



## Structural Reassessment of Existing Road Bridges in Germany

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## Summary

The assessment and the preservation of existing bridges is a great challenge to the departments of transportation and highways of the Federal Republic of Germany. The increased traffic volume and traffic loads in comparison to those which the existing bridges were originally designed for and the ageing of the structures necessitate a reassessment.

For this purpose a special code for the structural recalculation of existing bridges was worked out by a task group of the Federal States and the State of Germany on behalf of the Federal Ministry for Transport, Construction and Urban Affairs, which has been applicable since May 2011. First insights and experiences from its application shall contribute to the future development of this new regulation. In the context of a project of the *TU Dresden* with the State Office for Transportation of a north-eastern federal state the new regulation is being applied to existing road bridges in this one. The Institute of Concrete Structures of the *TU Dresden* is responsible for the scientific and technical supervision of the recalculation which is done by various consulting engineers.

This paper describes the approach to the recalculation of the existing road bridges in this federal state of Germany, the classification into groups of different types of structures, the prioritisation and the choice of representative bridge structures for the recalculation and the evaluation of its results for the final assessment.

**Keywords:** Bridges, Structural reassessment, Structural recalculation, German recalculation guideline, *Nachrechnungsrichtlinie*

## 1. Motivation

The preservation of existing bridges constitutes a steadily growing challenge to the departments of transportation. On the one hand today's traffic loads are generally higher than they were at the point of time most existing bridges were constructed. Basically one needs only take into account the considerably increased volume of traffic in the past or the so called Gigaliners having been allowed on the streets in some parts of Germany since 2012. On the other hand the ageing of the existing bridges makes their reassessment necessary.

Therefore a German state and federal workgroup on behalf of the Federal Ministry for Transport, Construction and Urban Affairs (BMVBS) developed a guideline for recalculation of bridges, the so-called *Nachrechnungsrichtlinie*, having been applied since May 2011. The experiences and findings having been gained at first practical applications should be integrated in the further development of this new code. The Institute of Concrete Structures of the *TU Dresden* intends to contribute to that development with the project introduced in the paper at hand. In collaboration with the State Office and several consulting engineers the recalculation guideline is currently being adopted to the existing road bridges in the federal state. The *TU Dresden* is here concerned with the scientific and technical supervision and evaluation.

## 2. Analysis of Existing Road Bridges

Firstly, the data of the existing bridges stock with its variety of road bridge buildings in the federal state being in the Federal (and State) easement were analysed in detail. Therefore the awarding authority made a building database available including all technical details of the bridge structures being relevant for this examination. Hereby both the essential technical building data and the results of the periodic examinations of the current bridge condition from building inspections were taken into consideration.

## 3. Selection Procedure of the Bridge Structures for the Recalculation

Only a limited amount of about 40 bridge structures is supposed to be recalculated. Therefore the whole stock for each material is grouped according to the type of structure, e. g. slab, beam, box girder etc. and according to method of construction, e. g. precast or in-situ. The prestigious ones of each group are then chosen to represent the total stock. The selection of these representatives was carried out according to certain criteria, which is why the structures were arranged regarding their priority within the group.

## 4. Recalculations

The guidelines and boundary conditions of the recalculation for the buildings were fixed in tender specifications by the awarding authority. The scope of the work was thereby basically oriented on the requirements of the code [2]. It further contains, beside a detailed description of the structure, an on-site inspection report to be prepared by the engineer responsible for recalculation so as to prove the current condition. The inspection is made with special regard to the existing damages of the building.

After the tendering and contracting the recalculations for each bridge structure were carried out by accordingly qualified and experienced consulting engineers.

## 5. Results from the Recalculations

As said at the beginning of the paper one central issue for the recalculation was the considerably grown traffic load compared to the original design. This progression was represented by the steady development of the design codes and reflects itself in a continuous augmentation of the normative traffic loads on the load side. This increase leads to the fact that especially old structures being classified in low bridge classes do not comply with today's standards any more.

Since a recalculation according to current standard traffic load models is not promising the traffic loads meaning the target level for the recalculation is being agreed upon between consulting engineer and awarding authority depending of each case.

## 6. Discussion, Conclusions and Acknowledgements

The increase of the traffic load constitutes a serious threat to the safety of our bridges owing to their age distribution and the state of the existing structural substance. The progressive ageing of the structures further contributes to the worsening of this situation.

The Institute of Concrete Structures of the *TU Dresden* wants to make its contribution to the safety of our bridges with the project introduced in the paper at hand concerning the scientific and technical support for applying the *Nachrechnungsrichtlinie* onto the bridge stock in one federal state.

We thank our awarding authority for the trust it has placed in our scientific and technical supervision within the project of applying the *Nachrechnungsrichtlinie*.

Our special thanks go to the consulting engineers having provided the static recalculations with great effort and accuracy.