Warwick Triangle Viaduct: **Inbound**

PROJECT OVERVIEW

The location of the Warwick Triangle in Durban, with its historic market for the informal economy, caused tremendous conflict between pedestrians and vehicles. It is a transportation hub and a major gateway to the Durban central area. Every day hundreds of thousands of pedestrians and traders, and more than a 100 000 vehicles entered and left the Warwick area, resulting in serious congestion and an alarming accident rate (of which more than 70% were pedestrian related). The 2010 FIFA World Cup provided an opportunity for the city to transform the Warwick Junction into a world-class transfer facility.

The solution was to separate commuter traffic from the Warwick Triangle through the construction of an inbound and outbound viaduct (see article on page 17 on the outbound viaduct). The main element of this project was the construction of a 1 000 m long inbound viaduct (which would serve as an extension of the Western Freeway on the inbound carriageway into the Durban CBD). This would remove the through traffic and create space where people could engage in economic activities and access public transport in safety.

1 Completed inbound Warwick Triangle Viaduct

WARWICK TRIANGLE VIADUCT: INBOUND

Technical Excellence category
Submitted by the SAICE Durban Branch

KEY PLAYERS

Client eThekwini Municipality Roads Provision Department
Professional Team eThekwini Municipality Roads Provision Department
Main Contractor Rumdel Construction Cape (Pty) Ltd
Major Subcontractors and Suppliers VNA Piling, National Asphalt, Beatus Civils, Afrisam, Amsteele

This 1 000 m link from the Western Freeway to Johannes Nkosi Street (ending just before Joseph Nduli Street) effectively by-passes the highly congested Warwick Junction precinct, thereby improving traffic flow through the area in a safe and efficient manner. The elevated section of this link is approximately 300 m long and consists of three lanes.

INVOLVEMENT OF MUNICIPAL ENGINEERS

The Ethekwini Transport Authority received funds for the reorganisation of the Warwick precinct from the National Department of Transport. The Ethekwini Roads Provision Department was then appointed to implement the project, which Department then decided to utilise in-house municipal engineering expertise.

RELOCATION OF SERVICES

A multitude of services located within the construction zone had to be relocated in the most efficient and least disruptive manner. This included the relocation of a 300 mm diameter steel water main and 400 mm diameter sewer along Johannes Nkosi Street. The 400 mm diameter sewer was located below the water table level and involved well-point drainage to lower the water table. Other services that needed to be relocated included major electrical cable relocations, CCTV infrastructure relocation, TELKOM infrastructure and traffic signals.

FOUNDING CONDITIONS AND WATER TABLE

The bridge was constructed across a zone of fairly complex geology. The water table is very shallow and tends to be perched on clay layers. Layers of mixed fill cover the natural ground surface in many places. Pietermaritzburg Shale bedrock occurs at depths of about 21 m in the west in Old Dutch Road and falls away eastwards to 27 m near Grey Street. Designers determined that piled foundations relying on end bearing onto bedrock were necessary. Strong water flows into open excavations below the water table were experienced during construction.

STRUCTURAL DESIGN

The inbound viaduct was designed to carry three lanes of traffic over the Warwick Triangle. It consists of a pre-stressed concrete box-girder 2,5 m deep, constructed in stages from the middle span outwards. Made up of six spans, the longest (60 m) are designed to allow for the acute angle of the traffic lanes intersecting beneath the deck between the main piers. The piers are also offset from the centre line of the deck to maximise the horizontal traffic clearance of the roadway below.

The slenderness ratio of 1:24 of the two longest spans required 75 000 kN of pre-stress to obtain an extreme fibre stress within the Class 2 envelope for a pre-stressed concrete structure under NA and NB36 loading conditions, and can accommodate an NC load in the ultimate limit state. A reasonably high-strength concrete of 45 MPa was used. The contractor elected to place the concrete by pumping, which required careful consideration of the placing sequence so as not to cause slumping of the concrete from the webs into the bottom slab before the latter had become suitably set. General frustration came in the form of early shrinkage cracks in the top of the deck, especially when placing in warm and windy conditions. Working around this problem

2 Inbound viaduct under construction
3 Warwick Triangle: a transport hub and informal trading area
4 A multitude of existing services within the construction zone had to be relocated
5 Warwick Triangle taxi bays

involved careful and thorough compaction and re-vibrating of the surface concrete, along with careful floating and accurate timing of the application of the curing compound.

The design of the bridge deck was carried out by the municipality's in-house structural branch of the Roads Provision Department, with the computer-aided design software package "Bentley RM-Bridge", which specialises in the time-dependency aspects of staged bridge design.

TRAFFIC MANAGEMENT PLAN AND RELOCATION

Prior to implementation of the road detour, the various stakeholders were consulted regarding the affected public transport facilities, such as the loss of parking bays along ML Sultan and Cross Streets.

Once agreement had been reached regarding the intended detour, the affected parties and the general public were informed about the road closures/detours through advertising, the distribution of pamphlets, and other communication methods.

On-site traffic monitoring was carried out by the Metro Police throughout the construction period. The Metro Police also attended technical meetings and assisted with the implementation of deviations and road closures.

Due to the construction of both the inbound and outbound viaducts, some informal traders were perrmanently relocated to alternative trading positions that would not hamper their trading activities. In addition, certain on-street taxi ranks also had to be permanently relocated. This was done as seamlessly as possible after extensive consultation with all the stakeholders.

CONCLUSION

Construction of this R152 million project commenced in March 2008. The inbound viaduct was opened to the public in February 2010, well ahead of the 2010 World Cup event, and since then people have been engaging in informal economic activities and accessing public transport in safety. ◻

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