Testing of composite girders with coiled spring pin shear connectors

Robert Hällmark, Rasoul Nilforoush, Victor Vestman, Peter Collin

Luleå University of Technology, Luleå, Sweden

Contact: robert.hallmark@ltu.se

Abstract

Today, steel girder bridges with concrete deck slabs are generally constructed as steel-concrete composite structures, to utilize the material and the structural parts in an efficient way. However, many existing bridges constructed before the early 1980´s were designed without shear connectors at the steel-concrete interface. With increasing traffics loads and higher amount of load cycles, there is sometimes a need to strengthen these bridges. One way to increase the bending moment capacity is to create composite action by post-installation of shear connectors. The authors have studied the concept of strengthening by post-installed shear connectors, with a focus on a connector called coiled spring pin. This paper presents the results from the first beam tests performed with this kind of shear connector. In line with the previous push-out tests, the test results indicate a very ductile shear connection, with a potential to be a material- and cost-efficient strengthening alternative.

Keywords: bridge; strengthening; rehabilitation; shear connector; test; composite girder; coiled spring pin

1 Introduction

Modern steel-concrete girder bridges are generally designed as composite structures, to utilize the different materials and structural parts in an efficient way. Existing steel-concrete girder bridges in the Nordic countries from the early 1980´s and older were, however, generally designed as non-composite structures without shear connectors transferring a longitudinal shear flow at the steel concrete interface. These bridges are often in good condition and could remain in service for several decades. However, since the traffic loads have been increasing over time and also the number of load cycles from heavy vehicles, the traffic load capacity might be a problem nowadays. If an assessment indicates that the traffic load capacity is too low for future demands, in terms of global bending moment capacity, post-installed shear connectors in one possible strengthening method. By installing shear connectors in non-composite steel-concrete girders, the traffic loads will act on a composite section instead. Since there are more than 2000 existing bridges of this type only in Sweden, Norway and Finland, there is a potential need for a cost- and material-efficient strengthening method. Especially since the allowed traffic loads have been increased to higher and higher levels in Sweden and Finland in recent years.

Strengthening of non-composite steel-concrete girders has been studied by several researchers, covering different types of shear connectors and installation methods. A research group at the University of Austin at Texas has performed a comprehensive study of different types of post-installed shear connectors, through modified push-out tests, girder tests and pilot test on an existing bridge [1-8]. Example of laboratory tests on post-installed shear connectors performed by other researchers are [9-12], while [13-15] reports from

https://doi.org/10.2749/ghent.2021.1700
Distributed by structurae