Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 156 (2016) 103 – 108

Procedia Engineering

www.elsevier.com/locate/procedia

9th International Conference „Bridges in Danube Basin 2016“, BDB 2016

Prestressed concrete bridges in Germany – overview of current new structures, re-analysis and research activities to preserve the existing infrastructure network

Oliver Fischer[a]*

[a]*Technical University of Munich (TUM), Chair of Concrete and Masonry Structures, Theresienstraße 90, 80333 Munich / Germany*

Abstract

Currently several major bridges are under construction in Germany, not only due to the construction of new roads and railway connections, but also because of the necessity to demolish and replace older bridges that no longer meet present requirements. Generally, the national infrastructure network is characterised by a relatively high average age of the existing bridges, a progressive increase in traffic volume (particularly with respect to the heavy traffic portion) and also a rise in weight of the individual vehicles and axle loads. In addition, several earlier design approaches for concrete bridges have been modified in modern codes, aiming to increase reserves in bearing capacity and to obtain more robust structures. Hence, an extensive assessment scheme was launched some five years ago, based on the so-called „Nachrechnungsrichtlinie“ (guideline for bridge re-analysis and assessment, latest release 04/2015), issued by the Federal Ministry of Transport and Digital Infrastructure, which provides a systematic staged re-analysis approach (four levels of analysis) adapted to the special demands of existing structures.

The present paper will firstly give a brief overview of selected new prestressed concrete bridges and related challenges and technical details in design and construction, including the utilisation of innovative materials and/or structural concepts. Subsequently, Germany's assessment strategy for existing bridges will be explained and relevant overall results and findings gained from the re-analysis scheme will be presented and discussed. Finally, current research activities focusing on a more realistic assessment of both actions (e.g. bridge-specific traffic loads) and resistances, i.e. the bearing capacity (particularly regarding the transmission of shear), will be addressed. In view of limited financial resources and the negative consequences induced by civil works in busy traffic infrastructure, it is of utmost importance to only strengthen (or even replace) those bridges where such measures are unavoidable and absolutely necessary.

Peer-review under responsibility of the organizing committee of BDB 2016

Keywords: prestressed concrete bridges; innovative structures; re-analysis and assessment; shear capacity; bridge-specific traffic loads

* Corresponding author. Tel.: +49-89-289-23038; fax: +49-89-289-23030.
E-mail address: oliver.fischer@tum.de

Peer-review under responsibility of the organizing committee of BDB 2016
doi:10.1016/j.proeng.2016.08.274

1. Introduction

The provision of an efficient, capable and fully functional traffic infrastructure network is of utmost importance in view of both guaranteeing mobility, transport and economic capability and preserving the people's quality of life. This particularly applies for countries with extensive trade relations and highly-developed industrial and economic activities. Hereby, critical points in infrastructure networks commonly are engineering structures such as bridges and tunnels, with unfavorable consequences arising from restrictions in service. Accordingly, the permanent preservation of unrestricted functionality and structural safety of these structures has to be pursued with highest priority.

In the following, a brief overview of selected new prestressed concrete bridges as well as related challenges and technical details (road and railway bridges) will firstly be given in section 2. Subsequently (section 3), Germany's re-analysis and assessment strategy for existing bridges will be explained and relevant overall results and findings gained from the re-analysis scheme will be presented and discussed. Finally, in section 4 current research activities focusing on a more realistic assessment of both actions (e.g. bridge-specific traffic loads) and load-bearing mechanisms and resistances, i.e. the bearing capacity (particularly regarding the transmission of shear), will be addressed.

2. New major bridges in Germany

In recent years and also today there are several major bridges under construction in Germany related to both the road and railway infrastructure network. On the one hand, structures are necessary because of new roads and railway connections, e.g. the new high-speed railway link Nuremberg – Halle/Leipzig, with some innovative slender bridges and the longest railway bridge in Germany (Saale-Elster viaduct, length of main bridge 6,465 m) or the HSR link connecting the cities of Stuttgart and Ulm with the new Filstal viaduct being one of the most challenging and spectacular German railway bridges. In addition there are also some measures on federal highways requiring bridges and engineering structures such as e.g. the extension of BAB A94 in Bavaria. On the other hand, there are also many locations along the existing network requiring the demolition and replacement of older bridges that no longer meet present requirements. In addition to some very old railway bridges (partially over 100 years) this applies for a series of roadway bridges in the course of highways, e.g. BAB A44, A61 and A3 (amongst others: bridge Heidingsfeld in the vicinity of Würzburg; Lahntal viaduct near Limburg [1], Fig. 1) and also to a couple of major river bridges, e.g. Leverkusen (cable-stayed bridge, severe fatigue problems) and Schierstein (steel and steel-composite beam bridges connecting Wiesbaden and Mainz, main span 205 m) across the river Rhine.

Fig. 1. Lahntal bridge, (a) balanced cantilever erection with auxiliary pier; (b) twin-box cross-section (width 21.44 m) before closure at midspan

Besides new major bridges and viaducts there are also smaller ones with interesting details mostly focusing on an enhancement of maintenance and durability. One example is the new flyover near Greißelbach being characterized by