The Evaluation of Effective Period of Buildings Including Soil-Foundation-Structure Interaction Effects

Freidoun Amini[1], **Masoud Shadlou**[2]

1- Associate Professor, Civil Engineering Department of Iran University of Science and Technology.

2- M.Sc. Student, Civil Engineering Department of Iran University of Science and Technology.

famini@iust.ac.ir
mshadloo@civileng.iust.ac.ir

Abstract

The aim of this paper is to propose a simple and reasonably accurate method for determination of modal periods of structure including soil-foundation-structure interaction (SFSI) effects. Mylonakis and Gazetas (2000) reported that Mexico earthquake was particularly destructive to 10-12 storey buildings founded on soft soil clay, whose period increased from about 1.0 s (assumption of fixed base structure) to nearly 2.0 s due to the SFSI. This conclusion demonstrates the effects of higher mode on the response of structure. In this paper, The results indicate for a constant depth of embedment and soil shear wave velocity, the actual modal period become a few smaller than proposed method of modal period and the proposed mode is efficient in the modal analysis.

Keywords: Modal Period, SFSI, Impedance Function

1. INTRODUCTION

Soil-foundation-structure interaction (SFSI) can significantly affect the seismic performance of building. Engineering models of these effects are required for rational evaluations of seismic demand placed on the soil-foundation-structure system, and for evaluations of the deformation capacity of such systems. These effects can be quantified by flexible natural period ($\tilde{T}$) and by the damping ratio ($\tilde{\zeta}$) of the complete structure-foundation-soil system (Jennings and Bielake, 1973). The effective period of soil-foundation-structure systems have been extensively studied either for surface supported foundations (Jennings and Bielak, 1973; Veletsos, 1977; Veletsos and Meek, 1974; Veletsos and Nair, 1975; Bielak, 1976; Luco, 1980) or for embedded foundation (Bielak, 1975; Aviles and Perez-Rocha, 1996, 1998). However, they have been examined an equivalent single-degree of freedom model.

The impedance functions, representing the dynamic force-displacement relationship for rigid or flexible foundations supported on an elastic half-space, constitute one of the key elements in the formulation of the linear SFSI problem. The past researches generally used separately the horizontal and rocking components of impedance function to assess effective natural period of soil-foundation structure system.

In major building codes or design documents (ASCE 07-5; ATC-40, 1996; FEMA-356, 2000), the interaction effects are expressed by increases in the fundamental natural period and the structural damping. These solutions overestimate the flexible natural period. On the basis of data recorded on 60 building covering a