Hospital Bend pre-selection scheme

The upgrading of the Hospital Bend interchange, the final phase of the planned upgrading of the N2 freeway between the Cape Town International Airport and Hospital Bend, is based on the concept of pre-selection lanes. The pre-selection lanes provide motorists with the opportunity to select their route through Hospital Bend a safe distance beforehand, thus reducing the need for extensive weaving manoeuvres

BACKGROUND

The initial planning for the upgrading of the Hospital Bend interchange, a priority 2010 Transport Infrastructure Project, commenced in October 2001 with the focus on the inbound direction. The planning for the outbound direction was added after South Africa won the rights to host the 2010 FIFA World Cup event.

The main objective of this upgrading phase was to minimise traffic weaving on Hospital Bend, thereby improving traffic safety, and also to reduce congestion on the section of the N2 freeway between the end of the dedicated public transport lane on the N2 and Hospital Bend.

The main components of the upgrading were as follows:

- Inbound pre-selection lane from Rhodes Drive which also required the widening of the Joyce Newton Thompson bridge
- Outbound pre-selection lane from Upper De Waal Drive which included new road sections and a new overpass bridge
- New access for Anzio Road which included a new overpass bridge

PLANNING AND DESIGN OVERVIEW

Integrated environmental planning

The Environmental Impact Assessment (EIA) process for this project commenced in 2001 and ran hand in hand with the conceptual design phase. From the beginning the primary issue of concern, identified during the extensive consultation process, was the treatment of the Anzio Road on-ramp towards the City, and its potential impact on the adjacent Table Mountain National Park and Rhodes Trust Land. Accessibility to Groote Schuur Hospital and the surrounding residential /commercial areas was also a major concern. The opposition of the adjacent community to the closure of this ramp culminated in the City of Cape Town EXCO taking a decision to retain the ramp and to bear the additional cost this decision would have on the project (direct cost in the order of R18 million).

1 Aerial view of the Hospital Bend project nearing completion

HOSPITAL BEND PRE-SELECTION SCHEME

Technical Excellence category

KEY PLAYERS

Client City of Cape Town

Professional Team Main Consultant: BKS OWS Joint Venture
Specialist Consultants: CCA Environment, OVP Landscape Architects, Melis & Du Plessis (geotechnical), Alten Hume (temporary works)

Main contractor Haw & Inglis (Pty) Ltd

Major Subcontractors and Suppliers Adenco Construction (Pty) Ltd, Amsteel Systems (Cape), Cape Otto Signs cc, Centremark Roadmarking (Pty) Ltd, DLE Engineering, Form-Scaff, Franki Afrika (Pty) Ltd, Keystone, Lourens Roadmarking cc, Racec (Pty) Ltd, Reinforced Earth, Urban Landscape Solutions, Vibrant Construction, Zebra Bituminous Surfacing cc

The requirements of the Environmental Management Plan (EMP), the main outcome of the EIA process, ensured that communication with the public was maintained through the electronic and printed media. The success of the EMP is evident in the positive response from both the private and public sector during all stages of the project.

Traffic engineering

As part of the conceptual planning and EIA process a total of 17 different options were evaluated with two options selected for the inbound direction and two for the outbound direction. The key design aspects which were assessed in evaluating the selected proposals were their ability to address the following:

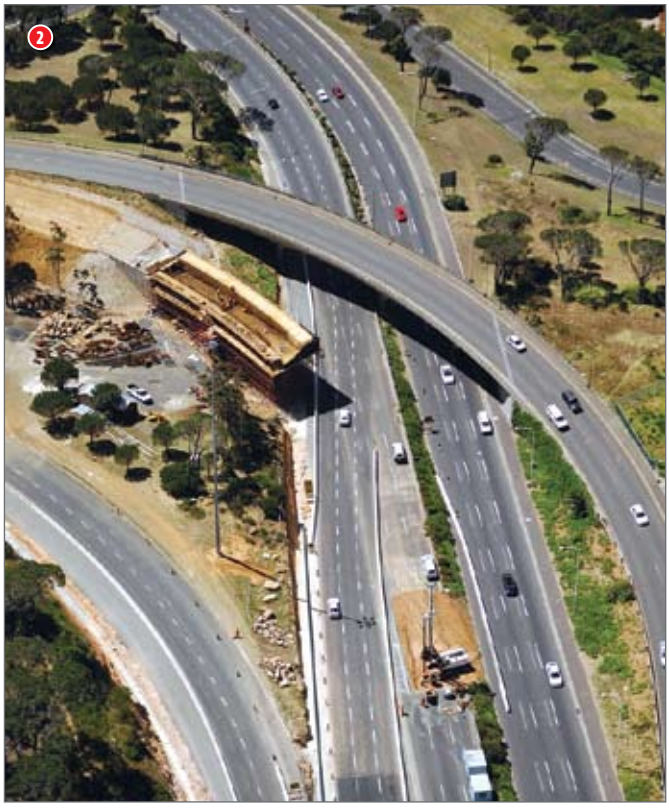
- The over-saturated operating conditions during the peak periods; the short weaving distance (800 m) between the bottom and top of Hospital Bend
- The number of lane changes
- The speed differential between the vehicles entering at the bottom of Hospital Bend (70 – 90 km/h) and those entering at the Anzio Road on-ramp (0 km/h).

These constraints meant that traffic operation fell outside the parameters of traditional traffic analysis software such as the Highway Capacity Manual. The initial analysis was based on first principles, and at a later stage micro-simulation software was used to assist in the resolution of problem areas and to provide guidance on expected traffic operation. Data collection included origin-destination, travel time and volume surveys, together with roadside interviews.

