Bonding between New and Substrate Concrete in Composite Beams subjected to the Effect of Repeated Loads

Tariq Emad Ibrahim
Department of Civil Engineering, College of Engineering, University of Basrah, Basrah, Iraq
civil.eng.tariq@gmail.com (corresponding author)

Oday A. Abdulrazzaq
Department of Civil Engineering, College of Engineering, University of Basrah, Basrah, Iraq
oday.abdulrazaq@uobasrah.edu.iq

Samoel Mahdi Saleh
Department of Civil Engineering, College of Engineering, University of Basrah, Basrah, Iraq
csamoel.saleh@uobasrah.edu.iq

Received: 14 July 2024 | Revised: 30 July 2024 | Accepted: 4 August 2024

 DOI: https://doi.org/10.48084/etasr.8392

ABSTRACT

This study uses experimental methods to assess the bonding strength of aged concrete compared with several types of new concrete under the effect of repeated loads. The major goal of this study is to evaluate several methods for creating bonding behavior. Additionally, it evaluates the influence of altering stiffness and shrinkage rates at the interface between concrete layers poured at different dates. The experimental tests examined the impact of numerous parameters, including surface preparation, bonding agent type, age difference, and the kind of concrete utilized in the new concrete. The flexural test results show that the percent of Pu (repeated) / Pu (static) was about 85%, 95%, 98%, 95%, 97%, 92%, and 95% for the composite beam with the shear connector, SCC, steel fibers, rough surface, SBR, SIKA, and HSC, respectively. The ultimate load increased by 126% for the composite beams with stirrups as shear connectors with respect to the reference beam. So, using stirrups as shear connectors between new and old concrete significantly increased the load-carrying capacity of the beam subjected to repeated loads.

Keywords beams; old concrete; repeated load; new concrete; self compacted concrete

I. INTRODUCTION

An essential part of the repair process is the bonding of newly poured concrete with the older concrete. The usage of traditional vibrated concrete in original and overlay concrete settings was the focus of this inquiry. There is a lack of information about the behavioral characteristics of several newly produced varieties of concrete, particularly regarding overlay concrete [1-4]. The substrate, overlay, and zone of bonding are the three distinct stages that make up the maintenance system, which might be thought of as a complicated system. The term "zone of bonding" refers to the region that includes and incorporates the bond plane in this context. For the bond region to sustain the various external stresses exerted on the system, enough structural integrity must be possessed. A link's resilience and endurance are influenced by several variables. Employing testing procedures that can accurately measure bond strength and pinpoint the specific failure mechanism is crucial for ensuring the quality assurance of bond strength. Many studies have been conducted, which have resulted in the creation of various testing procedures. Tests are often carried out in both lab and on-site environments [5]. The bond strength pertains to the level of adhesion between the overlay and substrate, and it has the capacity of being the most susceptible feature of the system. A robust connection is an essential factor in the formation of a cohesive system [6-9]. The curing conditions, water-to-cement ratio, surface roughness, age difference between concrete layers, additional cementitious materials, and the kind of bonding agent are the main factors affecting the strength of interfacial bonds. The three main methods for joining old and new concrete layers include using bonding chemicals, employing nails, and roughening up the substrate surface [10-12].

Authors in [13] examined how interface treatment affects the seismic performance of columns enhanced with Reinforced Concrete (RC) jacketing to improve the bending moment at the ultimate stage. A numerical study was conducted to gain a deeper understanding of the subject. For undamaged samples