

TECHNICAL ARTICLE

OVERVIEW OF GEOTECHNICAL DAMAGE CAUSED BY THE 2010 CHILE EARTHQUAKE

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1.- THE 2010 CHILE EARTHQUAKE

On February 27, 2010, at 3:34 a.m. local time, a large earthquake of Magnitude 8.8 hit the Central-South region of Chile. A significant number of aftershocks followed the initial quake, among which the most important one of Magnitude 6.2 occurred 20 minutes after the main shock. The earthquake triggered a tsunami that struck off the Chilean coast, devastating many towns located onshore, causing additional deaths and widespread damages.

The 2010 Chile earthquake is associated with the subductive seismic environment generated by the collision between the Nazca and South American tectonic plates, which are converging at an estimated rate of 65 to 80 mm per year. The Nazca plate is subducting below the South American plate, moving down and landward. The 2010 Chile Earthquake has been identified as a thrust-faulting type that occurred on the interface between both two plates, at an average depth of 30 km. The involved rupture zone covered a rectangular area of approximately 450 km by 170 km (see rectangle in Fig. 1). The earthquake together with the tsunami caused nearly 600 casualties and an estimated economic loss of 30 billion US dollars.

Horizontal peak ground accelerations (PGA) recorded on rock outcrop and soil deposits are presented in Fig. 1. It is interesting to observe that horizontal PGA recorded on rock outcrop are surprisingly moderate; none of the available data being greater than 0.32g. Nevertheless, it is important to mention that in the coast line, immediately in front of the epicentral zone, no instruments were available. Therefore, for this area it would be possible to presume the occurrence of higher PGA values than the ones reported. On the other hand, as expected, higher values of horizontal PGA were recorded on soil deposits, the maximum one being 0.94g, which was recorded in the city of Angol, located to the south of the rupture zone. To the north of the rupture zone, the maximum horizontal PGA was recorded in the City of Melipilla, reaching a value of 0.78g.

It is important to mention that several of the available records show a ground motion that exceeds 2 minutes of duration. Two examples can be observed in the acceleration time histories recorded in the cities of Talca and Constitucion (Fig. 2). The long duration of the ground motions seems to be characteristic of earthquakes of large magnitude that definitely increases their potential destructiveness.

On the other hand, according to the reported rupture zone (a rectangular area of approximately 450 km by 170 km), the usual concept of epicenter associated with a single point does not adequately represent the actual phenomenon of seismic energy generation-propagation. From an engineering point of view, the epicenter should be replaced, for instance, by the fault trace, corresponding to the locus of the projection at the surface of the probable initiation of the rupture.

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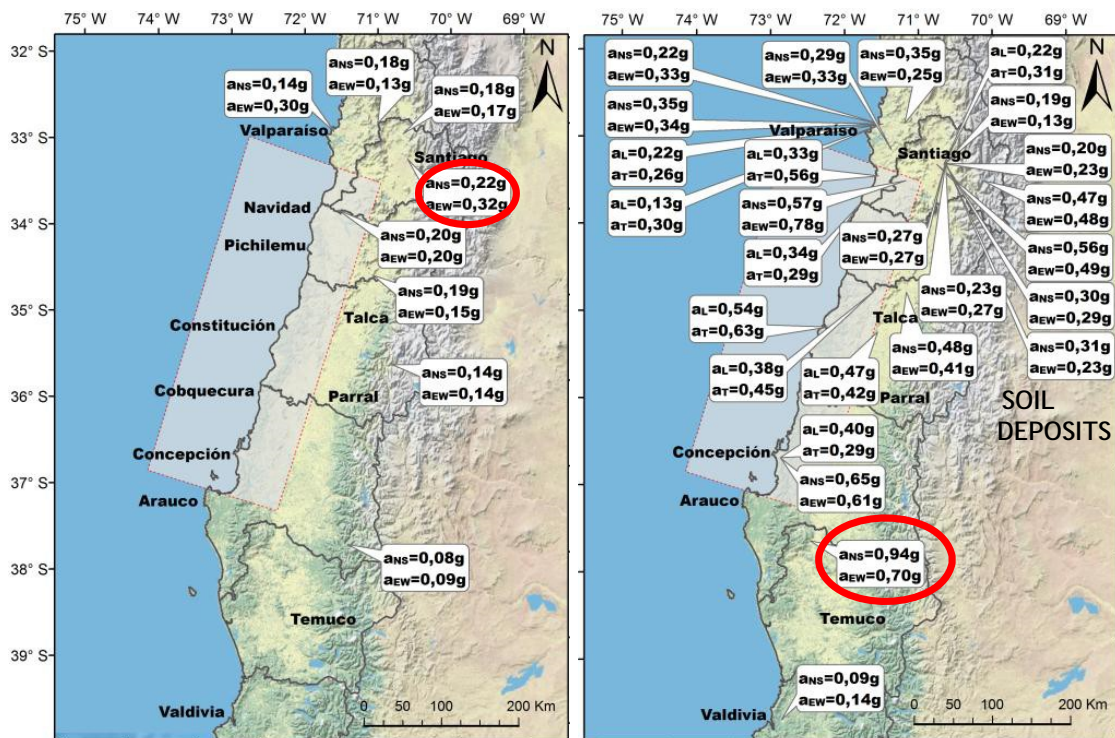


Fig. 1.- Horizontal PGA recorded on rock outcrops and soil deposits

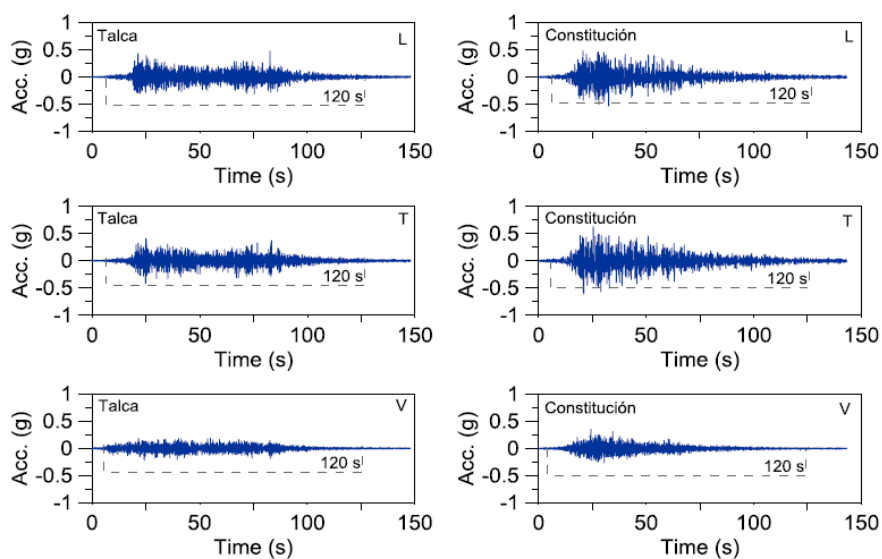


Fig. 2.- Acceleration time histories recorded in Talca and Constitución (Renadic)