Taj Mahal of paving
India builds highway to accommodate tourist attraction

A major new toll highway in India opened late last year and utilized Portland cement concrete (PCC) throughout, a rarity in India.

In India, typically major highways are constructed of bituminous concrete, but the 102-mile-long Yamuna Expressway—India’s longest—is constructed of rigid PCC, one of only two in the nation.

The Yamuna Expressway—built from 2008 to 2012—runs from Agra (home of the famed Taj Mahal) in the south to Noida in the north. Noida is located just southeast of New Delhi, in the north-central state of Uttar Pradesh at the foot of the Himalayas.

Because the Yamuna Expressway serves the popular Taj Mahal site—which is India’s most important tourist destination—it is meant to facilitate tourism as well as economic development. For that purpose virtually the entire route has been carved into planned urban/industrial development zones. It also permits easier distribution of agricultural goods to major urban centers.

Cost for the two-year Yamuna Expressway was in the neighborhood of $2 billion (US), including the cost of interchanges, utility services, environmental-mitigation measures and land resettlement and rehabilitation.

As is seen today throughout the world, the Yamuna Expressway was constructed on a familiar public-private partnership model. Like similar projects in India, Yamuna was constructed in a design, finance, build, operate and transfer scheme, administered by a state structure, the Yamuna Expressway Industrial Development Authority (YEIDA).

A concession to build and operate Yamuna Expressway was agreed upon between Jaypee Infratech and YEIDA, with a 35-year concession in which to collect tolls, and the rights to
develop surrounding parcels for residential, commercial and industrial uses.

Building Yamuna Expressway

For the most part, the expressway follows the valley of the Yamuna River, and these portions are built on a raised embankment above the floodplain. As such the initial contracts of the project encompassed construction of embankments that will resist subsidence, plus culverts and cart underpasses. The next package was for interchanges, bridges and vehicular underpasses, and the final was for the construction of granular layers and rigid pavements.

Some 50.2 million cu yd of earth was moved for the Yamuna Expressway, requiring the use of more than 115 excavators and 75 graders, as well as 110 compactors and 725 tipper trucks. To produce the 14.3 million tons of aggregate used in the expressway, four large jaw crushers, six large cone crushers and six crushing and screening plants were utilized.

For most of its length the expressway features a 13-in. concrete section, placed 52.5 ft wide by four Wirtgen SP 1600 pavers, the predecessor to the SP 80i series of concrete slipform pavers introduced at World of Concrete and Bauma 2013. Also, four TCM 1800 texture cure machines from Wirtgen were employed.

“Wirtgen was the first choice for Jaypee when they decided to build the landmark Yamuna Expressway,” said Ramesh Palagiri, managing director and CEO, Wirtgen India, as reported by Sumedha Mahorey in Efficient Infrastructure Magazine, Feb.-March 2013 issue. “Jaypee decided to go ahead with us as we offer the application expertise, which is very important in ensuring the right quality of a concrete road.

“For the Yamuna Expressway, many parameters had to fall in place to ensure that a world-class road was built,” Palagiri said, “starting with the production of concrete.

Yamuna Expressway in Numbers

Length: 102 miles
Number of Lanes: 6 (expandable to 8)
Type of Pavement: Portland cement concrete
Interchanges: 7
Main Toll Plazas: 5
Toll Plazas on Interchange Loop: 7
Underpasses: 35
Rail-over Bridge: 1
Major Bridge: 1
Minor Bridges: 42
Cart Track Crossing: 68
Vehicular Underpasses: 70
transportation of concrete, right concrete consistency and ensuring a continuous supply of concrete so that once the paver starts working there is no stoppage. For getting good levels we had to ensure that logistics was right for a continuous supply of concrete.”

Because much work took place in the hot Indian summer, to avoid excessive heat of hydration three chilling plants per paver had the capacity to chill 23,775 gal of mix water per hour to 43°F to produce concrete with a temperature of 68°F.

“We also had to take care of the temperature at which the concrete is placed and compacted to ensure the right parameters were maintained,” Palagiri said. “Wirtgen India, with its long experience in concrete-paving projects, was able to offer this application expertise to the customer.”

Some 3.66 million cu yd of concrete pavement were placed, incorporating 1.3 million tons of cement and 3.5 million cu yd of fly ash. In some sections superplasticizers were used. Structures incorporated 1.17 million cu yd of concrete and 143,000 tons of structural steel in structures. Concrete was produced by 12 314-cu-yd-per-hour batch plants utilizing a total of 24 cement storage silos.

As a result of its experience with this project, Indian specifications for cement/fly ash blends were updated to recommend a use of up to 20% fly ash by weight of cementitious material. R&B

Information for this article contributed by Wirtgen America Inc.

For more information about this topic, check out the Concrete Channel at www.roadsbridges.com.

Left: Because much work took place in the hot Indian summer, to avoid excessive heat of hydration three chilling plants per paver had the capacity to chill 23,775 gal of mix water per hour to 43°F to produce concrete with a temperature of 68°F.

Below: Some 50.2 million cu yd of earth was moved for the Yamuna Expressway. To produce the 14.3 million tons of aggregate used in the expressway, four large jaw crushers, six large cone crushers and six crushing and screening plants were utilized.