Results From Braking Tests On Snow-Covered Asphalt Roads

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A variety of criticism has been expressed by so-called experts who advise that many collisions occur on snow-covered roadways because drivers do not "drive according to the road conditions". This conclusion implies that there is a obvious and consistent set of road conditions that the driver should be able to recognize and adjust to. Such sage advice is always correct in that, if a driver had simply performed better a collision would likely have been avoided. We see numerous examples of drivers continually exceeding speed limits or driving recklessly and we come to the conclusion that essentially all winter mishaps on snow-covered roads are the fault of this inappropriate driving. Yet there is little scientific evidence to support that his widely accepted notion is true.

Regardless of inappropriate driver behaviour, the question remains whether there is such a thing as a consistent, snow-covered, road, surface condition. We have conducted some braking tests on a variety of urban and rural roads to test this hypothesis.

In a previous article ("When, Where and Why Roads Become Slippery - Some Objective Testing By Gorski Consulting", 2012) we described a testing set-up involving multiple video cameras that were attached to a test vehicle for use in our braking tests. This set-up enabled us to document the speed of our test vehicle when braking was commenced. It also documented the total time of braking up to the point that the vehicle came to a halt. By knowing the initial speed and time to brake to a halt it is possible to determine the quality of the interface between the tire and surface in terms of its maximum ability to generate a rate of deceleration. Accident Reconstructionists often refer to this value as the "co-efficient of friction" or percentage of "g". This value is often determined by attaching an accelerometer to a test vehicle during braking tests. An accelerometer might be useful when we want to study the details of the acceleration pulse because its numerous samples per second (usually 100 per second or higher) provide the details needed to study have that pulse changes.

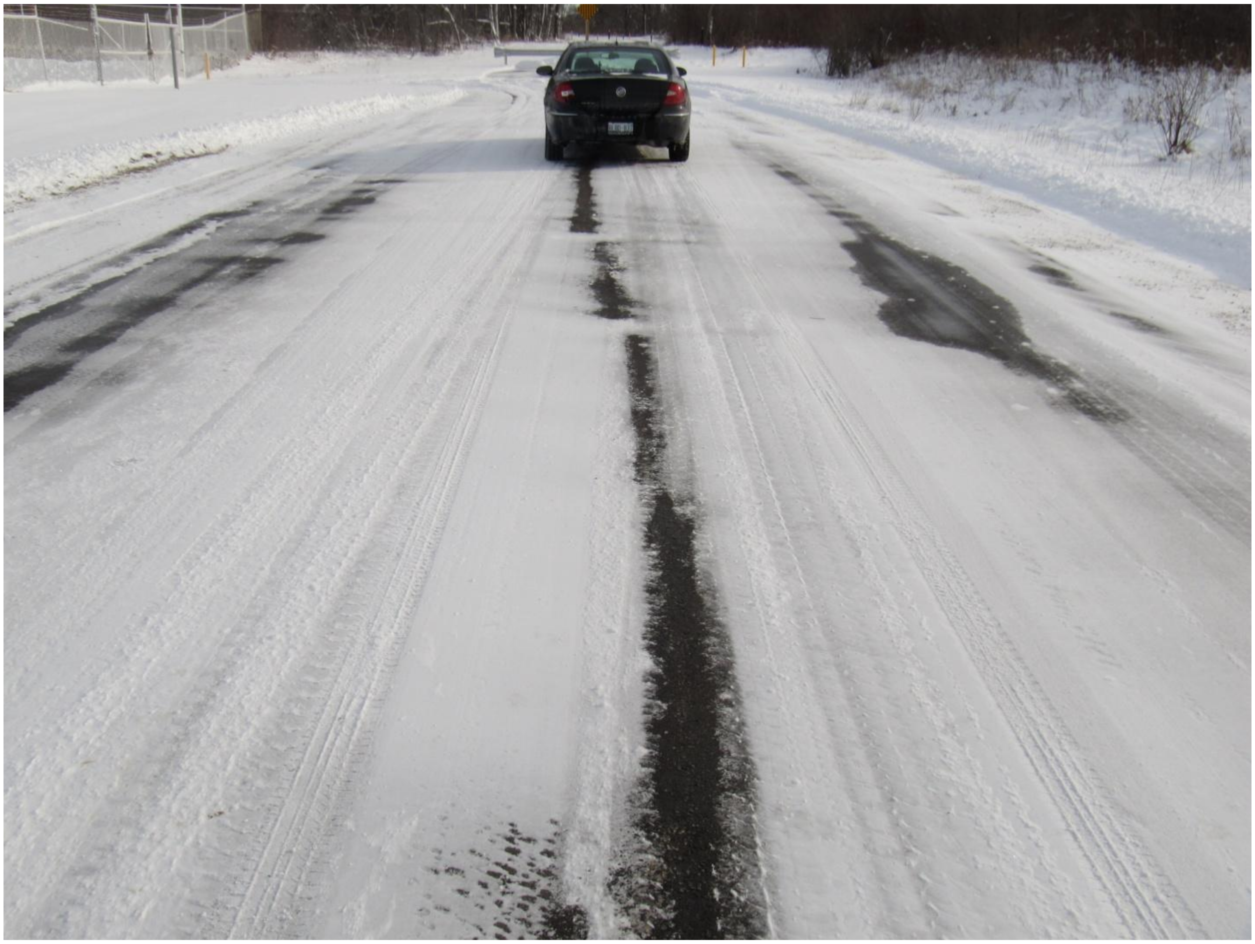
However we are not interested in how that pulse changes. Our only interest is in determining what overall rate of deceleration was afforded in a certain braking test and whether that overall value is consistent over many sites. The advantage of our method is that the video cameras also provide a detailed view of the characteristics of the surface over which the test was conducted.

