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Surface Waves in Strong-Motion Records and their Importance for Engineering Applications

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Strong motion records are composed by body as well as surface waves, however traditionally surface waves are considered of less engineering importance. Yet, surface waves generated within the sedimentary basin as a consequence of the interaction of incoming body waves with the heterogeneous basin structure could be a concern both in the near and the far-fields. The basin recorded ground-motion is distinct from the rocky site record. Typically, it has longer duration with long-period surface waves arriving at the later part of the seismogram. In order to properly explain the observation of surface waves in the basin records, we used a simple plane wave model propagating in a layered half-space medium. We considered basins with and without irregular boundary and seismic sources located both outside and beneath the basin. The multiple reflections and refractions within the basin due to the irregular basin structure is the primary cause for generating large-amplitude surface waves. Furthermore it appears that the source located outside the basin is more efficient in generating surface waves compared to the source beneath the basin. This feature is also supported by the observations during the earthquakes. In this communication, we used records from an aftershock of 1999 Chi-Chi earthquake to demonstrate the significance of surface waves in the strong motion records and we also explained a simplified yet powerful band-pass filtering approach to isolate the surface waves form the body waves. Later, we carried out a nonlinear dynamic analysis of steel framed structures ranging from 3 to 20 stories for both a basin record and the rocky site record. We noted that the long period surface waves have a significant contribution in the structural response especially for long-period structures (above 10 stories) and ignoring the surface waves in the structural design for structures located in the basin would heavily undermine the seismic risk.