VMI Mini Baja Senior Design Competition 2010

Introduction

Baja SAE Carolina marked the Virginia Military Institute's fourth year competing in the Baja SAE East competitions. This year the team worked hard and overcame many hurdles to design and build their fourth generation car. With a limited budget, the team was able to modify the 2009 car to have better suspension travel, steering and brakes. The team was able to present a very competitive design in this year's Eastern event.

Team Members (VMI's 2010 Racin' Roos)
Faculty Advisor – LTC Jay Sullivan
Team Leaders – Tyler Suttenfield, Josh McPherson
Members – Lance Hindle, Dave Messina, Travis Travis, Chris Mendillo

Baja SAE Program Objective

Baja SAE is an intercollegiate engineering design competition for undergraduate and graduate engineering students. The object of the competition is to simulate real-world engineering design projects and their related challenges. Each team is competing to have its design accepted for manufacture by a

fictitious firm. The students must function as a team to design, build, test, promote and compete with a vehicle within the limits of the rules. They must also generate financial support for their project and manage their educational priorities.

Competition Goals

Each team's goal is to design and build a prototype of a rugged, single seat, off-road recreational vehicle intended for sale to the non-professional, weekend off-road enthusiast. The vehicle must be safe, easily transported, easily maintained and fun to drive. It should be able to negotiate rough terrain in all types of weather without damage. Additional goals of the competition are to provide an opportunity for students to (1) learn that public safety is an important aspect of engineering, (2) learn the engineering design, fabrication and testing aspects that are necessary to produce a safe and competitive vehicle, and (3) provide a learning experience for students.

Component Summaries

Frame
The frame was reused from the 2009 Baja car. In modifying the frame, the team designed around the following desired characteristics: an extended wheel base, minimize weight, maximize ground clearance, increase shock travel, lower center of gravity, and comply with all SAE rules. By using these guidelines and integrating the desired drive train and suspension the team was able design a very compact, yet comfortable frame. Autodesk Inventor was used to produce a 3-D model of the design. Following the initial design, the ANSYS package was used to determine any weak points.

Suspension
The suspension group's design was very different from previous years, as it was based upon independent A-arms in the front and a swing arm in the rear. There was an emphasis on changing the mount design. The new design used Fox 2.0 air shocks to achieve 10 in of travel in the front and 12 in of travel in the rear.

Drive Train
This year's drive train was designed keeping reliability, ease in fabrication and cost in mind. By entering considerations such as engine output speed, tire size, and estimated torque needs, an analysis was written in MathCAD, and a top speed was estimated to be around 33 mph. To get the required reduction, a Comet 790 CVT was bought and used to connect the supplied Briggs & Stratton 10 hp engine to the Tuff Torq transmission, which had been reused from 2009. This transmission was heavy, but it gave the car Forward-Neutral-Reverse capabilities. Interestingly enough, the VMI car was one of only a handful of cars at the competition to have the ability to shift into reverse or even neutral. This characteristic definitely stood out with competition judges.

South Carolina and the Competition
The competition in Greenville consisted of evaluations on the cost and design reports, a technical inspection and brake test, four dynamic events, then a four hour endurance race. In the technical inspection, the team had some minor issues, but was able to fix them by the second day. Early, in the competition, the team had to make minor adjustments to the chain and brakes to continue in the competition. The team was able to complete all events and finished 74th overall in the competition. The car was drivable upon completion of the endurance race.