Inelastic spectra to predict period elongation of structures under earthquake loading - DTU Orbit (12/12/2018)

Inelastic spectra to predict period elongation of structures under earthquake loading

Period lengthening, exhibited by structures when subjected to strong ground motions, constitutes an implicit proxy of structural inelasticity and associated damage. However, the reliable prediction of the inelastic period is tedious and a multi-parametric task, which is related to both epistemic and aleatory uncertainty. Along these lines, the objective of this paper is to investigate and quantify the elongated fundamental period of reinforced concrete structures using inelastic response spectra defined on the basis of the period shift ratio ($\frac{T_{\text{in}}}{T_{\text{el}}}$). Nonlinear oscillators of varying yield strength (expressed by the force reduction factor, $R_y$), post-yield stiffness ($\eta_y$) and hysteretic laws are examined for a large number of strong motions. Constant-strength, inelastic spectra in terms of $\frac{T_{\text{in}}}{T_{\text{el}}}$ are calculated to assess the extent of period elongation for various levels of structural inelasticity. Moreover, the influence that structural characteristics ($R_y$, $\eta_y$ and degrading level) and strong-motion parameters (epicentral distance, frequency content and duration) exert on period lengthening are studied. Determined by regression analyses of the data obtained, simplified equations are proposed for period lengthening as a function of $R_y$ and $T_{\text{el}}$. These equations may be used in the framework of the earthquake record selection and scaling.

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