

Code Minimum Base Shear Requirements



February 2007
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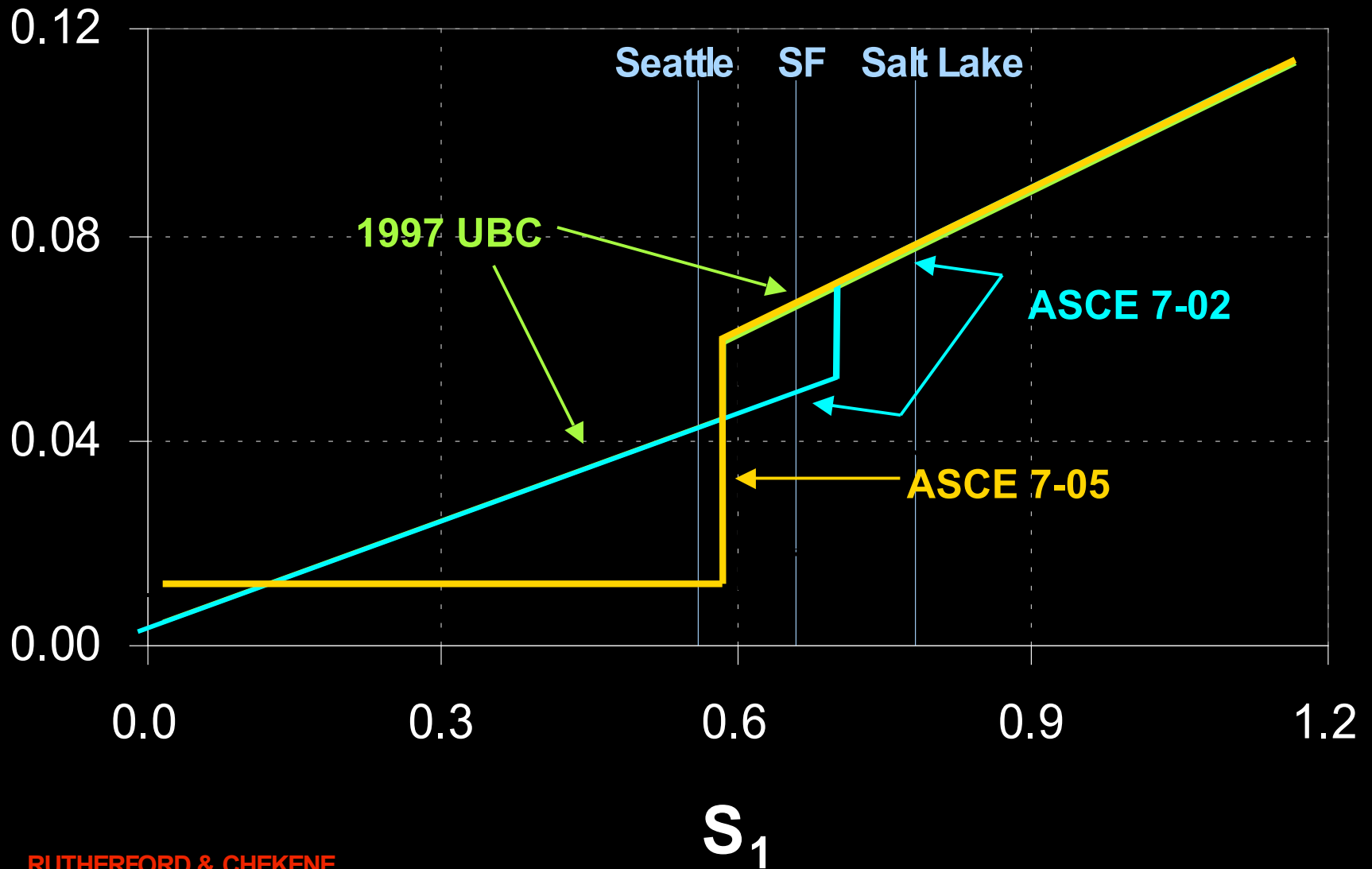
RUTHERFORD & CHEKENE



