The Netherlands

3.4 The Netherlands

- Concrete Pavements in the Netherlands

Concrete pavements have been constructed in the Netherlands for many years, mostly in the southern portion of the country due to serious settlements in the northern portion. Concrete pavements have been built on provincial highways, freeways, and airports. Many bike paths were observed to be constructed of concrete. In addition, concrete block pavers have been used extensively in the Netherlands in urban areas.

The Study Tour observed several concrete pavements on both the freeway system and provincial highways located in the southern portions of the country. The oldest pavement observed was constructed in the 1950's. Many of these concrete pavements carry heavy traffic because the Netherlands has some key truck routes that carry cargo to and from the port cities to the rest of Europe.

These pavements are nearly all jointed plain concrete. A few sections of CRCP have been constructed lately on freeways. Many sections of prestressed concrete pavements also exist at Schiphol Airport near Amsterdam.

The major area of current concern with concrete pavements in the Netherlands is tire/pavement noise characteristics. Major laboratory and field studies are underway in the development of low-noise surfaces that also have adequate friction and service life.

The Netherlands utilizes concrete block paving (CBP) extensively. Nearly 20 million square meters (23.9 million square yards) of CBP are placed each year. CBP blocks were introduced in the early 1950's and are now used for a wide range of applications from domestic pavements to complicated industrial pavements. (4)

- Designs

Freeways and Highways. Some older JPCP have been constructed in the Netherlands. The Study Tour travelled over a section of badly faulted undowelled JPCP on a sand base (N270) that was constructed in the 1950's and loaded with heavy truck traffic. Dowels are required for transverse joints of JPCP in the Netherlands.

One district in the southern part of the Netherlands prefers concrete pavements, due to their low maintenance and long life, and has constructed many sections. The costs of concrete and asphalt pavements are about the same in this area. The two-lane, two-way provincial highways typically consist of a 21-cm (8.3-in) JPCP slab with dowels and lane widening on each edge (the paint strip is painted 20 cm (7.9 in) from each slab edge).

The Netherlands adopted the German JPCP design during the early 1980's. This design included slabs 20 to 22 cm (7.9 to 8.7 in) thick, variably spaced dowels in joints, 5-m (16.4 ft) joint spacing, 11 m (36.1 ft) total full pavement width (two lanes 3.5 m

(11.5 ft) wide, a 1 m (3.3 ft) inner shoulder and a 3 m (9.8 ft) outer shoulder. Currently, the slab thickness is 26 to 28 cm (10.3 to 11.0 in) and dowels closely spaced (25 cm (9.8 in)) in the wheelpaths.

Some CRCP on freeways was also constructed in 1990 with a porous AC surface for low noise and good friction. The CRCP is advantageous because there is no reflection cracking from transverse joints through the porous AC surface. Another CRCP is currently under construction at this time with both a porous AC surface and a porous concrete surface being placed.

The base for the freeway pavements is lean concrete over a sand subbase. The lean concrete contains recycled rubble from old concrete. Differing from the German design, the Netherlands does not make attempts to bond the slab to the lean concrete base and does not notch the base. However, it was stated that the slab bonds to the base anyway for 10 years or more. Some problems with reflection cracking were reported. The depth of the side ditches are about 1 m (3.3 ft) below the base. Joints are sealed to keep out incompressibles.

Concrete Bicycle Paths. The Study Tour also observed many concrete bike paths (JPCP with short joint spacing and no dowels). Bicycles are a major form of transportation in the Netherlands. The paths were used jointly by bikes and local farm equipment.

Airport Prestressed Concrete Pavements. The Schiphol Airport in Amsterdam, which opened in 1967, is one of the largest in the world and carries a large amount of heavy aircraft traffic. After a comprehensive study, the airport chose to build prestressed concrete pavements on runway ends, all aprons and hanger floors. Since the original construction, many additional prestressed concrete pavements have been built due to airport expansion, so that now some 700,000 square meters (837,000 square yards) of prestressed pavement exists at the airport. Many of these pavements are now 25 years old and have shown excellent performance with very low maintenance. (1)

The pavement design is 18 cm (7.1 in) of prestressed concrete pavement, 2 mm (0.08 in) asphalt sand, 60 cm (23.6 in) of soil cement, and 20 cm (7.9 in) of sand over a clay subgrade that is 4 m (13.1 ft) below sea level. Slabs are 7.5 m (24.6 ft) wide by 30 to 120 m (98 to 394 ft) long. The original prestressing consisted of high-strength steel bars placed in tubes and then grouted, laid in the longitudinal and transverse directions to form a grid. Improved methods have been used in later years. (1)

• Noise Pollution

The Netherlands has adopted legislation to decrease noise pollution. The law requires that a theoretical calculation be made of the noise level of a newly constructed highway before the road is opened to traffic.

