

Why 1*G* Was Recorded at TCU129 Site During the 1999 Chi-Chi, Taiwan, Earthquake

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Abstract The strong-motion station TCU129 recorded a peak horizontal acceleration higher than 1*g* during the 1999 Chi-Chi, Taiwan, earthquake. Yet no structural damages occurred in its vicinity. Even some old buildings not far away from the station were not damaged. There did not seem to be very strong ground motion in this area during the Chi-Chi earthquake. To resolve these conflicting phenomena, we performed microtremor surveys in this area and installed additional two strong-motion accelerographs inside station TCU129 to compare the ground-motion records between the original and new accelerographs. We also compared the ground accelerations between station TCU129 and a nearby station TCU076. The results indicate that the high peak acceleration recorded at TCU129 during the 1999 Chi-Chi, Taiwan, earthquake was due to the effects of the concrete recording pier at station TCU129, and not due to the source, path, or site effects of the earthquake. Therefore, the peak acceleration values recorded at station TCU129 should not be used in studies of peak acceleration attenuation. However, the records are still useful, especially the integrated velocity and displacement time histories, for other studies.

Introduction

On 20 September 1999 a magnitude M_w 7.6 earthquake struck the Taichung and Nantou areas in central Taiwan. The earthquake occurred shortly after midnight (21 September 01:47 a.m. local time) when most residents were home sleeping. The official report from the Seismology Center of the Central Weather Bureau (CWB) put its epicenter at 23.85° N, 120.82° E, and its focal depth at 8 km. Since 1991, the CWB installed a very dense free-field strong-motion network in the nine metropolitan areas in Taiwan (Taiwan Strong Motion Instrumentation Program [TSMIP] network) (Kuo *et al.*, 1995; Wen *et al.*, 1995; Liu *et al.*, 1999). Therefore, a lot of high-quality data were recorded during the 1999 Chi-Chi event. Figure 1 shows the TSMIP station distribution in central Taiwan.

The TCU129 station is located in Hsin-Chieh elementary school, which is on the footwall near the Chelungpu fault rupture zone. This strong-motion station recorded a horizontal peak acceleration higher than 1*g* during the 1999 Chi-Chi, Taiwan, earthquake. Figure 2 shown the three-component acceleration waveforms recorded at station TCU129 and the nearby station TCU076 during the Chi-Chi earthquake. Waveforms at station TCU129 show that high peak values occurred in impulsive spikes. After visiting the areas surrounding station TCU129, we found that no structural

damage occurred in the area. Even a very old building, which is constructed of adobe blocks and not far away from the station, was undamaged by this destructive earthquake. It does not seem to indicate the occurrence of very strong ground motion in this area during the 1999 Chi-Chi earthquake. If this was the case, why was a horizontal peak acceleration higher than 1*g* recorded at station TCU129 during the Chi-Chi earthquake? The first causes to be considered are source, path, or site effects like other earthquake records (Shakal *et al.*, 1996). In this study, we compared the ground-motion records between TCU129 and the nearby station TCU076 about 3.4 km away. We also made microtremor surveys to check the site effects at station TCU129. Furthermore, two accelerographs were added inside station TCU129 to study the effects of recording pier on the recorded motions. Through these investigations we hope to understand why the station generated a horizontal peak acceleration larger than 1*g* during the 1999 Chi-Chi, Taiwan, earthquake.

Site Conditions at Station TCU129

The strong-motion accelerograph station TCU129 is located in the Hsin-Chieh elementary school at Ming-Chien, Nantou. It is on the footwall of the Chelungpu fault and about 1.9 km away from the fault trace. This station is not a typical TSMIP free-field station. It is a real-time station that

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