



Rehabilitation of the flood damaged Mhlali River Bridge and adaptation for improved resilience to extreme weather events

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Abstract

This paper presents a case study on the rehabilitation of the Mhlali River Bridge from damage caused by catastrophic flooding on the east coast of South Africa in April 2022. Due to significant debris blockage, the bridge deck was overtopped and was displaced off its bearings by 600 mm in a downstream direction. Scour of the approach fill behind the abutments had left the concrete approach slabs unsupported and the bridge was immediately closed to traffic. The repairs involved jacking the superstructure back into position, as well as adapting the bridge to increase its resilience to extreme weather events in the future. These adaptive measures included the installation of breather holes in the beams to allow trapped air to escape in the case of inundation to reduce the effects of buoyancy, and the construction of shear restraint blocks on the abutment and pier bearing shelves, to improve the superstructure's resistance to lateral hydrodynamic and debris loads.

Keywords: flooding; extreme weather; lateral hydrodynamic forces; buoyancy; scour; bridge repair; resilience; adaptation.

1 Introduction

Flooding is one of the most frequently occurring impacts of extreme weather events in South Africa and poses a significant threat to transportation infrastructure, a key component of a country's economy. Bridges over rivers and floodplains are particularly vulnerable to the actions caused by floods such as scour at the supports, lateral and vertical hydrodynamic forces, hydrostatic or buoyancy (if submerged) and impact loads caused by large floating debris. The effects of these actions were seen in the damage caused to the Mhlali River Bridge by the floods that occurred on the 12th of April 2022 in Kwa-Zulu Natal, South Africa.

The Mhlali River Bridge is located on National Route 2 providing an important economic link to the port of Durban from areas north and south of the country and into Southern African countries.

The bridge is owned and managed by the South African National Roads Agency Limited (SANRAL).

The Mhlali River Bridge was built in the 1960's and comprises of seven (7) simply supported spans, each spanning 17.6 m, giving a total length of 123.2 m. The superstructure consists of prestressed precast concrete beams with a reinforced concrete slab. The substructure consists of wall-type piers and full height abutments on pile caps supported off piles founded on rock. Figure 1 presents an image of the bridge in elevation while Figure 2 shows the bridge deck profile.

The flooding of 12th April 2022, as a result of storm Issa in the Kwa-Zulu Natal region, overtopped the Mhlali River Bridge and moved the bridge deck laterally 600 mm downstream. Both approaches to the bridge were scoured out leaving the approach slabs unsupported. The bridge was immediately