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Design and Construction of the Bridges on Guangzhou Metro Line 4

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Abstract

Elevated rail transit has been developed in some big cities in China in recent years. However, specialized codes for design of the bridges in the elevated rail transit system have not yet been established. Based on the prestressed concrete (PC) box girder bridges on Guangzhou metro line 4, some technical features of design principle and technology requisition, ensemble plan and design load of bridges on urban rail transit are explored. At the same time, due to the first time used on a large scale in mainland of China, the short-line match method technology and the principles of the coordinate transformation are briefly introduced, and the formulas of spatial dimensional coordinate transformation for geometric shape control and calculating the translation amounts of precasting by the short-line method are deduced. In addition, some of the methods for the geometric shape control of the precasting by the short-line method and cantilever assembly of the segments are also briefly discussed.

Keywords: elevated rail transit, bridge, design principle, short-line match method, geometric shape control

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1. INTRODUCTION

With the development of economic and society, the construction of fast rail transit systems is becoming a trend for development and modernization of city infrastructure. Due to superior efficiency, environment-friendly and aesthetic value, urban elevated rail transit has been developed and applied in some big cities in China. Guangzhou is one of the important cities of developing urban rail transportation, before the 16th Guangzhou Asian games 2010, the total length of metro lines is up to 255 km.

Guangzhou metro line 4 is one of the main metro lines from north to south with a total length of 56 km includes viaduct bridges of almost 30 km from Xinzao to Nansha. The Xinzao to Huangge section began operations on Nov. 26 2006, and Huangge to Nansha section opened to traffic on May 1st 2007. The bridges on Guangzhou metro line 4 are all prestressed concrete (PC) box girder bridges, and main bridge types include simply supported bridges, continuous beam bridges and a large span continuous-rigid frame bridge. Guangzhou metro line 4 is the first time to use short-line match method on a large scale. The construction planning map and typical bridges of Guangzhou metro line 4 are shown in Figure 1.



Figure.1 Guangzhou metro line 4: (a) planning map; (b) typical bridge

Based on the Guangzhou metro line 4 viaduct bridges, this paper first investigates the design the technology problem of design principle and technology requisition, ensemble plan and design load of bridges on urban rail transit. Then a three dimensional (3D) coordinate transformation formula of geometric control for short-line match method is deduced in this paper, and some methods and measures for geometric control of the precasting by segment short-line match method and cantilever assembly of the segments are also briefly discussed.

2. Design description

2.1. Design principle and technology requisition

As an important urban landscape, the principle of beauty, economy, advancement and practicality is required. In order to satisfy the scale harmony needs, the bridge height to span ratio is 1/2.3, the box girder height to bridge height ratio is 1/4 to 1/5, the pier width to girder height ratio is 1/1.6. On the basis of sight beauty, the design must satisfy the operation function of safety, durability, economy. At the same time, the structure design should aim at standardization and series for easy construction.

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