Stadsbrug Nijmegen

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Summary

Due to heavy traffic around the city of Nijmegen there is a new city by-pass under construction including a new bridge over the river Waal. The city requested a City Bridge, which will allow a five lane crossing, a two lane-cycle path at the east side of the bridge and a 1.0 m wide inspection lane at the west side of the bridge. In the architectural ambition document from the city, the client also requested a convenient adjournment on and under the bridge. The main bridge over the river had to span at least 240 m, had to fit perfectly within the landscape and join the bridge family of the city. Life cycle and maintenance of infrastructure in this paper shows a different approach on the topic by presenting the design of an integral approach bridge. The structure is a new construction type, built with modern techniques and new materials with a design life time of 100 years and less maintenance costs. Completion of the bridge project is scheduled for the end of 2013.

Keywords: Integral bridge, arches, design life time

1. Introduction

The city of Nijmegen decided to build a new bridge across the river Waal, to improve the accessibility to the city and traffic spreading around the city. The bridge will be built at the historical location known as “De Oversteek” (“The Crossing”), where American soldiers crossed the river to secure the existing Waal bridge during the operation Market Garden. The existing Waal bridge, dated from 1936, was at the time of completion the biggest arch bridge in Europe with a span of 244 m.

The contract to design, build and maintain the new bridge crossing the River Waal at Nijmegen has been awarded to a consortium after a design competition in 2009.

The bridge has a total length of 1,400 m. The southern approach bridge at the Nijmegen side, lays in a curvature with a radius of 500 metres. The main span crosses the river Waal in a straight line, while the northern approach bridge is in a horizontal curvature of 2,000 metres.

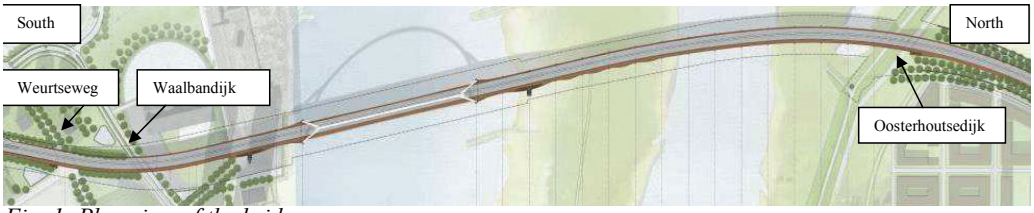

Fig. 1: Plan view of the bridge

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Fig. 2: View of the bridge

The approach bridges consist of a succession of concrete arches. The spans of these arches are 42.5 m. The thickness of the arches at the columns is just under 1.5 m and in the centre of the span 0.5 m. The void above the arches is filled with foam concrete to reduce the weight on the arches and covered with mixed aggregates and asphalt layers.

At the south side the continuous bridge measures a total length of 275 m. The main span with a length of 285 m consists of a steel single tied arch structure. The composite roadway deck is suspended from the arch by inclined stay cables.

The total continuous length of the side spans at the north side equals 703 m, including the abutment at the Oosterhoutsedijk. The concrete arches of the northern and southern approach bridges are rigidly connected to the bridge columns without bearings and expansion joints, to save maintenance costs. The northern approach bridge will be one of the longest integral bridge ever built in the world. The general width of the total bridge project is 25 m. The bridge is wider at the balconies and at two access points at the northern and southern approach bridge.

2. Design and durability

The design and execution of the bridge is classified in the CC3 class according to EN 1990.
In compliance with the client a decision was made to fulfil the CC3 requirement by an extra quality control (independent supervision) on the design and execution of the bridge. Therefore it was possible to classify the bridge in a CC2 consequence class, which equals a reliability index $\beta = 3.8$. Besides the above mentioned quality inspection level, the client has chosen an extra inspection level by TIS (Technical Inspection Service).

The bridge structure is designed according to the design loads from the EN 1992-2. Besides the standard and accidental loadings, the bridge has to fulfil the requirements that can lead to progressive collapse of the structure. To design the bridge on all possible accidental loadings, it is shown that the robustness of the bridge is well proven and the risk of a progressive collapse during the life time is limited to a minimum. During the erection of the bridge, special measurements have been applied to prevent progressive collapse.

The durability is covered and secured by the right concrete mixture in relation to the normative environmental classes. The quality of the concrete cover ensures the required lifetime of 100 years. The foam concrete that fills the arches can withstand the movements of the bridge for its 100 year design life time. Material and fatigue tests have proven the durability of the foam concrete. The outer and inner walls of the concrete bridge will be foreseen with brickwork. This prevents gravity painting and gives the bridge a very natural look in the river landscape.

Acknowledgements

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