Equivalent nosing force for a steel railway bridge based on in situ measurements

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Abstract

The weight and design speed of the railway vehicles increases in time. As a result, the values of design loads grow up. In old Bulgarian standard [1] the equivalent nosing force is prescribed as 60kN. In the present EN1991-2 [2] this value is 100kN. Meanwhile, a significant part of the very old bridges is not designed for nosing forces. In cases of long span between cross girders of the "open type" deck and lack of nosing braces, the load bearing capacity of longitudinal girders, concerning out of plane bending moments due to nosing forces, is insufficient. To investigate the value of equivalent nosing force are provided "in situ" measurements on the longitudinal girders of "open type" deck of a steel riveted railway bridge in exploitation in the Republic of Bulgaria. The strains and horizontal linear deformations are measured in the midspan of the longitudinal beams for real trains. The equivalent nosing force is calculated using developed procedures.

Keywords: steel bridge, longitudinal girders, "in situ" measurements, deformations, nosing force

1 Introduction

Due to the imperfections of the track and the railway vehicles, when the trains run in the longitudinal direction, there are also movements in a transverse direction. As a result, the wheel flanges, which do not allow the trains to derail, touching the rail's head, cause forces transverse to the road axis. According to the "Standard for the design of road and railway bridges and culverts" by 1990 [1], the transverse horizontal force in railway bridges has a characteristic value Q_{sk} = 60 kN. According to the European standard EN1991-2: 2006 [2], the nosing force has a value Q_{sk} = 100 kN, and when taking into account the coefficient for classified loads α = 1,21, specified in BDS EN 1991-2: 2006/NA:2015 [3], the characteristic value increases to Q_{sk} = 121 kN. The difference in Q_{sk} is more than twice. The question arises as to which of the above normative documents prescribes more realistic values. In an attempt to obtain an answer to this question, a research team from the University of Architecture, Civil Engineering and Geodesy (UACEG) has performed field measurements and calculations of the corresponding values of the transverse horizontal forces, caused by real railway trains, crossing a steel bridge with an "open type" deck.

2 Type and basic data for the researched bridge

The bridge, on which the values of the equivalent horizontal nosing forces have been experimentally determined, is a double span steel railway bridge, see Fig. 1, located above the river Iskar. In each span are placed two truss main girders, simply supported on the lower chord by fixed and linearly movable steel bearings. The deck is classic, "open type" (rails and wooden sleepers step directly on the longitudinal beams). Pin joined longitudinal and transverse beams, having approximately similar height, construct it.

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