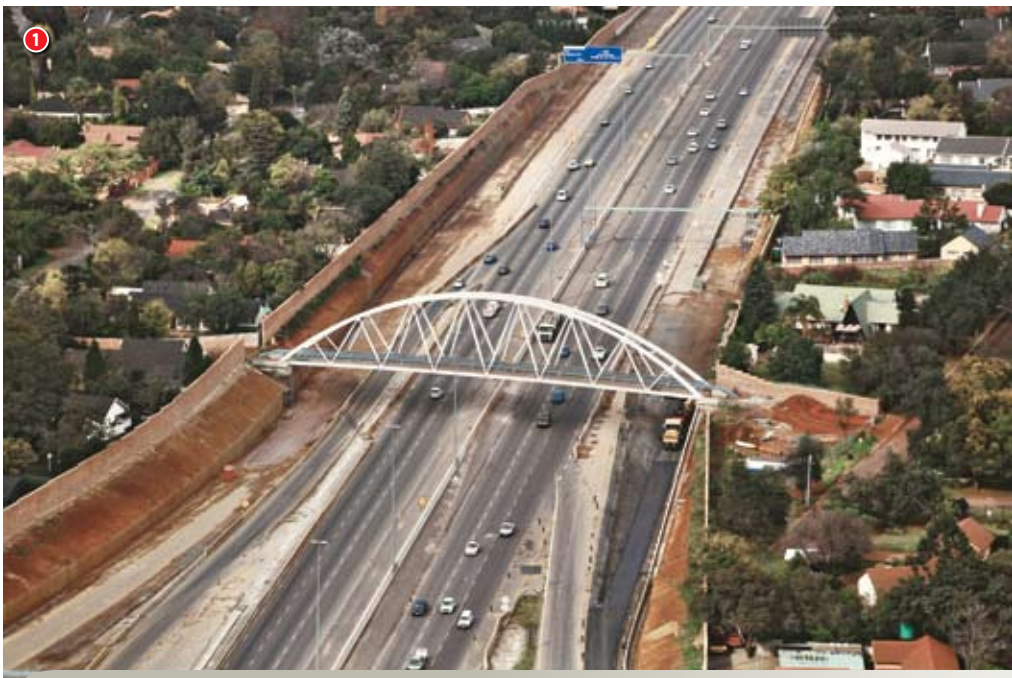
Lynnwood Glen pedestrian and pipe bridge



LYNNWOOD GLEN PEDESTRIAN AND PIPE BRIDGE (GFIP D2)

Technical Excellence category

KEY PLAYERS

Client SANRAL

Professional Team DCA Joint Venture comprising DEC (Pty) Ltd, Civil Concepts (Pty) Ltd, ARQ (Pty) Ltd

Main contractor BRCD Joint Venture

Major Subcontractors and Suppliers CADCON Steel Construction and Engineering

PURPOSE OF THE PROJECT, APPROACH TO THE DESIGN AND GENERAL FEATURES

The new Lynnwood Glen pedestrian and pipe bridge is part of Package D2 of the GFIP (Gauteng Freeway Improvement Project). The bridge is located between Atterbury and Lynnwood roads on the N1 in Pretoria.

The old post-tensioned concrete pedestrian and pipe bridge posed a major restriction to the N1 freeway improvements between the Atterbury and Lynnwood interchanges. The bridge openings were insufficient and could not accommodate all the lanes of the new widened freeway. Due to the shape of the old bridge, the vertical clearance near the abutments was also insufficient. The purpose of the new bridge was to resolve these restrictions.

The bridge, as well as being there for pedestrians, carries two steel water mains across the N1. These two pipes, 675 mm diameter and 300 mm diameter respectively, belong to the City of Tshwane Metropolitan Municipality. The 675 mm diameter pipe is used as a supplementary supply main to the Lynnwood reservoir, mainly during the summer months when domestic water demand is high. The

1 Aerial view of completed Lynnwood Glen pedestrain and pipe bridge across the N1 in Pretoria

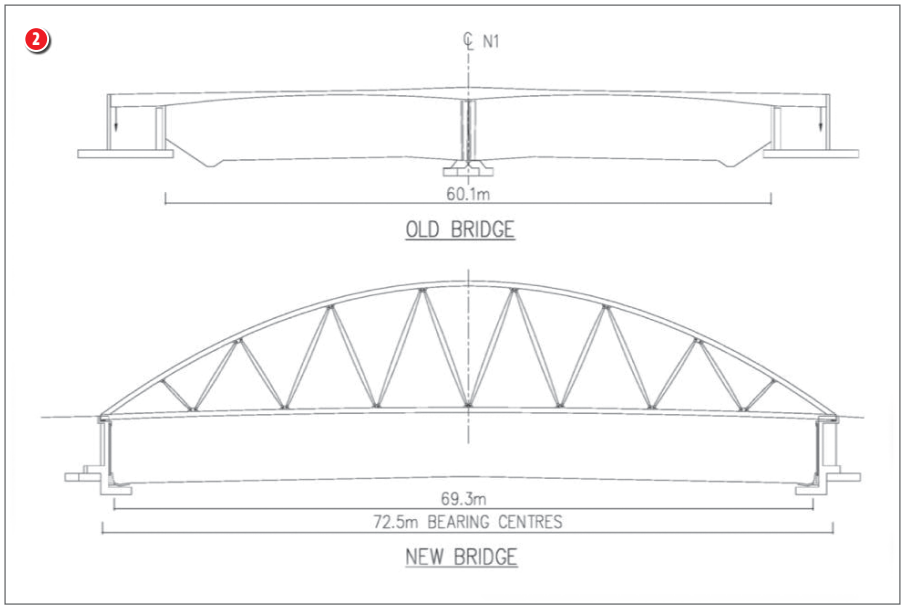
300 mm diameter pipe is the main supply to the portion of the water reticulation system east of the N1 and can thus only be closed down for a maximum of eight hours during off-peak periods.

