



A Innovative Longitudinal Prestressed Continuous Ultra-high Performance Concrete Box-girder Bridge

Rensheng Pan
PhD. Candidate
Hunan University
Changsha, Hunan, China
panrshc@hnu.edu.cn

Xudong Shao
Professor
Hunan University
Changsha, Hunan, China
shaofd@hnu.edu.cn

Hao Zhan
PhD. Candidate
Hunan University
Changsha, Hunan, China
zhanhao@hnu.edu.cn

Summary

A new box-girder bridge structure is proposed based on the superior mechanical properties of the ultra high performance concrete (UHPC). The proposed structure is the combination of UHPC and thin-wall box girder with densely distributed diaphragm plates, which can simplify the conventional three-direction prestressed structure into unidirectional (longitudinal) prestressed structure. Compared to the traditional concrete continuous box-girder bridge, the superstructure weight of the new bridge structure can be lightened by 50~60%. A trial design and some experimental studies were conducted to study the proposed bridge structure. Results of UHPC beam creep deformation test demonstrated that the creep deformation of the UHPC beam was about 1/5 that of ordinary concrete beam. Results of the UHPC box-girder model test indicated that the post-cracking shear performance of the box-girder could be improved by setting diaphragms.

Keywords: Continuous UHPC box-girder bridge; longitudinal prestressing; densely distributed diaphragms; trial design; shear performance; creep deformation

1. Introduction

Since prestressed concrete box-girder bridges exhibit some advantages, such as the convenient construction and good economic performance etc., they have become the main choice for the bridges with span smaller than 300m^[1]. However, there are two types of damages (i.e., numerous cracks in the main girder and excessive mid-span deflection) which commonly occur in the traditional long-span prestressed concrete box-girder bridges in China^[2,3]. One of the key reasons is the low tensile strength of ordinary concrete. Hence, the applications of high strength and high performance materials, which have become a trend for the further development of bridges in the future^[4], may provide a feasible way to solve the problems in conventional continuous concrete box-girder bridges. Ultra-high performance concrete (UHPC) exhibits satisfactory mechanical characteristics, such as high elastic modulus, ultra-high compressive and tensile strength, low shrinkage and creep coefficient^[5-7].

Therefore, a new box-girder bridge structure is proposed based on the superior mechanical properties of UHPC, namely, the longitudinal prestressed continuous UHPC box-girder bridge. It aims to make use of the high strength of UHPC to solve the problems in conventional concrete continuous box-girder bridges. As UHPC is used as the construction material, the deadweight of superstructure can be greatly reduced. Hence, the span of the new bridge structure can be enlarged to 400m or even above. In this paper, a preliminary conceptual design of the new UHPC bridge structure was presented. To investigate its feasibility, a trial design was conducted and an