

Granger Bay Boulevard and Green Point Roundabout

INTRODUCTION

Aurecon was appointed for the design and construction supervision of the Granger Bay Boulevard and Green Point roundabout that provides access for vehicles (public and private) and pedestrians to the Cape Town Waterfront and the new Cape Town (Green Point) Stadium. Due to the development of the stadium for the 2010 FIFA World Cup, provision had to be made for access to the stadium for large numbers of pedestrians in a manner which would remove the vehicle-pedestrian conflict.

The innovative solution to giving large numbers of people safe access to the stadium was to provide a pedestrian concourse under an elevated traffic circle. In conjunction with the urban planners and the architect, a concept was developed for a circular structure providing access from every direction, and with an element of a “human” scale, having features more like a building than an elevated motorway. The concourse would then become the focal point of an urban park, which would also form part of the redevelopment of the area.

SCOPE OF WORKS

The works for the construction of the Granger Bay Boulevard and Green Point traffic circle consisted of the following:

Road works

- Construction of approximately 1,2 kilometres of dual carriageway, four-lane arterial road, including three traffic

① Aerial view of the circle in use during the 2010 FIFA World Cup



GRANGER BAY BOULEVARD AND GREEN POINT ROUNDABOUT

JOINT WINNER – Technical Excellence category
Submitted by the SAICE Western Cape Branch

KEY PLAYERS

Client City of Cape Town, Transport, Roads and Major Projects

Professional Team Aurecon (consulting engineers), Comrie Wilkinson and Jakuba & Associates (architect, urban planners), Planning Partners and OvP (landscape architects), Mary Patrick (archaeologist), Bryan Hadfield (electrical engineer), Hayleth Gunter (OH&S), Ecosense (environmental control)

Main Contractor Martin & East

Major Subcontractor Darson Construction



circles, two new permanent signalised intersections, alterations to two existing signal installations and the construction of two Bus Rapid Transit (BRT) stations

- Accommodation of traffic, including the construction of a 0,5 km four-lane diversion, as well as the erection of temporary road signs and other traffic control devices (including a complete temporary signalised intersection)
- Construction, relocation and protection of existing and new utility services
- Construction of side-walks and cycle paths
- Construction of a pedestrian plaza area and parking areas
- Hard and soft landscaping
- Provision of lighting for road, parking and pedestrian areas.



Structures

- Only one bridge structure, the reinforced concrete bridge at Green Point circle, formed part of this project and was constructed on top of the existing circle. The bridge is circular with a total length of 140 m, and with an overall deck width of 13,4 m.
- The reinforced concrete abutments and piers are founded on spread footings on rock at shallow depths. The bridge deck is of the solid slab type, in ordinary reinforced concrete, supported on steel bearings and is continuous over its full length.
- Precast elements were used for the bridge balustrades and the edge copings.
- The BRT station constructed on the median of Granger Bay Boulevard could serve two articulated buses, while the Cape Town Stadium station, which is linked to the pedestrian plaza under the circle, was designed to serve four articulated buses at any time so that the peak demand from the stadium could be met.



CONSTRUCTION OVERVIEW AND TECHNIQUES

From an early stage in the design process, it was established that the most effective way to funnel large numbers of people towards the stadium, would be through a pedestrian concourse under a new Green Point traffic circle. Therefore the bridge needed to be a large, open structure to

- ② Early days in the construction of the traffic circle and pedestrian underpass
- ③ Deck construction – view from the pedestrian underpass
- ④ Installing precast copings on the deck

provide access from every direction, and of a “human” scale – more like a building than an elevated motorway. The design and construction had to be practical, but in addition the structure had to be aesthetically pleasing as it would become the focal point of an urban park which would form part of the redevelopment of the area.

The bridge design resulted in a final structure that resembles a flat ring with an outer diameter of approximately 75 m and a 45 m internal diameter. On its outer edge, the structure is supported on abutments at each of the four roads leading into the circle. The inner edge is supported on a ring of wineglass-shaped columns, with a narrow “stem” with widening at the top to accommodate bridge bearings, and which give the appearance that the deck is floating above the columns.

The deck consists of a relatively slim 650 mm thick continuous slab structure with flat tapered edges and a textured radial tongue and groove finish. Expansion joints are provided only at the abutments, and all movement takes place around the centre of the inner circle. The heavy

precast parapets necessary for potentially high vehicle impact loads have been effectively hidden from below with large, roughly elliptical edge precast copings. The structure was designed to provide areas (under the deck in front of the abutments) which could, in the longer term, be developed into commercial or community facilities. These areas were provided with all the utility services which might be required in future.

