

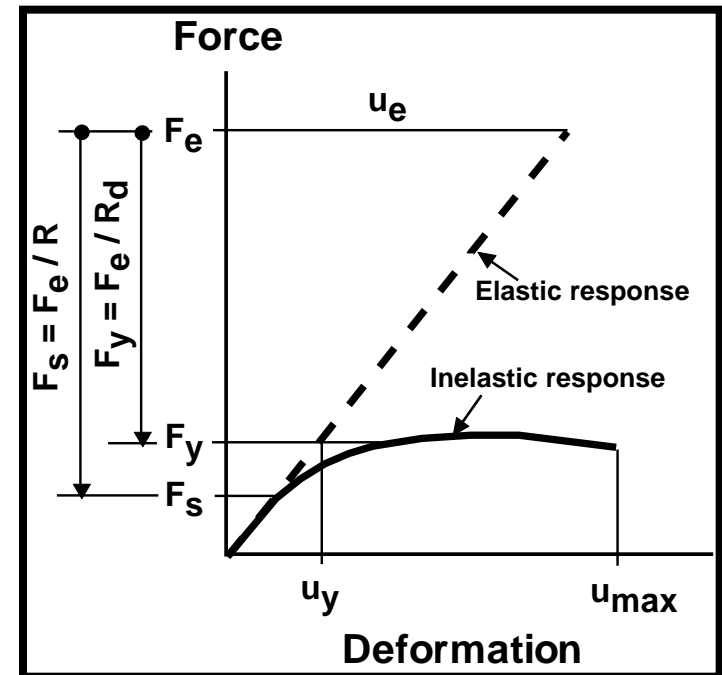
Beyond Elastic Spectra



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