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Balanced lift method for the construction of bridges with two spans

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ABSTRACT: Conventional construction methods for building bridges with one tall central pier over deep valleys are the balanced cantilever method and the incremental launching method. In a research project at the Vienna University of Technology a different approach for the construction of bridges with one tall pier, called the balanced lift method (Kollegger 2006), was investigated. The case study for the construction of an alternative design according to the balanced lift method for the San Leonardo Viaduct, a bridge originally built using the balanced cantilever method, will be discussed in this paper. Furthermore, several large-scale tests and the first application of the balanced lift method are outlined in the full paper.

1 BALANCED LIFT METHOD

1.1 *The underlying idea behind the balanced lift method*

The balanced lift method is a bridge construction method for bridges with tall or short piers, which was developed at the Vienna University of Technology. The underlying idea is to assemble the key elements of the bridge in a vertical position and then rotate the bridge girders from the vertical into the horizontal position with the aid of compression struts, as shown in Figure 1. The inventors' objective was to create a construction method that could accelerate and simplify the construction of bridges with very specific boundary conditions. Even though both constructions of the bridges start with fragile elements consisting of ulta-thin precast elements, monolithic bridges with solid cross-sections are obtained in the end.

1.2 *Bridges with one tall central pier*

In order to fully describe the balanced lift method for bridges with one tall central pier the San Leonardo Viaduct in Italy was studied and an alternative design proposed. The original design of the San Leonardo Viaduct is a cantilever beam joined at the pier, with supports at the ends (grey

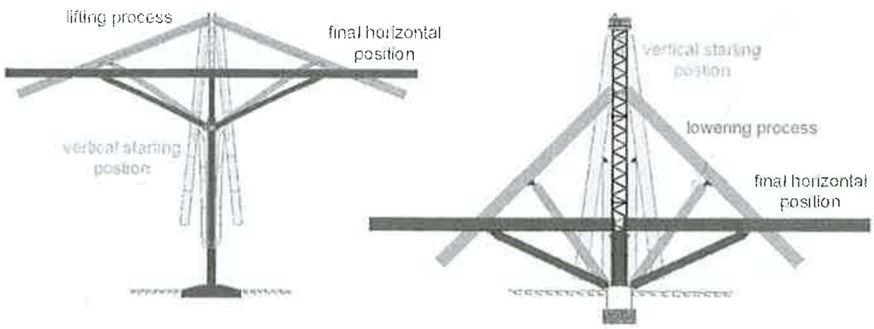

Figure 1. The balanced lift method for bridges with tall and short piers.

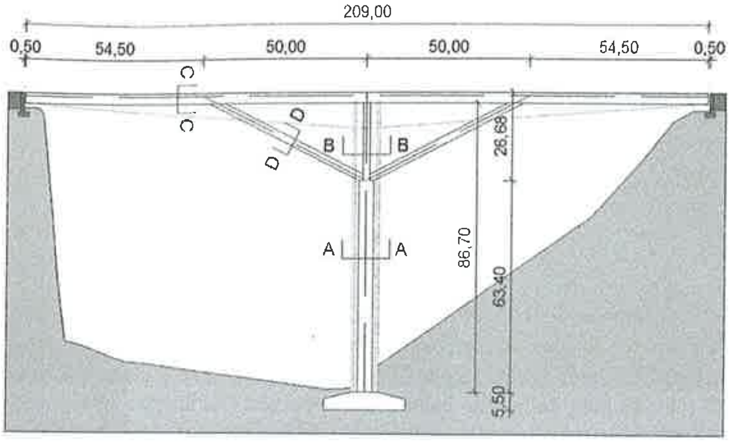

Figure 2. Design according to the balanced lift method with the original design in grey.

outline in Figure 3) with a span lengths of 105 m. The width of the viaduct is 23 m and the viaduct thickness is from 3 m to 10.60 m. The cross-section consists of a steal box beam, which is resistant to torsion. The beam is formed of a lower slab, two vertical walls and an upper slab connecting these walls and acting as deck for both carriageways. The design according to the balanced lift method proposes the construction of two balanced lift bridges and then connecting them with the deck slab. The spans are divided into lengths of two times 54.40 m and two times 50 m. The compression struts would have had positive effects on the height of the bridge girders, creating a slimmer and more elegant girder with a height of 3.38 m. A comparison of the thicknesses of the viaduct of both designs is shown in Figure 2. The compression struts and the bridge girders are made of hollow wall elements and ulta-thin precast elements during the first construction phases until they are filled with cast in-situ concrete.

1.3 *Bridges with one central short pier*

As shown in Figure 1 the balanced lift method, even though the method was primarily invented for bridges over deep valleys, can also be applied for bridges with shorter piers. The design with short piers is described using the example of the bridges over the Lafnitz and Lahnbach riversof the S7 motorway in Austria, whose start of construction has been set for the summer of 2015. The balanced lift design was also over 50% slimmer than the originally proposed steel bridge girders, with 2.0 m and 4.6 m, respectively. The cross-section of the bridges is a doubled webed t-beam with a width of 14.5 m. During the construction phase and the erection using the balanced lift method only the outer walls of the webs of the double webed t-beam cross-section (u-shaped bridge girders out of thin-walled precast elements) are existent.

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