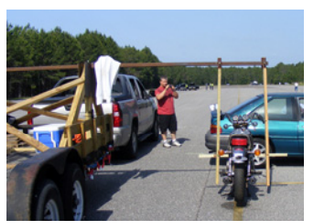
Ralph's Accident Reconstruction Newsletter: Volume 10, Number 3—Summer 2011

In May of 2011, I attended Special Problems in Traffic Crash Reconstruction, an annual seminar presented by the Institute of Police Technology and Management (IPTM), in Jacksonville, Florida, where I was one of the invited speakers. The purpose of this annual seminar is to expose the reconstructionist to the latest trends and techniques in the field of collision reconstruction. The seminar included staged collisions, general-session topics, and breakout sessions. The photos below show one of the staged events, a Chevrolet Caprice driven over a ramp on one side to make it flip. I intend to create some Current Feature pages on my Web site to give details and more graphical material concerning one or more of the staged collisions.

The photograph on the left, above, shows the Caprice with all four wheels off the ground as it is in the process of rollover. It rolled onto its top and slid to rest; its final position, just after it came to a complete stop, is shown in the photograph on the right. The photograph at the top of the adjacent column shows the pavement scars created by an exterior mirror housing and other body parts where the car first made contact with the pavement during the rollover. It continued the rollover, coming to rest on its roof and sliding to rest in that orientation. Two of the purposes of this and similar staged rollovers were to relate speed at the point of takeoff to distance traveled to the final position and to allow documentation and examination of pavement markings created by such events.

Other staged collisions involved a motorcycle being driven into a parked car. Various types and weights of motorcycles were used. The point of impact, speed of the motorcycle at impact, post-collision travel, and final positions of the car and motorcycle were documented. The photographs below show the test rig and orientation, one of the tire smears with rim gouging, and the subsequent post-impact tire mark from the car which resulted from one of those collisions.



At last! Toyota has worked with Bosch to provide access to Event Data Recorder (EDR) data in airbag control modules (ACMs) in late-model Toyota, Lexus, and Scion vehicles. As of this writing, I have received the set of five cables to cover all current vehicles made by Toyota under their various brands for the model years for which we will be provided access to the EDRs. Although some Toyota vehicles had EDR capability as much as ten years ago, access will probably not go back that far. Details concerning which vehicles and model years will be covered awaits the release and study of the next iteration of Crash Data Retrieval (CDR) software from Bosch, version 4.0. The current version, as this newsletter is being written, is 3.8. Until the release of 4.0, the cables are worthless.

I have been invited to give two presentations at the upcoming joint SCARS-SeARS-IAARS seminar to be held in Mt. Pleasant (Charleston), South Carolina, during the last week in July. One topic will address momentum and energy considerations; the other will address applications of CDR data.

Returning to the topic of the staged collisions conducted at IPTM in May, one of the purposes of the motorcycle crash testing was to have the motorcycle strike the side of the car at or very near a "hard" spot—i.e., on the end of an axle. Because of side crash safety mandates, there are many crash tests involving the sides of vehicles. These tests, however, are staged to collide with the side of the vehicle between the axles; i.e., the side of the passenger compartment. This section of a typical automobile would, of course, exhibit much more permanent crush as a result of the applied force than an axle. There is no reliable data set for broadside impacts at the ends of the axles; such testing, if conducted, would be very sensitive to offset from being exactly centered on the axle at impact and from varying impact angles, and different wheels and tires on a given vehicle would have some effect on the force-to-crush relationship. Also, there are some limited data points on impact-induced crush of motorcycles, but, with few exceptions (where many motorcycles of the same make/model/year have been tested in documented crashes), the spread of two standard deviations, which would include 95 percent of all crash test data, is so wide as to not be usefully applicable to a specific motorcycle in a specific crash. So, what's a reconstructionist to do? Well, there's force balance and there's rotational mechanics.

Some of you may remember Newton's third law from your high school or college physics course: in modern English, it's expressed as "For every action there is an equal but opposite reaction." Put another way, when one object exerts a particular amount of force on another object, the second object is applying the same amount of force toward the first object. So, in those cases where side crash testing has given us crush parameters and the motorcycle collided with the automobile in the region of the side of the passenger compartment, the force-crush relationship for the automobile, as demonstrated by crash testing and determined by analysis, can tell us what force was involved in causing the measured crush. Then, we know that the same amount of force was applied to the motorcycle by the car. The force-crush relationship will ultimately lead us to an energy value, from which we can get a value of speed. We can then add post-collision movement(s) to determine vehicle speed(s) at impact. Once we add up all the elements of dissipated energy, we will know the impact speed(s) of the vehicle(s).

So, why do we need rotational mechanics? Just like skidding a car using the brakes represents a dissipation of energy, the rotation of a vehicle as a result of an impact by another vehicle represents the dissipation of energy in terms of the applied torque necessary to create the observed rotation of that struck vehicle. By calculating the torque necessary to cause the rotation of the struck vehicle, and in consideration of the struck vehicle's inertial parameters, its axis of rotation, and other physical factors, we can arrive at a value of torque useful in evaluating the speed of the striking vehicle. Once we have calculated torque, we can determine the component of the motorcycle's speed which was perpendicular to the longitudinal axis of the struck vehicle. If the impact was not perpendicular, we can use simple trigonometry to determine the actual impact speed of the motorcycle. (Torque is defined as a force perpendicularly applied at some moment arm length or radius.) Aren't you glad we have Newton's laws and other aspects of physics and mathematics to help us find answers?

On a similar note, John Daily, Nathan Shigemura, and Jeremy Daily have published **Fundamentals of Traffic Crash Reconstruction** (IPTM, University of North Florida, Jacksonville). Among other methods and procedures, a sequence for determining the speed lost by a vehicle which is spinning is presented. The validity and accuracy of that sequence have been demonstrated repeatedly by extensive tests conducted by the Georgia State Patrol at the Public Safety Training Center, Forsyth, Georgia. The purpose of staged collisions and other staged testing is to demonstrate the accuracy of applying mathematics and physics to develop numerical conclusions regarding most aspects of collision reconstruction.

I am grateful to my clients for each opportunity to provide service. Please call anytime you have a question regarding my potential involvement in analyzing a motor-vehicle-related incident. Also, if you are looking for a speaker to give a luncheon talk or session talk on crash reconstruction, Crash Data Retrieval, tire failure evaluations, or lamp filament examinations (for on or off at impact) at a seminar, contact me: I may be willing to help.

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1804 Thornhill Pass, SE
Conyers, GA 30013
770.918.0973
Fax: 770.918.8076

Ralph Cunningham, Inc.
1804 Thornhill Pass, SE
Conyers, GA 30013