Direct low lateral slip roadgrip measurement compared with surface reflection of three laser beams

Niclas Engström¹ (niclas.engstrom@ltu.se), Henrik Andrén², Roland Larsson¹, Lennart Fransson²

1 Introduction

Roadgrip on winter roads depend on many factors. To ensure that entrepreneurs have successfully restored roadgrip, measurements on roadgrip is needed. To evaluate a non-contact method based on three laser beams with different wavelengths, it was mounted on a vehicle equipped with low lateral slip device measuring roadgrip.

2 Equipment

For reference we use an low lateral slip roadgrip measurement device, the RT3. The RT3 use a Bridgestone Blizzak Nordic WH-1 tire, slightly angled to achieve low lateral slip, see Figure 1a. 1b below. Roadgrip measurements were compared with results from an road eye, measuring reflection differences of three laser beams.

3 Tests

This test was performed in a steady stream of vehicles performing brake test on a brushed old polished ice surface. The towing vehicle was accelerated up to one of three measuring speeds, 30 km/h, 50 km/h or 70 km/h on the system 2000 ice before the brushed old polished ice. The measurement was initiated close to the start of the brushed old polished ice. Each test was performed three times for each speed. Tests were repeated several times each day. Example on temperatures and relative humidity charts recorded during tests can be seen in Figure 5.

4 Track

The test track section with brushed old polished ice was roughly 100 m long and 10 m wide. It was located on a test area 1 km long and 80 m wide prepared with a grader blade equipped with system 2000 teeth. Polished ice is created with an ice machine that floods the ice with water and smoothness out the water with a thick cloth. The polished ice surface was several days old and debris and snow was brushed of before test begun. The test track was professionally prepared on Lake Kakel, Arjeplog, by IceMakers, see Figure 6 below.

5 Results

In Figure 7 a), b) and c) we see that there is a patch in the beginning of the brushed old polished ice with lower road grip/HFN number than other sections of the brushed old polished ice. The reason for this is the stop distance tests that were performed parallel to our measurements. ABS systems often lock the wheels initially during a brake sequence, especially on a surface with this low road grip. This leads to a polished section where asperities are removed. The spikes in the intensity ratio are from accumulations of snow as there were some light snowfall on and off during these measurements. The snowfall also resulted in many corrupted measurements as the protective tube for the road eye was blocked with snow. The tube was cleaned frequently with a brush to enable measurements. Towards the end of the brushed old polished ice we see that both the HFN number and the intensity ration increase, this indicates that the road eye can detect changes in the surface characteristics.

6 Conclusions

These first attempts to find lower cost methods are not encouraging. To correctly measure roadgrip, one need a method that works in as many conditions as possible. We see in Figure 7 that the intensity ratio measurement method is easily disturbed by pollutions on the road surface that did not change the HFN number significantly. This will not stop these low cost detectors from entering the market. Each sensor will add its information to the main control module to enable warnings and interactions to reach the driver of the vehicle. One of the main problems that we encountered during the use of road eye is pollution of the lenses and thus disabling the sensor.

7 Acknowledgements

This work is supported by: The Center for Automotive System Technologies and Testing – CASTT project at Luleå University of Technology, D. The Swedish Road Administration, and the Kempe foundation. We would like to acknowledge Johan Kasselgren from Volvo, Halliday Technologies INC., Carl-Henrik Ulegård and Pontus Gruns from the Swedish road administration for their support.