Review Paper on Load Transfer Mechanism for Steel Concrete Joint

POURNIMA A. DONGRE
NIT Polytechnic Nagpur

Abstract- ***To look into the load switch mechanism of the metal-concrete hybrid pylon joint with cells and bearing plates, a theoretical model primarily based on the non-stop elastic interlayer method become established. Both the slip effect at the metal-concrete interface and the nearby compression effect of the bearing plate were considered within the proposed theoretical model. A section model take a look at with a 1: 3 scale became executed to acquire the strain distribution of the hybrid joint and the relative slip between metallic and concrete additives. Finite detail analysis became implemented on the tested section model, and the structural performance of the tested hybrid joint was compared with the FEA results. +e check and evaluation results show that the strain of metallic and concrete components is at a decrease level, and the relative slip between metal and concrete components is extraordinarily limited. +e bearing plates and shear connectors are the 2 load-transferring additives and could switch 40% and 60% of the vertical force into the decrease concrete pylon, respectively. The influence of torsion on joint behavior was insignificant. It was also shown that approximately 65% of the overall force transferred through the steel–concrete joint was in the form of compression effects between the bearing steel plate and UHPC, and that the remaining 35% force was dispersed via shear connectors.***

Indexed Terms- ***Load Transfer Mechanism, Eccentricity, Concrete, Loading Schemes***

I. INTRODUCTION

In current years, the newly constructed cable-stayed bridges in India normally need to provide a far wider bridge deck to meet the growing visitor's volume. +e growing operating site visitors load and the tons larger structural gravity of the bridge deck may be transferred inside the bridge pylon through the cable-girder anchorage system, the cables, and the cable-pylon anchorage machine. +e massive cable force in these cable-stayed bridges requires a sophisticated cable pylon anchorage system to make certain the burden switch reliability. If the concrete pylon scheme is selected, the steel concrete composite cable-pylon anchorage shape could be adopted for the expanded construction, whilst the configuration of the composite cable-pylon anchorage structure may be complicated. +e steel-concrete hybrid pylon might be an alternative for the construction of the cable-stayed bridges, seeing that the decrease part of the pylon might be constructed as a concrete structure and the higher a part of the pylon can be fabricated as a metallic shape. Besides, the upper metallic pylon is also beneficial to the cable-pylon anchorage machine and the multiplied bridge construction [4–6]. +e mixture of the higher steel pylon and the lower concrete pylon is the joint of the metal concrete hybrid pylon, and its load transfer mechanism is the examine goal of this paper. Many studies were carried out to research the performance of metal-concrete hybrid structures in particular for hybrid girders developed a nonlinear finite detail model to take a look at the behavior of the hybrid metal-PSC beam connection, and some green connection details have been recommended carried out three checks on small-scale metallic-PSC hybrid beams to determine and to propose the suitable joint for spliced hybrid I-girder bridges. Besides, a full-scale test turned into carried out on a spliced metal-PSC hybrid I-girder of 40 m duration to affirm the brand new type of the joint splicing metallic-PSC segment. In the metallic-concrete joint of hybrid girders, perfobond rib (PBL) connectors have emerge as another effective load transfer factor owing to their advanced mechanical performance, convenient construction, and extended provider life. In latest years, a series of studies have been applied to have a look at the shear performance and cargo transfer mechanism of PBL connectors particularly employed inside the hybrid girder of cable-stayed bridges

However, the existing studies especially consciousness on the load-sharing distribution within the more than one PBL connectors, and the ratio of the weight transferred by means of the bearing plate to the burden transferred with the aid of the headed stud or PBL connectors changed into not investigated in detail. +e configurations of the hybrid girder and the hybrid pylon in cable-stayed bridges have a few common characteristics, together with the employment of headed studs and/or PBL connectors. +e load transfer mechanism in the connecting a part of the hybrid pylon is still worth to be investigated.

