

# Design and Fabrication of All Terrain Vehicle Dumper

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**Abstract:** Material handling is an essential element in any farm land or garden. This can be done by big tractor trailers or hand carts. Small scale farmers who possess less land to operate, cannot afford expensive tractors for their small lands. Also today we don't find smaller dumpers which can help small farmers or house hold gardening. We have seen our gardeners and estate staff working hard with their hand cart to move the material in and around our college campus. Different types of All Terrain vehicles (ATV) are available in the market which are not suitable for the farmers. Hence we decided to develop an ATV dumper which is inspired from the idea of a dump truck. This dumper is having a removable and moveable dumper which will help farmers to move heavy material through various terrain. Our present work is aimed to design and fabricate an ATV dumper which makes a viable mode of conveyance to carry heavy material with ease around the college campus. Being an ATV dumper this can also be used further for farming. The all-terrain vehicle dumper is designed and fabricated in-house, which is at a low cost. Primarily the design of our project is established using conceptual design strategy by using the Solid Edge, Solid Works and then it is analyzed using Ansys workbench for structural feasibility. After freezing the conceptual design, fabrication is carried out using arc welding. We have also used fasteners to mount various parts with dampers to minimize the vibrations so that the end user will not have any difficulty in operating or servicing the machine. Interchange or replacing parts is very easy and convenient as all standard fasteners are used which are readily available in the market. It is fitted with a 150 cc petrol engine for powering the rear wheels of the cart and has a single seat for the driver. 4 wheels are used for stability and safety. Finally, the "All-terrain vehicle dumper" is tested with various loads and terrain conditions and worked

satisfactorily as intended to. This will be a user-friendly cart, perfectly suitable for the all-weather and all terrain conditions. Instead of using big tractors for a small and medium farm land or agricultural land, farmers can use this ATV dumper to move or carry or transport things around their land.

**Keywords:** Ansys, Solid edge, Solid works, fasteners.

## 1. INTRODUCTION

Material handling is an essential element in any farm land or garden. This can be done by big tractor trailers or hand carts. Small scale farmers who possess less land to operate, cannot afford expensive tractors for their small lands. Also today we don't find smaller dumpers which can help small farmers or house hold gardening. We have seen our gardeners and estate staff working hard with their hand cart to move the material in and around our college campus. All-Terrain Vehicle Dumper is derived from the 4 wheeler go-kart and huge earth moving dumpers, we have scaled it down onto the body of an go-kart and small or medium sized dumper which can be used in our college gardening area or carrying any heavy equipment's as we have only manual trolley to move around. This will help our hard working staffs to move hard and heavy equipment inside our college campus through various terrain of campus.

## RELATED WORK

### 1. "A Review On Design And Analysis Of Go-Kart Chassis"

(T. Z. Quaz, Omkar Jalvi, Sameer Shinde, Rohan Kamble, Tushar Sargar. 2018). The automotive chassis serves as a frame work for supporting the body and different parts of the automobile. Also,

