TEST SECTIONS OF NOISELESS CEMENT CONCRETE PAVEMENTS

CONCLUSIONS
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ir. Chris Caestecker
Flemish Brabant Roads and Traffic Division

From May 1996 till August 1996 six different test sections were cast on the N255 Edingen – Ninove.

4 different upper layers, each 4 cm thick, were cast upon a continuously reinforced cement concrete pavement with a thickness of 18 cm. Each of these 4 test sections has a width of 2 x 3 m:

1. on the first test section, 834 m long, a ZOAB 0/14 (Dutch abbrv. for "very porous asphalt concrete") layer is cast on the continuously reinforced cement concrete pavement with intermediate SAMI (Stress Absorbing Membrane Interlayer);
2. on the second test section, 286 m long, a stone mastic asphalt SMA 0/14 layer is cast on the continuously reinforced cement concrete pavement;
3. on the third test section, 832 m long, an upper layer in fine concrete 0/7 is cast, wet on wet. The surface treatment of the upper layer is carried out according to the "washing-out" method which was improved in Belgium;
4. on the fourth test section, and equally wet on wet, a ZOB 0/17 (Dutch abbrv. for "very porous concrete") is applied. This test section has a length of 537 m.

The four test sections are delimited on both sides by test sections with a bituminous casting, yet with different bituminous upper layers.
On one side, a test section, 269 m long, with an upper layer in non-porous asphalt AB-2 0/10 with chippings 10/14.
On the other side, a test section, 407 m long, with an upper layer in stone mastic asphalt SMA 0/10.

Acoustical measurements 1996 - 1998

On September 16th, 1996, immediately after the casting of the test sections, measurements were cast out according to the trailer method.

The principle of this method consists of 4 different test tyres, on 2 hydraulically adjustable axles, mounted in an acoustically insulated trailer, which passes on each lane at a given constant speed.
Microphones are installed 15 cm above the road surface at 70 cm in front of the axle as well as at 70 cm behind it in order to record the rolling noise continuously.
The test tyres are unequivocally laid down in the German publication GEStrO-92.
The measuring values are the average values taken from 2 rides, recorded by the 2 microphones near the 4 test tyres.
The measurements are carried out at 4 different test speeds: 50, 70, 90 and 120 km/h.
On June 17th, 1998, nearly 2 years after the casting, new measurements have been carried out. The results at the 4 different test speeds are represented in diagrams. Also the differences with the 1996 measurements are indicated.

Texture measurements 1996 - 1999

Following on the acoustical measuring, the texture of the different road pavements was measured with the dynamic laser profilometer of the Belgian Road Research Centre.

The principle of this method consists of an infrared laser distance measuring device, suspended in the bottom of a car which travels at a speed of 36 km/h, scanning the road pavement at 2 mm intervals. The test method is set down in the ISO standard ISO/DIS 13473-1 of 24.04.1996. The results are represented in a diagram.


Skid resistance measurements have been carried out with the Scrim and the odoliograph. The results are represented in diagrams.

Conclusions concerning the acoustical measurements

- As already generally experienced, the rolling noise of SMA pavements hardly changes in time.

- The rolling noise produced on fine concrete pavements remains almost constant. As a result, this kind of pavement continues to score well.

- The rolling noise of the upper layer in non-porous asphalt AB-2 0/10 with chippings 10/14 is reduced by almost 3dB(A). This is due to a reduction of the initial coarseness of the surface resulting from the disappearance of (excess) chippings.

- The porous pavements, both the bituminous pavement ZOAB 0/14 as well as the very porous pavement ZOB 0/7, completely lost their noise reducing characteristics as a result of the clogging of the pores. This isn’t at all astonishing on country side roads where the increased clogging of pores is not neutralised by the cleaning effect of the tyres of fast moving cars.

   The choice of the location of the test sections was influenced by the demand that their construction should cause as little as possible nuisance to the traffic, which is why this could not have been done on a motorway.

Conclusions concerning the texture measurements

Texture measurements were carried out during 3 characteristic periods:
a few days after opening the road strip, from September 13 to 17, 1996
after more or less 3 months of traffic, on December 2, 1996
and after more or less 3 years of traffic, from July 14 to August 4, 1999.

The MPD values (i.e. mean profile depth) after about 3 months of traffic have gone down
for the open pavements which is probably due to the pores getting partially silted up
already, and to a smaller extent for both SMA pavements.

The MPD values remain nearly constant after 3 years of traffic when compared to the
values observed after 3 months of traffic. As a matter of fact, a slight increase is observed
for the AB-2 (type II) pavement where the 10/14 chippings are slightly loosening; this also
goes for the ZOB pavement where a slight loosening of the 4/7 stones is also observed in
a certain zone, rather locally.

