Muden community access route restored

The Gracelands pedestrian bridge across the Mooi River in the Muden area of KwaZulu-Natal has restored all-year community access across the Mooi River. The old bridge was destroyed by floodwaters several years ago. The new hybrid suspension bridge was designed and constructed using lightweight galvanised steel sections and was erected almost entirely by hand without heavy lifting equipment. A unique feature of the design for this hybrid suspension and truss structure was the inclusion of a lightweight bracing truss in order to reduce undesirable sway movements of the 90 m main span

DESCRIPTION AND PURPOSE

This project comprises the construction of a structural steel suspension bridge of 90 m span over the Mooi River in the Muden area of KwaZulu-Natal.

The purpose of the structure is to provide safe passage over the Mooi River for people residing in tribal areas on the north bank of the river to enable them to access employment opportunities and the only nearby trading store located on the southern side of the river.

Summer rains during the months of November through to April make crossing the river at this point very dangerous and require the local residents to make a 10 km round trip to reach the river bank directly opposite from where they live. The desperate need for this bridge was identified by the KwaZulu-Natal Department of Transport-initiated Rural Road Transport Forum in conjunction with community organisations in the area.

This structure replaces a previous low-level suspension bridge consisting of six steel cables supporting a timber deck hung in catenary fashion between low-level supports. The original structure was destroyed during flooding of the Mooi River in the late 1990s.

The new structure was designed to allow the deck to follow a constant grade rising 3 m from bank to bank from the low point situated 1 m above the calculated 1:50 year flood line on the north bank.

A suspension-type structure was chosen to cater for a free span of 90 m which would obviate the need for intermediate supports located within the environmentally sensitive river channel. Severe annual flooding of the river would also have required a substructure of considerable strength to resist flood and debris forces. Obviating the need for construction of bridge piers within the river channel greatly simplified the environmental approval process which was an important require-

ment given the very short time available to design and construct the bridge.

A suspension type structure would also permit the bridge deck to be located well above the surrounding floodplain providing a higher factor of safety against flood damage at little extra cost in the event of more severe flooding than the 1:50 year design flood specified for the structure.

HYBRID SUSPENSION BRIDGE

A hybrid structure was designed in preference to the more conventional suspension bridge in order to limit live load deflections and sidesway which is often exhibited in lightweight, long-span suspension bridges. These dynamic deflections are uncomfortable or even dangerous for pedestrians under adverse loading conditions.

This hybrid structure incorporates elements of a conventional suspension bridge and elements of a truss type structure and exploits the ability of highly stressed suspension cables acting in tension to also act as compression members of the bracing truss. In addition, the light steel truss added to the suspension bridge is capable of carrying the imposed loading directly back to the supports.

The eight suspension cables were sized to carry all dead and imposed loads. Multiple cables were used in preference to using two larger cables purely because of their immediate off the shelf availability.

The width between cable centerlines was set at 3 m with the walkway consisting of modular components of 1,2 m width placed midway between the suspension cables. This approach also limits the application of eccentric loading on the structure.

This approach to the design was used to create a very stable structure with very little sidesway evident during unfavorable loading conditions.

FABRICATION AND CONSTRUCTION

Apart from the main H-section towers all other components were designed for modular off site fabrication and sufficiently lightweight to be handled generally by two or at most four persons in order to facilitate erection without heavy lifting equipment at this remote site.

Cable sizes were chosen according to strength requirements and availability. Friction grip bolts were used in all joints subject to dynamic forces and stress reversal to limit the possibility of connections failing prematurely due to the wear of conventionally bolted connections under dynamic loading. All steel components were hot dip galvanised before being delivered to the site.

Other components of the structure included rock anchors on the south bank, construction of a reinforced concrete and earth mass gravity anchor on the north bank where no rock at shallow depth was present.

All excavations for the reinforced concrete bases were completed by hand using local people sourced from the area. Readymixed concrete was brought in by road to obviate the need for site mixing of the small quantities required and to prevent waste material on site.

ENVIRONMENTAL

Environmental impact was reduced by constructing the two towers and two anchorages well away from the river channel. Only minimal site establishment was required. Site delivery of readymixed concrete obviated the need to bring sand and stone to site and site generated waste was therefore minimised.

