

A Probabilistic Methodology for Site Specific Response Analysis

Atila Ansal (1), Gökçe Tönük (2), and Aslı Kurtuluş (1)

(1) Ozyegin University, Civil Engineering Department, Alemdag, Cekmekoy, Istanbul, Turkey, (2) MEF University, Civil Engineering Department, Ayazaga, Istanbul, Turkey

Assessment of site-specific design earthquake characteristics for performance levels of Collapse Prevention, Life Safety, and Immediate Occupancy requires that a seismic hazard analyses is conducted to estimate earthquake characteristics on the ground surface for the exceedance levels of 2%, 10%, and 50% in 50 years. This analysis may be performed in two statistically independent, consecutive stages. The first stage involves the seismic hazard study to assess the design earthquake characteristics on rock outcrop for all exceedance levels. The second stage site response analysis to estimate design earthquake characteristics on the ground surface based on the geotechnical and geological site conditions.

A probabilistic approach may be adopted to evaluate the uncertainties and to determine the overall exceedance probability for the design earthquake characteristics on the ground surface. The uncertainties arising from the differences in the source characteristics are taken into account by using large number of seismic hazard compatible (i.e. fault mechanism, earthquake magnitude, and fault distance) real acceleration time histories for site response analyses. The uniform hazard spectra estimated by the earthquake hazard study on the rock outcrop may be used for scaling input motions and 1D site response analysis may be conducted for the investigated site to evaluate design earthquake characteristics.

A parametric study was carried out based on Monte Carlo simulation to account for site variability using a site response analysis code for 1D site response analyses. A methodology is proposed to estimate the design acceleration spectrum based on 1D site response analysis and the applicability of the proposed methodology is demonstrated based on the previous case studies.