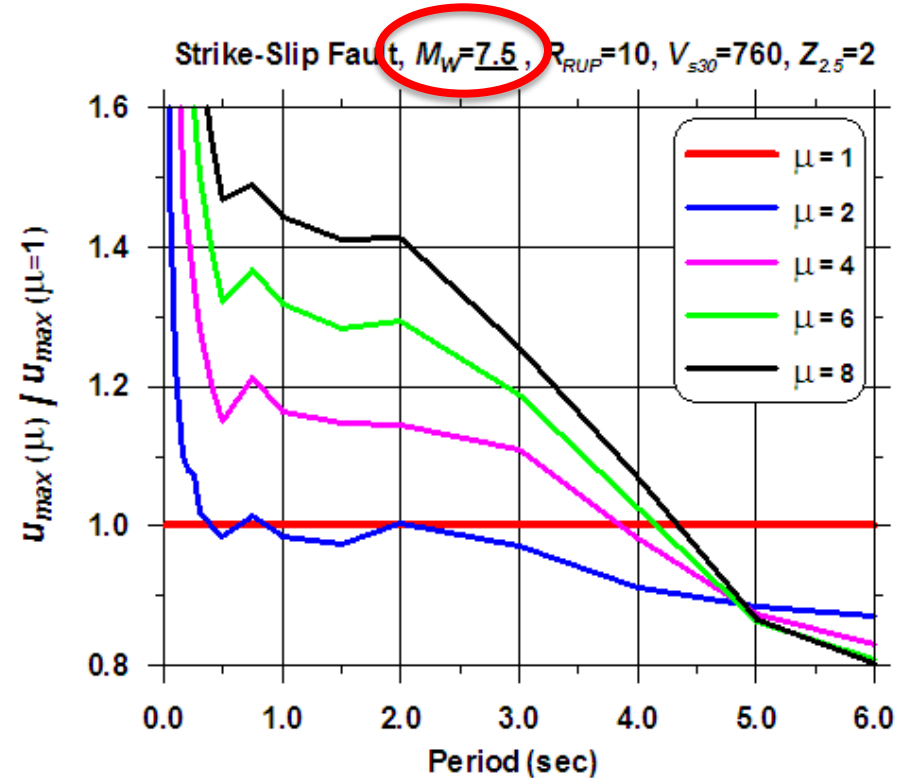
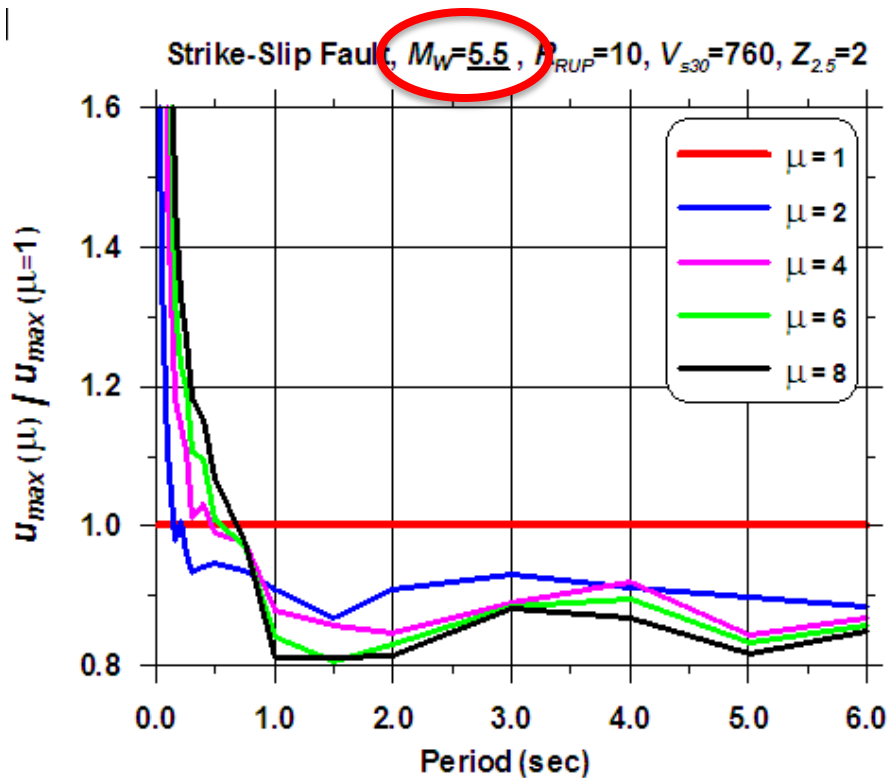
Most Structures Behave Nonlinearly During a Severe Ground Shaking

