

REVIEW OF THE ROSAVTODOR RESPONSE DATED FEBRUARY 11, 2011

**By: Shiraz Tayabji, Reporter
Precast Concrete Pavement Technology Scan
February 19, 2011**

General

As presented in the Precast Concrete Pavement Desk Scan report (dated November 2010), the precast concrete pavement (PCP) technology was developed in Russia in the 1960's during the Soviet Union era. This technology, although simple in concept, incorporates several unique features, such as, electro-thermic prestressing, use of thinner panels, and a unique method for tying panels together. The technology has been standardized at the national level in Russia and is available for use at no cost. This technology, with some refinements for application in the US, has the potential to provide a cost-competitive alternative to current US developed PCPS.

At the time of the completion of the Desk Scan, information was primarily obtained from Russian (Soviet-era) literature and from a Russian airfield engineering consultant. A request for information on the highway use of PCP was requested formally by FHWA's Office of International Programs during November 2010. The request was made to ROSAVTODOR, the Ministry of Transport of the Russian Federation's Federal Highway Department. A formal response, dated February 11, 2011, from ROSAVTODOR has now been received. This response is summarized below, followed by the Reporter's assessment regarding the overall usefulness of a site visit to Russia to study the Russian PCP technology.

ROSAVTODOR Response Summary

Precast concrete pavements are used for roads in the northern and hard-to-reach areas of Russia, including oil and gas fields' access roads and access roads to industrial and agricultural facilities, located predominantly in the I-II traffic climatic zones. The road construction using PCP has a rather long background, nearly 60 years, immediately after WWII. The road construction using PCP began to expand intensively since the 1970s, reached its peak in the 1980-1990s, and continues until present due to the development of access roads to the Western Siberia oil and gas fields (predominantly in the Khanty-Mansi Autonomous Area and Yamal-Nenets Autonomous Area).

1. Over six thousand kilometers of roads were paved with PCP in Western Siberia between 1960 to 1980s. The average service life of the PCPs is 10-40 years.
2. The precast slabs in urban conditions are used in exceptional cases, along small stretches of secondary streets and passages and primarily in smaller cities that have facilities to produce the precast concrete panels.
3. The PCPs are typically overlaid with AC or machine "milled" to correct the profile. The overlaid PCPs are considered to perform as AC pavements.
4. The PCP surfaces have defects and fractures that are unlike those in common cast concrete surfaces:

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- a. Surface scaling - Given the features of fabrication (poor freeze resistance of steam-cured slabs in hydrochloric solutions, production process features), the precast panels scale (peel) more often than other cast concrete surfaces exposing the reinforcement and endangering traffic.
- b. Smoothness - The smoothness (flatness) is more frequently upset due to the uneven placement (skewness) of the slabs.
- c. Load transfer at joints - The structural features of the slabs reduce load transfer (from slab joints to the beds). The "thin" precast slabs are more vulnerable to the roadbed deformation. The design of joints may be positive when the slabs are coated with asphalt concrete.
- d. Panel cracking - The cracking in panels impair dramatically their load carrying capacity.

The Russian Research Highway Institute (ROSDORNII) is experienced in research in the area of design, construction and diagnostics of PCP, including the following:

1. Identification of criteria for decision making in respect to the suitability of precast reinforced slabs for a specific project.
2. Methods of design and construction.
3. Data for design and long-term structural characteristics of PCPs.
4. Short-term and long-term functional (consumer) characteristics of PCP projects.
5. Types of reinforced precast concrete panels, including how they are designed, fabricated, steam-cured, transported and installed; and advantages of each type.
 - a. The concrete mixture compositions and quality.
 - b. Mechanisms of load transfer.
 - c. Requirements for steel reinforcement.
 - d. Transportation of slabs and materials.
 - e. Lifting devices.

The ROSDORNII staff is available, when necessary, to provide advice to the US Scan Team and help collect information about the above-listed subjects related to the Russian use of PCP technology.

The Russian PCP Practices

This information was compiled during February 2011 by:
Professor A.V. Smirnov, Doctor of Engineering Science, Siberian State Automobile Traffic Academy SibADI, Omsk, Russia (Phone: 8(3812) 651563)

Usage (Construction objects):

1. Industrial roads of the 3rd and 4th categories with the driveway 8 and 10 meters (26 to 32.8 feet) wide
2. Trunk roads of the 2nd category with the driveway 8, 10 and 12 meters (26, 32.8, and 39.3 feet) wide
3. Access roads to well clusters, oil and gas facilities
4. Aprons, airport facilities, heliports.

