1st National Congress on Soil Mechanics and Foundation Engineering
Shahid Rajaee Teacher Training University, Tehran, Iran
3-4 December 2014

Effects of Shear Wave Velocity on Scale factors of Records

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Abstract

This paper provides and evaluates record's scale factors associated with four classes of soil with different domain of shear wave velocity considering two common scaling methods based on the uniform hazard spectrum (UHS) method. The evaluation has been conducted based on the deviation in structural responses of the models. The assessed scaling methods are the ones which are broadly used by design professionals as well as they are compatible with commonly used performance assessment codes. As well, the records were selected from a very frequently applied list of ground motions. It has been recognized that although by reduction in shear wave velocity in the soil classes the scale factors increased, the amounts of deviation in structural responses are not depended on the class of soil. So, it could be concluded that the reliability of the structural responses is independent from shear wave velocity in the soil class.

Keywords: Soil class, Scale factor, Uniform hazard spectrum, Shear wave velocity, Deviation.

1. INTRODUCTION

Seismic provisions in current building codes and standards include rules for design of structures using nonlinear response history analysis in some conditions. Due to the lack of recorded data for the design level earthquakes (which are usually rare events), it is critical to develop intensity-based scaling methods which deal with number of records represented by intensity measures (IM), like peak ground acceleration, spectral acceleration on fundamental period of the model or etc., which are scaled associated with the intensity assumed target spectrum. These methods scale current ground motion databases to provide a group of earthquake motions that can realistically represent important aspects of the design motion controlling the nonlinear response of civil engineering facilities [1].

This study addresses the question of accelerogram scaling for predicting nonlinear seismic response of structures that supports either design or performance assessment based on four classes of soil. It emphases on evaluation of soil condition on scaling factors in accordance to the amount of deviations in the structural responses in view of two scaling methods. The scale factors and the selected records could be directly utilized from this paper in the other studies in this field without any excessive calculational attempts.

2. SITE CLASSIFICATION

Site class is used to characterized the type and properties of soils at a given site and account for their effect on the site coefficients, assumed in ASCE7-05 by the F_a and F_v, used in developing the design response spectrum. Site classification procedure does not encompass evaluation of potential geological and seismic hazard of the site. Based on the competency of the soil and rock material, a site is categorized as site class A, B, C, D, E or F. The site classes range from hard rock to soft soil profiles as presented in Table 1 [2]. This table appears in ASCE7-05 as Table 20.3-1.

To classify a site, the proper subsurface profile and necessary data need to be obtained. Site soil shall be classified based on the upper 30 m of the profile and where soil properties are not known in sufficient detail, site class D shall be used unless site class E or F are determined to be present. Seismic responses in