Puente Nigale – Seismic Design of the Cable-stayed Main Bridges

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Summary

This paper presents details of the seismic design of the main bridges for the Segundo Cruce del Lago de Maracaibo (Puente Nigale) fixed-link project. The link is 12 km long from shore to shore, and consists of east and west approach bridges and a main cable-stayed bridge over the navigation channel. The link accommodates two parallel bridge structures, one for road traffic and one for rail service.

The main bridges consists of two parallel cable stayed bridges with main spans of 430 m and is situated in a seismically active area characterized by a peak ground acceleration of about 0.27g for a 1000 year return period event.

The paper discusses the seismicity in the project area, the development of the seismic design loads, the seismic design criteria, the seismic design strategy and the seismic design of the structure. In particular, the deep pile foundations on soft soil presented unique challenges to the seismic design.

Keywords: Fixed link, Bridge, Cable-stayed, Seismic, Push-over Analysis.

1. Introduction

COWI A/S has been appointed the consultant for the basic design of the "Segundo Cruce del Lago de Maracaibo" (Puente Nigale) fixed-link project by the contractor Construtora Norberto Odebrecht (ODB). The owner is the Venezuelan Ministry of Land Transport. The main bridges (referred to as 'the bridge' in this paper) is situated in a seismically active area characterized by a peak ground acceleration of approximately 0.27g for the 1000 year return period safety evaluation event (SEE). The strict seismic performance criteria require limited access within days and full access within months after a SEE level event.

The paper presents the chosen bridge concept and discusses the bridge site in relation to geology, seismicity and other environmental loads in the project area. A detailed account is given of the seismic design criteria and the seismic design strategy. Finally the structural design of the bridge is discussed in relation to the seismic impact.

AASHTO LRFD Bridge Design Specifications [1] was adopted for the general design of the bridge. AASHTO Guide Specifications for LRFD Seismic Bridge Design [2] was adopted for the seismic design.

2. Bridge Concept

The bridge consists of two parallel cable stayed bridges. The main span between the pylons is 430 m (Fig. 1) and provides a 50 m by 300 m navigation clearance. Each 179 m tall pylon (Fig. 2) consists of two legs, each supporting a girder with stay cables in a central plane, and interconnected by a cross beam. Both bridge decks consist of single-cell concrete box girders, one carrying two rail tracks and the other carrying two vehicle lanes and one emergency lane in each direction. The deck is connected monolithically to the pylons. On the piers (Fig. 3) the deck is free to move

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