

The University of Akron

IdeaExchange@UAkron

Williams Honors College, Honors Research
Projects

The Dr. Gary B. and Pamela S. Williams Honors
College

Spring 2023

4WD Baja Upright and Wheel Hub

Nathan Thompson
nat61@uakron.edu

Jonathan P. Larson
jpl76@uakron.edu

Spencer D. Compan
sdc86@uakron.edu

Follow this and additional works at: https://ideaexchange.uakron.edu/honors_research_projects



Part of the [Applied Mechanics Commons](#), [Computer-Aided Engineering and Design Commons](#), and the [Other Mechanical Engineering Commons](#)

Please take a moment to share how this work helps you [through this survey](#). Your feedback will be important as we plan further development of our repository.

Recommended Citation

Thompson, Nathan; Larson, Jonathan P.; and Compan, Spencer D., "4WD Baja Upright and Wheel Hub" (2023). *Williams Honors College, Honors Research Projects*. 1743.

https://ideaexchange.uakron.edu/honors_research_projects/1743

This Dissertation/Thesis is brought to you for free and open access by The Dr. Gary B. and Pamela S. Williams Honors College at IdeaExchange@UAkron, the institutional repository of The University of Akron in Akron, Ohio, USA. It has been accepted for inclusion in Williams Honors College, Honors Research Projects by an authorized administrator of IdeaExchange@UAkron. For more information, please contact mjon@uakron.edu, uapress@uakron.edu.



4WD BAJA UPRIGHT AND WHEEL HUB

Spencer Compan

Jonathan Larson

Nathan Thompson

MECE 4600:402-461 & MECE 4600:402-497 Senior/ Honor Design, Spring 2023

Faculty Advisor: Kai Kwon

Honors Advisor: Dane Quinn

Faculty/Honors Reader 1: Christopher Daniels

Faculty/Honors Reader 2: Alper Buldum

*Redacted version to maintain confidentiality to the Zips Baja Team

May 2023

Project No. 15

Abstract

The University of Akron Zips Baja Team has switched to a 4-wheel-drive (4WD) vehicle as per the 2023 Baja Society of Automotive Engineers (SAE) rules. The 2022 Baja Vehicle was 2WD, thus the upright and wheel hub were designed exclusively for a 2-wheel-drive (2WD) Baja vehicle. This report entails the design process and methods of verification for the design of the 4WD upright and wheel hub.

Executive Summary

The governing body for the Zips Baja Team, Baja SAE altered the rules for competition, stating that Baja vehicles competing in the 2023 season must be 4WD or AWD. Regardless, the design of the upright and wheel hub require major design changes to accept a front axle. The axle that the upright and wheel hub are required to accept was predetermined by the University of Akon Zips Baja Design Team. In addition, the wheel bearing that the upright houses was also determined by the Zips Baja Team. The wheel hub and upright must work in conjunction with the current brake caliper, rotor, and rim with minimal modifications.

The goal of this design project was to design an upright and wheel hub assembly that maintains the steering geometry of the ZB2022 2WD Baja vehicle while increasing the mass of the upright and wheel hub by less than 20% over that of the ZB2022 design. The assembly must maintain the following steering geometry: the Ackermann condition, kingpin inclination, scrub radius, and mechanical trail. After the formulation of the design requirements, an objective tree was formulated that depicts the importance of certain requirements in the design of the components. To accomplish the goals set forth in the project, a morphological chart was created.

Each iteration that fulfilled the requirements was modelled using the CAD program SolidWorks® and simulated using the Ansys® static structural analysis. The cost and mass of each iteration was compared to that of the ZB2022 upright and wheel hub designs. Due to complications in the manufacturing of the 4WD Baja vehicle, physical fitment of the upright and wheel hub designs were unable to be completed at the time of this report submission. It should be noted that the 4WD Baja vehicle is expected to weigh significantly more than the 2WD Baja vehicle, thus it was required for the Zips Baja Design team to estimate the mass of the 4WD

vehicle. Due to the low confidence in the estimation of mass and location of center of gravity of the vehicle, a relatively high factor of safety (FOS) of 2 was chosen with the assistance of the designers of the Zips Baja Design team. After the minimum FOS of 2 was achieved for both the upright and wheel hub, the focus of the design was shifted to weight and cost reduction. The final design of the upright and wheel hub yielded a FOS of 1.97 and 1.93 respectively. The wheel hub increased in weight by 12% and the upright increased in weight by 11.6% with respect to the 2022 2WD designs.

Acknowledgments

A special thanks to our advisor Dr. Kai Kwon along with readers Dr. Dane Quinn, Dr. Christopher Daniels, and Dr. Alper Buldum. Also, a special thanks to the Baja team for providing invaluable data and resources to complete the project.