

EFFECT OF NEAR FIELD GROUND MOTIONS ON FORCE REDUCTION FACTOR AND RESIDUAL DISPLACEMENT OF STRUCTURES

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In the equivalent static seismic analysis, the inelastic force demand is generally determined in terms of the force reduction factor (R factor). The residual drift which occurs in a structure after an earthquake is an important parameter on the decision whether the structure can be repaired. The residual drift was included in the seismic design of Japanese bridges as a design requirement in 1995. It is known that the residual drift is nearly independent of the ductility demand.

Near-field ground motions have long pulsive accelerations with large amplitudes. They are damaging to structures as was evident in past earthquakes. However, the effect of near field ground motions on the force reduction factor and the residual displacement has not yet been clarified.

This research presents an analysis on the dependency of the force reduction factor and the residual displacement response spectra on ground motion characteristics.

When a structure is idealized as an elasto-plastic single-degree-of-freedom system, force reduction factor is defined as the ratio of elastic and inelastic restoring force.

Takeda degrading stiffness model was used to represent bilinear elasto-plastic hysteresis, by eliminating crack path. The estimated formula for the force reduction factor was assumed in the previous research (Watanabe and Kawashima 2001) and applied here.

The residual displacement which occurs in a structure after an earthquake is generalized by the residual displacement response spectrum (Kawashima, et.al 1998).

Though the residual displacements depend on the post-yielding stiffness, elasto-plastic Takeda stiffness degrading model was assumed here.

Fifty four components of free-ground motions were used in this analysis; 20 near-field ground motions, 20 middle-field ground motions, and 14 far-field ground motions. Ground motions recorded within 40km, 40 to 200km, and over 200km from the epicenters are defined here as the near, middle and far-field ground motions, respectively.

(1) R factors depend on the types of ground motions. R factors for near-field ground motions are smaller than middle and far-field ground motions. The R factors are similar for middle and far-field ground motions.

(2) The residual displacement ratios are computed for 54 ground motions, and they are averaged at every period for near, middle, far-field ground motions. The residual displacement ratios depend on the types of ground motions. The residual displacement ratios are larger for near-field ground motions than middle-field and far-field ground motions.

(3) There is not an apparent relation between R factors and residual displacements. For the same R factors, residual displacements have large scattering for every ground motions. It seems that residual displacements are independent of R factors.