To the question of risk management for failures of cable-stayed and prestressed bridges in Russia

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Summary

The characteristic cases of cable-stayed and prestressed bridge structures failures and collapses in Russia are considered. Some results of risk analysis methodology applied to bridge structures are given. The process of identification of potential hazards and possible failure modes, definition the critical risk of failure with respect to the bridge structures are described. In order to improve a technical condition of bridge structures and to reduce the risks of their failures and collapses, some risk management actions were suggested with respect to the cable-stayed bridge on the Russian island in Vladivostok. Some of them are given in the report. For example, an inspection monitoring system, founded on new non-destructive equipment, is developed.

Keywords: cable-stayed, prestressed structures, failures, collapses, risk management, life cycle.

Before the beginning of the XXI century, there was the only cable-stayed bridge in Russia over the river Sheksna in Cherepovets with a maximum span of 194.5 m, built in 1979. In 2000, the cable-stayed bridge was built in the Siberian city Surgut, with the largest span of 408 m. Since then, every year in Russia one or more cable-stayed highway, pedestrian and pipeline bridges are built. Now there are about 20 such bridges in Russia. Span length was gradually increased and reached 1104 m for the bridge over the Eastern Bosphorus Strait to the island “Russian” in Vladivostok, which is currently the world record. Height of the pylons of this bridge is 312m and the maximum length of cables is 580.5 m which also is a record.

Aspects of safe, reliable and efficient operation of the bridge on the Russian island were of particular relevance in the design. That's why the general design institute "Mostovik" have requested design bureau "Transmost" to develop individual system of operation, monitoring and maintenance for this bridge. It was required to consider not only unique structures, but also the surrounding environment, characterized by force and violence influences: temperature conditions, corrosion, seismic, wind and wave loads.

This article considers only some aspects related to risk management for failures of cable-stayed and prestressed bridges. The bridge on the Russian island contains both types of such load-bearing structures with a high degree of responsibility. Some data on failures and collapses of such structures were collected and analyzed during operation.

It should be noted that the failures of Russian cable-stayed bridges were hitherto insignificant. Basically, they are diagnosed as wire breaks in some rope sections, excessive dynamic vibrations and local damage from traffic. For example, on the bridge over the Ob River in Surgut several wires in areas close to the anchors on the pylon were broken. The monitoring system also identified adverse frequency spectra induced oscillations of cables. To minimize the negative dynamic effects, the bridge was equipped with additional dampers, and damaged areas were fixed by elongation of anchorage zone.

The small number of failures of cable-stayed structures in Russia is due, first, to their relatively short period of operation, initially increased attention to these structures, as well as their availability for inspection and maintenance. At this point there is another risk group which is no less disturbing - prestressed bridge superstructures. Having the same type of main load-bearing elements, as cable-

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