

## The Refurbishing of the Nibelungen Bridge Worms, Germany

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### Summary

If the Nibelungen Bridge (Fig. 1), opened on traffic in 1953, is forced into the corset of present-day technical regulations, then it loses its adequate load-bearing capacity. However, if one follows Finsterwalder's ingenious design idea of 1930 and enriches it with the ideal of fully prestressing, a careful strengthening will result with just a few external tendons laid carefully inside the two hollow boxes and an allowance for shear approach that will enable the structure to cope with today's live loads. Apart from the replacement of the tiebacks in one land pier, the further defects are due to the greatly changed, aggressive environmental conditions and the effect of de-icing salt that could not be foreseen in 1953.



Fig. 1: Nibelungen Bridge Worms, 1953

Knowledge of construction history also helped to preserve this masterpiece of civil engineering without having to make any concessions with regards to its use.

**Keyword:** refurbishing of early post-tensioned bridges, live load, external tendon, shear capacity, construction history

### 1. Introduction

With the construction of the second superstructure for the Nibelungen Bridge in Worms, the growing volume of traffic using the Rhine crossing at Worms is being taken into account. After the opening for traffic of the cantilevered hollow box-girder bridge, prestressed externally using a mixed construction method, a complete refurbishing of the early masterpiece of the chief engineer of Dyckerhoff & Widmann A.G., Ulrich Finsterwalder (1897-1988), is to follow in 2010.

### 2. State of the structure and historical assessment

The original bridge was opened to traffic in 1900. It consisted of three steel two-centred arches with the carriageway superimposed which were supported on pillars with caisson foundations. The shore bridges are solid, three-centred arches made of tamped concrete faced with natural stone.

The present Nibelungen Bridge in Worms forms part of federal highway 47 and links the municipalities of Worms and Bürstadt. The bridge has a total length of 745 m and is divided into three part structures of differing construction consisting of the some 109 m long shore bridge on the left side of the Rhine in Rhineland-Palatinate, the 351,8 m long centre part of the bridge crossing the Rhine and the shore bridge on the Hesse side of a total length of 295.5 m. The current traffic volume amounts to some 23,000 vehicles/24h with a moderate heavy vehicle share of 8.7%.

In the case of the shore bridges, the twelve three-centred arches made of non-reinforced concrete