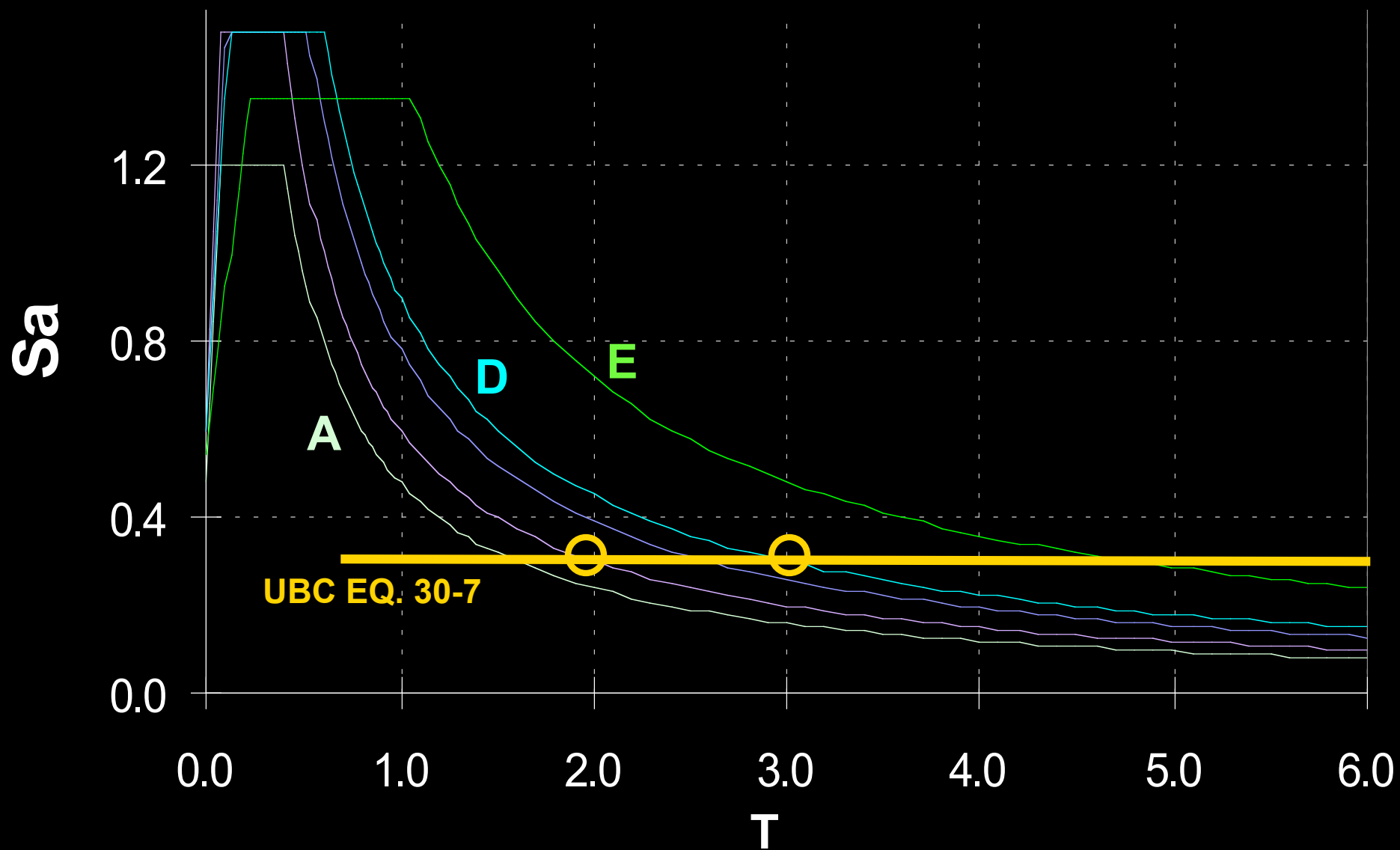
OUTLINE

- ❖ UBC, ASCE 7-02, ASCE 7-05
- ❖ Effect on design response spectrum, spectral displacement demand and required stiffness
- ❖ Why we should have a minimum base shear and drift limit
- ❖ Conclusions & Recommendations

