Analytical Analysis on Distortion Effect of Twin-I girder BridgeSystems

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Abstract: Application of twin I-girder bridge structure is very few in China. The structure is designed based on the requirement of bridge industrialization construction. So the structure has typically same spans, same cross section depth, and same cross section width with only two I girders and large deck width. Due to large deck width and weak torsional stiffness of I girders, the effect of distortion is more significant than traditional I girder system. The paper developed parametric study to investigate the distortion behaviour of twin I-girder bridge structure. The results show that it is not reasonable to use transverse distribution coefficient do design twin I-girder bridges. A modified coefficient is required.

Keywords: twin I girder, distortion, warping normal stress, bending normal stress, transverse distribution coefficient

1. Introduction

Twin I girder bridge structure only has two girders with limit cost use of steel, which is convenient for fabrication and erection. It is a good application for bridges with medium spans. I girder bridge structure is mostly used in railway bridges in China. The application of twin I girder bridge in highway bridges is rare. The traffic pattern and the design consideration of highway bridge structure are different from that of railway bridges. The design of twin I girder bridges cannot be conducted according to design criteria in railway bridges. Usually twin I girder highway bridge has a large deck width, and the spacial response is more significant than multiple I girders. Tradition design method for multiple girder system has some limitation to design twin I girder bridge system.

I girder bridge system is used often in Europe, USA, and Japan [1-5]. Most designs use multi-girder systems [6]. For multi-girder systems, adjacent girder are connected by diaphragms or cross frames which supply large torsion stiffness [7]. The design is usually based on one girder with transverse distribution coefficient under vehicle load.

Twin I girder application is mostly used in France in Europe [8 and 9]. Two types of cross-beams or diaphragms are used including cross beams and directly supporting cross-beams. For directly supporting cross-beam bridges, the overhang of deck is usually taken as 2 m. The plate thickness is thicker than that used in China. In the paper, the analysis is developed for twin I girder design uses thinner plate with larger overhang.

Under vertical loads, main girders carry bending moment, and also carry torsion due to unsymmetrical loading [10 and 11]. I section usually has weak torsion stiffness. For twin I girder system with large deck width, the torsion effect is larger than traditional I girders. The paper focuses on a parametric study to investigate the torsion behaviour of twin I girders.

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