

Intersection Collision of Oxford Cty Rd 74 and 43 April 6th, 2011

Posting Date: 07 Apr 2011

It has been reported that at two-vehicle, intersection collision occurred involving a westbound "SUV" on Oxford Rd 74 and a northbound "Hyundai" on Oxford Road 43. Two male occupants of the Hyundai tried to accelerate from a stop sign and were struck in the right side by the front of the SUV. The driver reportedly suffered a fractured collar bone while the seriously injured right front occupant sustained a fractured jaw and collar bone but fortunately did not sustain any brain injuries.

I examined the site this morning, April 7th, and find it an interesting reconstruction issue from the standpoint of who was at fault. The police will likely charge the young driver of the Hyundai with failing to yield the right of way but this is another example where the true fault for the collision may be somewhat grey, particularly because in the past, without the availability of event data recorders ("Black Boxes") police had a difficult time determining the precise speed of the vehicle on the uncontrolled road. I hope to discuss this further in the near future with some photos illustrating my point.

UPDATE: April 8, 2011, 1735 Hours

Another fatal collision has occurred in the Burford, Ontario area resulting in my being delayed in displaying the photos and my analysis on the current case. But this will be rectified shortly.

UPDATE: April 9th, 0825 Hours

Ok, I have assembled a number of photos from the site for discussion. First (below) is a view looking west from 175 metres east of the point of impact. This is a view looking along Zorra Road 74 which the direction driven by the Durango driver who had the right of way.



As usual my small orange cones are placed along the north roadside at 25 metre intervals. Note the slight high-crest on this (#74) road. The northbound Hyundai pulled out from a stop sign at the group of fir trees on the left side of the view.

Now below is a view from 50 metres east of the POI, still looking west, as we approach the intersecting roadway. After impact both vehicles travelled to the north east of the intersection and into the ditch running along the north side of Road #74.



Note to the left what kind of limited visibility is provided to the Hyundai driver past the grouping of fir trees.

Now below is a view of the middle of the intersection, still looking west. If you look closely in the middle of the westbound lane you should see a diagonal scrape that is oriented in a south-east to north-east direction. This scrape was caused at the point of impact (POI) between the vehicles and then they progressed into the north-east ditch in the background. The fact to observe is the eastward direction in which both vehicles travelled after impact. For example, if both vehicles had the same mass (weight) and speed then we would expect them to leave the area of impact at a 45 degree angle, assuming of course that they were originally travelling in their pre-crash directions.



The view below now takes us looking northeast from the centre of the intersection and we can see the trail of damage as both vehicles enter the northeast ditch. Note however that neither vehicle stuck any of the trees. If the Hyundai had been travelling any faster the result could have been different.



Before moving on to look at the post impact debris I want to show you (below) the limited line of sight afforded to the Hyundai driver.



We might look closer at the possibility that the driver was not afforded a reasonable change to view the road due to the trees shown above but that is not guaranteed. For example one should not stop "at the stop sign" as is often said. If there is a painted traffic stop bar then the front of the a vehicle should come to stop there. And if there is no painted stop bar then the front of the vehicle should approach the edge of the lane of the intersecting roadway. In the photo above I am simply showing you what a problem you create if you do not pull up to a position where you can see far enough along the intersecting road.

Let us return to the paths of the vehicles as they travel through the north ditch.

Below is a view of some of the tire marks and gouges.



The Durango came to rest just past the small blue sign that was knocked over while the Hyundai carried on further westward. The final rest position of the Durango is exemplified by the sudden stop of the deep gouges in the earth caused by the wheels of the vehicle. At the end of the gouge you can see how the earth has been built up as it was pushed forward. This is typical evidence of what you would see as a vehicle slides to rest in mud like this.



In many instances the travel path of a vehicle is not outlined by gouges from wheels and we must identify more subtle markings such as what is shown in the photo below.



Much like a woodsman following a trail you have to recognize fresh evidence of motion by way of disturbances in the natural layout of things. In the above case there are some fresh breaks to some twigs of a bush. Following such evidence leads us to the final rest position of the Hyundai as shown in the photo below.



As always you have to sort out what is evidence of final rest and what is evidence of towing or emergency personnel.

