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DESIGNING FOR THE REALITIES OF A DAY IN THE LIFE OF A GOOD LOOKING BUT HARDY FOOTBRIDGE

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Summary

This paper tells the story of the design development of three concrete footbridges across varying landscapes within South Africa. Their designs relate to their surroundings and also to the fact that they must survive the harsh realities of theft, vandalism and life with limited preventive and routine maintenance. They are aimed to be a tax payers dream and a friend to the communities they serve. A common thread through each bridge is the use of bespoke in situ concrete forms rather than standard precast concrete sections. In each case the bridges were staged and formed with shutters. Innovative structural systems such as an arch supported self-anchored multi-span stress ribbon bridge were conceived and developed.

Keywords: aesthetics; durability; stress ribbon; suspension bridge; economy; maintance; prestressed concrete

1. Introduction

This paper tells the story of the three concrete footbridges, developed by the South African Nation Roads Agency SOC Ltd (SANRAL) that might have been unremarkable but were allowed to develop a character of their own. All three live in the less glamorous parts of our urban world and are there to serve a basic road safety need. They are expected to fulfil their function without adding unnecessarily to the maintenance burden of their owning authorities. They must also survive the unwanted attention of thieves and vandals. In this context it is debatable whether it's worth standing out or whether these bridges should have followed what has gone before and blended unnoticed into the backdrop of our highways and footways.

2. The Bridges

The first protagonist in this story is the Pacaltsdorp Pedestrian Bridge. Situated in George, South Africa, the bridge serves its purpose by connecting a low cost housing township to work opportunities in the nearby city. Its neighbours along the highway are precast concrete beam and slab bridges. Although perhaps related to these more conventional form of bridges, the Pacaltsdorp bridge is different. It's a 65m long continuous four span, self-anchored arch supported stress ribbon bridge with a maximum span of 21.2m. The bridge has semi-integral abutments and a slender 220mm thick concrete stress ribbon deck that spans up to 12.6m between the crests of the arch sections.

Fig. 1. View of the completed Pacaltsdorp Pedestrian Bridge

In conceiving a footbridge design there are number of unique factors to consider. Firstly it is feasible to stage a footbridge and to maintain traffic flows beneath the supporting formwork. This is because footbridges have a minimum vertical clearance of 6.0m and it is possible for formwork to span across two lanes of traffic and still maintain a vertical clearance of 5.2m during construction. Constructing a cast in-situ concrete continuous bridge is therefore feasible in most instances. Local experience has shown that there is little cost difference between the construction of in-situ and precast concrete structures. In this light it seemed obvious to take the advantages that in-situ concrete offered. Those being the opportunity to create a bespoke solution at little or no cost premium and to design integral connections that eliminated bearings and expansion joints.

The Ergo Road Pedestrian is a variable depth pre-stressed cast in-situ concrete beam bridge with a main span of 42m and was developed with up-stand fins at the support points. This arrangement meant the depth of the beam at the mid-span, from walking surface to the beam soffit, could be limited to 720mm. This fact enabled an impressive span to depth ratio of 58. Once the solution conceived it was found there were simple design ideas that could combine the bridge's functionality with an attractive form. A main idea was the use of a curved vertical alignment that crested over the medium of the highway. This enabled the gradual ascent of pedestrians but also allowed the fins to appear relatively flat in elevation. An outstand on the deck edge was also used to express the fin from the standard deck section. This also allowed the flow and behaviour of the bridge to be conveyed with the standard deck section tapering towards the ends of the back spans, as shown in Figure 9.

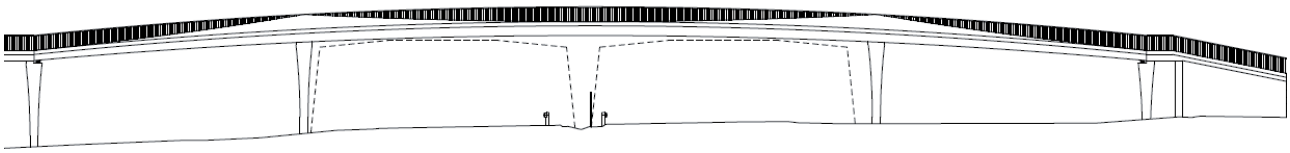

Fig. 2. Elevation of the variable depth girder

A close neighbour of the Ergo Bridge on the N17 is the Regents Park bridge. The site was especially dangerous for pedestrians and in the end a crossing with a 58m long main span was conceived to enable the future widening and clear span of the highway. The use a simple self-anchored suspension bridge with an in situ concrete deck slab cast on staging proved to be the most economical option.

The design process tried to retain the suspension bridge's grace quality whilst giving it some amour for the rigors of its surroundings. Sculpted splaying concrete pylons provide a durable support for the suspension cables and ensure the bridge's protection against vehicle impact. The suspension cables are inclined outwards to keep the bridge as open as possible and to keep the hangers out of reach of foolhardy vandals. The suspension cable itself uses triple coated mono strands that are contained within a grouted steel pipe. Although this system is well used it has some specific benefits when employed in Johannesburg's urban landscape. It essentially eliminates the risk of vandalism as would-be thieves will stop cutting the pipe when they hit the grout material.