Rehab of one of Southern Africa's heaviest **loaded pavements nears completion**

SSI ENGINEERS AND ENVIRONMENTAL Consultants is providing design and construction supervision of the rehabilitation of one of the heaviest loaded pavements in Southern Africa. This comprises Sections 1 and 2 of National Route 3 – an 11 km section of the dual carriageway N3 freeway between the Mariannhill Toll Plaza and Key Ridge in KwaZulu-Natal.

This route serves as a major link between Durban and Gauteng and carries significant freight traffic between Gauteng and Durban Harbour. It was constructed in the mid-1980s to bypass the then N3 through Kloof and, apart from some minor repair and maintenance actions, no major work has been undertaken on this road since it was first opened to traffic.

SSI's Jaco Liebenberg says that as a result, the condition of the road has steadily deteriorated over the past few years. Continuous high volumes of heavy, slow-moving traffic streaming in both directions through this section of the N3 have created rutting and deterioration of the road surface. The South African National Roads Agency Limited (SANRAL) initiated the rehabilitation project in 2006 and the project is scheduled for completion by September this year.

Awarded the design and construction supervision contract in April 2006, SSI considered a variety of approaches to the rehabilitation, including concrete pavement, innovative new high modulus asphalt technology from France, and conventional asphalt.

'We soon ruled out the concrete pavement option because of the cost factor,' says Liebenberg. 'This would have worked out around two and half times more expensive than asphalt. We also had to rule out the high modulus asphalt because there would have been difficulties associated with procuring the low penetration bitumen needed for this option, as well as the risk of its performance under South African conditions.

'We finally settled on a conventional asphalt base that is very rut resistant and has been designed to withstand high traffic loading.'

Specialist asphalt contractor Roadmac Surfaces was awarded a R95-million contract in June 2007 to mill off the deteriorated asphalt, and manufacture and lay the asphalt on the 11 km section of road.

ASPHALT MIX

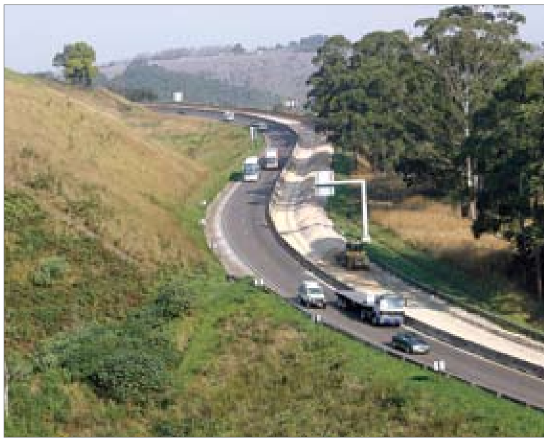
The asphalt mix has been designed with rut resistance as its main objective to address the heavy loading anticipated on the pavement over its design life of 10 to 15 years. The contractor has introduced a number of non-standard mix design processes to achieve the most suitable mix design. These include the Bailey method to obtain optimum aggregate packing in the mix, Model Mobile Load Simulator (MMLS) and Hamburg wheel tracking tests to evaluate the rut resistance of the mix, and Superpave tests on the binder to compare the binder selection with the American Superpave process.

Two different modifiers, SBS (styrene-butadiene-styrene) and EVA (vinyl-acetate ethylene copolymer), were evaluated in parallel and a mix design based on the best performing mix was selected. The mix design took almost two months to complete and consists of no less than six trial sections. A large number of cores were extracted from the trial sections and subjected to various tests to evaluate the rut and fatigue resistance of the mix.

Finally, a continuously graded asphalt mix, slightly courser than the standard COLTO mix, with 4,3 bitumen modified with 4 % EVA and a target void content of 4,8 % was accepted.

REHABILITATION OF EXISTING ASPHALT PAVEMENT

The existing pavement comprises a bitumen treated base (BTB) of about 160 mm on 300 mm stabilised layers, on selected natural gravel. The design traffic loading over 15 years is expected to be between 50 and 60 million E80s. For this extremely high traffic loading, the sub-base layer of



300 mm is actually too thin – a thicker layer of around 450 mm would be more appropriate.

However, practical considerations do not allow for the thickness of the sub-base layer to be increased and the design calls for a stiff and thick asphalt base layer. Therefore SSI's approach to rehabilitating the slow lane involves removing the existing asphalt base in its entirely and replacing it with a new 160 mm asphalt base. Selected sections of the sub-base will be stabilised in situ to reinstate its integrity where known problems have been identified.

The road was surveyed by the Lacroix Deflectograph to determine substandard sections on the sub-base with reasonable accuracy. This is a device that carries out continuous automatic measuring of the elastic deflection of the road pavement under a specific axle load. The resulting data can be used to analyse and assess the load-baring capacity of the road pavement and to refine the thickness of the strengthening pavement layers required for road repairs.

Based on these findings, a section of approximately 2 km of the northbound slow lane will be reconstructed with a 450 mm sub-base layer to address the existing poor sub-grade conditions. In the middle lane, which also carries considerable traffic loading, but is in a better condition than the slow lane, 80 mm will be milled out and replaced with a new asphalt base. Only isolated repairs are required in the fast lane and shoulders, after which the complete width will be surfaced with an ultra thin friction course (UTFC) using a proprietary surfacing product from France called ULM.

CONCRETE INLAY

At the Key Ridge limit of the project there is a compulsory truck stop on the northbound carriageway where heavy vehicles are obliged to come to a complete standstill before commencing their downhill descent to the Sterkspruit River. Trucks are channelled into a dedicated truck lane in the approach to the truck stop and the relatively slow speed of the trucks, their channeled movement and the highly repetitive loading has required a concrete inlay over this section, which also coincides with the segment of road that needs a complete reconstruction. A 200 mm continuously reinforced concrete pavement will be provided here.

CONSTRUCTION

Construction work of the slow lanes began in September 2007 after the completion of the mix design process, with rehabilitation work being carried out during day time and one lane being closed to traffic on a permanent basis. The project specification stipulates that rehabilitation of the middle lanes can only be carried out at night between April 2008 and August 2008 to accommodate the high traffic volumes in the day. At night traffic is reduced to one lane and by 05h00 in the morning, two lanes are again opened to traffic.

The 2 km reconstruction section on the northbound carriageway is being carried out under permanent closure during day time, where traffic is accommodated in two lanes with reduced widths. Construction of the surfacing layer is scheduled for June 2008, with the middle and fast lanes being worked on at night and the slow lane and shoulder during day time.

OTHER WORK

Other project work includes the repair of considerable erosion at the outlet of a culvert at one of the fills which, if not repaired, could result in failure of the fill embankment. Repair to failure of a nearby cut slope and significant concrete repairs to the apron of the Mariannhill Toll Plaza are also part of the contract, as well as joint replacement and erosion repairs at the abutment of the Shongweni Interchange bridge.

TRAFFIC ACCOMMODATION

Liebenberg says the most challenging aspect of the project is the safe accommodation of traffic around the construction works. Traffic volumes peak at more than 4 700 vehicles per hour, including a significant percentage of heavy vehicles.

'The major frustration facing construction personnel is the public's general disregard of construction signs and speed limits in our construction zones,' he says. 'We have actually recorded speeds of up to 162 km/h through the construction zones, while some trucks speed through the construction zone at 128 km/h.

'To address this, the project team, in liaison with SANRAL, have introduced a speed measuring and display device that indicates the speed of a vehicle to the driver. Preliminary findings indicate this is indeed having an effect on the behaviour of the public and has succeeded in reducing traffic speed to some extent.' □