Direct Shear: A Mechanism that is Often Ignored and Rarely Studied

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Abstract

The defect of excessive lone time deflection of prestressed concrete bridges has been researching for decades. Many researches focused on reducing the long time dead-load deflection of the completed bridge. Another research method is trial calculation, which includes adjusting prestress loss, structural stiffness, or modifying the creep model to fit the deflection changes of the real bridge. Nevertheless, there is still a lack of recognized solution. In this paper, with the continuous research on the excessive long time deflection of PC girder bridges in the Department of Bridge Engineering at Tongji University, another kind of shear caused excessive defection is proposed, which is also a mechanism that is often ignored and rarely studied: direct shear. The transverse analysis method of the box section and its influence on longitudinal direct shear are presented in detail. Finally, some research and design suggestions are put forward.

Keywords: direct shear; concrete bridge; excessive deflection; stress indicator of box section; transverse analysis of box section.

1 Introduction

The defect of excessive lone time deflection of long-span prestressed concrete bridges has been researching for decades[1]-[8], but there is still a lack of recognized solution. Researches included three major ideas: The first was to focus on reducing the elastic deflection by adjusting the design state or design parameters to optimize the long time dead-load deflection of the completed bridge. However, the dead-load deflection can be adjusted by controlling the construction process and by cambering the deflection of the completed bridge, which is not the defect of continuous excessive deflection to be studied. The second was trial calculation, which includes adjusting prestress loss, structural stiffness, or modifying concrete creep model to fit the deflection changes of the real bridge. However, the trial calculation method often only takes into account the deflection changes, but does not take into account the structural force state such as structural cracking. The trial calculation method could not achieve “both fit”, that is, while trying to fit the deflection, it also needs to pay attention to the structural stress and cracking. The both, i.e., the deflection and the stress distribution, need to be mutually verified. Third, inclined cracks of the web due to shear develop and the shear reinforcement in the web yields, which leads to the decrease of the shear stiffness of the web and leads to the increase of deflection. The author noticed this mechanism during the research on the auxiliary channel bridge of the Sutong Bridge, and began to study the shear reinforcement theory of concrete structures, which continues to this day. In this paper, with the continuous research on the excessive long time deflection of prestressed concrete girder bridges in the Department of Bridge Engineering at Tongji University, another

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