

Design and modelling of an all terrain vehicle

Kshitij Save¹, Soham Salunkhe², Ritu Tawde³, Yogita Zankar⁴

¹Department of mechanical engineering, Mumbai University, MUMBAI
Email: kshitij.save@gmail.com

²Department of mechanical engineering, Mumbai University, MUMBAI
Email: mailtosohamsalunkhe@gmail.com

³Department of mechanical engineering, Mumbai University, MUMBAI
Email: tawderitu578@gmail.com

⁴Department of mechanical engineering, Mumbai University, MUMBAI
Email: yogitazankar12@gmail.com

Abstract— The aim of this study is to do all the design considerations, make necessary calculations involved in the design of an ATV. The focus has been laid on the simplicity of design and its high performance. The design and development comprise of material selection, chassis and frame design, design of various components of powertrain, suspension and wheel assembly, braking system and steering system. During the entire design process, innovative ideas were always the primary goal. Most of the OEM (original equipment manufacturer) components have been chosen keeping in mind the easy availability and reliability and also according to the proposed design calculations. Keeping all parameters in mind we are going to design a vehicle which is ergonomic, aerodynamic, highly engineered and easily manufactured. Hence it makes the vehicle more efficient. Our vehicle can easily navigate through almost all terrain, which ultimately is the objective behind the making of any all-terrain vehicles.

Keywords— ATV, BRAKING SYSTEM, CHASSIS, POWERTRAIN, STEERING, SUSPENSION

I. INTRODUCTION

The objective of the study is to design a safest vehicle for driver. The roll cage is being strictly designed in accordance with SAE BAJA 2014 rule book. 3D Assembly of whole vehicle & Line model of the roll cage is modeled in SOLIDWORKS 2018. Finite element analysis (FEA) is carried out on line model of roll cage in cases of front collision, rear collision, rolling; front bump & Rear bump analysis in ANSYS. FEA of suspension arms was carried out in ANSYS. Based on the result obtained from above tests the design is modified accordingly. The Centre of Gravity was tried to keep in middle of the vehicle & closest to the ground for optimum stability. The length of the vehicle was kept small so as to reduce weight and maintain a desired center of gravity, while the width of the vehicle was kept the most to maintain stability in turns.

II. PROBLEM STATEMENT

All-Terrain vehicle or in short called as an ATV is basically a Land based automobile capable of reaching remote areas where normal cars/bikes cannot reach. ATV have a wide range of applications nowadays like in Military, Forest departments, Farming, etc. The project is to design an ATV by calculating all the required parameters, designing CAD model of each component and making the complete assembly of an All-terrain vehicle on Solid works CAD software.

III. METHODOLOGY

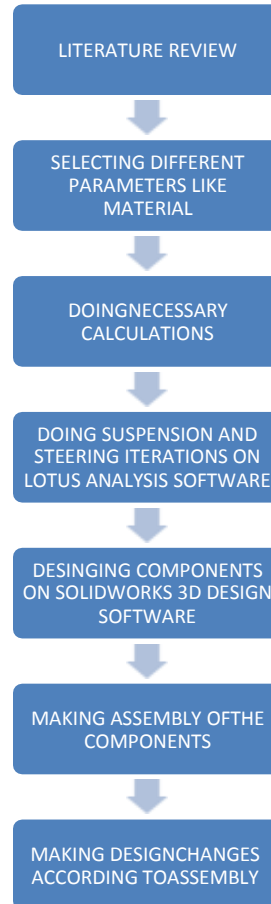


FIGURE 1: Flowchart of Methodology

The material used for roll cage is AISI 4130 (chrome-moly steel) i.e. chromium molybdenum alloy steel. This was selected on a comparative study on parameters like Availability, Cost, Weight and Strength. The primary objective of the roll cage is to provide the driver safe driving conditions. Great emphasis was put on the safety of the driver as well as on Driver Ergonomics while designing the chassis.

The transmission system must be able to deliver maximum torque from the engine to the wheel. Hence, continuously variable transmission (CVT) is used to gain maximum torque. The vehicle is powered by a 10HP OHV Briggs and Stratton engine with maximum torque of 19Nm at 2600 RPM and it is governed to the maximum RPM of 3800. CVTech CVT is used which has an overall ratio of 3.5:1 to 0.45:1. In addition to CVT it contains two stage reduction gearbox which is made up of Aluminum for a light weight housing of gears. The first reduction ratio is of 2.33 and second reduction ratio of 3.6 which provides the required velocity. The drive shaft is customized for required dimension with proper design. Both the end of half shaft contains CV joint. One end is connected with spool and another end is connected with wheel drive. The design aim of the steering team was to ensure smooth maneuvering of vehicle during Corners. In order to achieve this ratio of vehicle wheelbase to track width is kept close to 1:1. Steering system hard points were first fixed by considering the clearance and ergonomics. Later within the given range, iterations were made on the lotus analysis software for verification of the hard points and better dynamic behavior of steering system. Special attention was given to toe change during bump condition to ensure that the vehicle motion is in driver's control. Customized rack and pinion were opted to achieve a steering ratio of 3:1 that ensures vehicle lock to lock steer travel of 100mm with steering wheel rotation of 180 degrees while inner wheel angle at 43.67 degree and outer wheel angle at 29.21 degree i.e. an Ackerman percentage of 84.3% at static. Steering wheel diameter of 7 inch was designed considering driver input force of 60N to