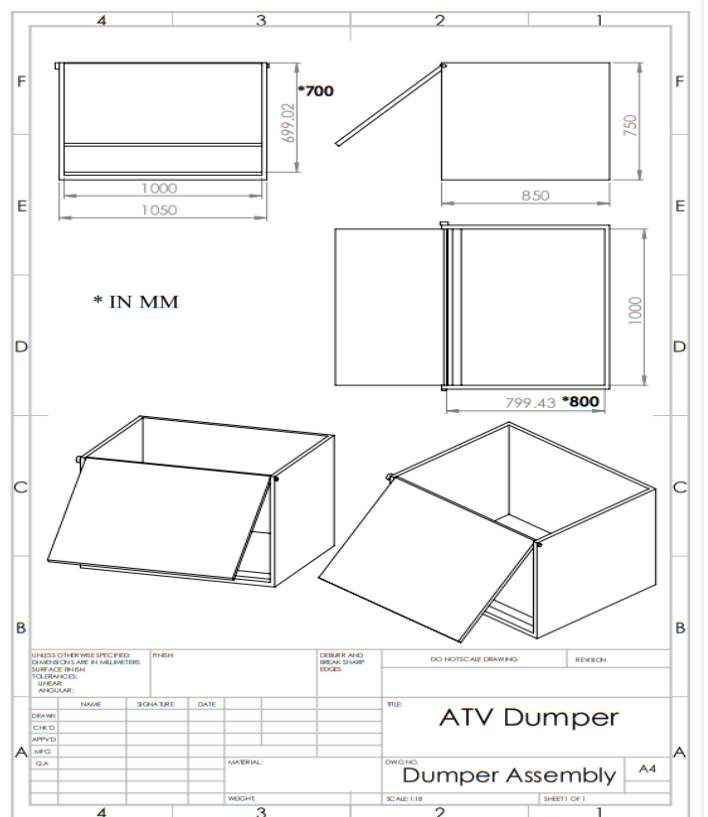
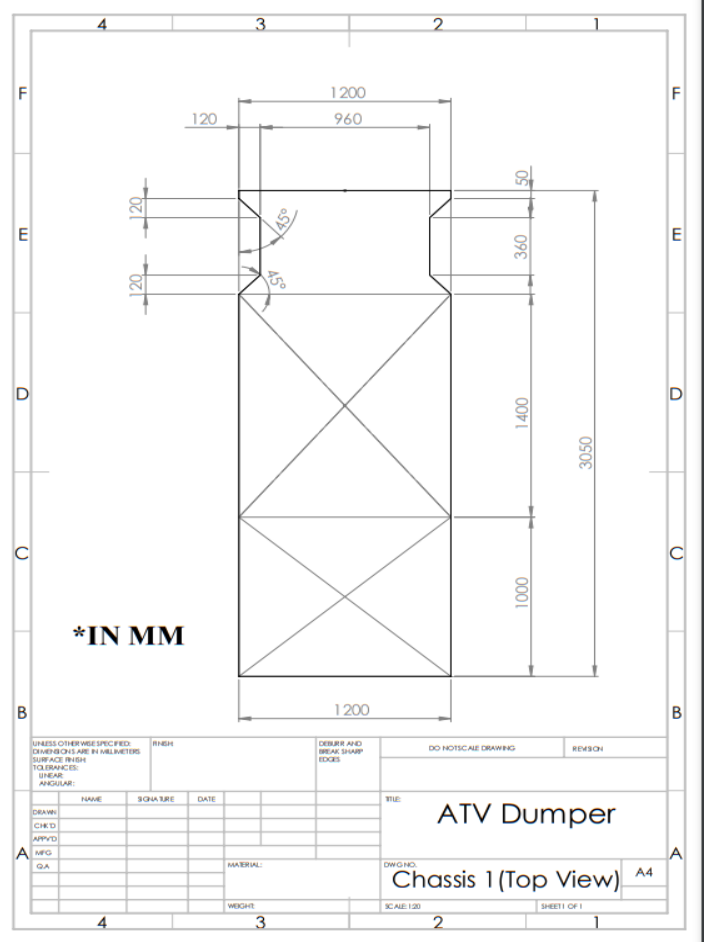
it has to withstand the shock, twist, vibration and other stresses caused due to sudden breaking, acceleration, shocking road condition, centrifugal force while cornering and forces induced by its components. This paper reviews the design analysis of a go kart chassis. In this paper an effort is done to study and review the various go kart chassis and its structural analysis and other design related aspects as well as the research methodologies used by the researchers.

**2. “Design And Fabrication Of An All Terrian Vehicle”**

(2018) Rishi Govind T.S, Noyal Thomson, Miswaramjind, Rinto Thomas, Sreyas.k, Vysakh.V.0 Assistant Professor, Dept. Of Mechanical Engineering, IES College of Engineering, Thrissur, Kerala, India 680551 Students, Dept. Of Mechanical Engineering, IES College of Engineering, Thrissur, Kerala, India. It is an experimental project to design and fabricate a Quad bike that can propagate along almost all terrains. It is simply called an All-Terrain Vehicle. As the name implies, it is designed to handle a wider variety of terrain than most other vehicles. Although it is a street legal vehicle in some countries, it is not street-legal within most states and provinces of Australia, the United States or Canada. The actual ATV is designed from a two-wheeler. The rider sits on and operates these vehicles like a motorcycle, but the extra wheels give more stability at slower speeds.

