Lateral and Torsional Acceleration Spectrum of Iranin Earthquakes Considering the Kinematic Soil-Structure Interaction Effects

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ABSTRACT

In the traditional dynamic structural analyses, free field responses of the site being used as the foundation input motion. To consider the effects of earthquake torsional motion, an accidental eccentricity is assumed at the imposition point of earthquake forces. However, studies on kinematic soil-structure interaction show that assuming a fixed value for eccentricity by ignoring the geometry and mechanical characteristics such as foundation dimension, soil shear wave velocity, angle of incident wave and the natural frequency of structure significantly reduces the accuracy of results. In this paper an efficient approximation formula is implemented for the estimation of foundation input motion. The lateral and torsional acceleration response spectrum of Iranian earthquakes are evaluated and, changes in the response spectrum with respect to the changes in the ratio of the foundation dimension to the shear wave velocity is also investigated. At the end of the paper the obtained lateral and torsional response spectral for each type of soil are used to estimate the required accidental eccentricities for common structural analysis.

Key Words: Torsional Motion, Kinematic Soil-Structure Interaction, Accidental Eccentricity.

1 INTRODUCTION

In the earlier studies about the structural response to the earthquakes, the superstructure is analyzed without considering the effects of foundation and the underneath soil. Such assumptions are reasonable for the analysis of structures over the bedrock, however in other cases the soil-structure interaction has significant effects on the results of analyses [1]. Available numerical methods are able to model such problems accurately, but they suffer from some deficiencies such as the complexity of modeling, high computational effort and the need for advanced skills in different fields of engineering. Hence, some alternative techniques such as substructure method are adopted by researchers.

In the substructure method, the model is divided into two subsections; the superstructure and the soil-foundation part. As the main goal is the analysis and design of the superstructure, the effects of the soil-foundation system are imposed to the superstructure model. Hence, the stiffness[1] and deformations[2] characteristic of the soil-foundation system (as the most effective parameters) are transformed to the superstructure model. For the evaluation of mentioned properties, the kinematic and inertial interaction analyses are necessary. In the kinematic analysis, a mass-less structure with a stiff foundation is assumed over the soil medium (figure 1). After the wave propagating in the

[1] Impedance Function

[2] Foundation Input Motion