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Anti-Roll Bar for SAE Baja Vehicle

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SENIOR DESIGN PROJECT REPORT

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Executive Summary

This report will explore the addition of an anti-roll bar as a proposed solution to improve the Zips Baja vehicle handling performance, which for the purposes of this report is characterized by the minimum turning radius able to be achieved when turning at high speeds. High speed is defined as the speed at which wheels start to slip when in a turn. The turning radius can be reduced by the addition of a rear anti-roll bar to the suspension. The goal of the project described in this report is to reduce the turning radius of the Zips Baja vehicle through the addition of an anti-roll bar while keeping costs under 0.5% of the total cost report and minimizing weight.

To complete the conceptual design of the anti-roll bar system, it was split into its components and each component was paired with its sub-function. Ideas to complete these sub-functions were brainstormed and compiled into a list. Each of these solutions were analyzed and scored through the use of an objective tree and decision matrix. From these scores, a conceptual design was selected to proceed into the embodiment design phase. Before further design decisions were made it was necessary to determine what equations would be necessary to evaluate the anti-roll bar. The roll stiffness is the defining characteristic of an anti-roll bar, and from the equation for stiffness it was possible to determine what other variables would have to be calculated or obtained through testing. The main goal of testing was to establish a relationship between changes in roll stiffness and reduction in turning radius, as this correlation varies greatly among different vehicles. However, first the speed at which transition from high to low speed would need to be calculated and verified through testing. It was also necessary to obtain the coefficient of friction of the tires through testing to be used in the calculation of this critical speed.

In the embodiment phase of the project, standard parts were selected where applicable. A prototype ‘proof-of-concept’ system was then constructed and installed on an older, but still relevant, model Baja vehicle. It was then subjected to field testing to verify performance and establish a correlation between roll stiffness and turning radius. Analysis of the data gathered from testing was successful in creating this correlation. Using the relationship found from testing, several iterations of the system were designed to optimize performance, cost, and weight. The final product resulted in reducing turning radius by 15.6% while meeting cost goals and adding minimal weight to the Baja vehicle.