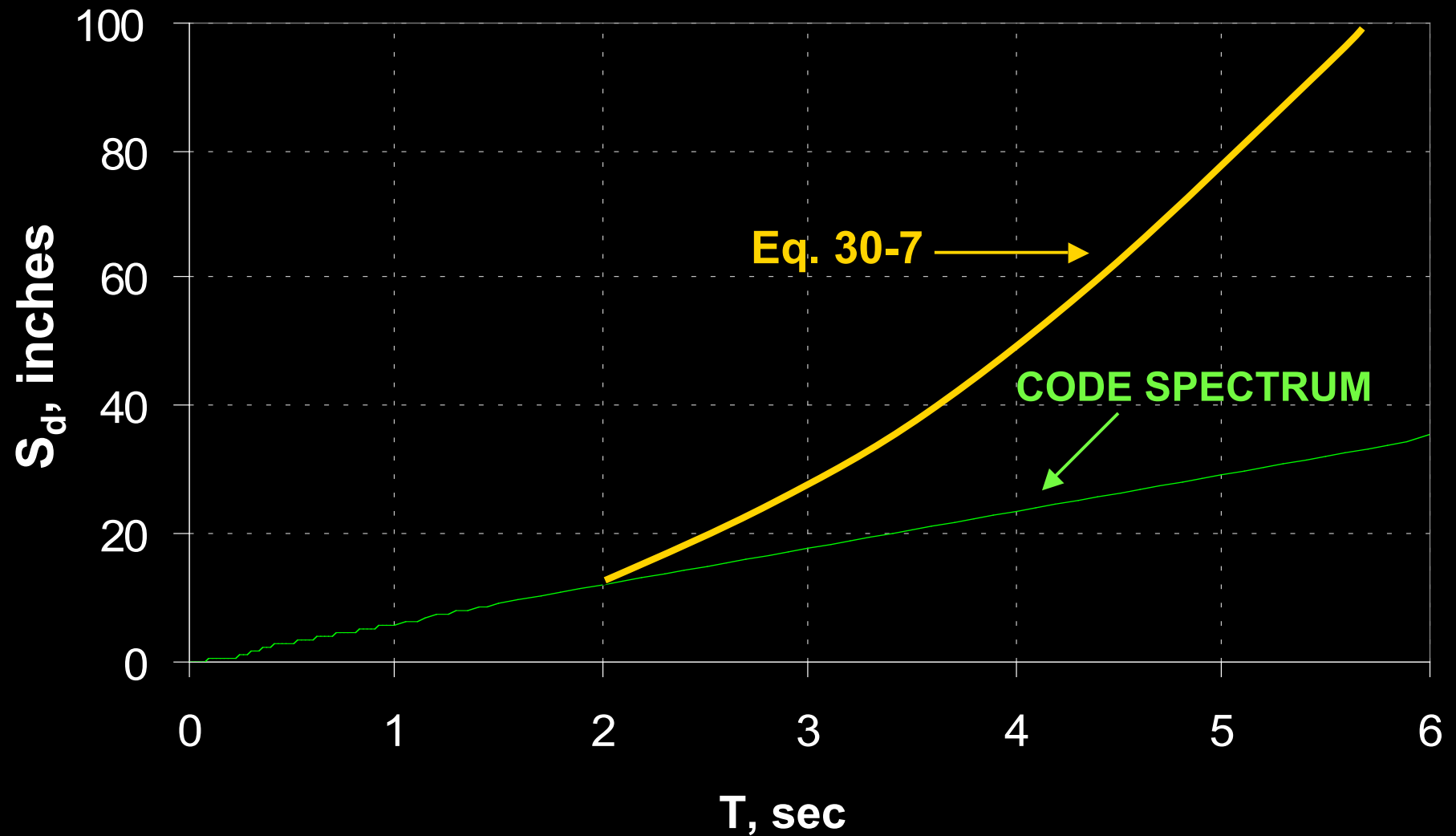
MINIMUM BASE SHEAR



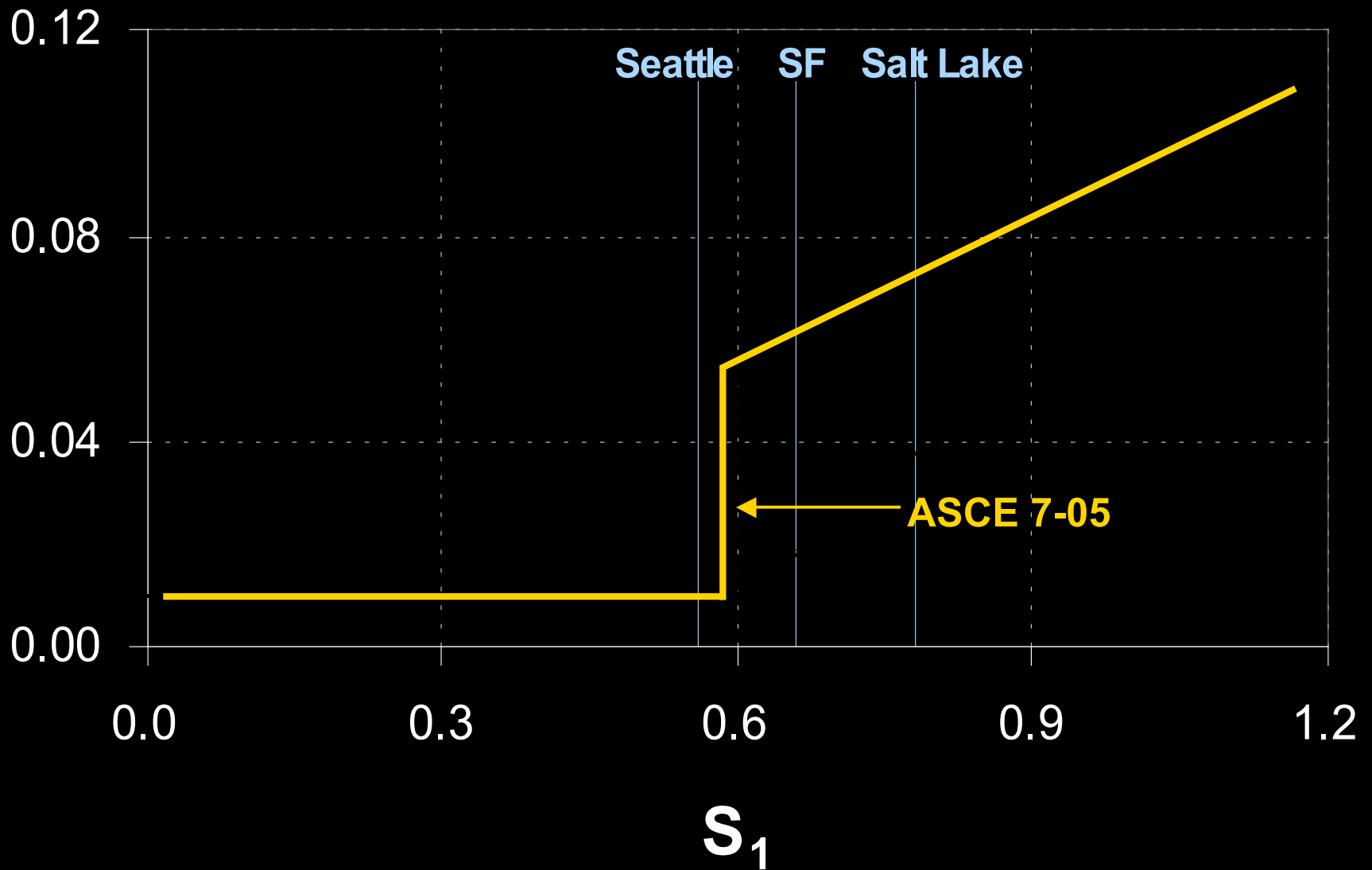
EFFECT OF EQ 30-7 ON SPECTRA SHAPE



