Collapse Process Analysis in Construction of Concrete-Filled Steel Tube Arch Bridge

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Summary

This paper gives a detail introduction of collapse simulation of some critical construction stages of Taiping Lake Bridge, which is a CFST arch bridge with main span of 336m in Anhui Province, China. Arch ribs are erected by temporary cables-stayed system with cantilever construction method. During construction of this bridge, in every one of the 23 working stages the collapse simulation was carried out with FEM method. According to the results the structure system of Taiping Lake Bridge in construction is strong enough. Here gives examples on two key stages.

Keywords: Concrete-filled steel tube, Collapse simulation, Construction stage.

1. Introduction

Long-span concrete-filled steel tube (CFST) arch bridges are often built with temporary cable-stayed system. Their construction process includes cantilever erection of steel tube arch ribs, closure of arch and demolition of temporary cable-stayed system, pumping of concrete into steel tubes and erection of spandrel structures, etc. Among these stages cantilever erection of steel tube arch ribs and filling of concrete into steel tube are the weakest parts. In the two stages only steel tubes undertake the whole load including the weight of concrete in the tubes. The most accidents happened in arch bridge construction are the collapses caused by instability. For multi-dimension statically indeterminate structure, its destruction is accompanied by appearance of plastic hinges. It collapses when ultimate structure becomes flexible. By the solution of ultimate bearing capacity with elastic-plastic method, the collapse process can be analyzed and corresponding load safety coefficients can be obtained. Taiping Lake Bridge is a half-through CFST arch bridge with main span 336m. In its design process the detailed stability analysis of critical states in both construction and completed bridge was carried out. The results of the collapse process analysis of Taiping Lake Bridge on two worst stages and corresponding load safety coefficient are given in this article.

1.1 Definition of critical load and collapse process

In elastic-plastic stability analysis, along with load increasing, displacement and yield will occur in higher stress area of structure that originally keeps balance, consequently, structure will keep balance on the new position. While load achieves certain point, structure displacement will continue even if the load won't increase, which will cause structure to collapse finally. The load on this point is ultimate load that structure can bear at most, and it is called critical load or ultimate bearing capacity.

For complicated structures, with normal analytical method it is very difficult to get the solution of

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