

## Relationship between damage ratios and ground motion characteristics during 2011 Tohoku Earthquake

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The relationship between ground motion indices, e.g., PGA, PGV,  $I_{JMA}$ , SI, and three different building damage ratios, i.e., total collapse ratios (TCRs), collapse ratios (CRs) and damage ratios (DRs), were constructed for the 2011 off the Pacific coast of Tohoku Earthquake. It was found that DRs relate better with ground motion indices than TCRs or CRs. It was also found that PGA was sensitive to predominant period of velocity response spectrum. Large PGA was not related with high DR if the predominant period is shorter than 0.4s or longer than 2.0s. However, the damage ratios are calculated based on an administrative unit, large variability can be seen from the fragility curves. It is necessary to examine the variability of ground motions within a small district, if the ground motions are estimated properly.

As the earthquake motions H/V can be represented theoretically, in proportional to the ratio of transfer functions between S- and P-wave, it has been suggested that H/V of earthquake motions can be used to determine the velocity structures. It implies that the microtremor H/V can also be used to estimate the velocity structures at damaged sites, if the consistency of H/V spectral ratios between microtremors and earthquakes can be confirmed there. The ground motions at some damaged sites are estimated by using the underground velocity structures inverted from the microtremor H/V spectra ratios. Then the estimated ground motions are used to be related with damage ratios at the damaged sites.

Keywords: building damage ratio, H/V spectral ratio, velocity structure, estimated ground motions