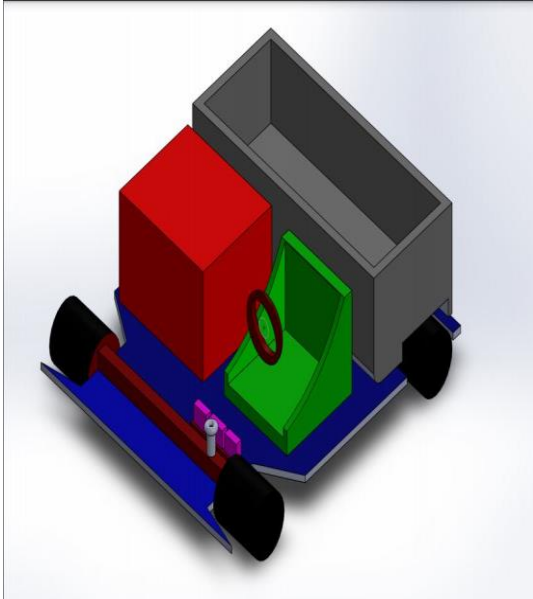
**3. “Study And Examine The Go-Kart Working Mechanism” Karan Par5.1 Conceptual Design”**

**5.1.1 - 1<sup>st</sup> Conceptual Design;**



(Fig 5.1.1)

(Fig 5.1.2)



(Fig 5.1.3)

(Fig 5.1.4)

- The above design (Fig 5.1.1, 5.1.2) is done by using SolidWorks, we have come to this dimensions by taking clearance of each individual part at  $\pm 50\text{mm}$ .
- But these dimensions came out to be large in size, weight imbalance and many more design flaws as seen in Fig 5.1.3, and this made us to redesign the whole entire operation.

ihar, Neeraj Negi, Divyanshu Dimri, Gaurav Ramola, Dheeraj Bhatt, Subhash Gadai, Nikhil Singh, Jagdeep Singh, Mechanical Engineering Department, Shivalik College of Engineering,

Dehradun, India. Generally, go-kart is a very fun to drive, it works on a simple structure about the chassis which is base of go-kart is made by different type of materials (alloy steel), after that this car includes various types of I.C engines according to the power consumption. Mostly go karts uses clutch system for that transmission is attached to engine at rear axle. In go kart small steering system uses, this is approximately 12inches. Tires in this car usually small as compare to normal car tires, they are able to work in both wet and dry road conditions.

## II. . REASON FOR SELECTION

Different types of All-Terrain vehicles (ATV) are available in the market which are not suitable for the farmers. Hence we decided to develop an ATV dumper which is inspired from the idea of a dump truck. This dumper is having a removable and moveable dumper which will help farmers to move heavy material through various terrain.

## III. PROBLEM DEFENITION

We chose this project in order to make a viable mode of conveyance to carry heavy products with ease around the campus. It reduces the strain of hard working people day in and day out. This project is intended to ease the load off of them while moving heavy stuff across the campus, it can replace heavy and expensive tractors and can be used on small lands. It's going to play an important role for carrying heavy stuff across the college campus. And further economically viable nature provides an upper hand to low income farmers at farm land to easily purchase it and save their time and effort and apply it elsewhere.

## IV. OBJECTIVE OF WORK

The objective of this project is to design and fabricate an ATV Dumper, all the necessary tests is done to ensured its reliability in off road riding and on road riding. Based on the results taken, it will be proved that the design of this vehicle satisfies its use. To carry the light and heavy farming equipment around farm land, instead of a big tractor where it is not necessary. This can go on off-road as well as on-road to ensure that the

end user can move anywhere around the land or campus. To carry books, stationary equipment, water cans, and construction equipment whenever there is a need in the college campus, to eradicate the manual trolley used in our campus, we came up with this idea so that it will be easy for our staffs to move things around

## V. METHODOLOGY

1. **Purpose Of The Project** – The sole purpose of this project is to help the farmers and our college non-teaching staffs to ease the work of moving/transferring miscellaneous things like construction equipment, books, water cans etc. around the college campus.