The roadway was constructed using three different types of pavement design (asphalt, segmented block paving and continuously reinforced concrete) to comply with the requirements of the urban design parameters and the BRT bus requirements. These three types of pavement design were considered in order to handle the abnormally high axle loads imposed by the articulated buses which were to be used by the BRT system. On a micro level, the development and first use of special traffic circle road markings, as well as the red texturing on exclusive bus lanes, contributed to the originality of the project.

Together with its team of architects, urban planners, landscape architects and electrical engineers, Aurecon provided an innovative traffic circle solution that is beneficial to the community and provides easy and safe access for vehicles, cyclists and pedestrians to the Cape Town Waterfront and the Cape Town Stadium, both of which are landmark projects on the Cape Town cityscape.

PROJECT CHALLENGES

The integration of the design development with the adjacent Cape Town Stadium

The integration of the design development with the adjacent stadium and its associated pedestrian precincts and plazas, was a specific client requirement and a major challenge, specifically during the design phase. In addition, different project timelines resulted in the design and construction drawings of the Granger Bay Boulevard often having to be fully completed before similar design details and issues could be resolved at the stadium.



Winner: Technical Excellence
Granger Bay Boulevard & Green Point Roundabout



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The decision to incorporate BRT stations

A further design and construction challenge was the result of a fairly late decision to incorporate the BRT stations into the project. The bridge abutment for the pedestrian plaza under the traffic circle was already coming out of the ground when it was decided that the BRT system

would serve the 2010 FIFA World Cup event and that the station therefore had to be built. While Aurecon was only responsible for the construction supervision, the late inclusion of the stations required considerable detailed design revisions to take into account all the aspects affected by this decision.

Existing traffic flows

The construction works had to be carried out in a manner which ensured that all existing traffic flows, as well as the construction traffic adjacent to the stadium construction site, were unhindered by the works. All abnormal road-borne loads destined for the stadium (including the stadium steel roof sections carried from the harbour), were successfully transported through the site. In addition, the design and construction had to take into account the large number of major urban utility services crossing the site, which included high voltage underground cables, water mains and sewers.

Roadworks across a hospital site

One of the other construction challenges encountered was the construction of a portion of the road works across the site of a hospital which continued to operate fully during the period. Planning and construction also required intensive integration with the separate client, professional and construction teams involved with the development of the adjacent stadium precinct.



- 5 Extensive underpass paving in progress
- 6 Completed paving and pedestrian way-finding signs



Deadline changes

A change in some 2010 FIFA World Cup-driven deadlines, which only became known after the construction contract had been awarded, meant that the first phase of the works (which included the arterial roads and the traffic circle structure) had to be completed earlier than originally anticipated in order to facilitate test events for the stadium. This phase of the works was therefore completed according to an approved accelerated programme.

Other noteworthy aspects of the bridge construction

- The circular deck required very complex steel reinforcement due to its 650 mm thickness and the stresses generated by the circular design.
- The tongue and groove soffit finish, while not unique, is not often used on a circular structure and required a great deal of attention to the formwork detail.
- The approximately 900 precast copings used on the edges of the deck to soften the visual impact of the

bridge presented significant challenges in both the manufacture (six different types/sizes were used) and the mounting, where they had to be accurately placed on the continuously curving outside edges.

FINAL BUDGET

The original contract amount was R68.5 million, including a contingency amount of R5.5 million for unforeseen expenditure. The significant additional work (to accommodate the BRT buses and stations, and additional adjacent parking and pedestrian areas) was added to the scope of the works as required by the client, eventually

amounting to the final contract amount of R122 million.

CONCLUSION

The many design and construction challenges faced on this project were generally solved by excellent cooperation between the contractor and Aurecon's project team management. Another contributing factor to the success of this project was the support received from the project manager of the City of Cape Town and his team. The Granger Bay Boulevard and Green Point traffic circle were completed successfully on time and within budget, and serves as a proud landmark for the City of Cape Town. □

What the judges had to say

The technical aspects of the design and construction were explained well in the presentation. The novel design and use of a continuous solid slab in ordinary reinforced concrete, with radial tongue and groove and

expansion joints at the abutments, blend well with the aesthetically pleasing layout. The innovative solution to conflicting requirements (vehicles and pedestrians at large sports events) makes this a winning concept.



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