Complaints have been received from residents in this densely populated country about the noise levels of conventional asphalt and concrete highway surfaces. Thus, extensive research efforts have been devoted to develop surfaces to reduce the noise level.

Noise is generated by the engines of vehicles and by the contact between the tire and pavement surface. Policy is directed to limiting the noise emission at these sources and to reducing the noise level by means of measures like barriers or embankments. Texture is the major factor of concern in controlling tire/pavement noise emission. (2) The following treatments are under evaluation.

Surface Layer of Porous Asphalt/Aggregate Mixture. A thin layer (4 cm (1.6 in)) of porous asphalt has been determined to reduce the noise level by over 3 dB(A) relative to dense AC on the A2 freeway at Weert (see details below). There is concern about the durability of a porous AC layer on a concrete pavement, especially with regard to deterioration from reflection cracking. Some sections have been sawed and sealed with reportedly good results. The mild winters in the Netherlands prevent problems with icing of the permeable layer.

Surface Layer of Porous Concrete. At least three field sites have been constructed with a porous concrete layer of 3 to 10 cm (1.2 to 3.9 in) thickness. A polymer additive (more than 10 percent by weight of cement) is needed to obtain frost and salt resistance and a sufficiently high flexural strength. Durability depends on the polymer content. The porous surface allows some of the air compressed under the tire to escape through the voids in the road surface, reducing the roadside noise. A 4 cm (1.6 in) layer having gap-graded aggregate with 25 percent voids produce the most noise reduction (see details below for A2 Weert site). For new construction, the porous concrete surface is placed two to three hours after the slab is placed. It is cured by covering it with plastic sheeting.

Surface Layer of Exposed Dense Concrete. The surface is exposed during construction using the same technique as in Belgium. Different aggregate gradations were tested with similar noise reductions. (2) The washed concrete noise level was comparable to dense AC and less than the conventional transverse brushed concrete surface.

Surface Layer of Epoxy/Fine Grained Aggregate. An epoxy resin binder was applied to a hardened concrete surface followed by a layer of crushed 3- to 4-mm (1.2 to 1.6-in) chromium ore slag (brand name Durop) and the surface was then rolled to produce a mosaic-like structure. The Durop surface treatment gave a noise reduction of 6 to 7 dB(A) relative to the original brushed concrete surface. This treatment is comparable to porous asphalt. (2)

Surface Texture By Diamond Grinding. This was performed on the A28 freeway and showed a reduction of over 3 dB(A) compared to the original transverse brushed concrete finish. However, this did not quite meet the requirements by 1 dB(A). (5)

- Project Sites Observed (All located near Eindhoven)

A2 Freeway,.Weert. This site consists of an original JPCP resurfaced with a 4-cm (1.6-in) porous asphalt and 3 cm (U-in) porous concrete to reduce noise levels. The Study Tour visit occurred during a rainstorm and a major difference in splash between a nearby dense AC overlay and the porous asphalt or porous concrete was significant. Both the porous asphalt and the porous concrete gave a very smooth and quiet ride. Figure 2.14 shows the surface of the porous concrete. Standing on the roadside of the porous concrete or asphalt surface shows that noise created from the passing heavy traffic is definitely less than the noise level near the dense AC surface.

Reflection cracks from the longitudinal and transverse joints in the JPCP were coming through the porous asphalt surface and starting to spall. The porous concrete was sawed directly over the joints in the JPCP and were not spalling.

Compared to the dense AC surface, the porous asphalt surface gave a reduction in the noise emission level of 3.1 dB(A). The porous concrete gave a noise reduction of 2.0 dB(A). It was stated that the porous concrete would have given a greater noise reduction if its thickness was 4 cm (1.6 in) instead of 3 cm (1.2 in) and various construction problems (low workability) could be avoided. (2) A major problem with the porous asphalt or concrete surfaces is that they fill up with loose material and thus their sound-absorbing characteristics decrease within a few years.

