VERTICAL RESPONSE OBSERVATION OF TEN-STORIED BUILDING DURING RIGHIT UNDER EARTHQUAKES

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SYNOPSIS

Concerns of earthquake engineers on vertical responses of structures during near souced earthquakes are recently increasing in Japan, because damages of structures recently constructed due to near souced earthquakes imply neccesity to review the earthquake proof design of structures considering dynamic effects of vertical responses of structures. This research intend to prepare basic data of vertical response modeling and vertical response analysis especially for nuclear power plant facilities.

RESULTS AND CONCLUSIONS

Vertical responses of a ten-storied building supported on piles are observed during right under earthquakes. The main structure of the building is center-core typed frame works and its dynamic properties have been researched by vibration tests in the horizontal and vertical directions.

From the earthquake response observation during right under earthquakes, vibration tests and numerical model analysis, results of this research are summerized as follows; 1) The vertical responses of the building are as important as the horizontal responses to dynamic stability of the structure during right under earthquakes. The larger the distance from the building to epicenter, the less the effects of vertical responses to the total dynamic responses of the structure during earthquakes. 2) The time when the maximum vertical responses appeared did not always coincided with the time when the maximum horizontal ground accelerations or the maximum horizontal responses appeared. 3) The building has no uniform vertical rigidity from center core to circumferential columns. The fundamental frequency of the building in the vertical direction is about 9.5 Hz and the second natural frequency is about 12.2 Hz. The first mode is uniform elongation and the second mode is inversed moving between the center core and the circumferential columns. It is pointed out that these modal vibrations are the cause of damages during near field earthquakes because beams of structures suffer the large shear force and bending moment due to differential movements between core and columns. 4) Nuclear power plant facilities in Japan are founded on firm rock ground. Results from vertical vibration tests to nuclear power plant facilities founded on firm rock ground indicate zoning models as practical models to the vertical response analyses. The zoning models consist of uniform portions of vertical rigidity of the structure, or column portions and wall portions. But for modeling of structures founded soft ground or suported on piles, sutable considerations are neccesary to adopt the zoning models, because these structures behave different moving from portion to portions verticaly.

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