2. **Design And Ergonomics Of The Project** – We are going to use CAD software and as well as real world design conditions to determine the final design and other parts to finish the design section.

3. **Material Selection** – We are going to use mild steel as it has High tensile strength. High impact strength. Good ductility and weld ability, and aluminum to ensure that our project is strong as we intended to do so.

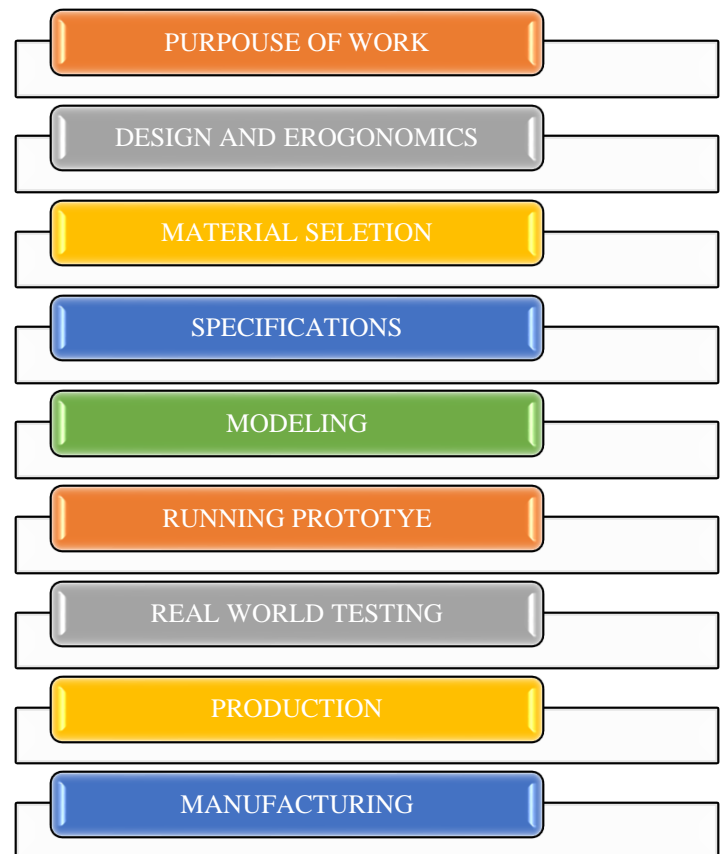
4. **Specifications Of Project** – Our project will be having a separate dumper connected to the end of the chassis behind the driver and engine, which will be handled by using hinges and tilted to dump the products down. A 150CC petroleum engine will be used to power the ATV dumper. Off-road tires are mandatory as we are going to drive this in damp or wet surfaces. Axle, brakes and other parts will be from generic makers as it will be easily available in retail shop if broken.

5. **Modelling The Project** – This project will be modelled using some cardboard and clay before getting into the actual running prototype as this will help the design flaws to be corrected and reduce the time of trial and error method in the actual running prototype.

6. **Running Prototype** – After the modelling is done and satisfied, we will be doing the real running prototype with the materials like mild steel, aluminum etc. during the process, and

testing out the various aspects of the prototype like the real load condition, off-road capabilities,

and other various conditions. (Flow chart Fig 5.1)

