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Experimental study on shear behavior of curved box girders with corrugated steel webs

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Abstract

Curved girder bridges with corrugated steel webs have already been constructed around the world; however, few works have been done on their shear behavior. To investigate the shear behavior of corrugated steel webs in curved girders, a curved box girder with corrugated steel webs was investigated and tested in current study. The method of three-point loading was used in the test. Test results indicate that the girder failed due to nonlinear shear buckling of the webs and the shear yield stress of the material was less than the elastic shear buckling stress of the corrugated steel webs. Failure of the corrugated steel webs was initiated by the local shear buckling of one of the corrugation panels, which propagated to other panels. In the failure stage, the interactive shear buckling occurred in outboard and inboard corrugated steel webs. In addition, many cracks appeared in the concrete top flange nearby the top supports and the concrete bottom flange between the 1/4 span to 3/4 span. The girder with corrugated steel webs can continue to resist the load after the occurrence of shear buckling. For the design of this type of curved box girder, it is necessary to consider the shear buckling of the corrugated steel webs.

Keywords: corrugated steel web; curved girder bridge; shear buckling; experimental study

1 Introduction

The composite girder bridge with corrugated steel webs is known as a new style of the bridge structure to overcome the weight problem of the common concrete box girder. The composite girder bridge with corrugated steel webs has many advantages over the common concrete box girder, such as lightweight, high efficient prestressing and aesthetic appearance. Due to the above advantages, the girder bridges with corrugated steel webs have been extensively constructed in France, Japan, and China.

Horizontally curved girders are frequently employed in the construction of highways and viaducts in view of design requirements and their aesthetic appearance. Most of the bridges with corrugated steel webs are the straight bridges, while applying corrugated steel webs in curved bridges have already accomplished. Such as, Hontani bridge(R=2400m, Japan), Katsutegawa bridge(R=1500m, Japan), Koinumarukawa bridge(R=1000m, Japan), Nakano viaduct (R=250m~400m, Japan), Altwipfergrund bridge (Germany), Meaux viaduct (R=1000m, France), Yuwotou bridge(R=110m, China), and No.3 east river bridge(R=256m~310m, China), and so on.

On the basis of the small longitudinal rigidity, corrugated steel web is not assumed to carry axial force, and it mainly carries the shear force. Therefore, the stability of corrugated steel web carrying shear force is one of the most important aspects of the composite girder bridge design. Three shear buckling failure modes of a web are possible, and they are global shear buckling, local shear buckling, and interactive shear buckling. It is widely accepted that local buckling is the dominant failure mode in sparse corrugations,

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