Exploration of Super-Large Span Steel Truss- Fabricated Concrete Composite Continuous Rigid Frame Bridges

Zhixiang ZHOU
Professor
Chongqing Jiaotong University
Chongqing, China
zhixiangzhou@cquc.edu.cn

Yanmei GAO
Lecturer
Chongqing Jiaotong University
Chongqing, China
Lg2346@163.com

Chengjun LI
Doctoral student
Chongqing Jiaotong University
Chongqing, China
junjunlc@qq.com

Guowen YAO
Professor
Chongqing Jiaotong University
Chongqing, China

Zhixiang ZHOU, born 1958, received his civil engineering degree from Southwest Jiaotong University, Chengdu, China.

Yanmei GAO, born 1974, received her civil engineering degree from Chongqing Jiaotong University, Chongqing, China. Her main area of research is related to steel-concrete composite structures.

Chengjun LI, born 1987, received his civil engineering degree from Chongqing Jiaotong University, Chongqing, China. Her main area of research is related to steel-concrete composite structures.

Basing on the existent study of prestressed concrete (PC) continuous rigid frame bridge and steel-concrete composite bridge, a new type of super-large span steel truss-concrete composite continuous rigid frame bridge (STCB) constructed by cantilever method is proposed in this paper.(Fig 1) Structure system and characteristic features are discussed, and the cantilever construction methods and major construction steps are introduced.

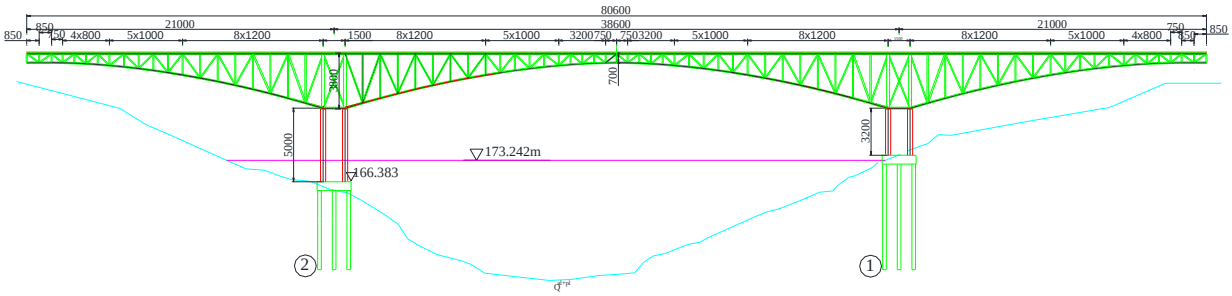

Fig 1 span layout of fabricated steel- truss composite continuous rigid frame bridge (unit:cm)

Meixi River bridge as an example of exemplary 386m-span STCB justifies the feasibility and reasonability, in which the side-span to mid-span ratio of the main beam is 0.54, and the beam heights in bottom and mid-span are designed to be 38m and 7m.

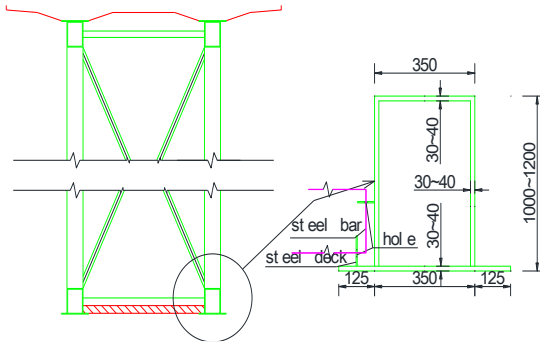

Fig 2 Sketch of the top flange PBH shear

Aiming at this super-large span steel truss-fabricated concrete composite continuous rigid frame bridge, novelties in detail constructions are designed to robust against the usual defects of conventional prestressed concrete continuous rigid frame bridge. For example, PBH shear connector is set in the flanges of box-shaped section of lower chords to ensure the cooperation of concrete and lower chords and complete the abundant connection between concrete and steel truss (Fig.2). Moreover, S-PC shear connector is also accordingly set in the top plate of steel girder to combine it with bridge deck after the top plates of steel girder are holed and poured (Fig 3). As to the construction methods, the author proposes the construction method of tensioning first, pouring shear slot followed namely connectionless method to maximize the reservation of prestress in top plate, in which tensioning is first completed without connection to shear connectors and then the connection between the top plate and the steel beam is completed after the shear slot is poured finally forming prestressed steel composite structure. The comparison results between connectionless method and connection method are shown in Fig4

