MEASURING SKID RESISTANCE IN THE NETHERLANDS

Gerriessen Walter¹, Wennink Martin¹, Jordens Rob²,
(Wegmeetdienst Pavement Consultancy, Apeldoorn¹/Ministry of Transport, RHED, Delft²)
THE NETHERLANDS/PAYS BAS

Micro; macro texture, skid resistance, braking deceleration, standards

By the economical and demographic developments the traffic intensity in the Netherlands has increased enormously. The roadnetwork is being used intensively with many daily congestions and for the first time in many years the amount of accidents is increasing again [1].

The pressure of the traffic can lead to shorter following distances, larger speedvariation and hence more conflict situations. To reduce the amount of head-tail accidents and the amount of avoidable reductions of the roadcapacity due to roadworks, the roadauthority stands in a great need of durable and permanently skid resisting roadsurfaces.

Next to that the society is increasing its demands for the quality of the livability and so wants rigorous standards for the noise pollution of the environment by the traffic.

In recent years roadconstructing participants are therefor intensively looking for durable roadsurfaces that will satisfy both the roaduser and the environment.

In this paper the focus will be on skid resistance as it was handled in a researchprogram that was carried out on 8 testsections in the eastern part of the Netherlands by the RHED and the Wegmeetdienst Pavement Consultancy in close cooperation with the roadauthority of the province of Overijssel.

Skid resistance in the Netherlands

History

Skid resistance of roadsurfaces is being measured in a standardised way since the sixties. By a statistical comparison of accidents on the highway network and the results of skid resistance measurements on these roads a minimum action level for the skid resistance has been determined in the seventies. Based on this and the knowledge of the long time performance of skid resistance through measurements during many years, acceptance levels for new laid roadsurfaces and warning and action levels for roads in use were determined. Since then many things have been changed: cars, tyres, roadsurfaces, the testingdevice etc.

Especially the development of new types of roadsurface has lead to the recent research of the skid resistance phenomenon.

Method 86% retarded wheel and levels of standard

As well as for the acceptance of new laid roadsurfaces as for the periodical monitoring of the road network in the Netherlands the friction coefficient $f_s$ is being used as measured with an 86% retarded wheel at a speed of 50 km/h.

During the measurement a 0.5 mm. thick waterfilm is spread out in front of the test wheel.

The various standards for this $f_s$ were determined from the earlier mentioned statistical comparison between accidents on highways and the measured $f_s$.

Taking into account the properties of the in the Netherlands used aggregate, a standard for the acceptance of new laid roadsurfaces and a warning and action level were determined.

Naturally these levels were connected to the used roadsurfaces on the highways in those days, being most of the time dense asphaltic concrete 0/16 and gap graded asphaltic concrete 0/22. The recently developed materials all ask for a test by the correlation research. In all cases this had been carried out one-sidedly by comparison of the testresults of new laid roadsurfaces and traditional roadsurfaces. Whether the interaction between tyre and
roadsurface then results in a value, that is predictive for the skid resisting potention of the roadsurface in relation to accidents hasn't been proved by that. Next to that the provincial and local road authorities have a need for the differentiation of standards based on characteristics of the use of road types other than highways. Nevertheless it is to be expected that the used friction coefficient $\mu_0$ on its own is not indicative enough to predict the potention of the roadsurface to deliver a certain level of roughness to facilitate the deceleration of braking cars. That is why in the recent research project more skid resistance parameters were included.

Other skid resistance parameters

Next to the above described method with the 86% retarded wheel in the Netherlands the following field tests are being carried out:
- Texture profile measurements with the laser SDP (South Dakota Profilometer) mounted at the ARAN (Automatic Road Analyzer). At a speed of 40 km/h the roadsurface is being sampled at a frequency of 62,5 kHz. From this measured texture profile a mean texture depth (MTD) and a texturespectrum are being determined.
- Braking deceleration tests with a passenger car. The brake tests are being carried out at a speed of 80 km/h using blocked wheels or an anti blocking system on a wet or dry roadsurface.
- Micro- and macrotexture measurements using the SRT and the Sandpatchmethod.

In the laboratory the following tests can be carried out:
- SRT measurements, most of the time in combination with the PSV-determination of aggregate.
- Measurements with the Wehner-Schulze device, also as a test for the polishability [2].

Research

Investigations

Recently 2 investigations have been carried out on test sections in the east of Holland:
- Investigation of the performance of the friction coefficient $\mu_0$ during the first 3 years of new laid roadsurfaces [3].
- Prediction of the skid resisting potention of a roadsurface to facilitate the deceleration of braking passenger cars [4].

