9th International Congress on Civil Engineering, May 8-10, 2012
Isfahan University of Technology (IUT), Isfahan, Iran

Evaluation of equivalent modal and uniform damping ratios in hybrid structures

Mohsen Gerami[1], Daryush Khodayarnezhad [2], Abbas Sivandi Pour[3]
1- Assistant Professor, Faculty of Civil. Eng, Semnan University, Semnan, Iran.
2- M.Sc. candidate of Earthquake Engineering, Faculty of Civil. Eng, Semnan University, Semnan, Iran.
3- PhD. candidate of Earthquake Engineering, Faculty of Civil. Eng, Semnan University, Semnan, Iran.

mgerami@semnan.ac.ir
daryush.khodayarnezhad@gmail.com
abbas.sivandi@gmail.com

Abstract

In hybrids, the different damping ratios of two parts of these structures make earthquake design of such structures troublesome procedure. Many design engineers end up using an overall conservative damping ratio equal to 2% in order to be on the safe side. In this paper, the MDOF structure is transformed to a 2-DOF oscillator; in the first step, an equivalent modal damping ratio is proposed. The new 2-DOF equivalent structure with equivalent modal damping ratios has been real appreciated eigen-values. Next step is introducing an equivalent uniform damping ratio that is obtained by semi-empirical error minimization and can be used in available commercial software. The results in models indicate that the use of these damping ratios with acceptable accuracy (in most cases errors are below 5%) and also the response of approximate structure obtained by these damping ratios is much closer to actual one when compared to the usual approach that adopts the overall conservative damping equal to 2%.

Keywords: Irregular damping, mixed structures, Complex mode, Equivalent damping ratios

1. INTRODUCTION

The scope of this work is obtaining the dynamic response of hybrid structures. These structures consist of two parts. The lower part is made of reinforced concrete called primary-structure, and upper part is made of steel called secondary-structure. The primary structure, denoted by letter *p*, is founded on the earth and secondary part, denoted by letter *s*, is resting in the primary-structure. These kinds of structures are irregular in height due to different response characteristics. Reasons for this irregularity maybe are the different stiffness or different energy dissipation mechanism. Furthermore, different distribution of material could be the cause of irregularity.
Several applications of such as structural configurations are encountered in practice. These structures are frequently used in stadiums or in some structures that need lower mass and more speed of construction at upper part of structure (see figure1).

(a) **(b)**

Figure 1. a) A stadium b) A hybrid structure