3rd International Conference on Applied Researches in
Structural Engineering
and Construction Management
Sharif University of Technology - June 2019

Fatigue Behavior of Headed Stud Shear Connectors in Steel-Concrete Composite Bridge Girders

Mohammad Saeed Mafipour[1], Sepehr Tatlari[2], Amir Reza Ghiami Azad[3*], Moslem Shahverdi[4], Soheil Mohammadi[5]

1,2- MSc Student, School of Civil Engineering, College of Engineering, University of Tehran
3*, 4- Assistant Professor, School of Civil Engineering, College of Engineering, University of Tehran
5- Professor, School of Civil Engineering, College of Engineering, University of Tehran

Email: rghiami@ut.ac.ir

Abstract

Fatigue is one of the main limit states in the design of shear stud connectors of steel-concrete composite bridges. In order to control fatigue in shear connectors, provisions mainly propose S-N curves. However, these curves have mostly been based on a limited number of experiments although many other S-N curves have been reported which are different. To address this issue, extensive data of conducted experiments on headed shear studs since 1950 are collected in this study, effects of various parameters on the fatigue behavior of headed shear studs are investigated. Finally, a three-level master curve is presented to evaluate the fatigue behavior of shear studs in steel-concrete composite bridge girders.

Keywords: Fatigue, Shear Studs, Bridge, S-N Curves

1. INTRODUCTION

Steel-concrete composite bridges have always been of interest as they combine the advantages of steel with concrete effectively. In order to design beams in the composite bridges two requirements must be satisfied;
1. Strength requirements, and
2. Fatigue requirements.

Strength requirements are generally well-known and can be satisfied systamitcly. On the contrary, fatigue requirements are more complicated such that most of the recent failures of composite bridges have been due to fatigue failures. Regardless of the type of materials used in the bridge, fatigue failures are brittle and can occur in stress levels lower than the yield stress. Composite bridges are subject to the cyclic loads from the traffic on the bridge making these structures vulnerable to fatigue failures.

Fatigue generally occurs in different components of structures. One of these components in composite bridges are the shear connectors that join the steel girders to the concrete deck of the bridge as shown in Figure. 1. These shear connectors are mainly designed to transfer the shear forces developed between the concrete deck and the steel girders, which result in a stiffer, stronger and more ductile behavior for sustaining the applied loads. The effective shear forces applying to shear connectors can be obtained by using available analytical methods [1].

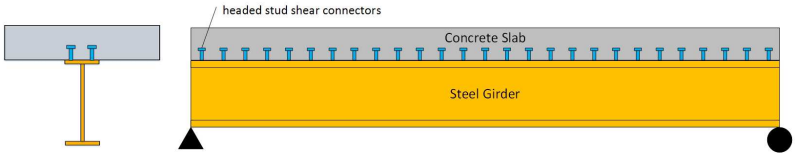

Figure 1. Composite Beam and its Section

The most well-known type of shear connectors are headed stud shear connectors. Symmetric shape and availability in various sizes are the advantages of headed studs. In order to evaluate fatigue of headed stud's provisions generally suggest S-N curves obtained from experimental studies. Hence, each of the provisions proposes a different S-N curve depending on the accepted experimental results. Therefore, a single S-N curve