



## Large culverts made with precast concrete arch-shape elements connected with cast in place concrete.

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### Summary

This paper deals with a new constructive system for large culverts using precast concrete elements. The proposed system includes arch-shaped elements for the main structure and wall elements to retain the earth over this main structure, being all those precast elements connected by cast-in-place concrete. The region of arch crowning receives a layer of cast-in-place concrete to provide transversal distribution of the vehicles concentrated loads and also to increase the cross section height. This paper presents the application of the constructive system for a single span of about 11 meters. It is a crossing over the railway line, with a total length of 25 meters, in the city of Teresina, North-eastern part of Brazil. The thickness of the precast arch is 180mm, reaching 300mm in the region of the arch crowning. The main features and hypotheses used in the structural design are presented. The procedures used for the manufacture of the precast elements and onsite construction are also described.

**Keywords:** precast concrete; arch; small bridges; constructive system.

### 1. Introduction

The arch made of stone, as a structural material, was already employed since ancient times for bridges and large spans culverts. Due to the replacement of stones by concrete as building material, structural arch system was losing its economic feasibility for structural systems where bending moments are predominant. However, by using precast concrete elements, arch systems can again take advantage of their inherent structural and aesthetic benefits for bridges and large spans culverts. Some possibilities of using arch systems for large spans culverts are presented in the following. Figure 1 shows schemes where single precast elements were used to span the entire opening [1-2]. However, larger spans can be achieved using two elements connected in the middle of the span, when 20 meters span can be reached [3-4]. Figure 2 shows a scheme with two precast elements, used in three crossing roads built in Canada [5]. So, it seems clear that precast concrete elements can be used in arch structural systems to produce efficient solutions for specific problems. In this way, the objective of this paper is to present a constructive proposal for large span culverts or small bridges using precast arch shaped elements to build a structure that permit the roadway can be placed directly over.

### 2. The constructive system

The basic idea of the constructive system is to use precast arch-shaped elements placed on the cast-in-place concrete base. These vaults have protruding reinforcement in the crowning region to receive the cast-in-place concrete. The extreme vaults also have protruding reinforcements to make the connection to the other precast elements which work as retaining wall. This constructive proposal was initially presented in reference [6] and later detailed in reference [7]. The sequence of