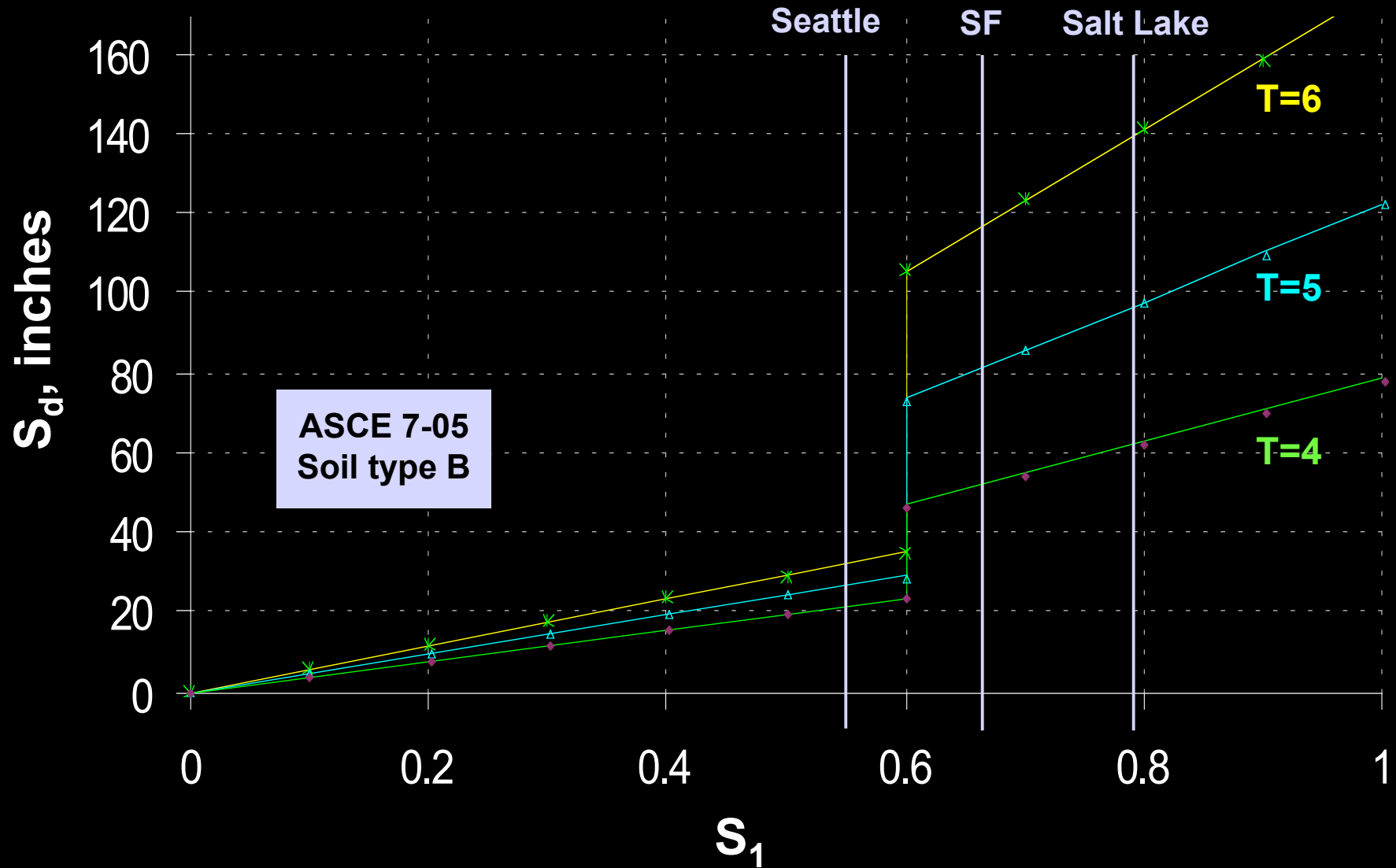
EFFECT ON SPECTRAL DISPLACEMENT DEMAND



MINIMUM BASE SHEAR



DISPLACEMENT DEMAND VS. S_1

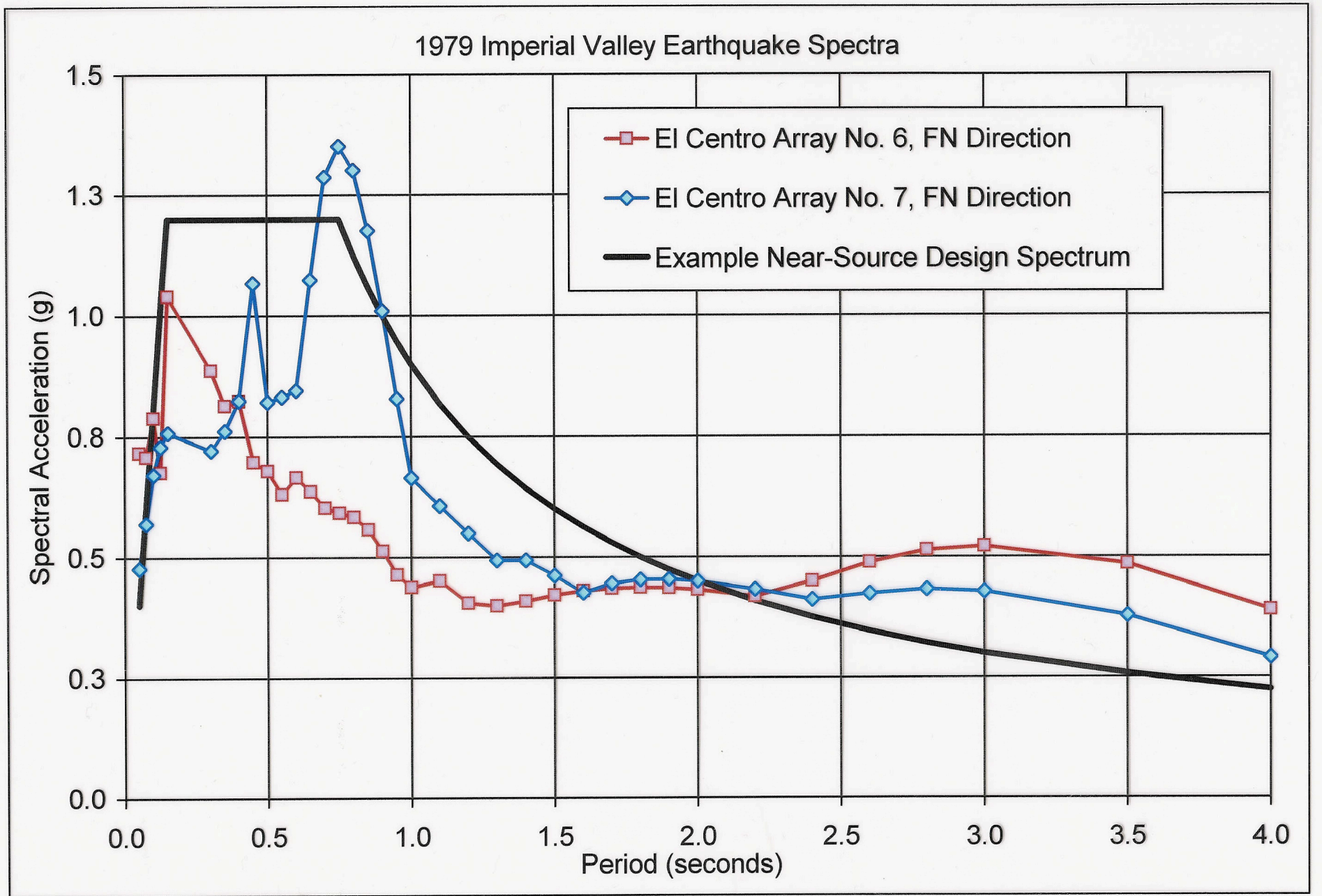


