Modelling of Structural Damping in Time History Analyses of Seismic Response of Chacao Bridge

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Abstract

This paper describes how structural damping has been applied in Time History Analyses (THA) of seismic response of Chacao Bridge in Chile, which is located in an active seismic zone. Correct modelling of structural damping becomes particularly important because of the concrete pylons, which will have high energy dissipation (i.e. structural damping) during a severe earthquake. Tuning global Rayleigh damping parameters are usually trivial for simple structures with only a few governing modes, but becomes difficult for a soft suspension bridge with stiff, but still flexible, pylons on relatively soft piles. The solution has been to apply element-wise Rayleigh damping, where the damping parameters of each element is tuned to fit important modes for the structural part the element is a part of. The procedure is tested by comparing acceleration-based THA to RSA.

Keywords: Seismic response; Time history analysis; Structural damping; Element-wise Rayleigh damping.

1 Introduction

The Chacao Bridge is a two-main-span suspension bridge crossing the 2,5 km wide Chacao Channel in Southern Chile. The bridge site is about 1000 km south of Santiago and is linking the Chiloe Island to main land. The site is located in an active seismic zone.

The bridge has main spans of 1155 m and 1055 m, a suspended side span of 284 m at the north end and a viaduct of 140 m at the south end. The total length between the anchorages is 2754 m. It has three concrete pylons of 157 m, 175 m and 199 m, and the two latter (Central and North Pylon) are located on piles with free length in water. An overview is shown in Figure 1. The softness of the main girder and free piles combined with the relatively stiff pylons, has presented challenges for the seismic analyses.

The seismic demand on the bridge is in general derived by Response Spectrum Analyses (RSA), but Time History Analyses (THA) have been performed to verify the RSA results. THA is also used to model non-linear behavior that cannot be represented in RSA, and to obtain coexistent response in multiple elements at each time step.

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