



Strengthening of a Curved and Skew Supported Prestressed Hollow Box Girder

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Abstract

Two equivalent motorway flyover ramps built in 1963, curved in view and with skewed abutments must be rehabilitated. The superstructures need to be strengthened due to deficiencies in shear capacity.

The post-tensioned concrete box section girder is supported by four bearings, all of which are of a different type. One of the bearings serves as a tension bearing, in form of a vertical, not inspectable post-tensioned cable. A monolithic connection of the superstructure with the abutment has been elaborated to provide a low maintenance alternative force path for the case of a potential loss of the tension in the vertical tendon. In addition, the proposed connection provides for the required seismic resistance.

The strengthening for shear force is executed by doubling the outer post-tensioned web.

Keywords: rehabilitation, strengthening, upgrade, post tensioned hollow box.

1 Introduction

The flyover ramps were built in 1963 as part of a motorway project. All the bridges along the route were erected on full scaffolding. The curved hollow box superstructure in concrete has been post-tensioned in stages. The curved in plan flyovers with skewed ends carry one lane of traffic and an emergency lane, each, to and from the motorway, respectively.

A condition and structural assessment showed that both structures have deficiencies in the shear capacity of the post-tensioned webs and in the torsion capacity of the bottom slab of the hollow box section.

The independent checking of the structural evaluation and the design of the strengthening

measures was completed in 2023. The structure was modelled in SOFiStiK with shell elements to evaluate the structural behaviour capturing the particularities of the curved hollow box section and the skewed supports, including the torsional response to the actions.

2 Original design

When the structure was designed in 1962, a simplified beam model was used, Figure 1.