Experimental Study on Flexural Behavior of Concrete Filled Steel Tube Girder Bridges

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Summary

Concrete Filled Steel Tube (CFT) is a structure in which the steel tube is filled with concrete material. Such structure enables to achieve mechanical effects like increased bearing capacity and improved deformability compared to single steel tube structure or RC structure presenting the same section. Even if CFT structure has been developed to improve the ductility and bearing capacity of columns receiving mainly axial compressive forces in buildings, its applicability as flexural member like bridge girder is evaluated regard to its remarkable bearing capacity, excellent deformability (ductility), inhibition of noise and vibration. This study intends to develop a new steel composite bridge structure using the CFT member as girder. Accordingly, the results of member and full-scale bending tests performed on a CFT girder-slab composite section in order to assess the flexural behavior of the CFT member are presented. Specimens were manufactured considering several parameters such as the strength of filling material, the eventual presence and number of inner shear connectors to evaluate the bending bearing capacity of CFT member. The specimen filled by lightweight and low strength air-mortar with compressive strength of 8 MPa exhibited strength increased by about 20% compared to hollow steel tube, and the introduction of ㄱ-shaped perfobond rib inside the tube to improve the composite effect increased the strength by 50%. Moreover, the filling of the steel tube augmented significantly the flexural strength and ductility compared to the hollow tube, which showed that the confinement effect of the tube supplemented the brittleness of concrete. The adoption of inner shear connector prevented sliding at the interface between the filling material and the tube, and allowed the section to behave as a composite section. The stiffening effect of the ㄱ-shaped perfobond rib is seen to contribute relatively to the increase of the bending bearing capacity.

Keywords: CFT (concrete filled steel tube) girder bridge, ㄱ-shaped perfobond rib, flexural behavior of CFT girder, composite bridge.

1. Introduction

Bridge structures can be roughly classified into two types that are steel bridges and concrete bridges regard to materials. Steel bridges are made of expensive material and are built throughout a complex process requiring welded or bolted connections between the structural members. In addition, steel bridges are vulnerable to buckling provoked by compressive forces, which require large amounts of stiffeners. Besides, the large self-weight of concrete bridges leads unavoidably to conservative design of the sections. The fabrication process of the moulds also brings additional costs and, difficulties are encountered in quality control as well as maintenance. Accordingly, applications on composite and hybrid structures agreeing with the behavioral characteristics of the members are actively implemented so as to supplement mutually such drawbacks and take full advantage of each structural member. Among these types of structures, Concrete Filled Steel Tube (CFT) is a structural member with improved deformability, stiffness and bearing capacity through the reciprocal confining effect between the steel tube and the concrete filling the tube. That is, the filling concrete prevents the sudden local buckling deformation of the steel tube, while the steel tube

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