Puente Nigale, Train/Bridge Dynamic Analysis

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Summary

An overall study of runability, comfort and safety aspects for real trains passing the planned Segundo Cruce del Lago de Maracaibo - Puente Nigale Bridge part of a fixed link across Lake Maracaibo in Venezuela has been carried out. For the analysis the AREMA codes apply. However, several Eurocodes defining design criteria for train/bridge dynamic interaction, train runability and cross wind effects has also been used.

This paper shows how train runability has been checked through global analyses by use of a 3D FE in-house developed Integrated Bridge Design and Analysis System (IBDAS) [1] allowing for direct dynamic train/bridge interaction analysis, i.e. the dynamic trains modelled as minimum 14 DOF per coach are interacting directly with the global FE-model utilizing a modal approach.

The dynamic modelling of five real trains has proved to be a highly valuable tool for examining the feasibility and safety of operating railway traffic on the fixed link.

Keywords: Bridge - train dynamic interaction, Runability, FE model

1. Introduction

An overall study of runability, comfort and safety aspects for real trains passing the planned Puente Nigale Bridge part of a fixed link across Lake Maracaibo in Venezuela has been carried out. The paper has focused on analysis for the Main Span of the crossing. The assessment of these issues are considered essential for verification of the technical feasibility and proof of safety for the 11 km crossing, comprised by 1,050 m short and medium span bridges, 4,500 m low level bridge, 4,800 m elevated bridge and a 910 m cable stayed concrete girder bridge with 430 m free span, which will be world record for one level concrete girder cable stayed bridge for carrying rail traffic.

The Owner Ministerio del Poder Popular para Transporte Terrestre has with the railway authority El Instituto de Ferrocarriles del Estado (IFE) planned the bridge to be part of the Venezuelan Intercity Rail network and as such the AREMA codes will apply. However, the AREMA codes do not foresee long span cable supported girders and therefore several Eurocodes defining design criteria for train-bridge dynamic interaction, train runability and cross wind effects will also apply for the bridge.

The adopted numerical code described in the following, includes the possibility for special investigations of running multiple train sets with individual properties for aerodynamics and suspension systems on the bridge.

Numerical capabilities allow within frequency domain the assessment of:

- dynamic factors for real trains passing the structure;
- dynamic response of bridge and trains exposed to dynamic wind loads;
- dynamic response of bridge and trains exposed to seismic loads.

An overall study of safety and comfort runability aspects for real trains passing the planned Puente

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