Fatigue Performance of a Precast Hybrid FRP-Reinforced Bridge Truss Girder System

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Abstract

The fatigue behaviour of a novel precast hybrid bridge truss girder system is experimentally investigated. The girders consist of pretensioned top and bottom concrete chords connected by vertical and diagonal truss members made of concrete-filled fibre reinforced polymer (FRP) tubes. The truss members are connected to the top and bottom chords by means of long double-headed glass FRP (GFRP) bars. The chords are also reinforced with GFRP longitudinal bars and transverse stirrups. Six large-scale truss girders were fabricated and tested. All girders had identical cross-section dimensions with 1.32 m overall depth. Three of the girders were 2.83 m in length. The remaining three were 9.82 m long. One short and one long girder were tested under static loading up to failure. The remaining four girders were tested under cyclic fatigue loading of different levels and amplitudes. The tests showed excellent performance of the truss girders in terms of strength, stiffness, and fatigue life.

Keywords: bridges; concrete-filled FRP tubes (CFFT); fatigue; Fibre-Reinforced Polymers (FRP); headed bars; hybrid; truss girder.

1 Introduction

An innovative corrosion-resistant system has been recently developed for short- and medium-span bridges [1]. The system consists of precast prestressed concrete truss girders and cast-*in-situ* or precast concrete deck. Each truss girder consists of pretensioned top and bottom concrete chords connected by precast vertical and diagonal web members made of concrete-filled FRP tubes (CFFT). A perspective view of a typical truss girder is shown in Fig. 1. Under gravity loads, the vertical members are mainly in compression and the diagonals are predominantly in tension. The truss members are connected to the top and bottom chords by means of long double-headed glass FRP (GFRP) bars. The chords are also reinforced with GFRP longitudinal bars and transverse stirrups. The top and bottom chords provide the flexural capacity, whereas the truss web members resist the shear forces in the girder. The deck slab is connected to the girders top chords by means of double-headed GFRP studs. The girders may be post-tensioned by external tendons after erection to balance the slab weight, to provide continuity in multi-span bridges, and to resist service loads on the bridge.

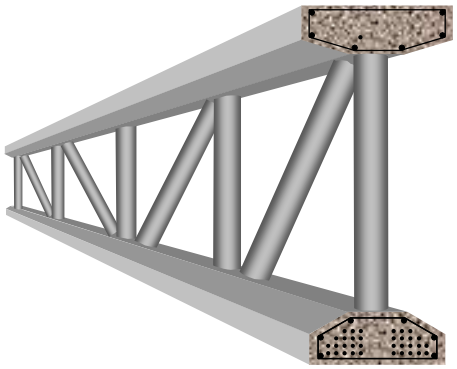

Figure 1. Hybrid FRP-Concrete Truss Girder

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