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Design and construction conditions

1. Broad incidence of roadbeds on the loose swampy soil (peat, slime) and on watered ground causing continued consolidation and settlement of wall banks.
2. Widely spread over ever-frozen clay soil (under the banks) thawing during the short summer period causing settlement.
3. Lack of industrial facilities to fabricate precast surfaces (PCCS), the need to fabricate them in large Siberian and Ural cities; hence, the unavoidable thousand-kilometer remote delivery by water or rail to the construction sites, burdened by multiple handling.
4. The speed of constructing roads leading to oil and gas fields - long hard winters and short summers necessitates a PCCS road construction at freezing temperatures.

PCCS Standard Designs

Standard dimensions of PCCS are 2x6 and 2x4 meters (6.5 x 13.12 and 6.5 x 19.6 feet). The road slabs are 16, 18, 20, 22 centimeters (6.3, 7, 7.8 and 8.6 inches) thick; the brands are PDN-16, PDN-18, PDN-20, PDN-22, and PAG 14, PAG 16. The slab concrete is prestressed by stretching longitudinal steel rods [10-42 centimeters (3.9 to 16.5 inches) in diameter] [OFF BY A DECIMAL POINT], followed by the force transfer to the solidifying concrete.

The upper and lower slab planes are fitted with steel fabric having the mesh 20-25 centimeters (7.8 to 9.8 inches) and rod diameter [6-8 centimeters (2.3 to 3.1 inches)] [OFF BY A DECIMAL POINT].

Panel Installation:

The slabs are erected with a lifting crane handling them through 4 prefabricated mounting eyes. Slabs are joined by electric welding through mounting eyes to the adjacent two slabs (after all the settlement ends). The slabs are placed on 3-5 centimeters (1.1 to 1.9 inches) thick sand bed; they are consolidated by the crane weight or vibration. The bed underneath the PCP is sand. To withstand heavy truck (cargo) traffic, the bed is cast from cement and soil 15-25 centimeters (5.9 to 9.8 inches) thick having compressive strength of at least 4-6 MPa.

Construction Process

The construction on weak soil is split into two stages. The slabs are just erected and left un-joined during the first stage. After the weak soil under the banks is compacted (after 4-12 months), the second stage starts: The slabs are lifted, the bed layer is added, the destroyed slabs (5-9 %) are replaced, the slabs are welded, and the joints (seams) are partially filled up with the cement and sand solution (mixture) and potted with the waterproofing paste. The slabs are left unwelded after every 20-25 meters (65.6 x 82 feet) leaving these joints to accommodate the summertime expansion.

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Panel Fabrication (Production)

The PAG slabs are produced in Perm', Kolchedanovo, Yalutorovsk (the Tyumen region), Biysk (in the Altai). The PDN slabs are produced in Omsk and Novosibirsk.

PCP Site Visits

According to Professor A.V. Smirnov, to inspect the roads using the PCP technology, it is advisable to visit the following:

1. Khanty-Mansiysk (the Khanty-Mansiysk Housing Construction Works).
2. Omsk to compare with the solid concrete slabs (the Ministry for Construction and Communal Facilities (the state enterprise Omskavtodor) where the road Omsk-Novosibirsk has been in operation for 30 years
3. The new Northern Byway in Novosibirsk constructed by the Road Building Enterprise Sibir.

Reporter's Assessment

Russia has the most extensive usage of PCPs in the world. There is over 50 years of experience of using the PCP technology in very adverse conditions (Siberian extreme weather conditions, poor soils and very heavy truck loadings). The PCP technology has been standardized and there have not been much innovative developments related to the Russian technology since the early innovation during the 1960's and 1970's. As state in the Desk Scan report, the Russian technology, although simple in concept, incorporates several unique features, such as, electro-thermic prestressing, use of thinner panels, and a unique method for tying panels together. This technology, with some refinements for application in the US, has the potential to provide a low cost alternative to current US developed PCP systems for specific applications.

Based on the new information available, the Reporter's assessment is as follows:

- Do not visit Russia because of time limitations. Visits to the PCP projects in the "remote" areas will require many days and may not be productive time-wise. In this case, the Reporter will continue to seek additional information from the designated Russian experts and incorporated the information developed in the final scan report.

END OF REPORT