Applying UBC eq 30-7 in effect reduces the drift limit for actual ground motion hazard.

R=5, soil B

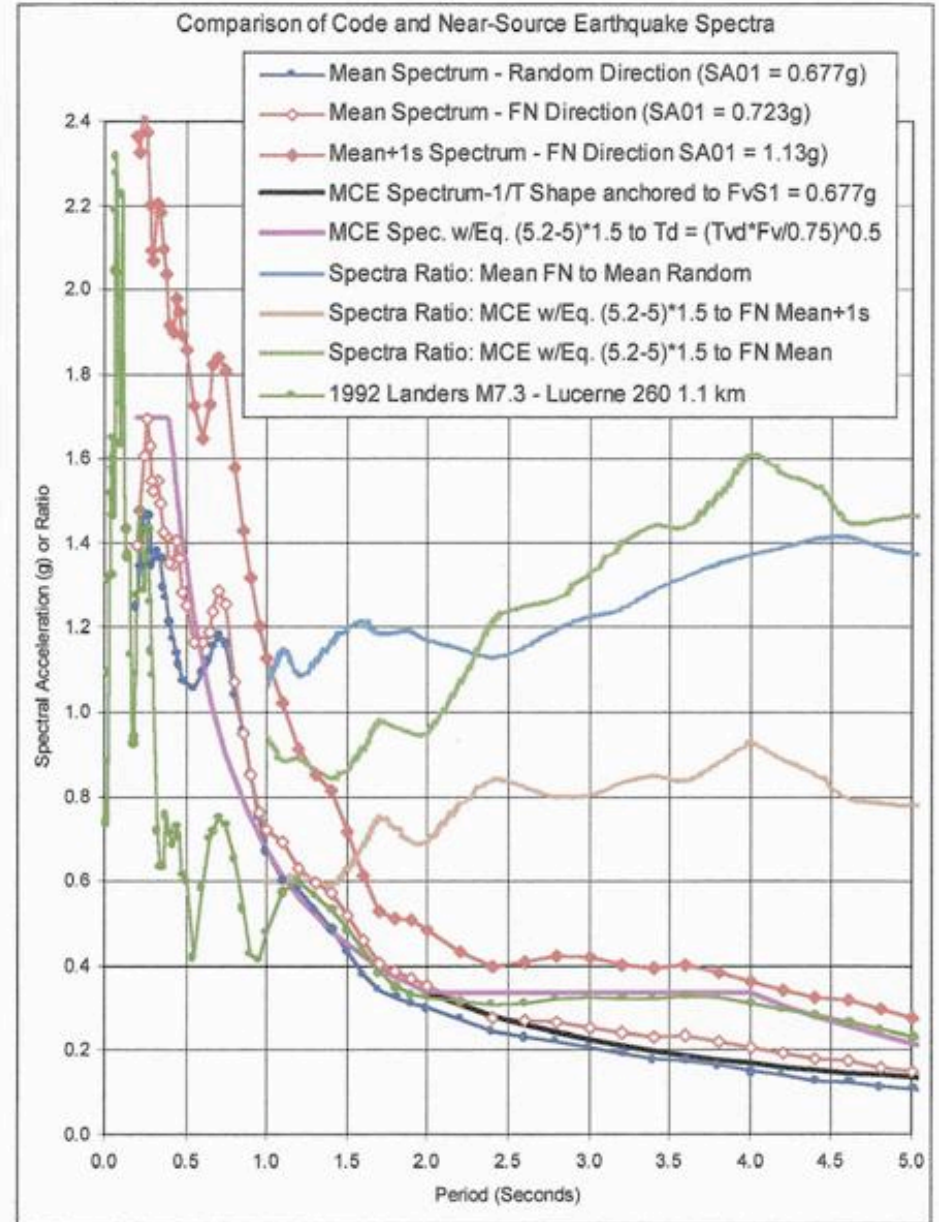
