Improving of fatigue assessment method of stud shear connectors using experimental data from studs' test of existing road bridge

Nikolai Kozak, Vladimir Bystrov, Dmitry Yaroshutin, Nikolai Daliaev

Saint Petersburg State University of Architecture and Civil Engineering, St. Petersburg, Russia

Contact: kozak.spbgasu@gmail.com

Abstract

Nowadays there are varieties of methods for fatigue assessment of stud shear connectors in bridges with steel-concrete composite superstructures. These methods can consider various parameters, such as traffic flow characteristics, asymmetry factors, etc. Bridge design codes used in Russia are quite conservative in this matter and prescribe fatigue assessment based only on the maximum stress value, taking into consideration the reduction factor, ignoring the actual traffic loads. To improve the methodology for fatigue assessment, the authors of the article performed a full-scale experiment on a reconstructed bridge on the federal highway in Russia. The purpose was to determine the actual dynamic stresses in stud shear connectors from the transport load. During the reconstruction of the bridge, strain gauges were installed on stud shear connectors, and then connected to a digital measuring system. The article provides a complete description of the methods used and the results of the experiment. Based on the obtained data analysis, authors propose recommendations for adjusting the standard impact factors. Based on the results of comparison of the damage values obtained theoretically and experimentally, the authors make a proposal on the need to adjust the design loads used.

Keywords: steel-concrete composite bridge, connector, stud shear connector, fatigue assessment, fatigue, endurance, damage, traffic load, dynamic impact factor.

1 Introduction

One of the most important identifying features of the structural behavior of bridge structures is the unsteady dynamic loading condition. Transport loads move along the bridge at a certain inconstant speed, the distribution of transport in the transverse direction is characterized, among others, by random values, and possible irregularities of roadway covering significantly increase the dynamic component of the load [1]. In such operation conditions, which include a large number of forces and stresses changes in the elements; a significant role is assigned to the endurance of structures.

With regard to the now widespread steel-concrete composite superstructures, one of the least studied is the question of the actual behavior and endurance of the structure joints in general and particularly stud shear connectors as their most common type.

Most of the researches that explore stud shear connectors behavior consider laboratory conditions (classic push-out tests), which do not fully simulate the actual structural behavior with multiaxial loadings and significant dynamic effects [2–7].

Earlier, for the purposes of this study, we conducted an analysis of the worldwide fatigue assessment methods, including the fatigue assessment of stud shear connectors [8]. The