For general analysis purposes I can say that the Hyundai was pushed to the west by about 30 metres while the Durango travelled close to half that distance before coming to rest. The degree to which each vehicle was pushed to west is a reflection of the impact speed of the Durango. We might conduct a simple "In-Line" momentum analysis to estimate that speed.

I am not going to search out the mass of each vehicle at this time but I will simply assume a mass of about 2000 kilograms for the Durango and 1200 kilograms for the Hyundai. Momentum is a product of the mass and velocity. So, to do our work we have to estimate the separation velocity of each vehicle as it left the area of impact. This is done by estimating the extent of deceleration of each vehicle during the distance that it travelled from impact to rest. Now this is the interesting part that the police reconstructionist has to deal with. What was the rate of deceleration of each vehicle through this mess of the north ditch?

For example the Durango essentially dug itself into an elephant pit as evidenced by the deep plowing of the wheels in the soft mud and earth. One should be tempted to use a very high rate of deceleration through the portion of travel through this mud while using a somewhat low level as the Durango left the impact and entered the ditch. But what about wheel locks due to crushed structure jamming the front wheels. I have no idea since I did not examine either vehicle. But knowing the obvious severity I would have to apply at least some drag to those front wheels of the Durango.

Let us assume the Durango travelled 15 metres to rest and half of its travel was through the mud. I assign mud deceleration of 1.0g and a roadway deceleration of say, 0.2g thus the average deceleration over the total distance of 15 metres would be about 0.5g. Using our standard "slide to stop" formula we say that the post-impact speed of the Durango in kilometres per hour is equal to the constant of 255 times the drag of 0.5 times the distance of travel of 15 metres. By doing this multiplication we get 1912. Now we take that 1912 under a square root sign and arrive at about 43.7 km/h for the separation speed of the Durango. In other words, this is the speed at which the Durango left the area of impact. I like to work in metres per second so I can take that 43.7 and divide it by 3.6 to get the speed of 12.15 metres per second.

Now to find the post-impact momentum of the Durango I would multiply the 12.15 by the mass of the Durango (2000 kgs) and get a momentum value of 24296 "kilogram metres per second squared". OK, maybe you get confused about the naming of the units so just look at the number: 24296. This is the most impact momentum of the Durango. Now we do the same thing for the Hyundai.

(For you purists I know I should be talking about velocity and that velocity has both a scalar (speed) and direction but I'm trying to simplify things for clarity by using layman's terms).

Hyundai post-impact speed: What is the rate of deceleration? Flip a coin? I don't know. How is the police reconstructionist going to know? Crystal ball, magic wand? We do the best we can from examining other collisions testing and simply solid past experience. The Hyundai also had to pass through the mud but notice that we could not see any tire marks in the ditch after the Durango's FRP suggesting that the wheels of the Hyundai might have been closer to free rolling. I would also have to consider from the vehicle positions that the Hyundai was possibly struck more in the front portion of the right side and that it rotated counter-clockwise and rolled leading with its front end to final rest (Don't ask me for now why I think that). I would generally apply a deceleration value in the range of 0.3g over the total post-impact travel distance of about 30 metres.

Applying the same calculations as we did with the Durango, the post-impact speed of the Hyundai ($255 \cdot .3 \cdot 30$ all under a square root sign) would yield about 47.9 km/h or 13.3 m/s. The post-impact momentum of the Hyundai would be 15967 kg m/s squared.

Now the beauty of this vacuum called Linear Momentum analysis is that it is assumed that the total post-impact momentum is equal to the total pre-impact momentum. And it is simple to assume that the Hyundai did not contribute any of the post-impact momentum in the westward direction because it was not going west. All of that post-impact momentum can be attributed to the Durango. So we simply add the two post-impact momentums ($24296 + 15967$) and get a total post-impact momentum of 40263. That momentum was the result of the Durango's pre-impact momentum. Now we simply remove the mass of the Durango from that value but dividing 40263 by 2000 to get 20.1 metres per second which is the impact speed (OK call it velocity if you like) of the Durango. Or by multiplying by 3.6 we get the speed of 72.5 km/h.

Well, one would think this Durango driver was pretty safety conscious as he was going below the speed limit at impact. Case closed. Well, not so fast. Could he have reduced his speed to something lower and therefore reduced the collision severity or avoid the collision altogether? Or was he travelling a lot faster but braked to a lower speed by the time the impact occurred. Now the waters get murky.