https://doi.org/10.2749/222137813808627181

In this paper, a 386m steel truss- concrete composite continuous rigid frame bridge is designed whose construction methods, design details and the overall mechanical properties are detailed described with the following conclusions to be referred. (1) The self-weight of main beam is significantly decreased with obvious greater spanning capacity. (2) Steel and concrete can be fully made use of in steel truss- concrete composite continuous rigid frame bridge because different combinations and timely connection are correspondingly designed aiming at different mechanic requirements in construction and service. (3) Linear and longitudinal prestress with connectionless integration is applied on the concrete bridge deck that the mechanic is clear making the mechanic more reliable. (4) Compared to conventional prestressed concrete continuous rigid frame bridge with the defects of unreliable performance and long-term large deflections, STCB is basically robust against the usual defects of excessive harmful deflection due to concrete cracking and creeping through the use of prefabricated bridge deck.

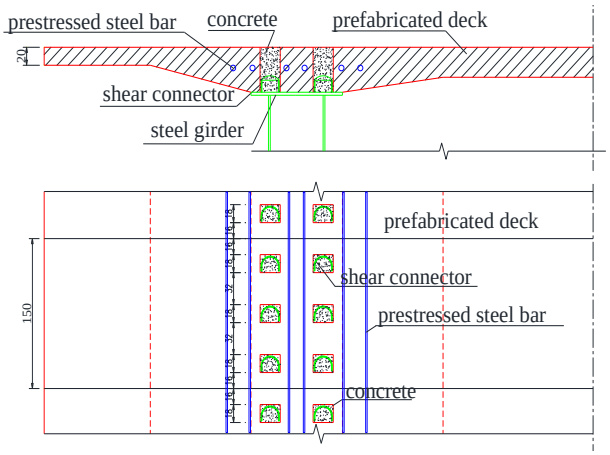

Fig 3 arrangement of prestressed beam and shear connector in the top plate(unit:cm)

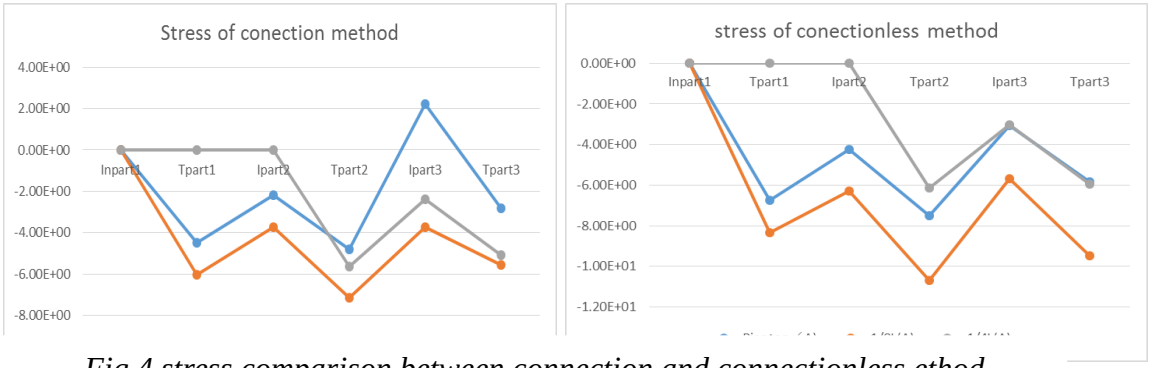

Fig 4 stress comparison between connection and connectionless ethod