

Construction monitoring and control for Jiaomen River arch bridge in Guangzhou

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Abstract

For novel arch rib, it is difficult to control the accuracy of the segments and whole bridge, especially for special shape bridge. It is also hard to balance the maximum lateral displacement (MLD) of arch rib and the maximum axis force (MAF) of jigs when removing temporary supports at high altitude. To address these issues, firstly, the derrick arch bridge with a total span of 231 meters is taken as the research object. Following the establishment of the finite element (FE) model of the bridge, an innovative criterion is proposed to consider both axis position and inclination angle, in which the error during the closure stage of the bridge is controlled available. Secondly, among three potential plans modeled with FE model, one was chosen to remove the jigs, which effectively reducing the MAF and the MLD. Finally, the field monitor tests were proofread with FE model results to ensure the reasonable state of the bridge.

Keywords: novel arch; unsymmetrical; extroversive; orientation; assembling jig removed; monitoring.

1 Introduction

Construction of bridge starts to make a difference in shape design since 1987 when the first design trial in a leaning arch bridge named Bac de Roda Bridge [1]. The special type bridges developed earlier in England as Bedford Arch Bridge [2] in butterfly shape has been completely constructed in 1995 and lead development in extroversive arch bridge design and construction. The first X-shape (Introversive) arch bridge is Xiaowan Bridge [3] in Yunnan Province. Lupu Bridge (Introversive) and Nanning Bridge (Extroversive) were built in 2003 and 2009 respectively, which indicate the recent advancement in special shape arch bridge [4].

Construction monitoring and control play a significant role in novel arch bridge construction, this is why many cutting-edge technologies become essential [5]. For the orientation and installation of arch rib, one of the most commonly

used methods in construction is to control the absolute error of the key points [6], which can conceal the inclination error easily and cause the unacceptable orientation. The serious inclination error can cause the stress concentration and undesirable stress redistribution, and further increases the risk of construction at high altitude.

Removing the jigs will increase the maximum lateral displacement (MLD) of arch rib and reduce the maximum axis force (MAF) of the jigs [7]. When the temporary supports are removed, each jig is uninstalled one by one. As a result, MLD and MAF are increasing accordingly. If the derricks are pre-tensioned, they can reduce the MLD in arch ribs but cause a higher MAF. Thus, to control the sequence of jigs removing and pre-tensioning of derricks should be taken into account.

In this paper, first describes the background and monitoring system in section 2. For section 3, the bridge construction phases and finite element