The key elements that were introduced to achieve the project objectives – reduction in weaving (improved safety) and the operation of the dedicated public transport lane – were:

- Inbound pre-selection lane from Rhodes Drive linking into the Anzio Road lane pick-up (requiring Anzio Road on-ramp to be relocated) – reducing weaving from 3 350 to 600 vehicles, morning peak hour
- Outbound pre-selection lane from Upper De Waal Drive – reducing weaving from 3 500 to 800 vehicles, afternoon peak hour

2 Construction in progress during the upgrading of the Hospital Bend interchange
3 Anzio Road overpass under construction
4 Completed Anzio Road overpass



- Third lane continuing inbound from Settlers Way into Hospital Bend
- Relocation of the Anzio Road on-ramp from the right to the left.

Cost considerations

As in any project, cost is an important consideration and during all the planning processes the design team's objective was to provide an upgraded facility, at acceptable design standards, while maximising the opportunity inherent in the existing infrastructure and road reserve to limit expenditure.

This focused approach resulted in the main feature of this project, namely the innovative pre-selection lane concept.

Geometric design

The need to confine the improvements within the existing road reserve (as identified in the EIA process) presented many unique challenges. The additional lanes, bridges, and improved geometric standards, where feasible, needed to be integrated horizontally and vertically with existing facilities. The completed design in this limited three-dimensional space was a remarkable civil engineering achievement.

The design also included other innovative elements to enhance traffic safety, such as a concrete-lined side drain that also serves as an emergency shoulder on the inbound carriageway.

Bridges

Anzio Road overpass

The Anzio Road access into the city included the construction of a sharply curved bridge overpass structure with a very complex geometric alignment due to the tight spatial constraints. The bridge deck curvature had to accommodate a horizontal transition curve leading into a circular curve (radius 23,2 m) with variable superelevation (3% to 8%).

Various bridge types and construction methods were considered, with a continuous four span cast in-situ voided slab deck selected as the best solution. Due to the unique deck layout and the three stage construction sequence, special attention had to be given to high torsion forces, bearing uplift at the abutments, creep and shrinkage effects and relatively high post-tensioning system losses. The state-of-the-art Austrian software package that was used for the analysis had to be specially adapted by the supplier to correctly model the behaviour of the bridge deck. The

deck was post-tensioned in the transverse direction at each pier, with Dywidag bars to withstand transverse bending at the supports. The construction method for the third span required temporary overhead support girders, in order to allow uninterrupted traffic flow with safe minimum vertical clearances.

De Waal Drive overpass

The new De Waal Drive link required a continuous three-span overpass bridge with a main span length of 45 m.

Site conditions, strict accommodation of traffic requirements and complex horizontal- and vertical geometric alignment of the bridge deck mostly dictated the bridge type and construction method for this bridge. The 2,2 m deep, post-tensioned hollow box girder deck was cast in-situ in three stages, with the second span being supported from an impressive overhead girder support system over Eastern Boulevard. The deck curvature had a radius of 153,6 m, variable superelevation (6,5% to 10%) and a maximum grade of 10%.

The bridge design, which had to make provision for high wind speeds, required specially designed vertical tie anchors at each abutment to counter expected uplift forces. The deck also had short profiled post-tensioning cables to counter transverse flexure at each pier.

5 De Waal Drive overpass under construction
6 De Waal Drive overpass nearing completion

Joyce Newton Thomson Bridge widening

The widening of the existing Joyce Newton Thomson Bridge also proved to be a challenge due to the geometric alignment and heavy traffic flow over and under the structure. The centre span of the deck was supported from temporary overhead girders to allow unhindered traffic flow during construction.

Project Management

To achieve the 2010 completion milestone and manage budget constraints, time and resource management by both the consultant and the contractor were critical to ensure that all elements were designed, approved and completed timeously. The Client played a significant role in this respect. The project management aspect has to be highlighted here as one of the primary reasons for the very positive end result and public perception during all stages of the project.

CONSTRUCTION ASPECTS

The communication procedures implemented with traffic authorities, radio stations and the press ensured that response time to incidents was kept to the minimum and that the public could be kept informed of construction events that would delay them.

The main feature of the bridge construction was the use of suspended formwork systems utilising purpose-made structural steel lattice overhead girders with heavy-duty steel support structures. The formwork design required extensive integration of the various design and construction elements, most notably the deflection of the permanent and temporary works at various stages of the construction process, and the effects of wind speed.

The phasing of the project was designed and implemented such that the general traffic disruption was kept to the absolute minimum. There were many times that this necessitated the contractor to work at night, a specific requirement of the contract. The construction programme, with three critical path elements, was monitored by dedicated full-time staff on a continual basis to ensure that the contractual milestones were achieved.

ACCOMMODATION OF TRAFFIC

Construction and public traffic management plans were fully integrated with dedicated 24-hour patrol and recovery vehicles. An uncompromising approach to minimising the negative impact on the travelling public resulted in the establishment of stringent traffic accommodation measures such as:

- No lane closures or deliveries during peak periods
- No lane closures but deliveries allowed during day-time
- Limited lane closures during night-time hours
- Road closures only permitted for critical elements (e.g. road sign gantries) and limited to 15 minutes.

The degree of adherence to these measures reveals an excellent understanding of the complexities of traffic accommodation on one of the busiest road sections in Cape Town by both the design team and the contractor. The general impression was that traffic operation actually improved compared to that experienced before construction commenced.

CONCLUSION

Construction was completed within the specified contract period and within budget (project duration: February 2008 – May 2010, and contract value: R260 million), and was very positively received by the public. □

Source: http://www.saice.org.za/downloads/monthly_publications/2010/2010-Civil-Engineering-dec/#/0