PROJECT MANAGEMENT

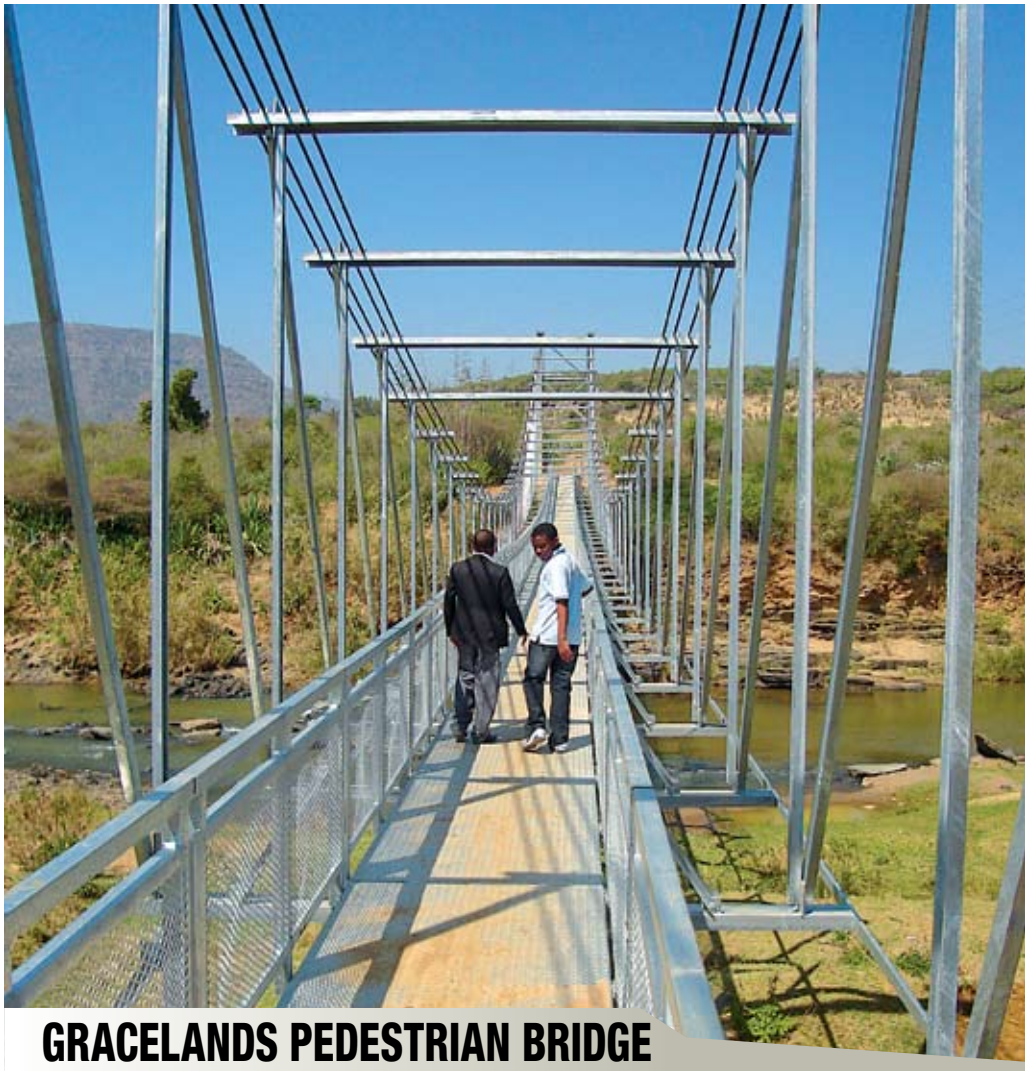
Client requirements dictated that this fast-track project be designed, put out to tender and completed within a five-month period. The originally defined four-month contract period was cut to three months due to the inclusion of the Christmas break in the tender period.

For various reasons the contractor was unable to achieve completion within the three-month contract period specified and the R2 million project – which included arranging for environmental approvals, land survey, tribal authority approvals, gaining permission to occupy the site from private landowners etc and completion of design and tender procedures and construction of the structure – was eventually achieved within a more realistic ten months.

Community support for the project was evident during the entire project and materials left unguarded on site for extended periods were not touched. The structure has made a big difference to an entire community and saved many man-hours previously spent walking around the obstacle or for the younger people risking their lives by swimming across the river.

OTHER PROJECTS

The client was so impressed with the final result in terms of form, function and ease of construction that the design was chosen for use in several other footbridge projects during the 2007/08 financial year. □



GRACELANDS PEDESTRIAN BRIDGE

Pietermaritzburg Branch Award for Technical Excellence

KEY PLAYERS

Client KwaZulu-Natal Department of Transport
Design and project management Emzansi Consulting Engineers (Geoff Bouttell – now GDB Engineers)
Contractors African Access International / Somerset Oaks Trading CC
Subcontractors Cousins Steel International / Big Red Rigging

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