



Estimation of the dynamic properties of floors using Heel Drop Tests

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Abstract

To evaluate the dynamic response of floors, it is important to estimate their dynamic properties, in particular natural frequencies and modal damping ratios. Heel drop test is a simple and inexpensive method of floor excitation to measure its dynamic properties. Even though this test can result in a relatively accurate estimate of the floor natural frequency, this may not be the case for the modal damping ratios. With the help of a number of volunteers, heel drop tests were conducted on a force platform placed on a test floor. The tests were also repeated using an instrumented hammer. The results showed that the measured natural frequency using heel drops was close to that found using the instrumented hammer. However, the modal damping ratios found using the heel drop tests were higher, which can be attributed to the human-structure interaction phenomenon.

Keywords: Modal Damping Ratio; Natural Frequency; Heel Drop Test; Human-Structure Interaction; Half-Power Point Method

1 Introduction

Structural engineers may need to estimate the as-built dynamic properties of existing structures for evaluation purposes and updating computer models for structural analysis. The fundamental frequency and modal damping ratio are two of the most important dynamic properties for evaluating the dynamic response of floors.

Using an accelerometer and an inexpensive analyser, the engineer can perform heel-drop tests to estimate the dynamic properties of structural systems [1, 2]. However, his/her presence on the floor can modify the estimated dynamic properties.

Since the human mass is generally much smaller than the floor mass, the effect of the person conducting the heel drop on floor natural frequency is usually not significant. However, this can modify the floor modal damping ratio due to human-structure interaction (HSI) effects [3-5].

In this paper, with the help of a number of volunteers, heel drop tests were conducted on a force plate placed on a test floor. The tests were also repeated using an instrumented impact hammer. The main aim of this research was to study the accuracy of heel drop tests to estimate the natural frequency and modal damping ratio of structural floor systems.