King Shaka International Airport
N2 Interchange

KING SHAKA INTERNATIONAL AIRPORT N2 INTERCHANGE

Technical Excellence category
Submitted by the SAICE Durban Branch

KEY PLAYERS

Client South African National Roads Agency Limited (SANRAL)
Professional Team Ilembe Engineering Joint Venture (PDNA, Goba, BKS,Y&S)
Main Contractors Ilembe Civil Construction Joint Venture (ICCJV)
(Lead contractors Group 5 and WBHO)
Major Subcontractors and Suppliers Stefanutti Stocks Civils KZN, Ilembe Building JV, NPC

OVERVIEW

The King Shaka International Airport (KSIA) N2 Interchange was required to provide unconstrained, free-flow access to and from Durban's new international airport. The advent of the 2010 FIFA World Cup and its rapidly approaching opening ceremony, coupled with a late start to the project, resulted in the monumental task of delivering a fully operational interchange in advance of the airport's immovable commissioning date.

The Ilembe Engineering Joint Venture (IEJV) that comprised PDNA, Goba, BKS and Y&S was employed by SANRAL to meet this challenge. Goba took responsibility for the design and project management of the interchange.

Rapid construction without compromising the quality of the end product, and with minimum disruption to traffic along the busy N2, was the main object of the implementation of the design. The design also allows for future upgrades of the interchange and the N2 freeway. The final design was a three-level interchange which includes the four ramps with a length of approximately 6,5 km, a 222,5 m incrementally

launched bridge deck, an 80 m conventionally reinforced bridge, a 40 m box culvert, as well as a nine-lane toll plaza and its administration building.

The construction contract was negotiated with the Ilembe Civil Construction Joint Venture (ICCJV), with WBHO and Group 5 being the lead contractors in the JV. Stefanutti Stocks Civils KZN and the Ilembe Building JV were employed as the major subcontractors.

High-speed construction without disruption to traffic on the N2 freeway was accomplished by the use of innovative, technically challenging construction techniques, such as incremental launching. The design and construction of the incremental launch bridge required meticulous attention to detail. The team of designers and contractors worked tirelessly, and continuously investigated options to speed up the construction and overcome any problems encountered to ensure the timeous completion of the interchange.

Additional to the main features of the interchange, the provision of water, sewer and stormwater reticulation, electrical and communication services, demolition of an existing bridge, signage in the greater Durban area, concrete and asphalt pavements, traffic studies, and environmental conservation plans made this one of the few projects which encompassed so many elements of civil engineering.

Despite the demands resulting from the immovable deadline, the project was completed within budget and with no major environmental or health and safety issues. Safety was a priority on this site, especially with the high-speed traffic on the N2 freeway.

DESCRIPTION OF THE PROJECT

Road works

The original brief called for a diamond-type interchange. This design, however, would severely restrict future expansion to cope with the expected increase in traffic.

1. The completed King Shaka International Airport N2 Interchange
2. Interchange construction site

A number of options for the layout of the interchange were investigated and it was decided that free flow from the airport to Durban could be achieved by way of a three-level directional three-leg interchange to cater for the expected traffic flow towards Durban. This interchange layout was found to be the most cost effective in terms of current cost through to future upgrade requirements.

In order to speed up the construction of the pavement layers, the contractor elected to use a Wirtgen to place the selected layers and to mix and place the stabilised sub-base layers. This machine was capable of placing 300 mm thick pavement layers in one operation. The pavement layer design was changed to make the two 150 mm layers of the same material to facilitate this proposal. An Ultra-Thin Friction Course (UTFC)

surfacing was paved over the asphalt base to considerably improve the riding quality and drainage of the pavement.

Bridges

The Ramp E Bridge was designed to be constructed using the incremental launching technique. Apart from facilitating rapid construction, this method minimised disruption of traffic on the N2 freeway. Incremental launching would also confine most of the bridge works to a single work area – the fixing of reinforcement, casting of the deck, pre-stressing and launching were all carried out in one designated area. This allowed for road works and the construction of the second bridge to continue unhindered and be completed on time.

Due to the restricted area of the median and the box culvert that crosses the N2 the two bridges share a pile cap which was specially designed to take the axial forces and bending moments from both bridges.

3 Incrementally launched bridge deck
4 The nine-lane toll plaza that was completed in record time

Another challenge was the construction of the piers, which have the shape of the stem of a champagne glass with flutes on the faces. A custom design was carried out and the formwork was manufactured off-site to achieve the quality required to accommodate the complex design.

High early-strength concrete was designed to achieve concrete cube strengths of 35 MPa in 60 hours to facilitate high-speed construction of the bridge deck while still being economical. Concrete was chosen as the main construction material for the bridges as it provides versatility, durability, a high quality finish, aesthetically pleasing shapes, resistance to the severe coastal environment and requires little maintenance.

The incremental launch was completed ahead of programme and helped ensure the successful opening of the interchange.

Toll plaza

Another dimension to the project was that SANRAL required a toll plaza to be constructed on the ramp taking traffic from the airport towards Durban. This proved to be a major challenge, as the final decision to proceed with the design and construction of the toll plaza was made well into the project construction period.

The construction of the toll plaza entailed excavating an area the size of a football field to a depth of approximately 15 m. The toll plaza apron area is 20 000 m^2 to accommodate the nine toll booths. A tunnel runs underneath the toll booths for safety and security when transporting cash to the building. Water, sewer reticulation, electrical and communication services also had to be provided to the toll plaza.

CONCLUSION

The interchange and the toll plaza were fully operational before the opening of the King Shaka International Airport (the contract period was from 23 May 2008 to 30 April 2010). This achievement is testimony to the expertise and dedication of the design and construction teams involved in this technically challenging project. ◻

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Source:
http://www.saice.org.za/downloads/monthly_publications/2011/2011-Civil-Engineering-december/#/0