



Structural Verification of Older Prestressed Concrete Road Bridges in Germany

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Summary

The paper specifies the scope and briefly summarizes the content of the German Provisions for Structural Assessment of Older Road Bridges. The general assessment procedure is described and aspects like modified partial factors and traffic loads to be considered are addressed. A special focus is put on the modified approach for the verification of shear load carrying capacity of prestressed concrete bridges.

Keywords: existing bridges; structural assessment; assessment provisions; assessment procedure; traffic load model; modified partial factors; prestressed concrete; shear

1. Introduction

A look at the stock of existing reinforced or prestressed German concrete road bridges reveals that there are more than 1000 large federal road bridges in use today which have reached a service life of about 30-50 years. As these structures cannot easily be closed for rehabilitation or even replacement without causing major traffic disturbances, a comprehensive structural assessment campaign was recently initiated in order to obtain accurate evaluations of their future usability. The unrestricted usability of these bridges is of vital importance for maintaining an efficient German road network. Generally, an existing German road bridge can be regarded as usable if its reliability level is not lower than the level required for new structures. A simple and conservative way to evaluate the reliability of existing bridges is to perform a structural assessment based on current design codes and under consideration of today's design loads. However, considerable changes of traffic load models occurred over the last decades and the design and detailing rules for new structures have constantly been improved over the course of time. Therefore, many of the existing older German road bridges are not built according to the latest generation of design codes.

As first experiences from structural assessments of selected existing bridges based on current design codes and under consideration of today's design loads frequently lead to failing several SLS and ULS checks, a working group of transportation officials, researchers and consulting engineers gathered, discussed and enhanced approaches for a structural assessment under consideration of today's experiences and state of the art methods. The outcome was the first edition of the German Structural Assessment Provisions for Older Road Bridges [1], which has been published in May 2011. The full paper provides the concept and scope as well as an outline of the content of the new Structural Assessment Provisions. In addition, the part of the Provisions dealing with the verification of shear load carrying capacity of prestressed concrete bridges is described in detail.

2. Concept, scope and content of the German Structural Assessment Provisions for Older Road Bridges

The German Structural Assessment Provisions for Older Road Bridges enable an evaluation of safety and serviceability of existing reinforced and prestressed concrete, steel, composite and masonry road bridges built according to previous codes. The Structural Assessment Provisions are based on the approaches of the current German bridge design codes (*DIN-Fachberichte*) but also

allow for additional verification measures. In a stepwise approach (level 1 – level 4) more and more prior information about the structure can be included and more sophisticated verification models than contained in current codes can be applied. Higher levels of assessment might yield additional load bearing capacities but also require more complex and time-consuming analyses.

A level 1 structural assessment according to the German Structural Assessment Provisions for Older Road Bridges has to be performed for each structure. A level 1 assessment is equal to a re-design according to the current bridge design codes (*DIN-Fachberichte*). Even though the safety and serviceability of the bridge can most likely not be verified in this step, it is important to obtain the results in order to compare the deficiencies of different structures against a consistent scale (i.e. against the code requirements for new structures). A level 2 assessment allows for the use of more precise models and an adjusted safety concept not contained in the original code. As it is possible to choose from a variety of modifications, level 2 assessments are always adjusted to the characteristics of each individual structure. Therefore, a comparison of the results of level 2 (or higher) assessments of different structures is not feasible. A level 3 structural assessment corresponds to a level 2 assessment under consideration of measurements made at the structure. In a level 4 assessment, scientific methods like a probabilistic analysis or a nonlinear 3D finite element analysis can be used. In order to facilitate a better overview of the structural assessment process according to the German Structural Assessment Provisions for Older Road Bridges, Fig. 1 summarizes all important sequences.

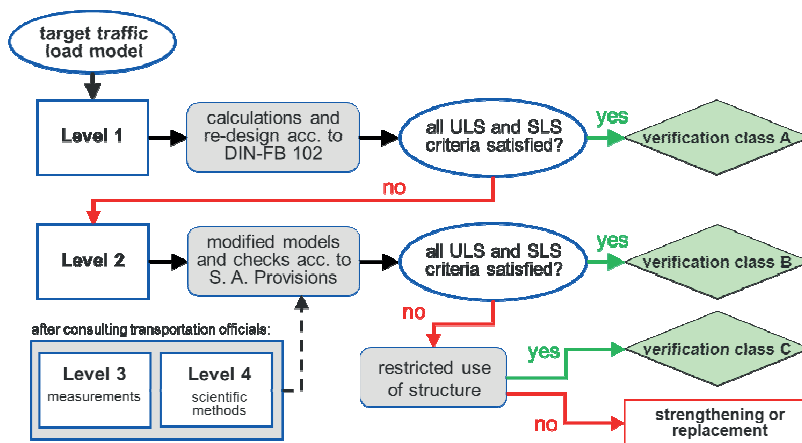


Fig. 1: Assessment procedure according to the Structural Assessment Provisions for Older Road Bridges

First applications of the assessment approach of the Structural Assessment Provisions have shown that an assessment based on the new Provisions can lead to a significant reduction of required strengthening measures and yields a more realistic estimate of the load bearing capacity. At the moment the German Structural Assessment Provisions for Older Road Bridges are used in the structural assessment of selected, representative federal road bridges. After the end of this test phase, most likely in late 2013, a second edition of the Structural Assessment Provisions and a comprehensive background document will be published. The second edition is supposed to be based on EN 1992-2 rather than DIN-Fachbericht 102 in order to provide a link between the Structural Assessment Provisions and the code in effect then.

3. References

- [1] BUNDESMINISTERIUM FÜR VERKEHR, BAU UND STADTENTWICKLUNG, *German Structural Assessment Provisions for Older Road Bridges*, (in German: Richtlinie zur Nachrechnung von Straßenbrücken im Bestand), available online: www.bast.de, May 2011.