As an example, the photo below shows a typical snow-covered, asphalt, road surface in an urban centre of Southern Ontario, Canada. Snow on the road becomes beaten down to a crushed and packed form. In the wheel tracks there may be irregular segments of road where most of the snow has been removed and there may be a thin coating of snow that may be adhering to the pavement or may be loose. To each side of a wheel track there could be packed snow. Still further from the wheel track there could be deeper packed snow or a larger quantity of loose snow.

In a rural setting the road conditions could be similar but also quite different as shown in the example photo below.

If a driver were to commence maximum braking on such surfaces there is no guarantee what qualities of the surface the tires of the vehicle experience. If the tires are on relatively bare pavement then the rate of deceleration would be expected to be higher. If the tires are on a layer of packed or crushed snow next to the wheel track the rate of deceleration could be different. And if the tires happen to stray into the deeper areas of packed or loose snow the deceleration rate could be different from either of the other two conditions.

Our braking tests included a freshly plowed asphalt surface as shown below.



As seen above, this surface contained a very thin layer of packed snow. A skid test at 52 km/h resulted in an average deceleration rate of 0.197 g.

Another braking test was performed a few hours later on this same surface and using the same vehicle however about 1 to 2 inches had fallen on the plowed surface. The contains of that surface are shown on the following page. The second braking test was performed at the same speed of 52 km/h resulting in an average rate of deceleration of 0.164 g.

Although the extent of degradation in the braking ability of the vehicle was not large there was a noticeable difference. In the first test the stopping distance would be about 54 metres whereas in the second test it would be 69 metres.

Thus, if a driver applied his brakes for a vehicle ahead at a distance of 60 metres when there was about 1 to 2 inches of snow on the ground he would cause a rear end impact. Whereas, under the same scenario except freshly plowed surface, the vehicle would come to a halt over a car length away from the rear bumper of the vehicle ahead.

Although a driver would be able to see whether the roadway was covered by snow or freshly paved, it is unlikely that he would be able to detect that his vehicle would slide about three car lengths further on one surface than on the other.

Next, we could consider what level of deceleration could be expected from a surface that contains a little bit of visible pavement such as the scenario depicted below.

Our testing from a variety of speeds between 47 and 77 km/h provided deceleration rates between 0.242 and 0.425 g. At the lowest deceleration rate a vehicle travelling 77 km/h would stop in a distance of 96 metres whereas at the highest deceleration the distance would be about 55 metres.

Thus if a driver is travelling on rural highway at a speed 77 km/h and he starts to brake for a stopped vehicle that is 60 metres away, he might be able to come to as stop about a car length behind the rear bumper of that vehicle if the rate of deceleration is at 0.425 g. However under road conditions that appear similar the rate of deceleration could be o.242 g and that same braking action might cause a significant collision because, upon reaching the rear bumper of that vehicle ahead, the braking vehicle would be needing an additional 36 metres of braking distance before it could stop. That braking vehicle would still be travelling about 47 km/h when the impact occurred.

Videotaping of our braking tests makes it possible to see the precise characteristics of the road surface on which these tests were performed. None of the tests we performed were in conditions where there was an underlying layer of ice. Yet it is not uncommon for drivers to be travelling on a relatively centre-bare road and then encounter an area of pavement that contains a length of ice adhering to the pavement. Such a condition is extremely dangerous as the stopping distance under icy conditions is greatly increased.

The presence of ice is also dangerous when exists on only one side of the lane thus causing a relatively high rate of deceleration on one side of the vehicle and a very low rate on the other. In such a scenario it becomes much easier to begin to rotate out of control because there could be a substantial moment about the vehicle's centre-of-gravity that could over-power the tires' normal ability to keep the vehicle travelling straight ahead.

In our opinion it is difficult for a driver to tell the precise level of deceleration afforded by asphalt road surfaces that are covered by various depths and conditions of snow cover. Various experts claim that experience and attentiveness can be used to make that correct judgment. That is not the case. In some instances there is no reliable way to detect when a road surface becomes exceptionally slippery. Therefore it is very important, not only to focus on driver behaviour in reducing wintertime collisions but it is equally important to ensure that a roadway receives proper maintenance .

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