Design And Fabrication Of A Four-wheel Drive Train System

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Abstract

Any surface or terrain can be traversed with an all-terrain vehicle (ATV). It is designed specifically for rough driving situations. An ATV has many features, including soft suspension springs and high-ground clearance. It is very popular to use a four-wheel-drive (4WD) transmission in a light ATV. The ATV's ability to travel off-road is improved by having power on all four wheels. The design and validation of a four-wheel driveline for a light ATV utilizing various modeling and simulation software are covered in the technique. Ansys is used to analyze the driveline components to choose the best materials. The goal of this study is to set the groundwork for future advancements in the driveline of ATVs. For components that are designed using SolidWorks and for the load applied on various components we use ansys workbench to find out the deforming as well as vulnerable parts, and those constraints that need for us to make an efficient drive.

Keywords: All-terrain vehicle, transmission, driveline.

1. INTRODUCTION

The powertrain in a vehicle is made up of the main components that generate power and deliver it to the road surface. The engine, CVT, gearbox, differential, drive shafts, and propeller shaft are all included. The powertrain encompasses all of the components used to convert stored energy into kinetic energy for propulsion. The powertrain of BAJA vehicles is a difficult task to design. We concentrated on transmission system packaging to make it more compact and serviceable. Gaged continuous variable transmission achieves the initial speed reduction. The CVT was chosen for its adaptability, smoother performance, and availability of the desired reduction ratio range. And the CVT used is cv-tech which transmits sufficient output from the engine to the gearbox. The gearbox is a two-stage reduction, to transmit efficient torque and power on wheels. Whereas a four-wheel drive train system is the required power and torque transferred to all wheels while driving with the help of a gearbox and front differential which is connected by a propeller shaft from the transfer case.

2. MATERIALS AND METHODS

2.1 METHODOLOGY

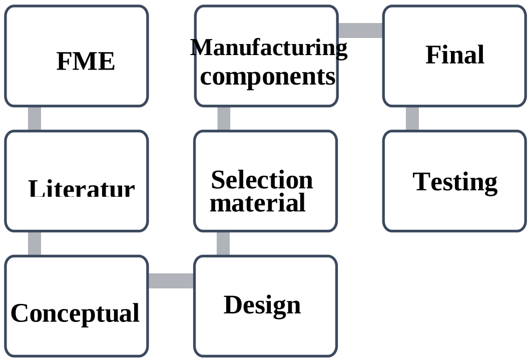
Failure Modes and Effects Analysis is always the first step in the manufacturing of the powertrain system (FMEA). Both Product FMEA and Design FMEA are performed to identify common failures, their severity, and their consequences. FMEA is followed by a thorough examination of research papers on similar topics. This provides a clear idea and process that must be followed to improve driver safety, vehicle reliability, and drivability. The conceptual design is then completed using 3-D modeling software such as SolidWorks. The design must then be calculated to improve it further. These designs must be analyzed to determine if they fail, as well as the failure points and modes. To determine the main stresses, failure points, and modes, Finite Element Analysis software such as ANSYS Workbench is used. Following analysis, the design can be optimized to improve performance while reducing weight. The material is chosen during the analysis phase. The components are then assembled using proper assembly techniques. After all components and subsystems have been manufactured, they are assembled. The final phase is rigorous dynamic testing to ensure that it can withstand all harsh terrain conditions.