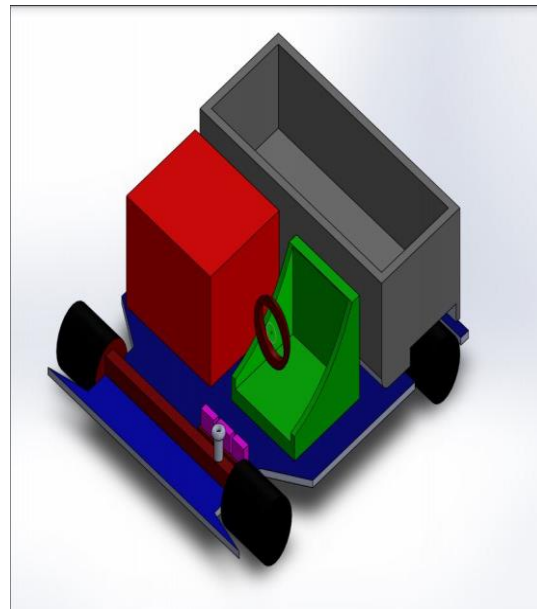
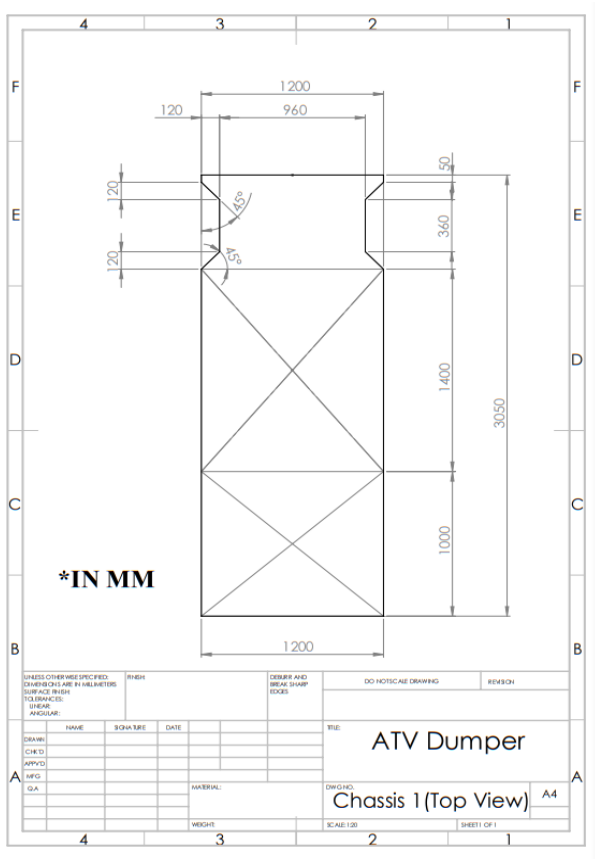


(Fig 5.1 Flow chart)

### 5.1 Conceptual Design:

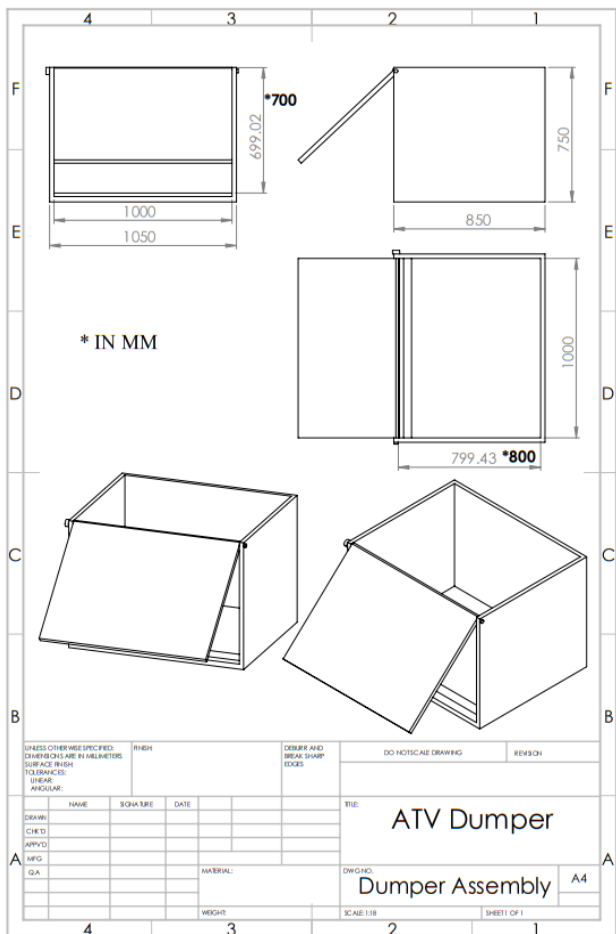
#### 5.1.1 - 1<sup>st</sup> Conceptual Design





