

Seismic and tsunami fragility of industries, revealed by the 2011 Tohoku-oki earthquake

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We have developed seismic and tsunami fragility curves of industries by using damage data of industrial companies, estimated strong motions and estimated tsunami heights of the 2011 Tohoku-oki earthquake. The damage data were obtained from 7,019 industrial companies through inquiry surveys by the Regional Innovation Research Center of Tohoku University. As a damage level indicator for each company, we introduced a ratio of an economical damage of physical fixed assets excluding lands to previous balance of the physical fixed assets. The estimated strong motions of the 2011 Tohoku-oki earthquake at all the sites of the companies were from the database of the so-called QuiQuake system (Quick estimation system for shaking maps triggered by observation records) operated by the National Institute of Advanced Industrial Science and Technology (AIST). It is noted that the estimated data were obtained by taking account of seismic local site effects and the actually observed ones. The tsunami height data at each site of the company were obtained by interpolating the confirmed data compiled by the 2011 Tohoku Earthquake Tsunami Joint Survey Group (2013). It is found that a frequency-damage level distribution for each seismic intensity is well correlated with a binominal distribution where the only parameter characterizing the distribution is an average value of the damage levels in each seismic intensity. The tsunami fragilities are also obtained as a function of the tsunami height in the same way. These fragility curves can be useful not only to estimate economic damages for future huge earthquakes, but also to rapidly assess the damage just after earthquakes.

Keywords: Seismic, Tsunami, fragility curve, industry, the 2011 Tohoku-oki earthquake