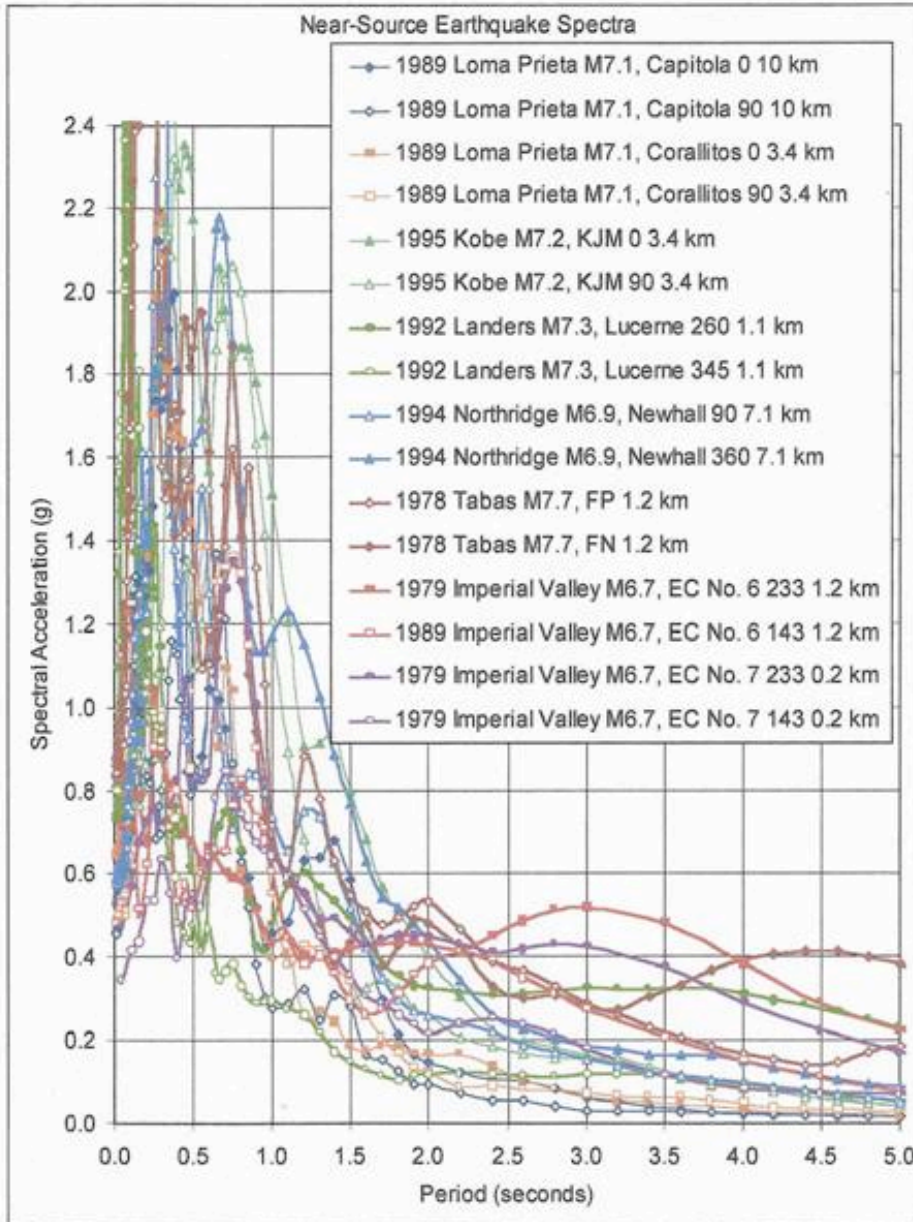
	<u>Eff. DBE drift limit</u>
No 30-7 for drift	2%
30-7 for drift, T=4	1%
30-7 for drift, T=6	0.7%
30-7 for drift, T=8	0.3%