(Fig 5.1.3)

(Fig 5.1.4)

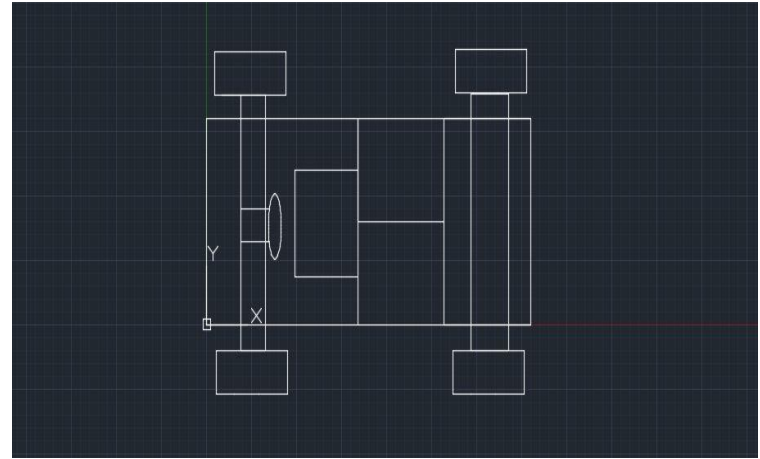
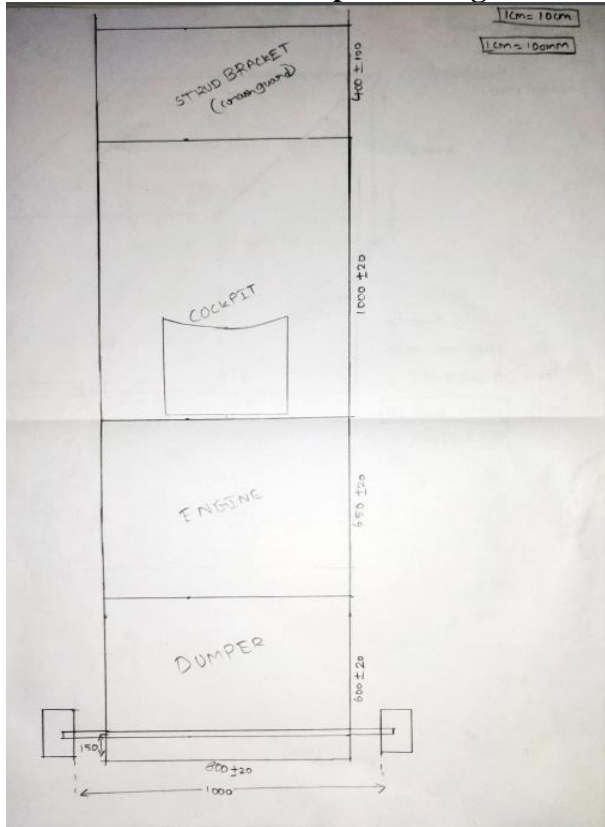


(Fig 5.1.1)

