Numerical Analysis of Flexural Behaviour of High Strength I-Shape Steel Composite Girders with Corrugated Webs

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Abstract

With the high out-of-plane stiffness and shear buckling strength, the number of stiffeners and the thickness of the web can be reduced when using corrugated webs in composite girders. The finite element model is established according to the existing experimental results. The flexural behaviour of I-shape steel composite girders with the corrugated web was investigated by numerical analysis. From the numerical results, the flexural behaviour of I-shape steel composite girders can be improved by increasing the strength of materials. The concrete slab grade range of C50 to C60 was recommended to ensure full use of concrete and high strength steel material properties. The high strength steel grade with nominal yielding strength between 420MPa and 460MPa were suggested for bottom flange with priority, while steel grade no less than Q345 was suggested for corrugated web to avoid the safety risks caused by the premature reaching of the yield strength of the web.

Keywords: high strength I-shape steel composite girder; corrugated web; flexural behaviour; finite element analysis; material matching.

1 Introduction

The I-shape steel composite girder with corrugated web consists of the corrugated web welded with the flange, and the upper flange and the concrete slab are combined with studs. In recent years, composite girders with corrugated webs have been used more and more widely in bridge construction due to their lightweight, large spanning capacity, apparent stress, and elegant appearance. The I-shape steel composite girder with corrugated web appropriately combines the two different materials of concrete and steel, which improves the structure's stability, strength, and material efficiency. As of 2018, more than 80 composite girders with corrugated webs have been made in China [1-2]. With the increase of traffic volume, the continuous accumulation of engineering experience, and the continuous innovation of construction technology, the composite girders with corrugated webs have gradually developed in the direction of large-span and complex bridge types. Therefore, bridge construction has higher requirements for steel and other materials. It is essential to study how to improve the mechanical property and material utilization of the composite girders with the corrugated webs [3].

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