From Charlie K.

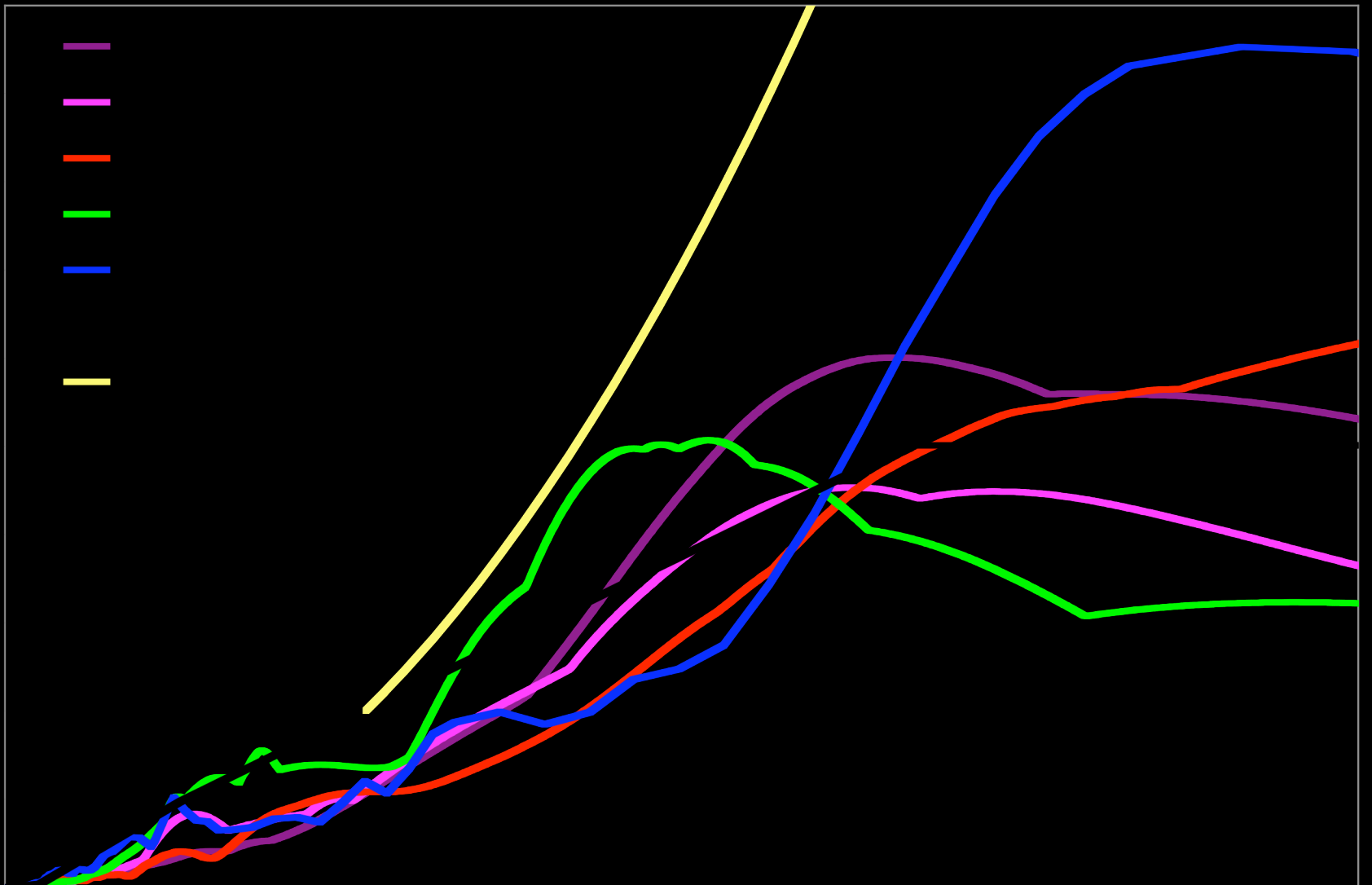


From Charlie K.

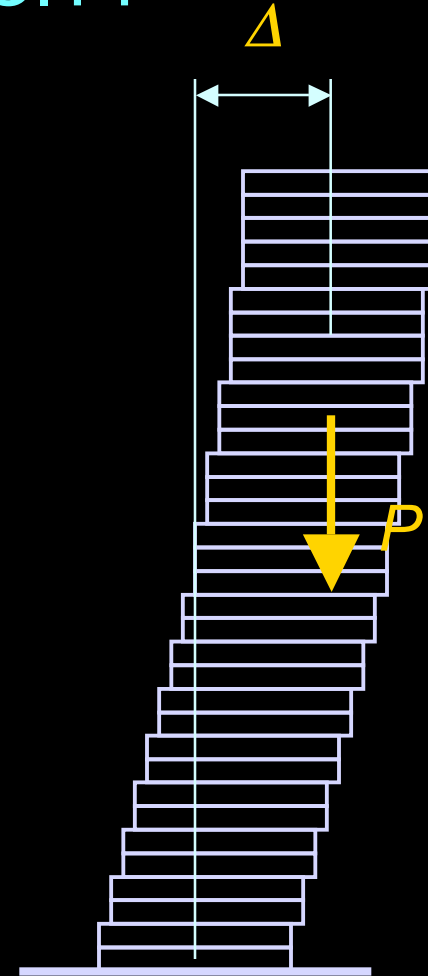
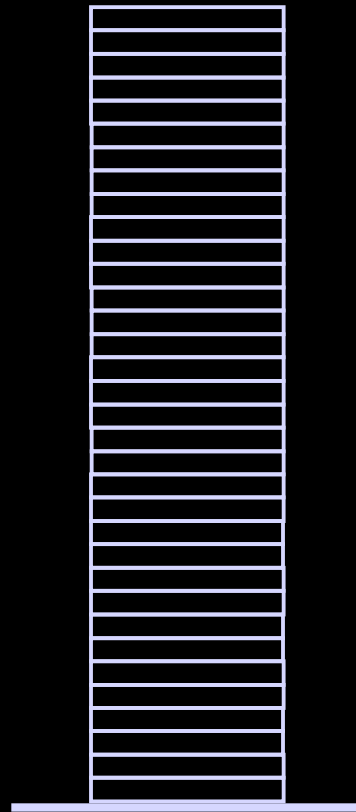
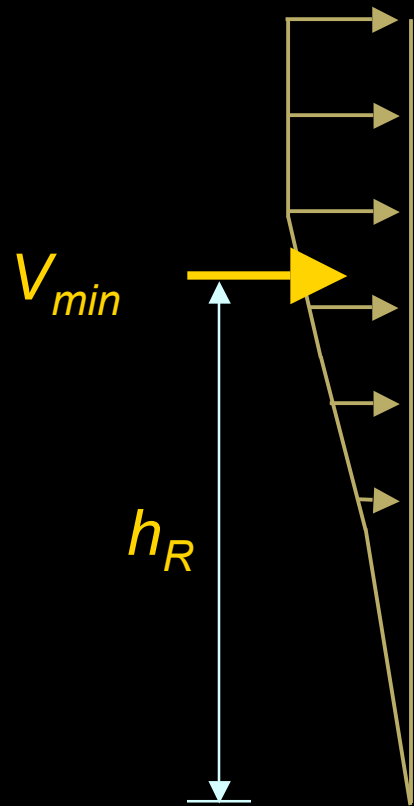
Near-Source Factors - Comparison of Spectra



