THE EFFECTS OF LOCAL SOIL CONDITIONS ON THE CHARACTERISTICS OF NEAR-FAULT DIRECTIVITY PULSE

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Pulse like near-fault ground motions resulting from directivity effects are a special class of ground motions that are challenging characterize for seismic performance assessment. These motions contain a pulse in the velocity and sometimes in acceleration time histories often occurring in the direction perpendicular to the fault rupture at locations near the fault (almost within 15 km from the fault) where the earthquake rupture has propagated toward the site (Bray and Rodriguez-Marek (2004), Somerville et al. (1997)). Near-fault recordings from recent earthquakes indicate that this pulse is a narrow band pulse whose period increases with magnitude as expected from theory. This magnitude dependence of the pulse period causes the response spectrum to have a peak whose period and amplitude increase with magnitude (Xie et al. (2005); Xu et al. (2013)), or size of asperity(s) on a fault (Ghayamghamian, 2005). Meanwhile, the effects of local soil conditions on the near-fault directivity pulse parameters have not yet investigated, and need to be further examined.

In this study, 40 near-fault ground motions from Chi-Chi earthquake (1999) are gathered to investigate the relations among directivity pulse amplitude and period with local soil conditions (Fig.1). For this purpose, the Chi-Chi (1999) earthquake is selected since it was experienced by the large number of stations with different soil conditions. This makes a good opportunity to investigate on the variation of forward directivity pulse parameters at the sites with different soil conditions. The selected near-fault motions are gathered from Pacific Earthquake Engineering Research Center database and examined to have forward directivity pulse. The selected near-fault records are next classified into 4 categorizes according to the soil profile of their recording stations, namely A, B, C and D.

From figure 1, three big asperities can be seen on the fault plane of Chi-Chi earthquake. Due to large distance of rupture, the sites in the vicinity of the asperities might be dominated by different periods of rupture directivity pulses. Then, the near-fault area in the forward rupture direction (from south to north) is divided into two regions (regions 1 & 2). In region 1, the periods of directivity pulses are dominated in the range of 1 to 2.5 sec, while the periods of directivity pulses in region 2 are dominated in the range of 2.5 to 5 sec. Figure 2 show the mean acceleration response spectra (SA) for different site classes in regions 1 and 2. Note that in region 2, the soil type A is not exist. These results clearly show that the amplitudes of the directivity pulses with different periods become large as the soil type getting loose from soil type A to D. The outcomes also provide the first field evidence on the directivity pulse amplification due to local soil characteristics and their importance in design.

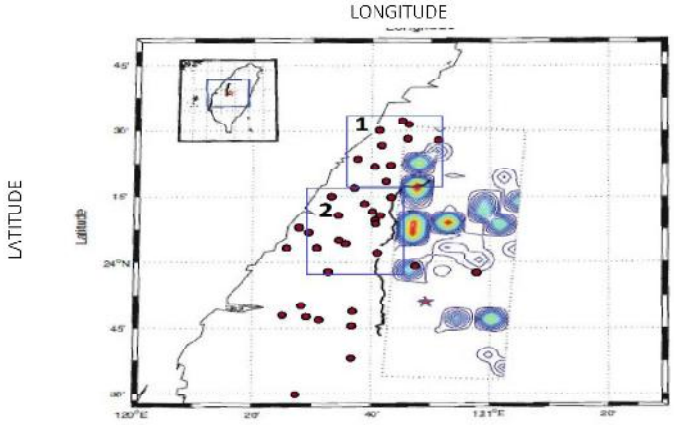

Figure 1. The distribution of selected stations on the background of the fault plane of Chi-Chi (1999) earthquake

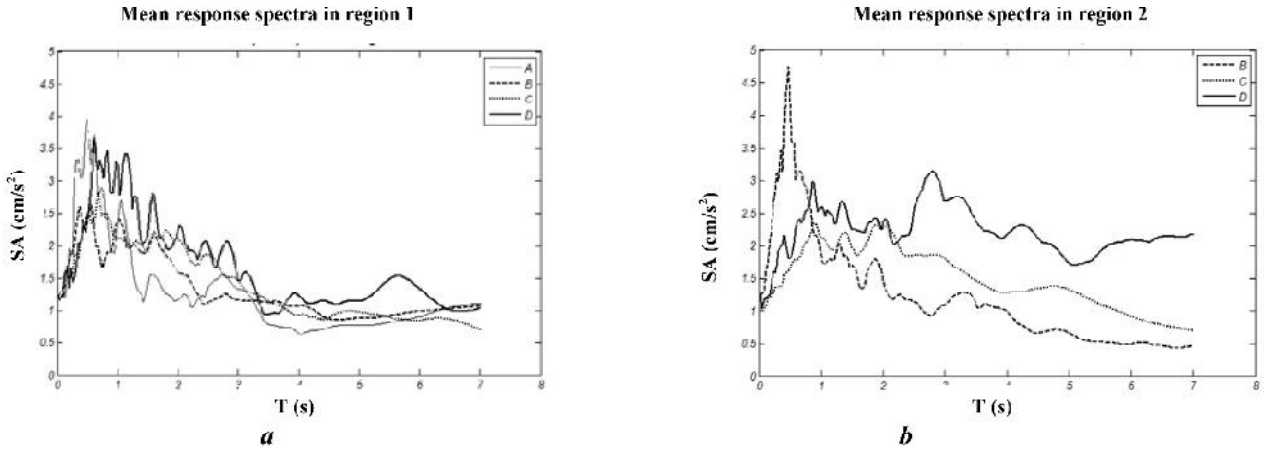

Figure 2. Mean acceleration response spectra, a) in region 1 and b) in region 2

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