Various options were looked at in order to meet the requirements of the new freeway widening:

- Raising of the old deck and modifications of the abutment in order to provide the desired clearances
- Removal of the pedestrian access altogether and relocation of the pipelines either by jacking the pipe under the freeway or by relocating the pipeline over the Lynnwood Road bridge
- Replacement of the bridge with a new structure.

The first two options proved to be problematic, for the following reasons:

- The structural system of the old bridge included 'hold-down' or tension anchors within the abutments. The option of modifying the abutments and raising the deck was therefore not feasible. In addition, the risk of damaging the



2 Lynnwood Glen pedestrian and pipe bridge – the old and the new
3 Assembly of steel bridge structure completed alongside the N1
4 Lifting and erecting the 142-ton structure

pipelines whilst the bridge was being modified would have been too great.
- The permanent removal of the pedestrian access was also not desired by the City Council and the local residents.
- Jacking a culvert for the pipelines under the N1 would have been very difficult due to the depths of the jacking pits in close proximity to the private properties in the area and the restrictions it would pose on the traffic flow.
- Deviation of the pipelines, for example over Lynnwood Road bridge, would have been very expensive and it would have been difficult to accommodate a 700 mm diameter pipe over this bridge.

The option of replacing the bridge with a new structure was thus preferred. During a workshop between SANRAL and the designers it was decided to opt for a steel bowstring arch bridge as depicted in Figure 2.

The following were some of the reasons:

- The walkway levels and pipeline invert levels remain virtually unchanged, whilst still providing the required bridge clearance
- Removal of the old bridge and the installation of the new structure are split into independent activities, thereby reducing the impact of disruption to both traffic and water supply
- The new bridge spans the full length thereby removing the need for the construction of new piers in the median which would have been difficult due to access restrictions
- The bowstring arch bridge in addition produced a feature which is quite fitting within the surrounding areas of intense commercial development.

The design approach was to attain the following:

- Necessary clearances – the new bridge provides a vertical clearance of 5,8 m and the span is 72,5 m, providing the required horizontal clearance for the extra lanes.
- Relatively easy construction – the bridge was designed so that a significant portion could be fabricated in a workshop and it could be transported in separate segments and be assembled alongside the road. Once assembled the contractor could lift the entire steel structure into its final position.
- Minimum traffic disruption – the traffic would only be disrupted 3 times – twice for the demolition of the old bridge, and once for the erection of the new bridge.
- Minimum water supply disruption – the transition of the pipelines from the old to the new bridge necessitated careful planning and construction phasing.
- Aesthetical and environmental blending – the main arch members lean towards the centre line of the bridge, the cross-bracing members are made up of circular tapered sections, the bridge is white with light grey handrails and a darker grey pipe. All these features highlight the structure during the day, while effective lighting at night does the same.

CONSTRUCTION TECHNIQUES AND SPECIAL MEASURES THAT WERE REQUIRED TO ACHIEVE COMPLETION

To minimise the areas of adjoining properties that SANRAL (South African National Roads Agency Ltd) needed to expropriate, and to minimise the pipeline realignments, it was decided to construct the new bridge as close as possible to the old one. The old bridge consisted of two decks, one for the pipes and the other for pedestrians. It was necessary to demolish the old pedestrian portion first. The bridge was saw cut into 5 sections and the sections were removed by crane. Temporary supports were placed at calculated positions to ensure that the release in the prestressed cables from the old bridge would not cause a collapse.

The new bridge was created from six segments which were fabricated at the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5 Leaning arch members and tapered cross bracing members

factory individually and then transported to site by abnormal-load vehicles. The six segments were assembled at the side of the road using specially hidden bolted connections. After the assembly and lining up of segments had been completed, these bolted connections were closed with cover plates, rendering a smooth external finish to the bridge structure.

The assembled bridge was lifted into its final position utilising four lifting hooks that were designed to take the forces. The traffic was diverted through town while the 142-ton structural steel portion of the bridge was lifted into place by one of the biggest crawler cranes in South Africa with a lifting capacity of 800 tons.

The bridge was temporarily placed on jacks to allow for the curing of the permanent bearing grout.

Once the new bridge was in place, the deck slab was constructed utilising concrete. Not long after, the new pipelines were installed over the new bridge and the tie-ins were made at the ends. This allowed the contractor to then demolish the pipeline-carrying portion of the old bridge.

CONCLUSION

The replacement of the Lynnwood Glen pedestrian and pipe bridge was a challenging project and the resulting structure has already become a landmark in the Pretoria area, the more so as there is no other bridge like it across a national highway in the country. □

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