Design of an SAE Baja Vehicle Drivetrain

Emerald Hernandez, Dan Bruton, PhD
Department of Physics, Engineering, and Astronomy

Project Summary

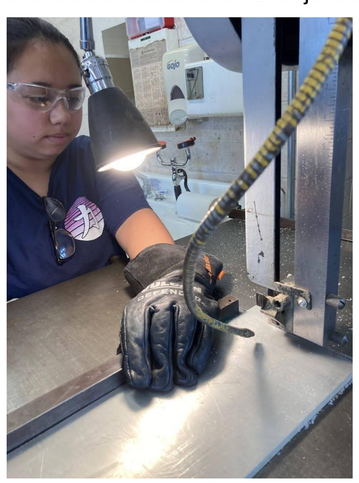
The project involves designing and building a drivetrain for a small vehicle that adheres to the Society of Automotive Engineers' (SAE) design constraints. The project's focus is on designing and building the drivetrain, which is a critical component of the vehicle that transfers power from the engine to the wheels. The three primary objectives of the project are:

1. To design and build a functional drivetrain for the small vehicle that meets the design constraints set by the SAE.
2. To test and validate the drivetrain's performance using various testing methods, such as simulation and on-vehicle testing.
3. To document the design and construction process in a report that includes details such as the design approach, materials used, testing results, and project outcomes.

Figure 1: Frame and Drivetrain

Project Justification

The project offers undergraduate students a chance to work on a structured design and manufacturing project, providing valuable practical experience and enhancing their mechanical engineering skills. The involvement of experienced engineering faculty ensures proper mentorship and guidance throughout the project, drawing from their expertise in mentoring students through various research courses and design experiences. Additionally, the project outcomes have the potential to benefit future SFA teams in the SAE Baja competition by documenting and sharing the design and manufacturing processes, serving as a valuable resource for upcoming teams. This knowledge transfer can foster innovation in off-road vehicle design and manufacturing, ensuring the continued success of SAE Baja teams.



Methodology

This project is a continuation of previous work on the SAE Baja vehicle in the Maker Space of the STEM Building. The project's new work focuses on the drivetrain design, which is an essential component of the vehicle that transfers power from the engine to the wheels. The drivetrain design involved working on the engine components and continuously variable transmission (CVT) to optimize their performance and meet the design constraints set by the SAE.

To achieve this, the drivetrain components were modeled using computer-aided design (CAD) software. Once the individual components were designed, they were assembled into a complete drivetrain system that tested. We also focused on documenting the design and testing process in a report available online for future students.

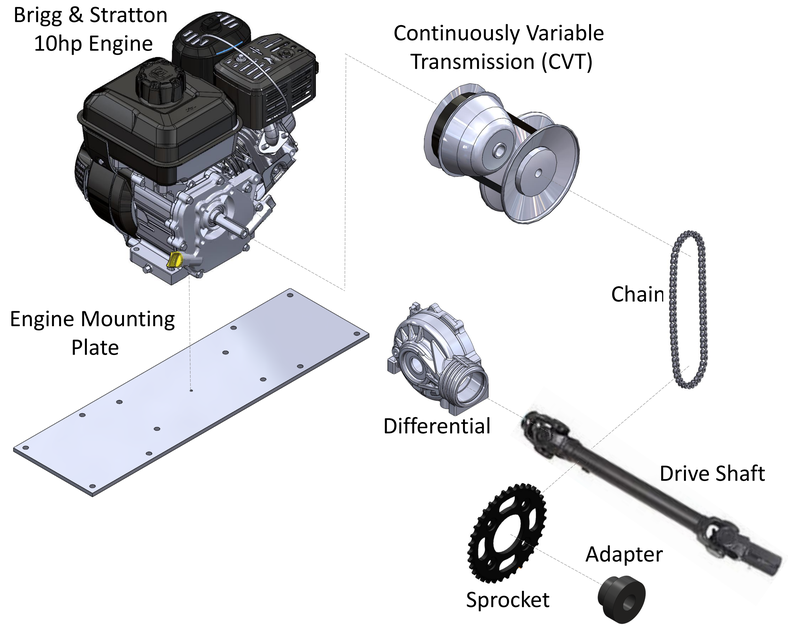


Figure 2: Exploded View of Engine and Drivetrain

Timeline for the Project

Week 1 – Built testing mount for Engine, CVT, and other components using MakerPipe connectors and conduit.

Week 2 – Connected the fuel tank, fuel line, and shutoff valve. Tested the engine with standard fuel and SAE 30 oil.

Week 3 – Connected CVT and adjusted torque spring. Added transfer belt and successfully tested Engine with CVT connected.

Week 4 – Added cross bar supports for the mount. Repositioned the differential. Adjusted the length of the chain using a master link. Cut and reduced the drive shaft diameter.

Week 5 – Added sprocket with adapter and bearing to the driveshaft. Tested completed drivetrain design. Finalized a research poster, video presentation, and website.

Summary and Results

The main objective of this research was to design and assemble an SAE Baja Drivetrain. A flexible and versatile test area was created using conduits and adjustable connectors. The engine was securely mounted on an aluminum plate, and precise positioning of mounting holes ensured proper alignment with other components. The Gas Tank was securely fixed, and the Fuel Line and Valve were added, meeting the SAE requirements for the vehicle design.

A Continuously Variable Transmission (CVT) was implemented to provide variable torque based on engine shaft speed. The CVT was angled downward to enhance its interaction with other components. Successfully mounting the Differential, featuring an input shaft and two outputs for the rear wheel half-axles, was achieved. A shaft with a U-joint was added to the Differential.

To connect the CVT and shaft effectively, a sprocket and chain were introduced, ensuring efficient power transfer between the components. Additionally, a bearing was installed to provide temporary stability during testing. The image to the right shows the final results. A QR code is included that links to a video showing our test.

Overall, the research achieved the desired objectives of designing and assembling the SAE Baja Drivetrain, demonstrating successful integration and functionality of the various drivetrain components.

Figure 3: Completed Assembly with QR Code Linked to a Video

References

- 2023 SAE Baja Rules: https://www.bajasae.net
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