Many studies were performed to research the performance of steel-concrete hybrid structures in particular for hybrid girders. Kim and Nguyen evolved a nonlinear finite element version to observe the behavior of the hybrid steel-PSC beam connection, and some efficient connection details have been recommended. Conducted three exams on small-scale steel-PSC hybrid beams to decide and to propose the appropriate joint for spliced hybrid I-girder bridges. Besides, a full-scale check was performed on a spliced steel-PSC hybrid I-girder of 40 m period to affirm the new type of the joint splicing steel-PSC segment. In the steel-concrete joint of hybrid girders, perfobond rib (PBL) connectors have end up another powerful load switch thing owing to their advanced mechanical performance, convenient construction, and prolonged service life. In recent years, a sequence of research have been carried out to examine the shear overall performance and cargo switch mechanism of PBL connectors specially employed in the hybrid girder of cable-stayed bridges. However, the existing research particularly consciousness at the load sharing distribution in the more than one PBL connectors, and the ratio of the load transferred by using the bearing plate to the load transferred through the headed stud or PBL connectors turned into not investigated in detail. +e configurations of the hybrid girder and the hybrid pylon in cable-stayed bridges have a few commonplace characteristics, together with the employment of headed studs and/or PBL connectors. +e load switch mechanism in the connecting part of the hybrid pylon is still well worth to be investigated. In this paper, a theoretical version for exploring the weight switch mechanism within the steel-concrete connecting part of the hybrid pylon is introduced firstly. +en, a scaled model of the connecting part, taken the hybrid pylon of Jishui Gan River Second Bridge as the prototype structure, was fabricated and tested. +e load-sharing ratio through the bearing plate and the shear connector was measured, and the weight transfer mechanism within the connecting part of the hybrid pylon changed into analyzed.

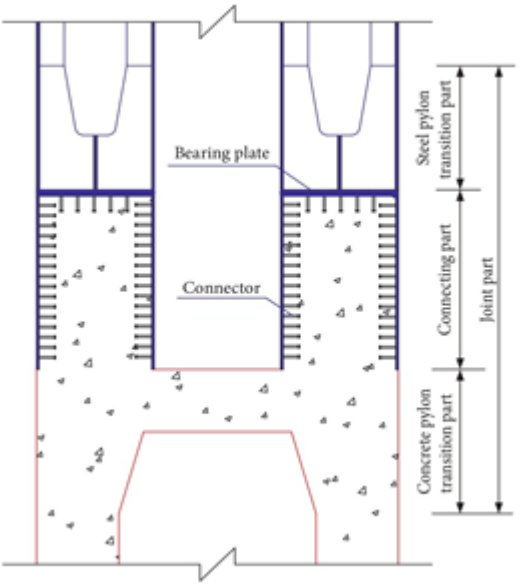

Fig. 1 Schematic Diagram of Hybrid Joint Structure

II. RESEARCH METHODOLOGY

- Research on Load Transfer Mechanism

Research Method. In order to know better of the stress distribution of the test model, the test model was loaded by 1.0 time axial force combined loads and the finite element analysis on the test model was carried out. The testing results and the FEA results are contrasted and they are almost the same. In this method the stress of each area of the model is obtained by combining the test results and the FEA results [4], then the sections of the model are divided into many areas named Ai, and assume that the stress distributes averagely in each area, when the stress σi of the bridge in axial direction is obtained.

- Research on Load Transfer Mechanism of the Structure.

The load in the steel-concrete composite joint section is delivered through the bearing plate and the shear studs, the difference value of the load bore by the sections which are behind and after the bearing plate

bore is the load bearing plate bears, then the remaining load is delivered by the shear studs. The section S4 before the bearing plate and the section S5 after the bearing plate are selected as research sections, the distributions of stresses are obtained by FEA results and the test results, distributions of stresses.