From WJE



P-Δ EFFECT ON LATERAL CAPACITY

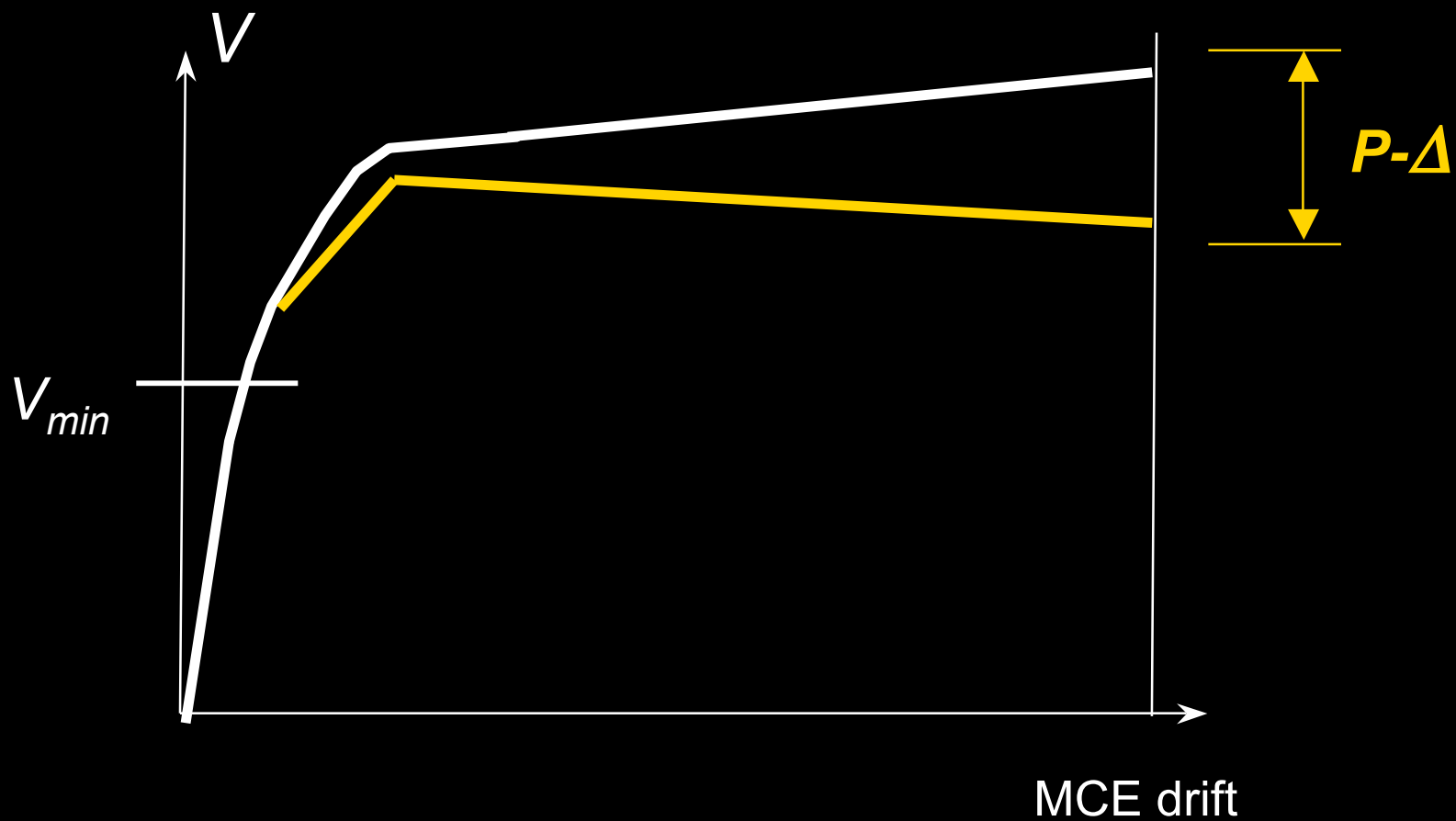


$$V_{min}$$



$$M_{R,min} = V_{min} h_r$$

LIMIT P- Δ REDUCTION IN LATERAL CAPACITY



CONCLUSIONS

- ❖ There should be a minimum base shear for strength, about 4% or 5% $\times W$ for a high-rise with typical flexibility.
- ❖ The current limit on the drift produced by the actual ground motion hazard, 2% DBE, 3% MCE, are needed.
- ❖ These two checks provide a “safety net”, without which we would be completely putting our trust in NLRH analyses.

CONCLUSIONS

- ❖ Eq 30-7 reflects >mean ground motions from $T=2$ to $T=4$ seconds. If applied beyond $T=4$ it becomes increasingly conservative.
- ❖ Applying UBC Eq 30-7 to drift in effect reduces the drift limit, severely for longer periods.
- ❖ Applying UBC 30-6 and 30-7 *for strength only* provides an adequate safety net.
- ❖ ASCE 7-05 minimum base shear of 1% (applicable to $S_1 < 0.6g$) is unconservative.

PROPOSAL ON MINIMUM BASE SHEAR

- ❖ Minimum base shear should depend on the building's actual drift demand, which is only indirectly tied to seismic hazard.
- ❖ A minimum based on seismic hazard (safety net to the safety net) should be based on the long period acceleration, including soil effect. i.e., S_{M1}

PROPOSAL ON MINIMUM BASE SHEAR

Design for strength, but not drift, for

$$C_{min} = (\delta_{max, mce} / 0.02)(0.04) \geq 0.05S_{M1}$$

$\Delta_{max, mce}$ = MCE story drift ratio, worst story,
average of records

$$C_{min} = (\delta_{max} / 0.02)(0.07) \geq 0.05S_{M1}$$

Δ_{max} = DBE story drift ratio, worst story

PROPOSAL ON MINIMUM BASE SHEAR AND NEAR-FIELD DEMANDS

Consider extreme actual records, unscaled.

[Tabas, Lucerne, 1979 El Centro, Sylmar]

NRLH with $P-\Delta$ shows no collapse, and no individual story drift $> 4\%$