FOR OVER 20 YEARS, Blackburn Village residents have found employment opportunities in the surrounding sugar cane fields. In 2001, the development of Umhlanga Ridge New Town Centre created additional economic opportunities for the area, causing Blackburn Village to grow dramatically.

The village lies adjacent to the National Route 2 Section 26 (N2-26), a 120 km/h four-lane dual-carriageway freeway carrying more than 32 000 vehicles per day. In 2008, a pedestrian survey revealed that during the morning peak period more than 500 Blackburn residents were walking south towards Umhlanga along the N2 shoulder, most of whom were also crossing both carriageways at grade in order to get to Umhlanga. This growing use of the national road by pedestrians was resulting in pedestrian and vehicular deaths and had become an increasing concern for The South African National Roads Agency Limited (SANRAL), as South Africa already has one of the highest pedestrian fatality rates in the world according to the World Health Organisation.

Increasing traffic volumes and the anticipated opening of the new King Shaka International Airport persuaded SANRAL to proceed urgently with a pedestrian bridge and walkway.

Responsiveness to needs of client and community

The bridge and pedestrian walkway were identified as a community development project for the Blackburn area and SSI Engineers and Environmental Consultants was tasked with providing a design. The project began with early stakeholder inclusion in the form of public meetings held with the community of Blackburn and its leaders.

In order to satisfy the community's preferred geometrics of the walkway, the bridge location would have to be built at the location of N2-26's widest median (80 m between carriageways). This location, more than 1 km away from the informal at-grade crossing point being used at the time, would be required to be built over 9 m above the existing road level, with a total bridge length of approximately 180 m. The input provided by members of the Blackburn community increased the complexity of the project, but was invaluable in aligning the proposed design with the needs of the end users.

Influence of the consulting engineer

In addition to the extra length of the structure required to meet the needs of the community, the natural valley contained in the median offered some technical challenges. Aesthetic considerations were given to the impact of multiple columns, but additional constraints were offered by the stream and adjacent wetland, as well as poor founding materials disclosed by the geotechnical investigation.

Conceptual designs were greatly influenced by the deck height, median terrain and soil profiles identified in the geotechnical investigation.

Design options such as a six-span continuous beam and column structure and a two-span stressed-ribbon bridge were explored, along with more innovative and technical solutions such as a cable stay option and a double arch. It was the aforementioned factors, in particular the difficult founding conditions at the selected location, which dictated the costs of each option. The significant depth to adequate founding along half of the bridge's length favoured fewer footings.

Utilitarian options offered almost no cost savings over the more challenging long-span solutions and in early 2009 SANRAL's technical team approved the cable stay pedestrian bridge in the form in which it now stands.

Unique design aspects

The bridge deck is 177.5 m long and 4.9 m wide (with a 3.0 m walkway width) and has an average walkway slab thickness of less than 200 mm. The walkway slab is supported by 750 mm deep and 900 mm wide concrete edge beams that contain the deck post-tensioning ducts and provide bearing anchor points for the stays.

Stiffener ribs at 4 m spacing provide transverse strength to the deck and form a deck underside that is similar to a coffer slab. The edge beams also serve as raised kerbs, on which the 2.1 m tall mesh safety screens are fixed. The bridge span comprises two 70 m cable-stay supported spans on either side of the pylon, with an additional 18 m back span between the right abutment and pier column.

Blackburn Pedestrian Bridge is one of the longest cable-stayed pedestrian bridges in Africa

The bridge deck is primarily supported on the central pylon's base, a 9.5 x 9.5 x 1.8 m spread footing founded over 7 m below existing ground levels onto sound shale, with an allowable bearing capacity of 500 kPa. The large spread footing used a slower-curing concrete mix to minimise curing temperatures and avoid cracking.

The spread footing supports the 60 m tall pylon, which at the base consists of four 900 x 900 mm reinforced concrete columns.

The legs are braced every 8 m with stiffener beams to prohibit any rotation of the legs. These beams are set in from the leg faces. The legs are sloped inwards at 1:12.5 (longitudinal) and 1:17.7 (transverse), creating two different A-frame profiles. The inward slope of 1:17.7 remains at constant full height, while the longitudinal leg slopes vary to vertical via a parabolic transition. The four legs combine to form two and then combine again into one central mast of 1.2 x 1.3m at the top, from which the stays are anchored. In total, 32 high-tensile low-relaxation cable stays are used to support the bridge deck from the central pylon. The longest of the fanning cable stays are over 65 m in length and pass through the deck at 26 degrees from horizontal, while the shortest stays are 25 m in length and 69 degrees from horizontal.

At 177.5 m, the Blackburn Pedestrian Bridge is one of the longest cable-stayed pedestrian bridges in Africa. Coupled with its uniquely shaped pylon, design and detailing required technical expertise and careful attention to detail.

PROFESSIONAL TEAM

Client: South African National Roads Agency Limited • **Bridge network manager:** Edwin Kruger • **Project manager:** Ravi Ronny • **Project liaison manager:** Ms Nomsa Modise • **Project liaison officer:** Mr Madlopha • **Consulting engineer:** SSI Engineers and Environmental Consultants • **Principal structural specialist:** Bruce Durow • **Structural design specialist:** Jonah Ptak • **Detailing and documentation:** Basil Kroeger • **Geometrics design specialist:** Peter Forrest • **Electrical design specialist:** Kevin Pillay • **Project principal, engineer:** Brian Downie • **Resident engineer:** Kurt Hillerman • **Assistant RE:** Stefan Kaffka • **Wind loading expert:** Dr Adam Golliger • **Geotechnical specialists:** Drennan Maud and Partners: Mike Hadlow • **Contractor:** JT Ross / Devru Joint Venture | **JT Ross Construction Contracts manager:** Henry Laird • **Site agent:** Clayton von Weichardt • **Quantity surveyor:** Rajesh Chattergoon | **Devru Construction Managing director:** Kiruben Naidoo • **Site manager:** Shaun Naidoo • **Quantity surveyor:** Rajesh Chattergoon | **Structural Systems Africa General manager:** Paul Heymans • **Operations manager:** Sean Kelly | **Giantlight Contracts manager:** Otto Horlacher | **Métier Mixed Concrete Technical manager:** Gregg Hollins