III. MODEL TEST FOR THE HYBRID JOINT

- Test Model Configuration

The configuration of the check version for the hybrid joint, and a 1 : three scale test specimen become fabricated based totally on the configuration of the hybrid joint of River Bridge. +e peak of the take a look at specimen is 1936 mm in total, and the define measurement of the metallic wall plate is 1166 × 1268 mm. +e concrete base was poured at the bottom of the take a look at specimen as a helping platform 300 mm in peak, and its cross section outline size is 1766 × 1728 mm. A steel plate 20 mm in thickness changed into welded on top of the take a look at specimen because the loading surface. In the test specimen, the perfobond plate and the headed stud connectors were organized on the metallic-concrete interface. +e number of those shear connectors inside the take a look at specimen is similar to inside the hybrid joint of the actual bridge. +e hole diameter of the perfobond plate connector is 37.5 mm, and the metal bar thirteen mm in diameter became hired to run via the hole. +e headed studs are thirteen mm in diameter and 80 mm in top, and the vertical spacing many of the PBLs and the headed studs is a hundred mm. Before the loading at the joint specimen, the mechanical houses of the steel plate and the concrete have been measured, and Tables 1 and 2 show the common tensile homes for each metallic plate hired in the joint specimen and the common mechanical residences for the poured concrete.

- Test Loading Scheme

According to the finite element evaluation for the actual bridge, the most damaging axial force within the hybrid joint of the unmarried pylon is predicted to be 57200 kN. As the shear pressure and the bending moment on the hybrid joint are an awful lot smaller than the axial compressive pressure, the shear pressure and the bending second were overlooked and handiest the axial compressive pressure was loaded on the check specimen. According to the similarity criterion among the take a look at specimen and the real hybrid joint, the loading axial pressure P is set to be 6500 kN and the loading grade is 0.1P.

- Measuring Program

+e measuring point format for the take a look at specimen is proven in Figure 8. +e stress gauges had been used to screen the strain of the steel plate within the test process. +e measuring factors at the external wall plate were A1, A2, A3, A4, A5, and A6 in a clockwise order, the measuring points on the longitudinal net had been B1, B2, and B3, and the measuring factors on the transverse internet were C1, C2, C3, and C4. Seven rows of the measuring factors have been organized from pinnacle to backside of the specimen in total, and the numbering order is 1 to 7 from top to bottom of the specimen. +e embedded pressure gauges were set in the metallic lattice cells to measure the compressive pressure of the concrete. +e pressure gauge numbers were F1, F2, F3, F4, and F5 in collection as proven in Figure 8. +ere were four rows of strain measuring factors arranged from pinnacle to bottom corresponding to 1, 2, 3, and 4. +e relative slip and the general compressive displacement on the metallic-concrete interface have been measured the use of dial gauges. +e relative slip gauge numbers had been K1, L1, M1, and N1 and had been set at the bottom of the joint. +e dial gauge numbers that measured the general compressive displacement are K2, L2, M2, and N2 and were positioned at the bearing plate on the outdoor of the metallic plate wall.

CONCLUSION

The big load from metallic box beam is dispersed when delivered through the transition segment, the weight is smoothly brought to the metallic-concrete composite joint segment, it indicates that the transitional feature of the transition segment is significant, the transition segment of the metal beam can disperse the load, so that the metallic-concrete composite joint phase is in an exquisite stress state. When the load is brought to the concrete beam via metallic-concrete composite joint section, 66.9% of the burden is bore with the aid of bearing plate, while the remaining load is bore via shear studs, load distribution percentage of individuals is reasonable, it shows the load is smoothly brought via the structure,

and the metallic-concrete composite joint section is reasonably designed.

REFERENCES

[1] Liu Yuqing: Steel-concrete hybrid bridge, Beijing China Communications Press, (2004). (in Chinese)

[2] Rovnak M, Duricova A, Ivanco V: Nontraditional shear connections in steel-concrete composite structures [J]. Composite and Hybrid Structures, 2000, 1(2): 305-312.

[3] Liu Qiong, Huang Cai-ping, Dang Zhi-jie: Experimental studies on the load wearing overall performance of Steel-concrete junction in field girder of Cable-stayed bridge[J]. Journal of Railway Engineering Society, 2009(9): 46-49. (in Chinese)

[4] Huang Caiping, Zhang Zhongxian, Chen Kaili: Model check and switch mechanism of steel-concrete composite shape for hybrid girder cable-stayed bridges. Journal of Huazhong University of Science and Technology (Natural Science Edition), v 40, n 1, p 67-71, January 2012. (in Chinese)

[5] Ministry of Communication of P.R. Of China: Steel and timber shape layout code for toll road bridge, Beijing, People's Communication Press, (1989). (in Chinese).