Curved cable-stayed bridges

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Summary

Designing of curved cable-stayed bridges allows to increase safety of its users (drivers). They also allow to adjust bridge to the existing or planned road communication configuration. Some unexpected behaviour of such structures may appear during its exploitation. Therefore it is necessary to gather information of ways of designing and non-typical behaviour of such bridges. Two curved cable-stayed bridges located in Poland are presented in the paper, including description of the structures, the way of their construction and their behaviour during exploitation and filed tests. The first one is a cable-stayed bridge in Skorogoszcz (Poland), which has two spans of 59.75 m each. Pylon is made of steel and the deck has composite structure: three beams are made of steel and is plate made of concrete. The second bridge is a viaduct along National Road No. 94 over the A4 highway in Wykroty. It is a continuous double span (45.47 + 45.28 m) cable-stayed structure with a prestressed concrete deck and the V-shaped pylons are made of steel.

Keywords: curved cable-stayed bridge, concrete, composite, statics, dynamics.

1. Introduction

Many difficulties concerning bridge structure and its fitting into a road configuration appear very often during designing a new road system in urban areas. Usually these problems demand: low structural height of the deck (the height between road level and the lowest point of the deck); fitting into complicated road configuration, that brings a necessity of designing bridge curved in both horizontal and vertical planes.One of possible solutions of mentioned above problems is to design and construct a cable-stayed structure, which has very low structural height. Examples of such curved cable-stayed bridges built in Poland is presented in the paper.

2. The cable-stayed bridge in Skorogoszcz.

The National Road No. 94 near the old bridge over the Nysa Klodzka river in Skorogoszcz was 5.84m wide, it was perpendicular to the river and there was a dangerous turn on the approach to the bridge (many car accidents had happened at this turn, very often cars had fallen into the river). A new bridge was designed to improve the road configuration. It had to eliminate the dangerous turn (replaced with a turn with much more larger radius and located partly on the new bridge) and it had to connect with a street located on the right river bank in densely urban area. A new road at that location had to keep its previous height, because of the connection with side-street near the right bank abutment. These requirements forced a designing a bridge with low structural height of the deck, such as cable-stayed one. It was built in 2005 (Fig. 1a & 2a).The paper presents static and dynamic test of the bridge carried out during proof load test and during its exploitation.

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Fig. 1: Curved cable-stayed bridges: a) over the Nysa Klodzka River in Skorogoszcz (after its opening to traffic), b) over the A4 motorway in Wykroty (computer image)

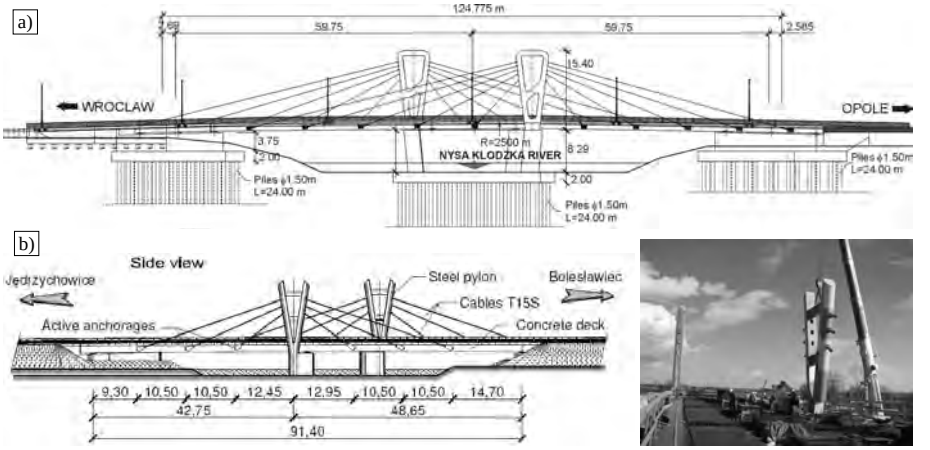

Fig. 2: a) Side view of bridge in Skorogoszcz, b) side view and pylon erection of viaduct in Wykroty

3. The viaduct over the A4 motorway in Wykroty.

The viaduct was designed in Wykroty along National Road No. 94 over the A4 motorway (Fig. 1b) which is currently under construction and will connect Zgorzelec and Krzywa. The structure will provide a safe passage of existing road over newly built motorway. It is a continuous double span (45.47 + 45.28 m) cable-stayed structure with a prestressed concrete deck and a steel V-shaped pylons. The viaduct is currently under construction (Fig 2b). The bridge is planned to be completed and open to traffic in June 2008.

4. Conclusions

Designing of curved cable-stayed bridges allows to increase safety of its users (drivers). They also allow to adjust bridge to the existing or planned road communication configuration due low structural height of the deck (the height between road level and the lowest point of the deck). Because of complicated geometry of the deck (mainly its curvature), bearing of such bridges should provide acceptance of large horizontal forces. To prevent this problem pylons may be fixed in the deck, then horizontal forces from stays tension and deck curvature will equilibrate within the deck and will not cause large horizontal forces in supports.