Identification of Nonlinear Site Response Using the H/V Spectral Ratio Method

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ABSTRACT

The horizontal-to-vertical spectral ratio has become increasingly popular in studies of site effect and determination of the predominant period of a site. In this study, this method is extended to identify nonlinear soil responses. To establish this phenomenon, borehole array records that already showed nonlinear site responses using spectral ratios between surface and borehole station pairs were analyzed. Moreover, in this study, the horizontal-to-vertical spectral ratio method was applied to weak and strong motion records from the same dataset. The results demonstrate that nonlinear site responses can be evaluated using horizontal-to-vertical spectral ratios of surface recordings at a single station.

(Key words: Horizontal-to-vertical spectral ratio, Nonlinear site effect, Borehole array)

1. INTRODUCTION

Nonlinear site effects, such as increases in damping and reduction in shear wave velocity as input strength increases, are commonly observed in the dynamic loading of soils using geotechnical models. In recent years, mounting evidence indicates that nonlinear site effects in strong-motion seismology are more common than previously assumed (Beresnev and Wen 1996). Direct seismological evidence of nonlinear site effects was reported using spectral ratio techniques for two-station pairs, including soil-to-rock and surface-to-borehole station pairs (Wen 1994; Wen et al. 1994).

In recent years, several large earthquakes were recorded by modern digital surface and vertical arrays. Borehole data ensure reliable assessment of the soil transfer function. Obser-

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