N266 Highway, Uden and N279 Highway By-Pass Helmond. Several test sections were observed having exposed aggregate surfaces. The surface of one exposed aggregate surface is shown in Figure 3.13. Noise measurements show that the exposed aggregate surfaces produce a noise level comparable to a dense AC surface for passenger cars only. For traffic with 20 percent trucks, exposed concrete surfaces gave a noise emission level of 2.5 dB(A) greater than dense AC.

- Traffic Loadings

The legal single-axle load in the Netherlands is 10 t (22,000 pounds) which is expected to increase to 11.5 t (25,300 pounds) or greater in 1993 with the rest of the European Community. A considerable number of overloads occur on the highway system.

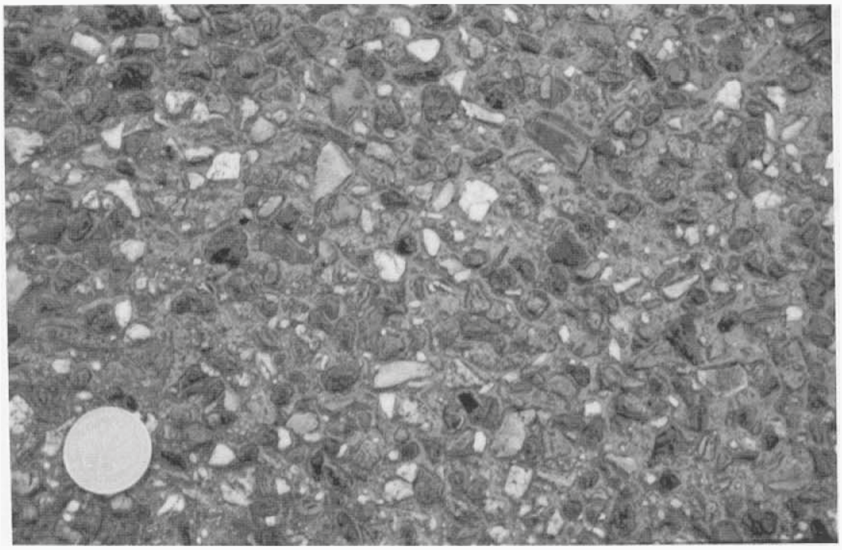

Figure 3.13 Exposed aggregate surface in the Netherlands.

- Summary for the Netherlands

Concrete pavements in the Netherlands are currently being constructed in greater quantities than before. The main problem that developed in the 1950's was joint faulting as a result of **not** using dowels. The adoption of the German dowelled JPCP design eliminated this problem and has produced low-maintenance long-term performance. There is a strong willingness to try new ideas in the Netherlands.

The main concrete pavement concern now is reducing tire/pavement noise. Considerable research is underway and several techniques are under evaluation. It was stated that either the porous (polymer) concrete surface or the epoxy/aggregate surface treatment could produce noise levels comparable to that achieved by porous asphalt. (2) Experiments **have shown** that it is possible to obtain a surface layer of porous **concrete** which meets the requirements of noise absorption, durability and strength, but further research is needed. (2)

- Netherlands References

1. van Noortwijk, H. and A. V. D.Meent, "The Application of Prestressed Concrete to the Construction of Airfield **Pavement,"** Proceedings of Second International Conference on Design of Concrete Pavements, Purdue University, 1981.

2. Eerland, D. W., Th. S. Grob and H. J. C. M. Onstenk, "Developments in Noise Reduction of Concrete Roads in the Netherlands," provided to the US TECH Study Tour, 1992.

3. Onstenk, E., "Measurements of Noise, Texture and Skid Resistance," Interim Report Subtask 1.2, Institute For Materials and Environmental Research B. V., the Netherlands, March 1992.

4: van der Vlist, A. A., "Urban Concrete Block Paving in the Netherlands," Association of the Netherlands Cement Industry (VNC), the Netherlands, February 1992.

5. Veer, G. and C. L. Dolle, "Low-Noise Surfacing on Concrete Roads," paper provided the US TECH Study Tour, 1992.