CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
Bradley A. McAskill

Project Number
S0211

Project Title
Common Crash Cushions

Abstract

Objectives/Goals
To build and test different crash barriers that effectively reduce the impact force on the vehicle colliding with them.

Methods/Materials
Construct a very durable "vehicle." Construct a track that the vehicle may travel down. Construct a simple machine that will convert the force 40 lbs falling, to pulling the vehicle down the track. The vehicle is accelerated down the track using this machine until the vehicle impacts a solid wall, the deceleration is then measured using an accelerometer. The accelerometer is also used to determine the speed of the vehicle at the time of impact. A baseline deceleration at the time of impact is established. More tests are conducted with different barriers. One barrier is two 3/4 inch PVC pipes that are 3 feet long and can flex when impacted. Another barrier is two shock absorbers from the suspension of a car. And the third is a one gallon jug filled with water and sealed. The deceleration on impact of the different barriers is then compared to the baseline to determine the barrier's effectiveness at removing energy from the vehicle during impact.

Results
Because the accelerometer could not react fast enough only the time data is useful during impact so the deceleration had to be calculated mathematically using the available data. In all tests the vehicle is traveling approximately 8.8 m/s at the time of impact. The solid wall brought the vehicle to a stop in 0.04 seconds, indicating a maximum deceleration of 222.8 m/s2. The deceleration with the PVC pipe barrier is 162.75 m/s2, the deceleration with gallon jugs was 194.5 m/s2, and the deceleration with the shock absorbers was 170 m/s2.

Conclusions/Discussion
The PVC pipe had the lowest deceleration, however, due to the elastic properties if PVC it was the least effective barrier. After the vehicle impacts and comes to a complete stop, the PVC rebounds and accelerates the vehicle in the opposite direction of impact increasing the total acceleration. The shock absorbers are the most effective barrier. The gallon jugs were the next most effective, then the solid wall, then the PVC pipes. An impact acceleration the same as what was recorded for the baseline tests, 222.8 m/s2, could cause serious injury to a person, thus the importance of developing crash barrier technology. The results of the experiments conducted suggest that using shock absorbers is the best way to reduce the force a person might experience in an accident.

Summary Statement
To design and test different crash barriers to determine which is the most effective at removing energy from a vehicle during a collision.

Help Received
Physics teacher Mr. Mark Grubb supplied the accelerometer and answered occasional questions.