

Identification of Structure Dynamic Characteristics Using Forced Excitation Tests

Arman Tatar^{1*} - Fayaz Rahimzadeh Rofooei² – Ali Niousha³

¹ Building and Housing Research Center (BHRC)

² Sharif University of Technology

³ University of Science and Culture

ABSTRACT

Structure dynamic characteristics are defined as parameters which is used to predict the response of the system under loads with vibrating nature. Knowing the dynamic characteristics of a structure plays a vital role in understanding it's behavior under seismic loads. It also helps engineers to improve their design to perform better under dynamic excitations including environmental excitations, stochastic excitations like earthquake and live load excitations. In order to identify these characteristics, Forced Excitation Tests (FETs) are one of common ways.

Keywords: System Identification, Forced excitation test, Modal analysis, FRF, Transfer function

1. INTRODUCTION

Dynamic characteristics of a structure is referred to parameters which define structure oscillating properties under seismic loading. This seismic loading could be from any kind as deterministic (periodic like a machinery or non-periodic like train load) or random like earthquake or wind. Usually these dynamic characteristics are studied in modal analysis which are called Modal Parameters. This is due to the fact that this method is performed for measuring and analyzing the dynamic response of structures during vibrational excitation. It should be noted that the dynamic characteristics of a vibrating structure could also be predicted by analytical techniques such as the Finite Element Methods (FEM), however it is clear that errors in the analytical models are inevitable. On the other hand modal data extracted directly from measurements of the actual structure is more likely to be true and near the reality.

Forced Excitation tests are among many methods that utilize dynamic responses of structure to extract the dynamic characteristics. With proper instrumentation of structure and reliable methods for signal processing, modeling and identification, dynamic properties could be extracted. For vibration testing of a structure, an excitation source, measuring system and a digital signal processor is needed. In forced excitation test the excitation source is usually a device with specified range of frequency and force which exerts seismic excitation to the system. This device is usually a mass system which is mounted on the structure and rotate or vibrates in a controlled matter. Measuring system in this method is the sensor network that it's type, placement and other variables depends on the structure and the examiner's goal. Generally accelerometers, velocimeters and displacement sensors are used in common and commercial use. At last but not least, Digital Signal Processors are systems that record the data, both input and output, and removes the noise and errors of the instrumentation and measurements. Each of these elements are important for a successful and correct measurement of structure's dynamic parameters. Figures 1 through 3 shows examples from each of these three elements.

* arman_1369_t@aut.ac.ir