRONT

We have taken 30% extra force than the calculated value. The following analysis has been carried out under 16 KN force on every point.

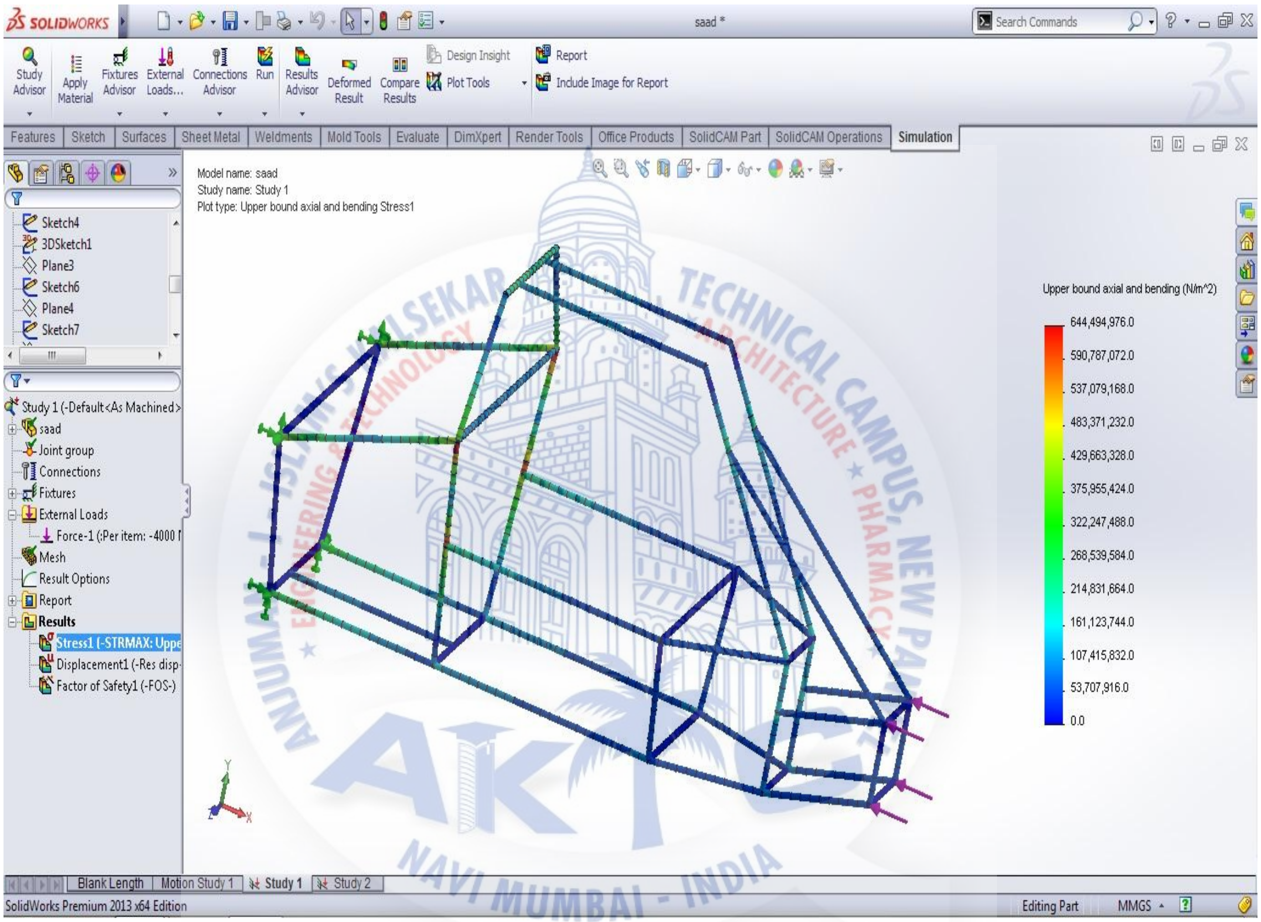

FIG 13: STRESS ANALYSIS AT FRONT

b. Axial and Bending Stress at the REAR

16 KN force has also been applied at the REAR end at each point. The results of the analysis are as shown below:

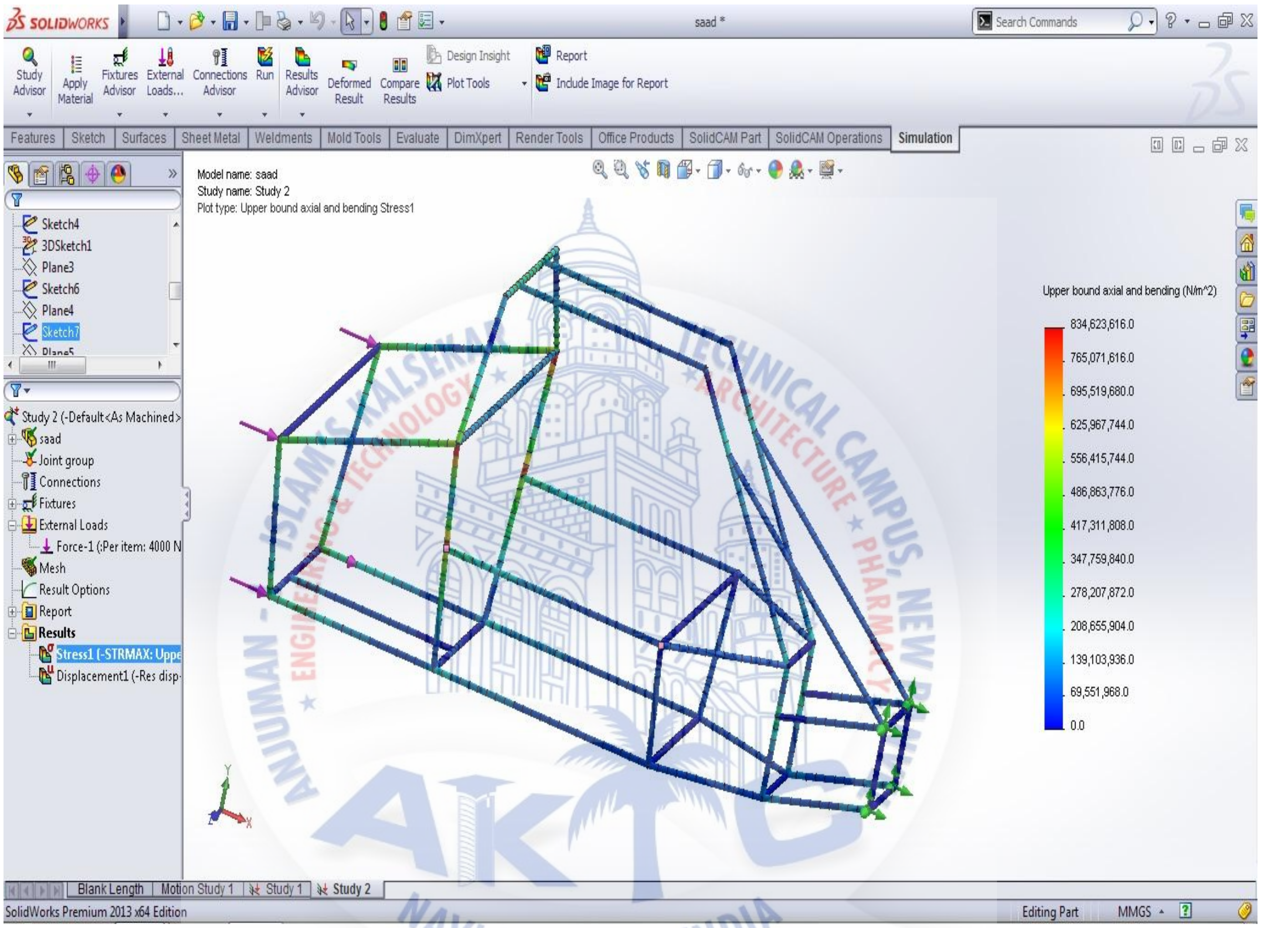

FIG 14: STRESS ANALYSIS AT REAR

c. Displacement at the REAR end

The vehicle showed no deflection when 12.5 KN force was applied which was the calculated value. To check the strength of the vehicle we just increased the value by 30%. And the results are:

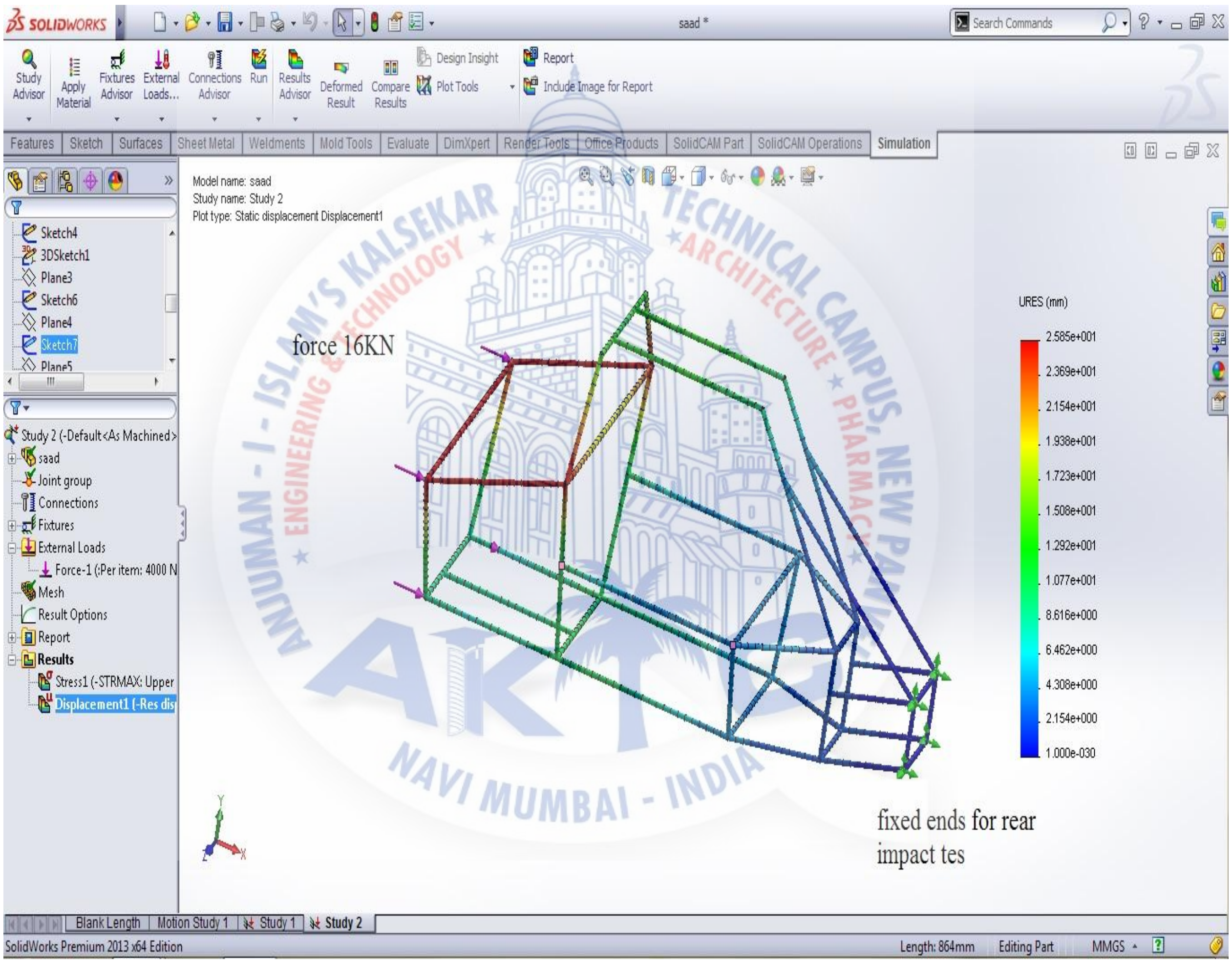

FIG 15: DISPLACEMENT AT REAR

d. Displacement when force applied at FRONT

As said the force was applied 30% higher than calculated value. The results of the analysis are shown below:

