Study on Long-term Deflection Control Performance of Long-span Prestressed Concrete Combination Structure Rail Transit Bridges

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Abstract

Rail transit bridges must meet stringent requirements for deflection control throughout the operation period. To provide a reference for the selection of bridge type and structure for long-span rail transit bridges, this paper conducted a comparative study of four PC(prestressed concrete) combination structure bridge types' long-term deflection control performance. The structural configurations of the bridge types under research were trial designed using the same arrangement with a main span of 250 m and design parameters, and the Finite Element models for long-term deflection calculations were developed. According to the findings, all of these bridge types exhibit high vertical structural stiffness and excellent long-term deflection control performance, satisfying rail transit's technical requirements. Additionally, Excess weight and prestress loss have a less detrimental effect on arch-assisted girder bridges.

Keywords: hybrid system； creep effect； influencing factors； long-term deflection prediction.

1 Introduction

Prestressed concrete (PC) girders offer the advantages of high structural stiffness, low vibration and noise, competitive prices, and minimal maintenance, able to meet the smoothness, stability, and reliability requirements of urban rail transit. However, as operation time increases, excessive deflection with cracks is the common issue for long-span PC girder bridges [1].

In comparison to highway bridges, the deformation control for urban rail transit bridges should be more stringent. The deflection of the deck of a rail transit bridge will proportionately increase the acceleration and load shedding rate, affecting the smoothness and safety of train operation [2]. As a result, the long-term deflection effect of the main girder must be strictly controlled. According to Chinese code for urban rail transit bridges [3], the long-term creep deflection of PC girders with a minimum span of 50 m and without ballast should not exceed L/5000. Based on statistics of the deflection of long-span PC continuous girder or PC continuous rigid frame bridges in the world, the aforementioned requirements are no longer suit for the bridges with the main span exceeds 200 meters [4]. While an all-steel main girder structure is feasible in terms of force and long-term

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