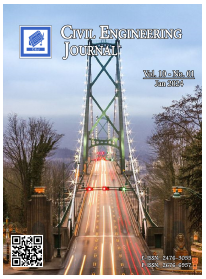
Available online at www.CivileJournal.org

Civil Engineering Journal

(E-ISSN: 2476-3055; ISSN: 2676-6957)

Vol. 10, No. 01, January, 2024



The behavior of Shear Connectors in Steel-Normal Concrete Composite Structure under Repeated Loads

Abdulamir A. Karim [1], Jawad Abd Matooq [1*], Oday A. Abdulrazzaq [1], Fareed Hameed Majeed [1], Samoel Mahdi Saleh [1]

[1] *Department of Civil Engineering, College of Engineering, University of Basrah, Iraq.*

Received 30 September 2023; Revised 15 December 2023; Accepted 21 December 2023; Published 01 January 2024

Abstract

In today's construction industry, the use of composite beams is becoming more and more important, particularly for long-span bridges that must withstand repeated loads from moving automobiles. This work investigates the behavior of composite beams through experimentation. Six push-out steel-concrete specimens are made and tested with various levels of static and repetitive loading applied. The specimens are made of rolled steel sections that are joined to concrete decks on both sides by stud shear connectors. Two approaches—one static and the other repeating—applied a push-out load to two sets of samples. One has a stud shear connector measuring 16 mm, and the other measures 25 mm. Three specimens were made for each group. To determine the final load, one specimen from each group underwent a static push-out test in the first stage. In the subsequent phase, repeated loads of 0-80% and 25-80% of the maximum static load were applied to the remaining ones. The analysis process measured the variation in slip between the concrete decks and the steel section over several load cycles. It was found that the recorded slip values at the ultimate load increased about four times just before the failure. The recorded values of the residual slip at the end of each load cycle decreased with the increase in load cycle numbers. Also, it was found that the values of the residual slip depend on the values of the lower and upper limits of the load level.

Keywords: Composite Beams; Push-Out Test; Repeated Load; Residual Strength; Load Slip Relation; Composite Construction.

1. Introduction

Composite construction constitutes one of the most cost-efficient structural systems by using the desired properties of various materials in an optimal manner. Concrete decks or slabs connected to rolled steel sections are widely used in the applications of long-span bridges and floors. The rolled steel sections are connected to concrete slabs using mechanical devices called shear connectors to transfer the horizontal axial forces between the two components to ensure their integrity. The use of shear connectors between steel beams and concrete slabs appeared in the 1950s rather than the design of each component to behave separately, keeping in mind the design of steelwork to carry the whole weight of the concrete [1].

Many types of shear connectors were developed, such as steel bars and tees with hoops, channels, angles, and stud shear. The stud shear is proven to behave as a ductile member, so it is most widely used with a practical length of 65 to 150 mm and a diameter of 13 to 25 mm, although larger dimensions are also found [1]. So most experimental and theoretical research was focused on composite beams with headed stud shear connectors.

* Corresponding author: jawad.abd-matooq@uobasrah.edu.iq

http://dx.doi.org/10.28991/CEJ-2024-010-01-013