



Department of Civil, Geo and Environmental Engineering  
Chair of Concrete and Masonry Structures

## Extended approaches for structural assessment of existing concrete bridge systems



**Dipl.-Ing. (FH) Marcel Nowak, M.Sc.**  
marcel.nowak@tum.de

**Univ.-Prof. Dr.-Ing. Dipl.-Wirt.-Ing. Oliver Fischer**  
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### Motivation

For highly developed countries like Germany, the traffic infrastructure – and especially the highway network – is of essential importance to ensure mobility, economic capacity, and quality of life for its people. Bridge structures are often critical points within this network, as restriction or even loss of functionality generally entails considerable and expansive consequences. For this reason, permanent sustainment of unrestricted functionality and safety of such structures has highest priority.

### Main objectives

The main parameters influencing the structural assessment of existing concrete bridges shall be described in a manner that is more realistic, but still feasible for engineering practice. Following this principle, a consistent concept shall be proposed,

allowing for verification of full functionality and structural safety throughout the remaining lifetime of a structure without leaving the required level of structural reliability. This would help to minimize the need for strengthening, retrofitting or reconstruction of existing bridges, and hence allow to use valuable resources in a more targeted, efficient and sustainable manner.

### Implementation

In a first step, the representation of traffic load impact on bridge structures is investigated in more detail. Statistical analysis of recorded traffic data along an exemplary route has to be performed to obtain stochastic descriptions for relevant parameters representing the site-specific traffic.

These serve as input for extensive numerical traffic simulations that generate sequences of artificial traffic with the same statistical characteristics as the real traffic recorded along the route. For sensitivity analysis, as well as to account for exceptional traffic conditions or future traffic developments, several traffic simulations with varying parameters are performed and evaluated. For evaluating the demands of bridges subjected to this traffic, the structures are modelled using influence functions for relevant structural response parameters at decisive locations on the structure. Subsequent statistical analysis of the resulting response time histories allows for the determination of characteristic demand values, with a defined probability of occurrence (as specified in the Eurocodes). These characteristic values are used for calibration of the site-specific load model, by adapting the  $\alpha$ -values of the current load model from the Eurocode such that an evaluation of the system with this “reduced” model leads to the same demands as obtained by evaluation of the simulated traffic.

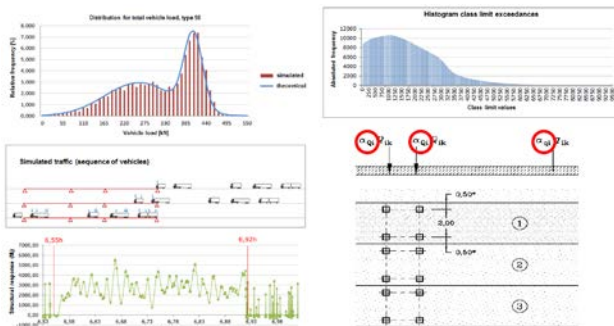


Fig. 1: Modified load model based on traffic data [1]

The result can be considered as a modified load model, more realistically representing the site-specific traffic, for the use in the evaluation of existing structures. This allows for the development of more efficient concepts for dealing with an extensive and aging infrastructure network, as it

enables a more significant and realistic evaluation of the structure without reducing the level of reliability.

### Further scope of research

Further research efforts aim for helping to reveal the potentials of an integrated consideration of structural reliability on system level by combining more realistic descriptions of load impact and structural resistance with information obtained from bridge inspections and structural monitoring by means of extended probabilistic concepts allowing for an even more detailed assessment of structural reliability.

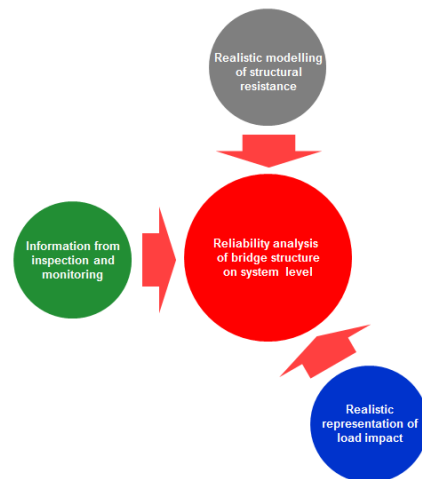


Fig. 2: Integrated approach for structural reliability assessment of existing bridge structures

### References

[1] Frank, S.: Simulation von Verkehrslasten auf Straßenbrücken und Ermittlung der Tragwerksreaktion an ausgewählten Systemen, Master Thesis, Lehrstuhl für Massivbau, TU München, 2014