

Ambient Vibration Measurement and Earthquake Resistant Behavior Analysis on a Two-Tower Tall Building with Enlarged Base

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Abstract: The two-tower building with enlarged base is a high-rise structure form favored by the architect. The enlarged base can be used as the emporium and the towers can be used as dwelling or business house. The two towers can be connected by air corridors, which have better visual field and service function. In this paper the ambient vibration measurement was conducted on a 86 meters high frame-wall apartment tall building. This building consists of two towers connected by air corridors and an enlarged base. The natural frequencies, translational and torsional mode shapes are measured. SATWE module in PKPM software is used to model the structure and the analytical modes are calculated. It is found that due to eccentricity of the air corridors, each vibration shape in the structure has component of torsional (rotation in the plane of the floor) vibration, and the higher modes are all torsional modes. In comparison with the experiential formulas used in calculating fundamental period of tall building in different country, it is found that the measured fundamental period of the structure is higher than the results by calculation. It shows that the measured stiffness of the structure is higher than that of the analytical model. It is relevant to the stiffness of infilled wall and other affiliated facility, as well as the use of shell element in modeling the air corridors to underestimate the flexure stiffness of the story. At last design ground motions are used in the elastic dynamic time history analysis by using Newmark- β method, and the results show that under the analytical ground motion, the response force concentrate on the transfer story on the third storey and the highest air corridor on the top of the tower, and the shear force has greatly changed. Due to the connection of the air corridor, in direction x and y the bending moment and lateral displacement are approximately equal to each other.

Keywords: two-tower structure with enlarged base; tall building; ambient vibration measurement; experimental modal analysis; earthquake resistant behavior analysis