Development and Standardisation of New Precast Concrete Open Spandrel Arch Bridge System

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Summary

A new method of constructing open spandrel arch bridge has been developed for span ranges from 12m to 27m using precast concrete techniques. The buildability of this new system has been proven in a pilot project. It has also been proven to be an economically viable alternative to conventional bridge solution. Nonetheless, stocks of steel moulds catering for the full spectrum of span ranges have remained a costly logistic issue with many operational difficulties. The problem may become more acute especially for bridge market of relatively lower volume but with many geometrical variations. This paper presents a systematic approach to standardise the design and development process with great emphasis on the practical aspects of precasting and moulding requirements. Three sets of moulds for two types of geometrical framing, called M-Series and K-Series Open Spandrel Arch Bridge have been developed to cater for the targeted span segment.

Keywords: Open spandrel arch bridge; closed spandrel arch bridge; precast concrete; self-propping; standardisation; moulding; strut

1. Introduction

The importance of bridges had been proven since civilization of mankind, with countless bridges of all kinds built around the world to fulfill the development needs. Of which, arch bridges had been recognized and successfully applied with exceptional performance as far back as 100 B.C. by the Romans and 610 A.D. by the Chinese [1], [2]. Many of these arch bridges are still in service conditions with unbelievable durability and spectacular appealing aesthetical appearance.

Prior to nineteenth century, stone, timber, wrought iron and steel were the important materials used in bridge construction. The subsequent discovery of new building material then had led to the first reinforced concrete bridge built in 1875 in France [3] with success. It was discovered that concrete with its superior inherent properties of strength, durability and good workability to be molded or cast into any desired shape has offered economic benefits, especially for arch bridge construction. The advancement in this field was further driven by rapid development in analytical theories, reinforcing techniques and concrete technologies. The introduction of revolutionary precasting techniques for the past decades has further invoked greater creativity for the design and construction of arch bridges. New innovative designs in with improved buildability features were introduced to challenge the limits of arch bridge construction.

2. Standardisation of Bridge Construction

In the current competitive bridge construction sector, the main challenge for the builder is the escalating costs of labour and materials. On the other hand, the publics are demanding for timely delivery of products with improved quality and durability at affordable prices. The key success factor is then relied on industrialised system with prefabricated components, emphasising on cost efficiency and speedy construction. In this respect, designs incorporating precast concrete are

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