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Quantification of Effects of Structure-Soil-Structure Interactions on Urban Environment under Rayleigh Wave Loading

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Abstract : The effects of multiple Structure-Soil-Structure Interactions (SSSI) on the seismic wave-field is generally disregarded by earthquake engineers, particularly the surface waves which cause more damage to buildings. Closely built high rise buildings exchange substantial seismic energy with each other and act as a full-coupled dynamic system. In this paper, SSI effects on the building responses and the free field motion due to a small city consisting 25- homogenous buildings blocks of 10-storey are quantified. The rocking and translational behavior of building under Rayleigh wave loading is studied for different dimensions of the building. The obtained dynamic parameters of buildings revealed a reduction in building roof drift with an increase in number of buildings ahead of the considered building. The strain developed by vertical component of Rayleigh may cause tension in structural components of building. A matching of fundamental frequency of building for the horizontal component of Rayleigh wave with that for vertically incident SV-wave is obtained. Further, the fundamental frequency of building for the vertical vibration is approximately twice to that for horizontal vibration. The city insulation has caused a reduction of amplitude of Rayleigh wave up to 19.3% and 21.6% in the horizontal and vertical components, respectively just outside the city. Further, the insulating effect of city was very large at fundamental frequency of buildings for both the horizontal and vertical components. Therefore, it is recommended to consider the insulating effects of city falling in the path of Rayleigh wave propagation in seismic hazard assessment for an area.

Keywords : structure-soil-structure interactions, Rayleigh wave propagation, finite difference simulation, dynamic response of buildings
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