Box Tunnel under XVII-th century arch Trujillo bridge at Lima (Peru)

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Abstract

A heavy lifting operation was performed to build a concrete cut & cover tunnel underneath an ancient XVII-th arch stone bridge, Trujillo Bridge, at Lima, Peru. Two piers, 3000 tons each, were temporary shored by 300 mm diameter piles. Thirty seven 400 tons synchronized hydraulic cylinders worked together compensating the piers settlements, limiting the movement during the whole operation between -5 mm and + 2 mm, with no perceptible damage to the historical bridge. Six prestressed galleries per pier were manually excavated through the pier foundations to bridge the loads to the hydraulic devices supporting beam. Due to the high seismic hazard (0.53g PGA for 1000 years return period), a temporary earthquake resisting system has been installed throughout the whole construction process.

Keywords: heavy-lifting; temporary shoring; settlement; seismic; historic bridge

1 Introduction

Trujillo Bridge is an ancient stone arch bridge dated at the XVII-th early years, in 1610 [1], only 75 years after the Lima (Peru) foundation, where it is located. It keeps only four out of seven original arches, spanning 10 m each, between massive piers 6 m wide. The platform was initially 9,6 m wide. Each pier, with triangular and circular edges upstream and downstream, weighs to its foundation about 30000 kN, directly to natural gravels, four meters below the riverbed. The arches and resistant external walls are built with stones, filled with rocks from the river and lime mortars. Nowadays the remaining part belongs to the Lima historical city center, registered as a valuable cultural heritage, working as a footbridge. Modern intervention include the platform widening with steel beams, and the enlargement with precast beams spans; other modifications include bricks replacing the original stone blocks.

The site is known as an extremely high seismic risk area, as it is located near to the subduction friction zone between Nazca and South American plates. Lima region has been struck by historical earthquakes with 8 to 9 magnitude. For new civil construction infrastructures, as bridges and public structures, a 1000 years return period risk level is usually adopted, associated with a 0,53·g PGA.

The increasingly growing traffic in Lima is persuading to invest in new infrastructures, that could alleviate the most congested axis. That is the case of Linea Amarilla urban highway, an investment from LAMSAC, a company owned by INVEPAR, and constructed by the Brazilian company OAS. It is a high capacity road which runs along the river Rimac through 9 km.

Figure 1. Trujillo Bridge, XVII-th century historical bridge at Lima, Peru

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