

Analysis and optimization of a continuous composite bridge with uplift-restricted and slip-permitted connectors

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Abstract

To improve the cracking resistance of reinforced concrete (RC) slab at hogging moment region in continuous composite bridge system, a new connection concept called the uplift-restricted and slip-permitted (URSP) connection has been proposed. This paper presents both the design and analysis of a three span continuous composite bridge where URSP connectors were used. Based on design process of the project, some practical design guidelines and construction methods are proposed for the application of URSP connectors. Finite element model of the bridge considering construction process is established according to the case project. Simultaneously, another model of the same bridge with only stud connectors is built for comparison, the results show that URSP connectors can effectively improve the cracking resistance behavior of RC slab with little influence on the overall stiffness and strength of the composite beam. Furthermore, the optimization analysis of URSP connector at structure level is studied. The design guidelines and the analysis results in this paper can provide a reference for further study on the application of URSP connectors in continuous composite bridge system.

Keywords: continuous composite bridge; optimization analysis; cracking resistance; hogging moment region; uplift-restricted and slip-permitted.

1 Introduction

Steel-concrete composite structure system is widely used in bridges and buildings due to its good mechanical properties and overall economic efficiency. However, in some part of the composite structures, such as hogging moment region in continuous composite bridge, stay-cables area of cable-stayed bridge, consolidation region in rigid bridge, tensile stress may occur in these hogging moment regions. Since connectors like studs can transfer shear force between steel and concrete, creep and shrinkage effects as well as temperature stress may lead to the cracking of concrete, which may influence the long-term durability of the

structure. Therefore, cracking of concrete at hogging moment region is a major issue in these composite structure systems, particularly in continuous beam bridges.

Several methods were proposed to solve concrete cracking in composite structures: prestressed technique, bearing lifting technique, optimization of construction process and group studs technique. Prestressed technique is a common solution, but it has high stress loss in composite structures. By adjusting the relative height of bridge bearing to change the internal forces, bearing lifting technique can reduce tensile stress of concrete in hogging moment region; but it is quite inconvenient for construction, and do not have