ABSTRACT

Bridge Constructed Using the Cantilever Method – Connection with Both Sides Existing Tunnels for Improved Earthquake Resistance

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The present investigation aims at the reduction in the inertial seismic actions of a highly monolithic bridge, constructed with the cantilever method, through connection of both ends with existing tunnels. The proposed connection is achieved through the extension of the continuous deck slab, slightly oversized in thickness, towards the tunnels and the configuration of an interlocking device, in form of dowel – notch, with the solid tunnel foundation. The width of this slab, namely the "continuity slab", is equal to the distance between the wing-walls, with which it is in contact, and has the ability to slide as a drawer between them. Flexible micropiles avert buckling of the aforementioned slab and improve foundation soil conditions. The serviceability requirements of the deck are arranged by the cracking of the extension slab and by joints in the proposed dowel connection the width of which is determined by the in-service movements of the deck. The proposed interlocking layout contributes efficiently to the reduction of the inertial seismic actions during a longitudinal seismic action through shear stresses that develop at the dowel-deck interface. As far as concerns the seismic actions in the transverse direction of the bridge, the extended part of the deck slab, acting as a plate, effectively restraints the superstructure at the abutment. The proposed system is proved more efficient when it is implemented in loose foundation soil conditions. Furthermore, the need for hollow piers, due to significant displacements of the bridge, can be reduced with help of the proposed restraining technique, while cost-effectiveness and seismic response of the bridge are improved. For the analysis of the strongly non-linear dynamic response of the resulting structural system, which dissipates part of the induced seismic energy, time history analysis was implemented in order to model response to artificial earthquake motion that is compatible with the corresponding soil-dependent Eurocode 8 elastic spectra.