2.2 Material

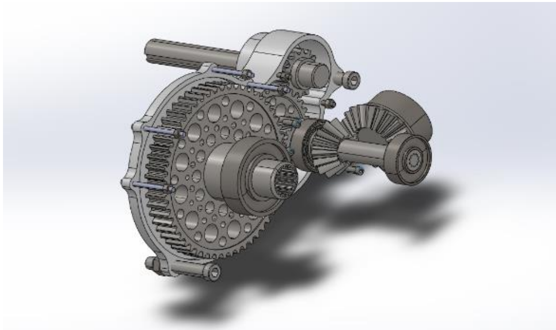
Aluminium (Al)-7075 has a higher strength-to-weight ratio and is stronger than Al-6061. The material is also employed in the aerospace and transportation industries, where lightweight, high-strength components are needed. The gearbox and differential case will be designed with integrated mounts. Given this, Al-7075 was discovered to be the best material for designing component casings. 17NiCrMo6 (Nickel – chromium alloy) is a low-cost material with a high surface hardness and wear resistance. As a result, it is used to make gears and shafts. (AISI 4130) is low-alloy steel with strengthening additions like chromium and molybdenum. The steel grade is tough and strong, yet it is also weldable and machinable. It is a flexible alloy with high corrosion resistance and medium strength. It possesses an excellent overall balance of strength, toughness, and fatigue resistance. The material for the propeller shaft is chosen. And material properties are given below in

Material Name	Shear modulus (GPa)	Tensile Strength (N/mm^2)	Yield Strength (N/mm^2)	Poisson's ratio
17NiCrMo6	79	1200	850	0.3
Al-7075	26.9	572	510	0.33
AISI 4130	80	560	460	0.3

2.3 WORKING METHOD



3. RESULTS AND DISCUSSION



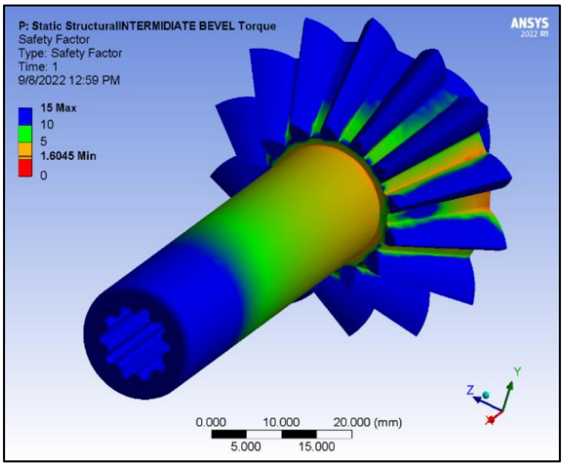
3.1 DISCUSSION AND WORKING

To begin manufacturing, the engine was obtained from an authorised Briggs and Stratton provider and the model is 19 series which is of 10HP and 19Nm. The gears for the 2-stage reduction gearbox were first machined in accordance with the calculations and gearing ratio. The gearbox casing was designed to allow maximum oil circulation while maintaining the smallest possible profile. The splines on the gearbox side for the drive shaft were then chosen. The hub for the wheel side was chosen with appropriate splines. The length of the drive shaft was measured using both the splines and the ATV track width, and the drive shafts were manufactured. The CVT was also purchased and was connected to both the crankshaft of the engine and the gearbox. The distance between the engine and the gearbox was calculated so that there is no overlap. According to width and length of CVT belts were chosen to avoid tear and withstand the velocity produced by the engine.

The fuel tank was installed above the engine, allowing fuel to be fed to the engine via gravity. In addition, the engine must be protected from any fuel spillage from the tank. So a shield was built and used to cover the engine, and a spill tube was attached so that any excess fuel flows straight to the ground rather than pooling in one spot. SAE rated fuel lines were used to ensure that the fuel does not burn in the event of a fire.

In addition add-on were introduced to stop failures occurs when driving, a proper propeller shaft casing is done, as well as CVT casing these two casing is must in an powertrain system in a ATV vehicle.

3.3 ANSYS TEST RESULTS



4. CONCLUSIONS

The manufacturing of an ATV's powertrain system was successful, with only minor changes to the original design. Assembly was carried out in a safe and sound manner, allowing for easy installation and replacement in the event of a part failure. In the event of a failure, the majority of the parts and subsystems were replaceable. The powertrain system was manufactured in accordance with the calculation, and the efficiency and gradability of the powertrain system were maximised. Heat and friction losses were minimised to the greatest extent possible. The required speed and torque characteristics were successfully attained.

To improve efficiency, the drive shafts can be converted from Constant Velocity (CV) joints to Universal (UV) joints, and the propeller shaft connecting is (UV) joints.

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