



# Assessment of Steel Railway Bridges for Wind and Traffic Load Effects

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## Abstract

The paper describes the final results of the project focused on the assessment of the existing railway bridges with respect to the wind load and traffic load in both ultimate limit state and equilibrium limit state. The outcomes of the project are based on extensive wind tunnel testing. Detailed probabilistic and reliability study is presented in this contribution using the wind tunnel data, and available railway traffic and wind speed data for a given location. The main result is a set of reduction factors for wind forces acting on specific railway bridge types and rail vehicles and calibrated combination factors for simultaneous action of unloaded train and wind in equilibrium limit state.

**Keywords:** Steel railway bridges, wind tunnel, probabilistic analysis, equilibrium limit state, wind modeling, traffic modeling.

## 1 Introduction

Lot of European countries are nowadays dealing with an aging railway infrastructure where a number of existing bridges are reaching their design service life and are currently being assessed and classified according to their load-bearing capacity. This is an urgent issue in the Czech Republic with one of the oldest and most dense railway infrastructure where many of these old bridges are listed as cultural heritage monuments. In order to preserve these structures which are often located on local lines of low importance, railway authorities tend to be open to introduction of refined methods for remaining service life estimation. This paper summarizes the results of extensive wind tunnel measurements performed on a set of representative steel railway bridges for which load-bearing capacity and overall performance was highly limited by wind load effects in both Ultimate Limit State ULS and Equilibrium Limit State EQU. The results of the measurements are used to develop a set of wind load reduction factors and combination factors for simultaneous wind and traffic actions. All

approaches are in accordance with the UIC guidelines [1,2] and are in broad agreement with the principles provided by Eurocodes.

## 2 Wind tunnel measurements

Experimental measurements were carried out in a climatic wind tunnel located in the Centre of Excellence in Telč, Czech Republic which is part of the Institute of Theoretical and Applied Mechanics of the Czech Academy of Science. It is a closed-circuit wind tunnel of the Göttingen type. The tunnel is divided into two sections; an aerodynamic section is adapted for aerodynamic measurements of the wind effect on structures and a climatic section is used for synergic modelling of climatic factors such as temperature, rain, icing, and radiant heat. The wind tunnel is shown in Figure 1.