- Current practice:
 - Carry out hazard analysis on *Elastic Spectra*
 - Reduce elastic spectra using a "reduction factor" (R'')
 - Obtain "Inelastic Spectra" for design
- Is this process accurate enough, or conservative enough?



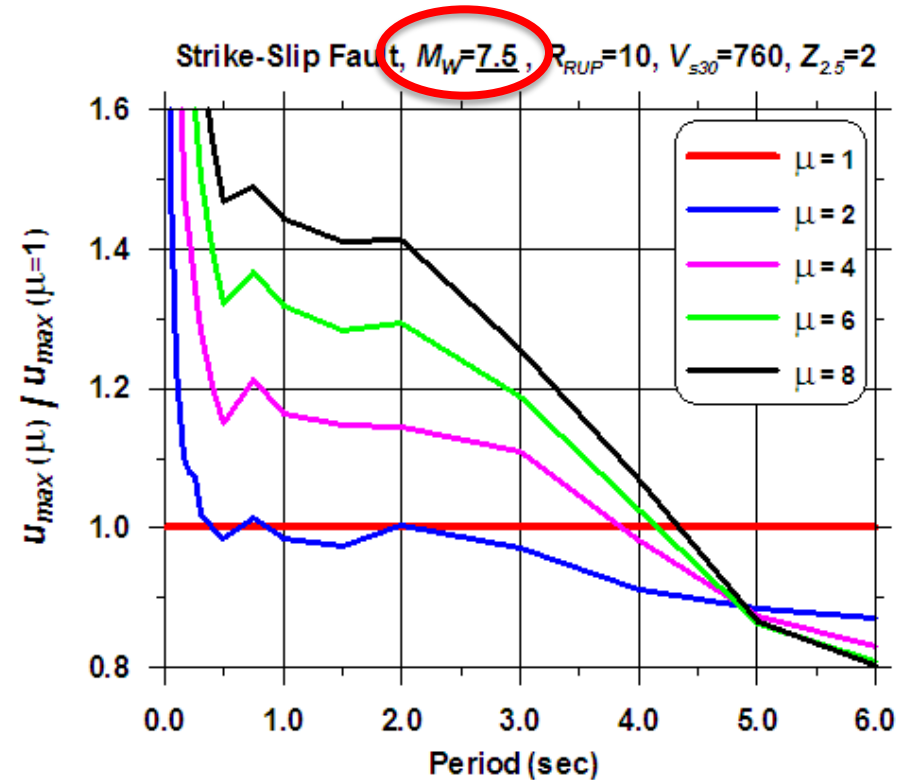
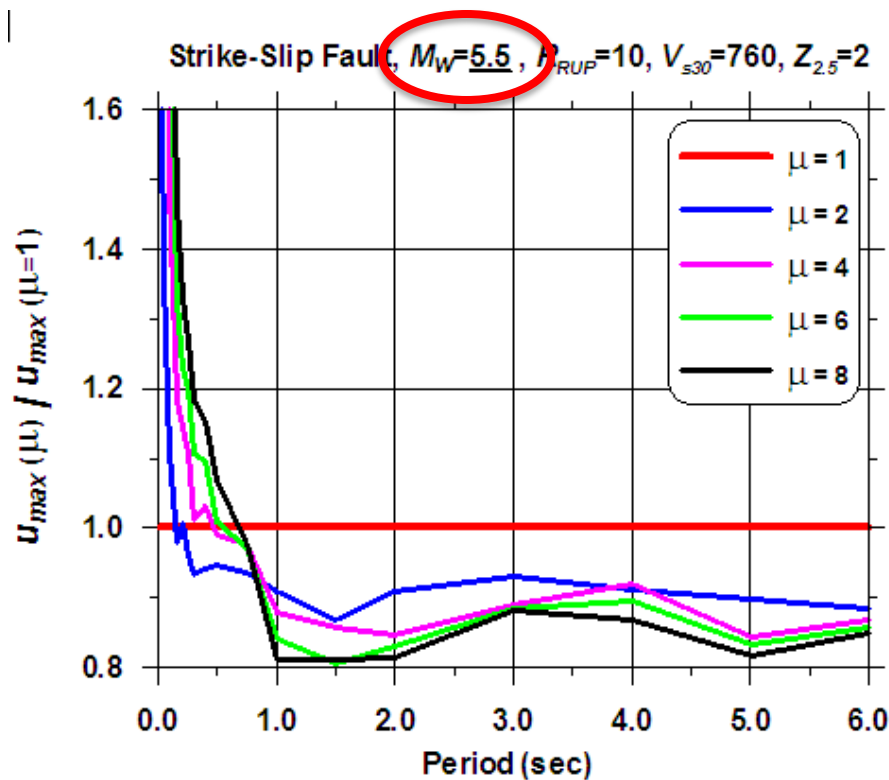
$$\mu = u_{max} / u_y$$

