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JG Afrika successfully repairs the Groot Marico River Bridge to keep traffic moving

The swift action taken by JG Afrika on behalf of the Bakwena Platinum Corridor Concessionaire to repair the damaged Groot Marico River Bridge on the N1/N4 prevented further damage to the toll-road and provided road users with a more convenient alternative to a 36 km detour while repairs were being undertaken to the structure.

This busy highway from Gauteng to Botswana is operated and maintained by the Bakwena Platinum Corridor Concessionaire (Bakwena) on behalf of the South African National Roads Agency Limited (SANRAL).

JG Afrika, a leading South African engineering consultancy, is contracted by Bakwena to undertake regular inspections and oversee the maintenance of the major structures along the route. The Groot Marico River Bridge is among the largest of the 280 structures, including bridges and major culverts, along the highway.

JG Afrika first noted the crack in one of the bridge's piers in 2015 during the routine bridge inspections which take place every five years. It was noted on the Bridge Management System, which JG Afrika uses to monitor the state of the structures and prioritise repairs that need to be undertaken.

Located in the North West province, the 80 m-long bridge is 7 m high and comprises six spans and five piers.

The first half was built in the 1970s and the second is tied to the original structure and was constructed in 2002.

After extreme flooding in the North West province in early January 2017 after a prolonged drought, the crack in the bridge pier widened. This resulted in the rotation of the pier and the settling of the deck structure.

G4 Civils' personnel who were operating in the vicinity reported the sagging deck to Bakwena and JG Afrika in early 2017.

Emma Day, a JG Afrika associate and highway engineer, oversees the firm's bridge inspection and maintenance contracts with Bakwena, and was appointed by the firm to manage this project.

Day was supported by colleague, Kobus Burger, who undertook the initial bridge assessments and repair design. Burger, a technical director at JG Afrika, is a SANRAL-registered senior bridge inspector who specialises in complex technical structural undertakings.

“The settlement was on the older side of the structure. We immediately closed this section and implemented a stop-and-go system to redirect the vehicle traffic to the newer portion of the bridge. This provided a safe short-term solution until we completed our assessments of the settlement to determine the actions that were required to repair the structure,” Day says.

JG Afrika’s assessments revealed that the failure was as a result of the erosion of the founding material below the old bridge’s spread footings.

The initial design entailed installing piles at the four corners of the failed pier, and a concrete beam with a lip would be cast between the piles to support the pillar.

However, the engineering team had to quickly come up with an alternative solution when the damaged pier rotated further when piling commenced during the repair operations. They decided to dowel into the existing pier and to then cast it into the concrete beam.

As it turned out, this solution proved to be a more effective means of undertaking the repairs by doing away with the need to excavate below the pier to construct the lip on the concrete beam. The solution was designed in only a week to ensure that the works programme progressed according to schedule.

Repairs started in the dry August period and the bridge was opened to traffic before the December holiday break when the highway experiences a significant increase in traffic volumes.

Completing the project in such a short time frame relied on careful planning of each individual step undertaken by the different contractors.

Day attributes much of the success of this project to excellent team dynamics between resident engineer, Pieter Janse Van Rensburg, and the representatives of the contracting teams. This is in addition to the combined skills and experience of the contractors.

They included G4 Civils, the main contractor, and sub-contractor, Civilcon, which also advised and provided input into the final repair design. Stefanutti Stocks Geotechnical was appointed to undertake the piling and MBR undertook the jacking of the bridge deck.

“The river was diverted by means of a large berm before the installation of the propping and staging to support the bridge during the repairs. Piling commenced once the bridge deck had been supported. The scope of the piling works also included the construction of piled protection structures in front of the piers on either side of the failed pier to prevent the possible failure of the other piers,” she explains.

After their installation, Civilcon started constructing the concrete beams to join the piles and support the pier.

A rapid high strength concrete was used to further accelerate the works programme, with this 40 MPa concrete mix design achieving a desired strength in only seven days.

With the structure now stabilised, MBR jacked the bridge up by 100 mm to its original height. The bridge deck was then supported on steel shims of varying heights to accommodate the angle of the pier. This phase was followed by the repair of the crack and the reinstatement of the river bed to complete the repair works.

Day concludes that she is proud of JG Afrika's involvement in yet another successful project for a long-standing client that continues to demonstrate its unwavering commitment to operating a world-class highway.

Images & Captions:

[Img_0637]:

[Caption] : Installation of the piles.

[Img_1889]

[Caption]: The repaired pier and reinstated riverbed.

[Br 1 to 5]:

[Caption]: Steel shims supporting the jacket bridge deck.

[Img_0631]:

[Caption]: Excavation for the construction of the concrete beam.