Seismic design of the bridges and the tunnel of the project "Vía Parque Rímac", Lima (Perú)

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Summary

Vía Parque Rímac is the name given to the new expressway concession that will help to speed up the congested traffic of Lima, the capital of Peru. The road follows the course of the Rímac River, opposite the historic centre of the city and has a total length of about 9 km, with an underground section of almost 2 km, solved with a cut and cover tunnel. This road will be one of the main transport links of the city, connecting eleven districts and shortening travelling times to El Callao, where the port and the Jorge Chávez international airport are located. Works are scheduled to be completed in 2015, with an investment of around $700 million.

This article describes the cut and cover tunnel and the viaducts on the stretch, with their main singularities. Reference is made to the construction process adopted and it's also analysed the methodology used against the seismic actions, according AASHTO codes.

Keywords: tunnel, seismic design, racking, free-field deformation, seismic risk study,

viaducts, composite decks, capacity design, seismic isolation, LRB.

1. Introduction

The Vía Parque Rímac concessionaire is Lamsac, in which take part the Brazilian construction company OAS, also in charge of the execution of the works. The concession period is 30 years. The underground stretch is solved with a cut and cover tunnel which alignment runs under the Rímac River riverbed and this is a determining factor for its construction process and for its design.

Different obstacles along the alignment need to be overcome and crossed, creating the need for a total of 14 viaducts. Six of them cross the river and the rest cross interchanges and other roads. The significant geometric constraints, usually due to the proximity of buildings, give rise to structures with medium and large spans. One of them, viaduct 9 (Cerro de San Cristóbal), has two 110 m long spans and a curved alignment.

TYPSA has completed the Final Design for the tunnel and the viaducts, developing structural design as well as numerous complementary studies: geological and geotechnical studies of the foundations and ground supports, a hydrological study of the river course and a study of the impacts on the existing structures. In addition, TYPSA is present on site as Technical Assistant to OAS.

The seismic analysis has been carried out with the utmost rigour, as required by the real risk of the site and because it is a determining hypothesis. The tunnel is designed using the method known as "racking", in accordance with the criteria established by Wang [1], collected by FHWA [2] and by AASHTO [3].

The viaducts are designed taking general AASHTO [4] codes into account with regard to materials, load scenarios, combinations, and concrete and composite bridge dimensions. Two options have been managed for the seismic design: capacity-based design, considering the ductility and formation of plastic hinges [5], and seismic isolation, using LRB supports (Lead Rubber Bearing) [6].

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