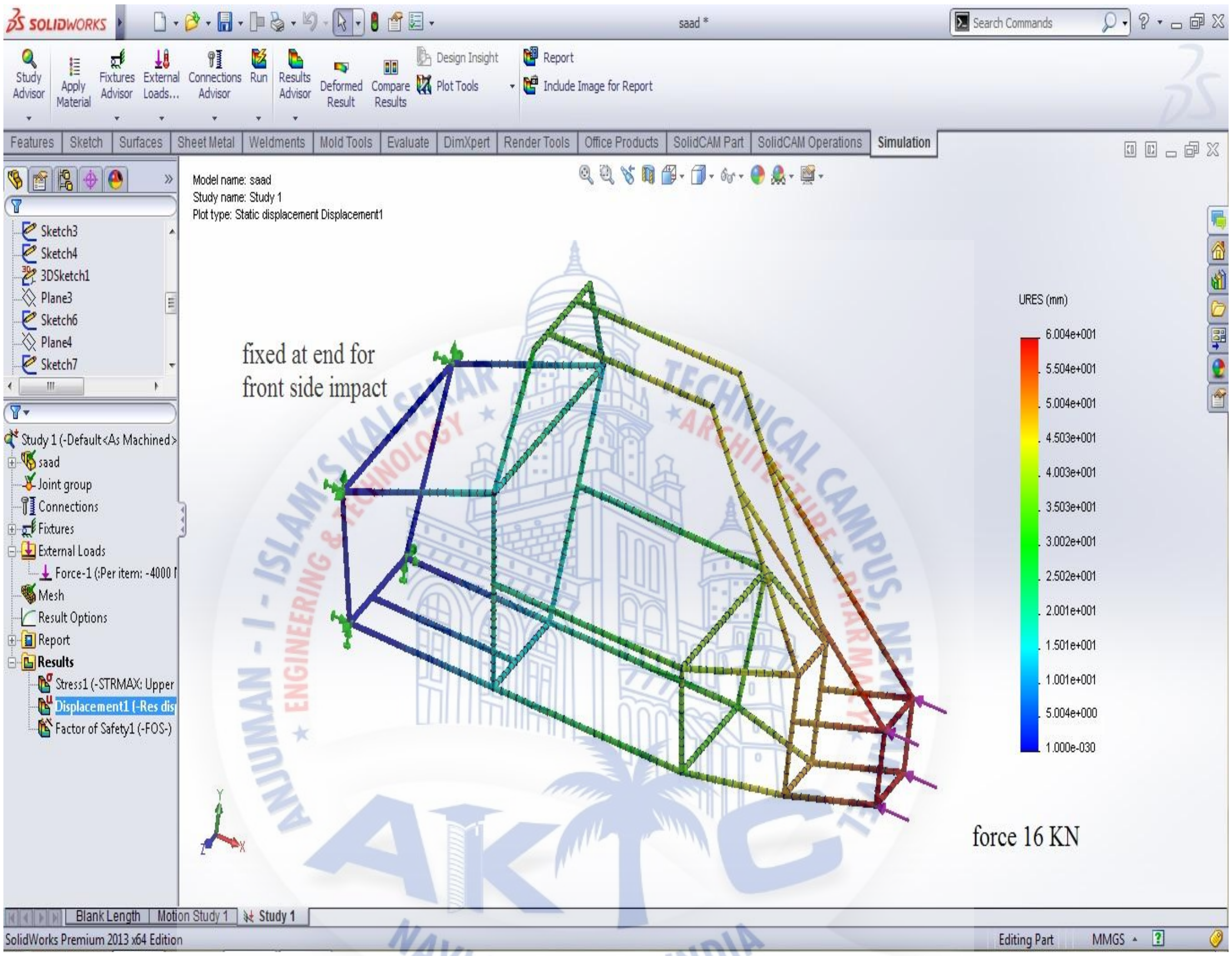

FIG 16: DISPLACEMENT AT FRONT

Chapter 5

Results

i. The maximum stress at the FRONT was found to be
THEORETICAL = 56.147 MPa
ANALYSIS = 63.53 MPa

ii. There was no displacement found when 12.5 KN of force was applied. The minimum deflection was found at 16 KN which was 6 mm at the Front.

iii. The maximum stress at the REAR was found to be:\
THEORETICAL = 66.866 MPa
ANALYSIS = 69.371 MPa

iv. There was no displacement found when 12.5 KN of force was applied. The minimum deflection was found at 16 KN which was 2.58 mm at the REAR.

v. The maximum stress at the SIDE was 156.911 Mpa

The estimated cost of vehicle is lower than the market cost and the detail of cost is shown in the table below.

TABLE 1: BILL OF MATERIAL

SR.NO	DISCRIPTION OF PARTS	QUANTITY	COST PER PIECE	TOTAL COST
1	Engine	1	14000	14000
2	Battery	1	4000	4000
3	Hose pipe	2	175	350
4	Auto Cad Design			1200
5	File	1	150	150
6	Hack saw	1	200	200
7	Knuckle	4	1200	4800
8	Ball Joint	7	200	1400
9	Shock absorber	2+2	1000+500	3000
10	Fuel Tank	1	800	800
11	Steering system	1	1700	1700
12	Tires	4		7500
13	Engine mounting	3		650
14	Transmission Accessories			1950
15	Paint			9500
16	Fuel			1800
17	Rubber packing & sleeves			400
18	Silencer	1		650
19	Seat & Seat Belt	1		500
20	Clutch Cable	1		400
21	Accelerator cable	1		350

22	Gear Shifter Knob	1		450
23	Head Light	3	200	600
24	Brake Light	1		275
25	Horn	2	175	350
26	Brake T-Joint	4	45	180
27	Brake Pipe Line	1		725
28	Brake Nipple	5	45	225
29	Horn Press Button	1		90
30	Horn Relay	1		195
31	Headlight Switch	1		45
32	Fuel Knob	1		225
33	Fuel Gauge	1		350
34	Acrylic			1500
35	Wheel Cap	4	200	800
36	Speedometer	1		430
37	Bonnet lock	2	70	140
38	Steering Wheel	1		1580
39	Side Mirror	2	280	560
40	Body Material			15000
41	Wire			2200
42	Fasteners			1650
43	Transportation			2800
44	Maintenance			850
45	Other Expenses			2700
		Total expenses		**96010**

Chapter 6

Conclusion

ATV was successfully design and studied.

Various components and the material used are assumed to be reliable and less costly than the available market ATV.

All the values of stresses and displacement were found to be safe and within limits by practical and theoretical calculation.

Chapter 7

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