Ratio of inelastic to elastic displacements



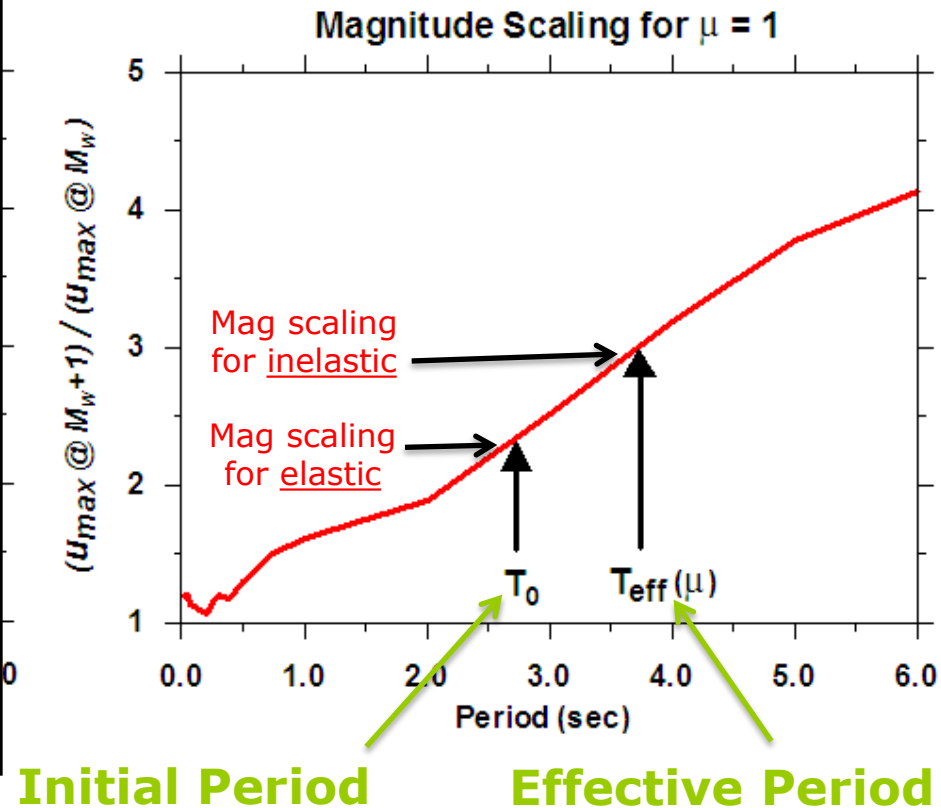
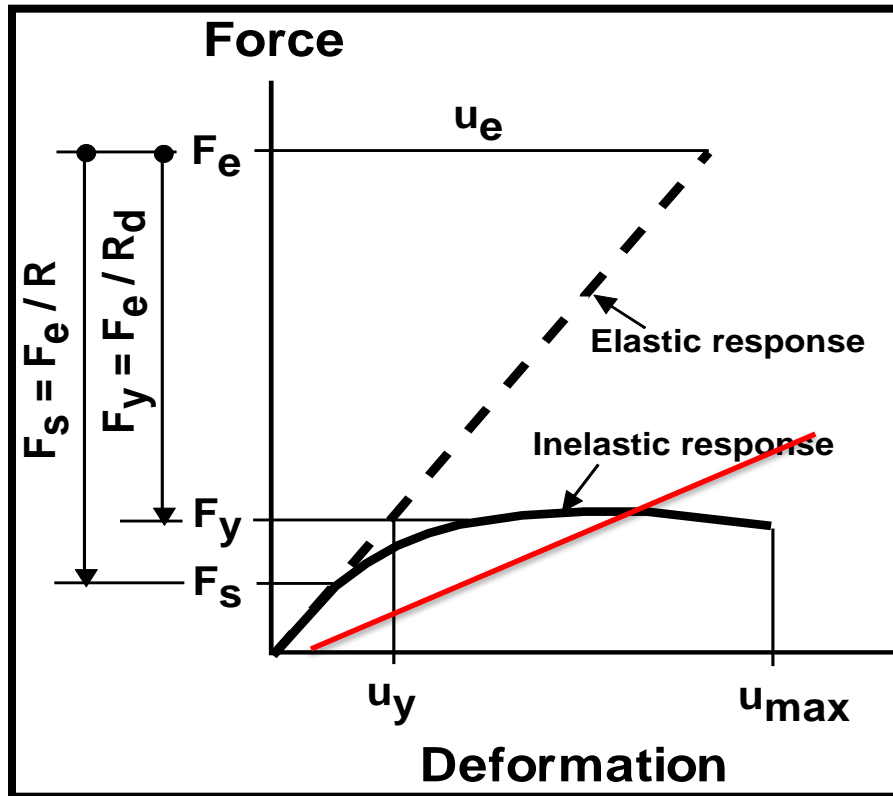
For large magnitudes, especially for high ductility, inelastic displacement > elastic displacement over wide period range

Ratio of inelastic to elastic displacements



For large magnitudes, especially for high ductility, “Constant Displacement Rule” can result in under-prediction over wide period range

Magnitude Scaling: Increase of Ground Motion by Increasing Magnitude



You generally under-predict to use magnitude scaling for elastic systems and apply it to inelastic systems, especially for high ductility