enable steering of vehicle without causing fatigue to driver during the endurance. Steering effort of 14 Nm is required to steer the vehicle.

Fox Float 3 Evol R series shocks were used as they are light in weight and incorporate variable stiffness Parameters. They provide a travel of 5 inches and have an extended length of 18 inches. In front, unequal double wishbone type suspension is incorporated which provides flexibility in design for required roll center height, camber gain, for efficient cornering and low unsprung weight. In rear H-arm and camber link is used. The use of an H-type lower arm and a single lateral upper link is a special case where the H-arm is being asked to perform the function of four links instead of just three.

The objective behind the braking system is to lock all the four wheels statistically and dynamically and to increase the safety of the driver and maneuverability of the vehicle. Tandem master cylinder with four outlets is used to generate hydraulic pressure which will induce a clamping force between brake rotor and friction pads of brake caliper. Dual piston caliper is used to generate more clamping force and it also results in compact wheel assembly with less unsprung mass. Brake rotors are custom manufactured to achieve the required output and to achieve design requirement for reduction of weight. Brake lights are activated by hydraulic pressure transducer which actuates at required pressure resulting in increased safety. Brake fluid of DOT 3 grade is used. Brake lines in the circuit are OEM product having maximum working pressure of 135 bars against the actual working pressure of 83.9 bars.

IV. CONCLUSION

The chosen design was the safest and the most reliable car for any long terrain. All the parameters like safety, cost, performance, reliability, durability, aesthetics, standard dimensions and material were also taken in consideration on the same time.

REFERENCES

- [1] ShivshankarAngadi[1], PrajyotPalande[2], AnuragKandke[3]: International Research Journal of Engineering andTechnology(IRJET) Design and analysis of Gearbox of and All- Terrain Vehicle
- [2] Dr.V. K. Saini[1], Sunil Kumar[2], Vishal Choubey[3]: International Research Journal of Engineering and Technology(IRJET)Design and analysis of BAJA ATV (All- Terrain Vehicle) Frame
- [3] AkshayPawar[1], SurajZambare[2]: International Research Journal of Engineering and Technology(IRJET) Design of Steering system for All- TerrainVehicle
- [4] J Shri Harsha[1], D Vijay Reddy[2], AVRK teja:International Journal of Scientific and Engineering Research Design and dynamic characteristics of suspension system for All- TerrainVehicle
- [5] Yashwant A. Sakhare[1], Sunil B. Ghatul [2], AditiA. Mudgalkar[3]: International Research Journal of Engineering and Technology(IRJET)Design of Front Suspension System of anATV
- [6] Amit Kumar Shakya[1], Harshit Mishra[2]: International Research Journal of Engineering and Technology(IRJET)Design Methodology of steering system for All- TerrainVehicle
- [7] Vivek Singh Negi[1], NayanDeshmukh[2], Amit Deshpande[3]: International Journal of Advanced Engineering and Research Development Design of Braking System of BAJAvehicle
- [8] AlbinVargheese[1], AswinDevasiya[2], Josin Jacob[3]: International Journal of Scientific and Engineering ResearchDesign and analysis of Suspension System of All- TerrainVehicle
- [9] Rishabh Jain[1], Dr.P. S. Ranjit[2]: International Journal of Advanced Engineering, Management and Science (IJAEMS) Design of a Drive Train for SAE BAJA Racing Off-RoadVehicle
- [10] RajkumarKewat[1], Anil Kumar Kandu[2], Kuldeep Kumar[3]: International Journal of Engineering Research and Applications (IJERA) Dynamic analysis of Double Wishbone With S Link And ToeLink
- [11] Deekshith[1], UdayaKiran[2], Vijaya Kumar[3]: International Journal of Engineering Research and Development Design, Analysis and Manufacturing of Disc Brake Rotor
- [12] Harsh Raghuvanshi[1], N.S. Ramnaveen[2], Puneet Malhotra[3], Rakshit, Anurag Khatri[4]: International Journal of Engineering and Advanced Technology (IJEAT) Innovative Design of an All-Terrain Vehicle (ATV)