The last mentioned investigation forms the base of this contribution. The aim of this investigation is to develop a methodology for the measurement of skid resistance parameters, with which it is possible to predict the average braking deceleration of passenger cars on a 'standard' wet or dry roadsurface.

Hypothesis

The design of the investigation is based on the hypothesis, that it must be possible with
- the results of a measurement of the friction coefficient with the 86% retarded wheel at a speed of 50 or 70 km/h (depending of the speed of the trafficflow),
- the knowledge of the influence of the speed on these results,
- the results of a simultaneous lasertexture measurement,
- a correction factor, composed by corrections for the percentage of retardation (86% to 100%), the type of rubber, the brake effectivity etc.

to determine the average braking deceleration of an average passenger car on a 'standard' wet or dry roadsurface according to the scheme below.
Testsections

The 8 testsections have surfaces of split mastic asphalt (stone matrix asphalt) of 3 different gradings, dense asphaltic concrete, porous asphalt, a surface dressing and a mini toplayer.

Testprogram

On the 8 testsections the following testprogram was carried out in the spring of 1995:
- measurement of the friction coefficients $f_{50}$ and $f_{70}$. The results are the average values of $f_{50}$ and $f_{70}$ and the trend of $f_{50}$ and $f_{70}$ over the testlength,
- measurement with the ARAN-laser SDP. The results are a mean texture depth (MTD) and the texture profile,
- brake tests with a passenger car at a speed of 80 km/h and blocking wheels on a dry roadsurface. The results are an average braking deceleration and the trend of this deceleration during the braking.
Test results

Examples of the results for split mastic asphalt 0/8 are given in the graphics below.

Fig. 1

Fig. 2

Verification of hypothesis

Through the test results the hypothesis was verified.

Influence of testspeed on friction coefficient

From the MTD and the friction coefficient \( f50 \) or \( f70 \) it appears possible to determine the influence of the test speed on the friction coefficient within the speed range of 30 km/h to 90 km/h [5]. In the graphics below the relations are given. It has to be noticed however that all friction values are in the high region. So there must be an extensive verification in the low region of friction values.

\[
\begin{align*}
\beta_{70} &= 1.37 \times \left( \frac{0.06 \times \ln(MTD)}{(MTD)^{0.7}} \right) \times (-1.48 \times e^{-0.06}) \\
\beta_{70} &= 1.11 \times \left( -0.07 \times \ln(MTD) \right) (MTD)^{0.7} \times (-1.7 \times \sqrt{70} \times \ln(70)) \\
\beta_{70} &= \frac{1}{9.11 \times \left( \frac{0.20 \times \ln(70)}{(70)^{0.7}} \right) \times (37.85 \times (70)^{0.7} \times \ln(70))} \\
\beta_{70} &= -0.26 \times (2.14 \times (70)^{0.7}) \times (-1.02 \times \sqrt{70} \times \ln(70))
\end{align*}
\]
Influence of a wet or dry roadsurface on the braking deceleration

The braking deceleration of an 'average' passenger car using blocked wheels on a dry roadsurface is calculated from the friction coefficient on a wet surface using a correction factor. This speeddependable correction factor is being determined from the comparison of some braking deceleration measurements and the measurement of the friction coefficient in the speedrange of 30 km/h tot 90 km/h. To determine the braking deceleration on a dry surface the influence of the 0.5 mm thick waterfilm was being eliminated by regarding the speed of 30 km/h as so low a speed that the waterfilm would have a neglectable influence on the friction coefficient. These acceptations ask for an extensive verification in the near future. The graphic below shows the braking deceleration on a 'standard' wet and dry surface.

Differentiation of standards

From investigations of causes and circumstances of accidents minimum braking decelerations of passenger cars and trucks should be determined for the various use of different types of road. After that these braking decelerations of passenger cars can be translated into minimum standards for combinations of the MTD and f50 of f70 through the way as drawn out in this contribution. The translation of braking decelerations of trucks can be the subject of a next investigation. However one should always keep in mind that the braking deceleration shows variations due to the type of tyre, type of rubber, brake characteristics, braking behaviour etc.

Recommendation

For a good prediction of braking decelerations on wet and dry road surfaces it is recommendable to carry out a simultaneous measurement of a conditioned friction coefficient and a textureprofile. The advantage of these combined tests is that the results make it possible to make a statement on both the safety aspect of the road and the production of rolling noise.

Literature


2. Wehner-Schulze tests, Ministry of Transport RHED, Delft, Holland, 1995

3. Investigation of skid resistance on 8 testsections, Wegmeetdienst Pavement Consultancy, Apeldoorn, Holland, by order of the Province of Overijssel, 1995