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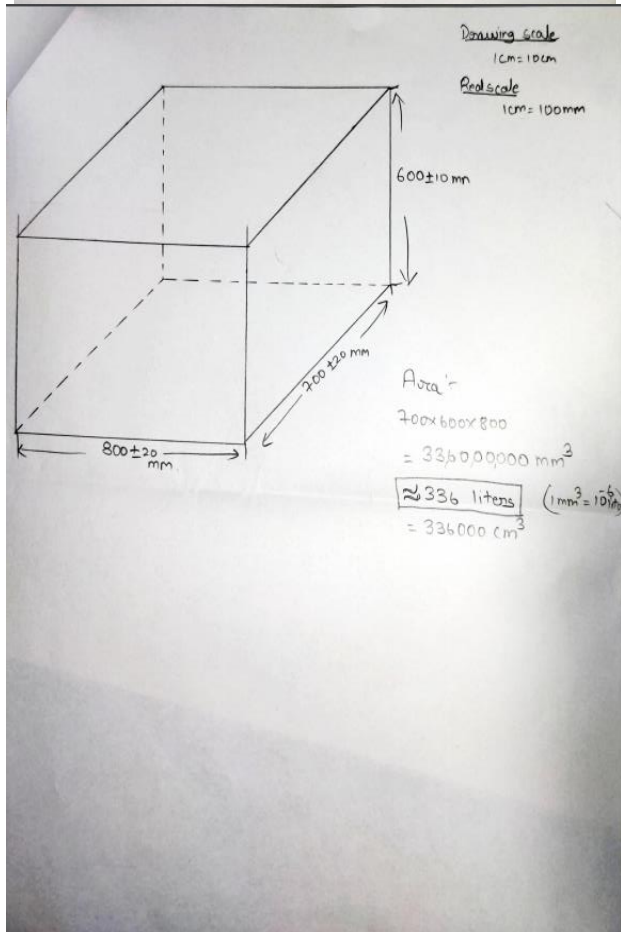
5.1.2 - 2<sup>nd</sup> Conceptual Design



(Fig 5.2.3)

- This was our 2<sup>nd</sup> design of reducing the overall size and reducing the clearance of  $\pm 20$ mm.
- But the breadth was too small for any movement for the user and made it difficult for any future upgrades.

5.1.3 - 3<sup>rd</sup> Conceptual Design;



(Fig 5.2.1)

(Fig 5.2.2)



(Fig 5.3.1)





(Fig 5.3.2)



(Fig 5.3.3)

- Here in this 3rd design, we have increased the breadth from 800mm to 1000mm because 800mm was too small for any movement of user.
- This is the final design as this satisfies the needs.

## 5.2 Material Testing

We have done intense testing on the materials which is used in the ATV dumper as to ensure its safety, longevity, usability and other factors. We have tested various materials for the chassis where different dimensions and different gauge is tested by using Universal Testing Machine (UTM).

1. **78mm\*38mm, Length-500mm, Gauge-2mm.**



(Fig 5.2.1)

The maximum load bearing capacity of this material is 1.5 Ton.

2. **60mm\*38mm, Length-500mm, Gauge-2mm.**



(Fig 5.2.2)

The maximum load bearing capacity of this material is 1.15 Ton.

3. **38mm\*38mm, Length-500mm, Gauge-3mm.**



(Fig 5.2.3)

The maximum load bearing capacity of this material is 2.2 Ton.

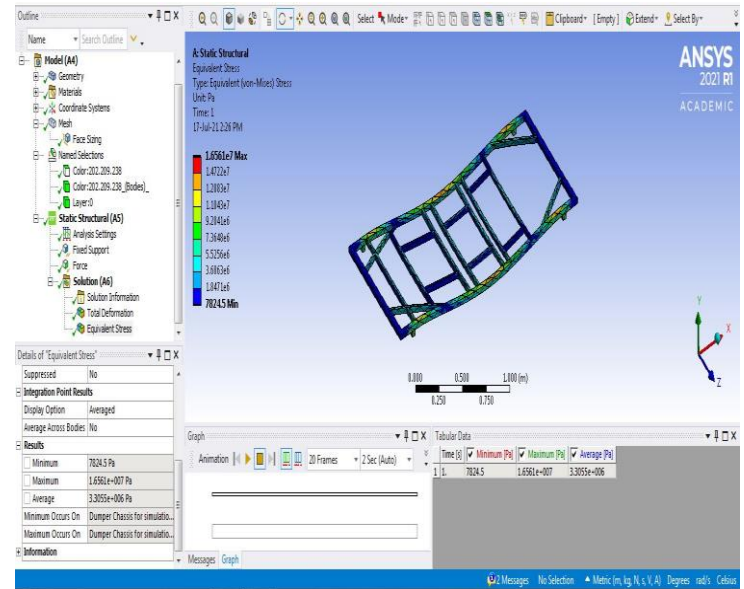
By having these test results and keeping safety as a priority, we came to a conclusion that 3rd material (Fig 5.2.3) can be used for chassis and other load bearing area in the chassis.

