

SHORT COMMUNICATION

JUMPING OF BELL HOUSES CAUSED BY NEAR-FIELD GROUND MOTION. CASE HISTORIES AND SHAKING TABLE EXPERIMENT

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SUMMARY

Earthquake-induced jumping of Bell Houses evidenced in epicentral areas of two earthquakes is discussed here. The earthquakes are the 1995 Hyogoken-nanbu, Japan earthquake and the 1909 Anegawa, Japan earthquake. Site-investigation was conducted to estimate vibration characteristics of the House and the ground. A series of shaking-table experiments, using models of a Bell House, demonstrated that the jumping followed by remarkable displacement can take place even by horizontal ground motion alone, when the strong motion is abruptly applied in the direction diagonal to the framework of the Bell House. The jumping process in the model experiment seems to be consistent with observations at real Bell Houses. © 1997 by John Wiley & Sons, Ltd. Earthquake eng. struct. dyn. 26: 657-665, 1997.

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KEY WORDS: near-field; earthquake-induced jumping; Bell House; shaking-table experiment; case histories

INTRODUCTION

Recent destructive earthquakes such as the 1994 Northridge, California and the 1995 Hogoken-nanbu, Japan earthquakes have highlighted urgent necessity to take account of near-field ground motion in seismic design of urban facilities. However, characteristics of the near-field strong motion are not well known to a satisfactory level of accuracy, mainly due to the limited number of the recordings. To supplement the scarcity of the recordings, back analyses of evidences are sometimes conducted using numerical or experimental methods. The authors¹ conducted a simulation of jumping displacement of boulders observed in the near-field of a Japanese earthquake, and confirmed that the jumping of objects could be an indicator of ground motion intensity.

This paper deals with the jumping of Bell Houses evidenced in epicentral areas of a recent and a past earthquakes in Japan. Referring to the case histories, the jumping is reproduced by shaking-table experiments using models of Bell Houses to find a key to the associated ground motion characteristics.

TRADITIONAL BELL HOUSES IN JAPAN

As schematically shown in Figure 1, a traditional Bell House, usually located in a precinct of a Japanese temple, is mainly made of wooden columns and beams, a tiled roof, and shoe-stones. The house has no walls

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