Upgrading the 4th Ring Transportation Corridor in Zhengzhou, China - Optimized Camber Analysis for close to 1,200 Precast Bridge Frames

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Abstract

The City of Zhengzhou is a major transportation hub in the heart of China. The fast-growing city was in need of an additional elevated expressway to increase the traffic capacity from 10 lanes to 18 lanes on the 4th Ring Transportation Corridor. The additional elevated expressway has a total length of 93.3 km and faced complex boundary conditions. 1,200 different bridge-frames were designed for the elevated expressway. The precast segmental bridge frames are continuous girders or rigid frame systems. The short-line match-casting system was utilized for the fabrication of close to 50,000 unique segments. Parameter studies were performed to better understand the influence of the boundary conditions and to optimize the camber analysis. This approach reduced the modeling effort tremendously and allowing the camber data for 1,200 bridge-frames to be analyzed in an accelerated time frame. The largest precast segmental bridge project in the world was partially opened to traffic in 2020 and is now fully operational.

Keywords: Zhengzhou; elevated expressway; precast segmental bridge technology; short-line match casting; fabrication camber; erection camber; optimized camber analysis; geometry control.

1. Introduction

The city of Zhengzhou, with a history of over 5,000 years, is the capital of the Henan Province and a major transportation hub. Zhengzhou has a population of 10.1 million. Due to the poverty-alleviation relocation project, within the next 10 years roughly 5 million more people will move into the city, making large infrastructure projects imperative. To satisfy the needs of the fast-growing city, the 4th Ring Transportation Corridor was developed. This expansion is considered one of the largest transportation projects in China. The 4th Ring Transportation Corridor in Zhengzhou is an elevated viaduct expressway above the existing 4th Ring around the city center. It increased the traffic capacity from 10 lanes to 18 lanes and improved the connection of the inner city with its suburban areas. The industrialization technology of bridge design, fabrication, erection, and construction has been fully implemented to the greatest extent in this project.

1,200 different bridge frames were designed for the entire elevated expressway. The expressway has a total length of 93.3km, with additional 90.0km of interchanges and on & off ramps. The

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