### 5.3 FEA Analys On Chassis

In the figures given below we can see the different types of deformation, Where Max load of 400KG (~3924N) has been applied to the various places of the chassis and here we have the results.

Fig 5.3.1 represents Total deformation which has a average deformation of ±10mm.

Fig 5.3.2 represents Equivalent Stress which has a minimum value of 7824.5Pa (797.87Kg/m<sup>2</sup>)



(Fig 5.3.2)

### 5.4 Various Parts Needed For Atv Dumper

**Off-road tires** – which can be moved on any terrain like normal road, dirt road, gravel road unpaved roads etc.

**Rectangular dumper** – which can carry the equipment loaded inside the dumper and driven around.

**Engine** – 150 cc engine is needed to carry the load.

**Steering mechanism**– user can drive it like a go-kart to move around.

**Square steel tube** – which is used to do the chassis of the ATV dumper.

**Axle** – which can transfer rotational torque to the rear wheels.

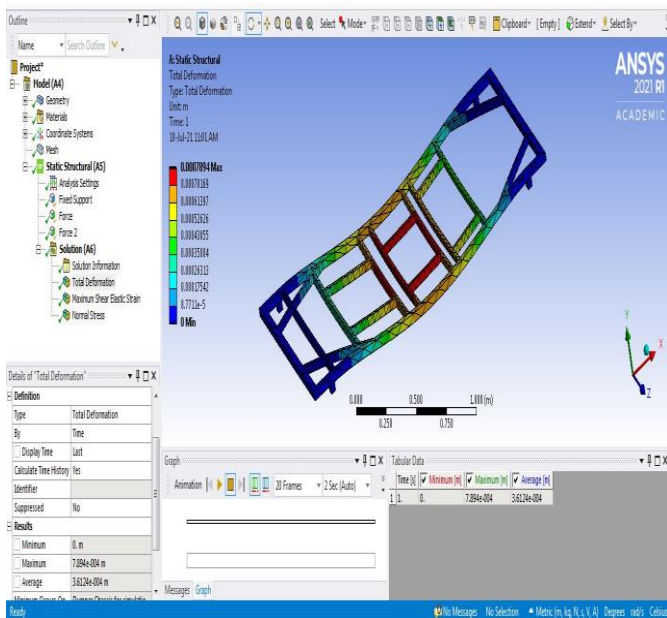
**Brakes** – which is needed to stop the vehicle.

**Sheet metal** – which is needed to cover the under belly and cover the engine from the driver.

**Bolts and nuts** – used to fasten the loose ends and clamping 2 or more joints Accelerator, brake, clutch pedals – it is needed to control the engine acceleration, apply or release brakes and engage or disengage clutch for change of gear.

**Gear Box** – which is used to change the gears.

**Hinges** – used to move the dumper to dump on the ground.



(Fig 5.3.1)



**Petrol Can** – which is used to carry the fuel for the engine.

**Misc. parts** – which will be required in future.

## VI. DISCUSSION ON THE RESULT

After freezing the conceptual design, fabrication is carried out using arc welding. We have also used fasteners to mount various parts with dampers to minimize the vibrations so that the end user will not have any difficulty in operating or servicing the machine. Interchange or replacing parts is very easy and convenient as all standard fasteners are used which are readily available in the market. It is fitted with a 150 cc petrol engine for powering the rear wheels of the cart and has a single seat for the driver, 4 wheels are used for stability and safety.

## VII. CONCLUSION AND FUTURE WORK

The “All-terrain vehicle dumper” (ATV) is designed and fabricated in-house, which will be very useful and at a low cost. This will be a user friendly cart, perfectly suitable for all conditions. It has a turning radius of 740 mm (0.74 meters), and can carry a load of 150 Kgs which includes the driver and other parts. It is been tested with various loads and terrain conditions as intended to. After testing and painting, it will be donated to the college so that our estate staff can use it. This will definitely reduce their fatigue and increase their efficiency.

### REFERENCES

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Note that the equation is centered using a center tab stop