Conclusions concerning the skid resistance measurements

For equipment calibration reasons, the skid resistance measurements carried out on
December 3, 1996 by means of the Scrim, are considered to be unreliable.

The results of all test sections amply meet the 0.45 requirement laid down (measured with
the aid of the odoliograph).
The results are as expected:
- the open ZOB and ZOAB pavements have an equal value skid resistance;
- the SMA pavements as well as the AB-2 pavement with 10/14 chippings perform a
  little better in the long run than the fine concrete 0/7 pavement, the skid resistance
  value of which remains around the acceptable value of 0.60.

General conclusions

- Fine concrete pavement offers positive acoustical results not only in relation to
  other pavements but also in relation to bituminous pavements. After 3 years, fine
  concrete pavement still preserves its acoustical characteristics. This durable
  cement concrete pavement can certainly be qualified as noiseless pavement and
  can be compared with noiseless bituminous pavements.

- Fine concrete is also a good solution from a financial point of view.
  A 22 cm thick fictitious continuously reinforced cement concrete pavement is
  regarded as a reference pavement.
The construction cost of a ZOB wearing course with a thickness of 4 cm on a
continuously reinforced concrete pavement with a thickness of 18 cm can be
estimated at 1.4 times the cost of the reference pavement. Adding polymer to the
very porous concrete mixture means a 25% cost increase.
The construction cost of a fine concrete wearing course with a thickness of 4 cm on
a continuously reinforced concrete pavement with a thickness of 18 cm can be
estimated at 1.1 times the cost of the reference pavement.

Consulted literature

1. Weg met geluid
   publicatie 67
2. Betonhardening: 
  verkeersveilig en geluidsarm 
  CUR/C.R.O.W. 
  GoudaEden, oktober 1994

3. The PIARC-workshop 
  "Noise reducing concrete surfaces" 
  Experiments with porous concrete in the Netherlands, 
  H.J.C.M. Onstenk 
  Vienna, 24/25 February 1992

4. State of the art report and recommendations for practice and 
  further developments 
  BRIT/EURAM PROJECT BE 3415 
  Surface properties of concrete roads in accordance with traffic 
  safety and reduction of noise 
  October 1994

5. Geluidsarme wegverhardingen van cementbeton 
  Nieuwe ontwikkelingen - Oostenrijkse ervaringen 
  ir. L. Hendrikx - VCN 
  Bouwkroniek - 24 januari 1992

6. Betonwegen 
  Optimisation des caractéristiques de surface des routes 
  en béton 
  Dr. G. Descornet 
  Beton en geluid 
  Uitgewassen beton en open beton op Nederlandse wijze 
  ing. J.E. Schipper 
  Studiedag 21 maart 1990

7. Test sections of noiseless cement concrete pavements 
  ir. C. Caestecker 
  The Ministry of the Flemish Community 
  Environment and Infrastructure Department 
  Road and Traffic Administration 
  Cement Concrete Pavements Commission 
  April 1997

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Concrete, measurement, noise, texture, skid resistance, test
PROEFVAKKEN VAN GELUIDSARME CEMENTBETONVERHARDINGEN
TEST SECTIONS OF NOISELESS CEMENT CONCRETE PAVEMENTS

Schaal: 1/450000
ROLLING NOISE according to the TRAILER - METHOD 17.6.1998

Test speed 70 km/h

Difference with regard to 16.9.1996

-0.1
-2.2
-2.2
2.3
2.2

94.0
93.8
93.5
93.1
92.5
92.0
91.0
90.0

Stone mastic asphalt 0/10
Stone mastic asphalt 0/14
Very porous concrete asphalt 0/7
Very porous asphalt 0/14
Fine asphalt 0/10
Dense asphalt 0/10 (+10/13 chippings)
ROLLING NOISE according to the TRAILER METHOD 17.6.1998

Test speed 120 km/h

<table>
<thead>
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<th>Material</th>
<th>dB (A)</th>
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<tbody>
<tr>
<td>Dense Asphalt 0/10</td>
<td>-2.9</td>
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<tr>
<td>(+10/14 chippings)</td>
<td></td>
</tr>
<tr>
<td>Fine concrete 0/7</td>
<td>-0.6</td>
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<tr>
<td>Very porous asphalt 0/14</td>
<td>3.0</td>
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<tr>
<td>Very porous concrete 0/7</td>
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<tr>
<td>Stone mastic asphalt 0/10</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Difference with regard to 16.9.1996
TEXTURE MEASUREMENTS with the laser profilometer of the Belgian Road Research Centre

MPD (mm)

- ZOB 0/7
- Fine Concrete 0/7
- ZOAB 0/14
- SMA 0/14
- SMA 0/10
- AB-2

Colors:
- Green: 13-17/09/96
- Red: 2/12/96
- Yellow: 14/07-4/08/99