

9th International Conference "Bridges in Danube Basin 2016", BDB 2016

Highway Viaduct Renovation

Ivanka Topurova^a, Petar Nikolov^b, Kostadin Topurov^{c*}

^{a,b,c}University of Architecture, Civil Engineering and Geodesy, Hristo Smirnenski 1, Sofia 1000, Bulgaria

Summary

The viaduct is positioned on the highway, connecting the city of Sofia with the northern part of Bulgaria. The total length of the viaduct is 645m, where it has 16 spans of 40.5m length each. The maximum height of the piers is 50m.

During the renovation of the deck and the piers has been discovered that some of the 120t post-tensioned concrete beams are in very bad condition. Approximately more than 50% from their origin load bearing capacity has been diminished. A decision was taken for these beams to be replaced by steel ones.

In the paper are described the design and the implementation of the renovation of the important structural elements, including the problems which were encountered upon. The design approach of the different elements has also been analyzed. The main innovation in the project is in the usage of concrete and steel beams in one and the same span. Due to the replacement of some post-tensioned beams with steel beams, the beneficent requested a full-scale load test of the bridge to be provided before it enters in operation again. The results from the static and dynamic tests of the renovated viaduct have been provided.

The renovated viaduct is in operation since the beginning of December 2015.

© 2016 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the organizing committee of BDB 2016

Keywords: existing highway viaduct; renovation

1. Introduction

Approximately 120 kilometers of the existing highways in Bulgaria, through the mountains in both directions - south and north from Sofia, have been constructed between the years 1975 and 1988. In this area have been executed many viaducts as well with height reaching up to 130 meters. For the construction of these superstructures have been used three types of precast post-tensioned concrete beams - 27m, 39m and 58m in length. The heights of

* Corresponding author. Tel.: +00359 887 39 29 03.

E-mail address: ivankatopurova@yahoo.com

these beams are 180cm, 240cm and 330cm, while the weight is around 40t, 120t and 240t respectively. As a rule, the beams have been produced in a region very close to the erected viaducts and have been transported with special equipment at a very low speed. The beams were fixed on their positions by special steel truss structure with appropriate mechanical equipment. The concrete deck slab is cast-in-situ for the main number of these viaducts.

The concrete piers are with hollow core cross sections and were erected by using sliding formwork.

A special assessment made on the bridges along the highways and main roads in Bulgaria, that took place between 2004 and 2005 and was financed by the EU, indicated that the bridges are not in good condition. Moreover, according to the report from this investigation, 64 bridges are close to possible accident. There are many reasons for that, but the main one is connected with their improper design, construction and lack of maintenance.

The viaducts mentioned above mainly have problems with the piers, the continuous slabs, the expansion joints, the bearings, the drainage system, the carriageway surface, the surface of the pedestrian parts and the traffic-safety barriers. From structural point of view, the major problems are the damages to the piers and the continuous slabs. The defects in the drainage systems and the expansion joints are the reasons of the defects in the substructures - the continuous slab, the main beams and the bridge slab. The origin of some defects is due to the design concept problems in that type of structure.

The viaduct described in this paper has many problems including structure of the bridge deck slab, main beams and pier. The bridge renovation started in the spring of 2015.

The authors of this paper are part of the team under the leadership of Prof. Topurov, which preceded the investigation, design and full-scale testing of the renovated viaduct. The viaduct is in operation from the beginning of December 2015.

2. Original design

The viaduct has multi-span, simply supported superstructure. Each span is 40.5m long and there are 16 spans in number, so the total length of the bridge is approximately 650m. The beams in longitudinal direction are connected with continuous slab laid over the piers. The viaduct is divided in longitudinal direction in three parts with four expansion joints - two on the abutments and two in-between the ends. Intermediate expansion joints are allocated on the piers №5 and №11 respectively. The expansion joints are of a modular type. The superstructure is constructed with four precast post-tensioned beams, 39m long and around 120t in weight. The beams span is 38m. The deck slab is executed from precast element with 299cm by 305cm in size and 20cm thickness in cross direction. The connection between the precast panels is done with cast-in-situ concrete on top of the precast beams with suitable reinforced detail. This cast-in-situ joint combines the slab with the precast beams and the precast slab elements (see fig 1a). The superstructure has two cross beams at the end of each span. No intermediate cross beams are used.



Fig. 1 Longitudinal view of the viaduct

Download English Version:

<https://daneshyari.com/en/article/5030190>

Download Persian Version:

<https://daneshyari.com/article/5030190>

[Daneshyari.com](https://daneshyari.com)