

Effect analysis of soil interlayer on seismic dynamic response and failure mode of metro station structure

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When the metro station structure is built in the site with weak interlayer, the metro station structure shows different patterns of destruction. In this article, based on the nonlinear elastic-plastic finite element model for metro station, considering the structure-soil dynamic interaction, the influence laws of the weak interlayer on the dynamic response and failure mode of the metro station structure under near and far-field earthquakes are studied. We found that the weak interlayer in the middle of the metro station has the greatest effect on the displacement, dynamic amplification factor and internal force of the metro station which leads to the poor anti-seismic performance of the metro station structure, and the metro station is more vulnerable to damage under near-field earthquake. When there is a middle interlayer, the maximum horizontal displacement of the metro station increases 63% at most compared to no interlayer under near-field earthquake. The interlayer below the metro station has a minimal impact on the dynamic amplification factor which shows that the existence of the interlayer below the metro station could reduce the vibration of the metro station to a certain extent. At last, indoor shaking table test for metro station was done, through which we determined the position of initial failure and the failure mode of the metro station structure under earthquake, and shaking table test results demonstrate the validation of the numerical simulation results.

Keywords: weak interlayer, metro station, near and far-field earthquakes, shaking table test, failure mode