**Solution to Car Crash Reconstruction**

May 28, 1971 near Coldwater, Ohio. Crash occurred at about 8:22 p.m. EDT = 7:22 EST = 19:22 Zulu

Using an online application I found the sun’s altitude to be between 5-6 degrees (just above the horizon), and its azimuth to be 293-294 degrees (WNW). The sky was mostly clear. I was certain to use STANDARD time in the calculation even though the event occurred under DAYLIGHT SAVING TIME. See: <http://aa.usno.navy.mil/data/docs/AltAz.php>

The officer’s note about the cars continuing 85’ (31m) down the road is not clear; however, because he also notes that the cars landed in the ditch, one might legitimately conclude that the distance of travel after the collision was 31m due east. I will make this assumption. (If one assumes that the cars went 31m some 10o north of east, the solution would be similar but speed of vehicle #2 would be 2% lower than calculated given the basic assumption – a negligible amount.)

Answers to **SPECIFIC** questions:

The speed of V#2 can be determined from how far the two cars went down the road following the collision, 31m, using the work-energy principle and the fact that μk=0.75 per the drag tire test. First, we need to find the speed of the cars immediately after impact.



Now, using conservation of momentum in the east-west direction, we have:



Vehicle #1 – Cougar (two passengers)

m1 is the mass of Vehicle #1. From the spec sheet, we see that the Cougar specified has an empty weight of 3499 lbs. Add to that the weight of one male (150 lb) and one female (100 lb) for a total combined weight of about 3,800 lbs. Converting weight into mass we have m1 = 1727 kg.

Vehicle #2 – Mustang (one passenger)

m2 is the mass of Vehicle #2. From the spec sheet, we see that the Mustang specified has an empty weight of 2650 lbs. Add to that the weight of one male passenger at about 150 lbs for a total combined weight of 2800 lbs. Converting weight into mass we have m2 = 1272 kg.

From these data we can determine the speed of Vehicle #2 immediately prior to the collision.



Converting 50.4*m/s* to mph gives, v2 = 113 mph. It is clear that Vehicle #2 was far exceeding the speed limit.

In a similar fashion, we can calculate the speed of Vehicle #1 immediately prior to the collision. The north-bound path of the two cars was about 15.5 feet (5.65m) assuming the impact occurred in the right lane of Vehicle #2. The speed of Vehicle #1 drug Vehicle #2 into the ditch about 15.5 feet north of the centerline if its path.



From this information and the data presented earlier, we can determine the speed of Vehicle #1 immediately prior to the collision.

Using conservation of momentum in the north-south direction, we have:



Converting 15.8*m/s* to mph gives, *v*2 = 35.3 mph

A normally accelerated car staring from a full stop will reach a speed of 5-10mph by the time it reaches the point where Vehicle #1 was impacted by Vehicle. From this evidence it is clear that Vehicle #1 did not come to a full stop as was required by law for this intersection, and at best contributed to the cause of the accident as a result.

The speed of the two cars following impact (and going in a direction about 10 degrees north of east) can be found from the use of the Pythagorean theorem.



Vehicle #2 went from 54m/s to 23.2m/s (approximately) during the impact with Vehicle #1. The average speed during this interval was 0.5(54m/s + 23.2m/s) or 38.6m/s. The distance of doing so was perhaps 1 meter, half the width of Vehicle #1. From these data we can determine the duration of impact.



The force of impact can be found by using the data of Vehicle #2:



The acceleration both cars (and their passengers experienced) is found using Newton’s second law:



Vehicle #2 clearly would experience more acceleration in this case because of its lower mass relative to Vehicle #1. Still, the impact is sufficient to kill all occupants as the calculation of G forces show.

If an acceleration of 9.8m/s2 = 1G, then the passengers of Vehicle #1 experienced 89 G’s and the passenger of Vehicle #2 experienced 121 G’s. When the G-force (so called) exceeds 30-60 in a car crash, the occupants typically are killed. This was the case for both vehicles, hence the deaths.

Back, then, to the **GENERAL** questions:

* Did vehicle 1 pass the stop sign without stopping? Evidently.
* Was vehicle 2 exceeding the speed limit? Clearly!
* What environmental factors contributed to the accident if any? The sun was located low down in the WNW making it difficult for Vehicle #1 driver to see Vehicle #2 approaching, and the high rate of speed of this driver would have made it difficult for the driver of Vehicle #1 to accurately judge the amount of time required to pass through the intersection before Vehicle #2 arrived on the scene.
* Who was at fault for this accident if anyone? Both drivers were at fault, #1 because he evidently did not stop at the stop sign as required and #2 because he was speeding to an excessive degree. Had #1 stopped at the stop sign as required by law, the accident might well have still occurred due to the blinding presence of the sun. The greater culpability, therefore, rests with driver #2.