

Potential Issue Team Study Topics in Ground Motions and SFSI

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Overview

Ground motions

- Site factors
- Ground motion level for liquefaction
- UHS as scaling target
- Utilization of max direction ground motions

Soil-structure interaction

- SSI for pushover and response history analysis
- Kinematic interaction effects

Site Factors

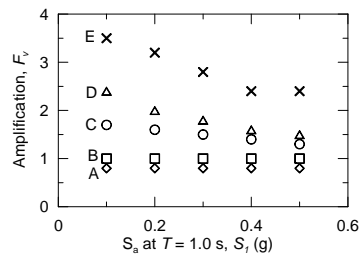
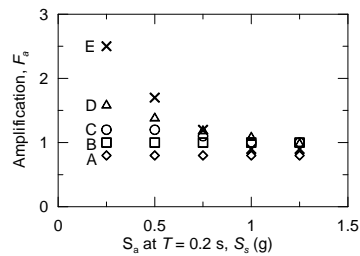
- Site classes A-E: site factors from V_{s30}
- Site class F: site specific study required

Table 1. Site categories in NEHRP Provisions (Martin, 1994)

NEHRP Category	Description	Mean Shear Wave Velocity to 30 m
A	Hard Rock	> 1500 m/s
B	Firm to hard rock	760-1500 m/s
C	Dense soil, soft rock	360-760 m/s
D	Stiff soil	180-360 m/s
E	Soft clays	< 180 m/s
F	Special study soils, e.g., liquefiable soils, sensitive clays, organic soils, soft clays > 36 m thick	

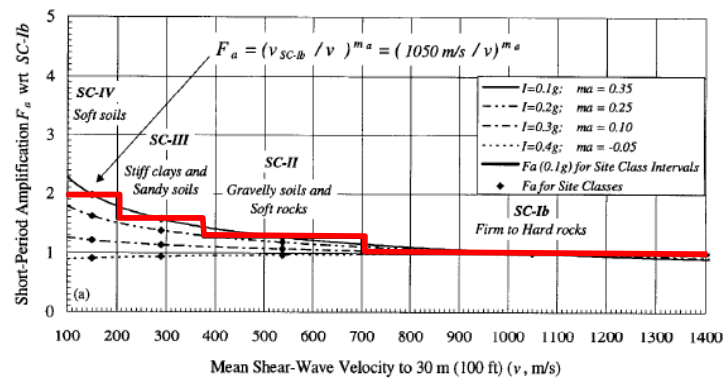
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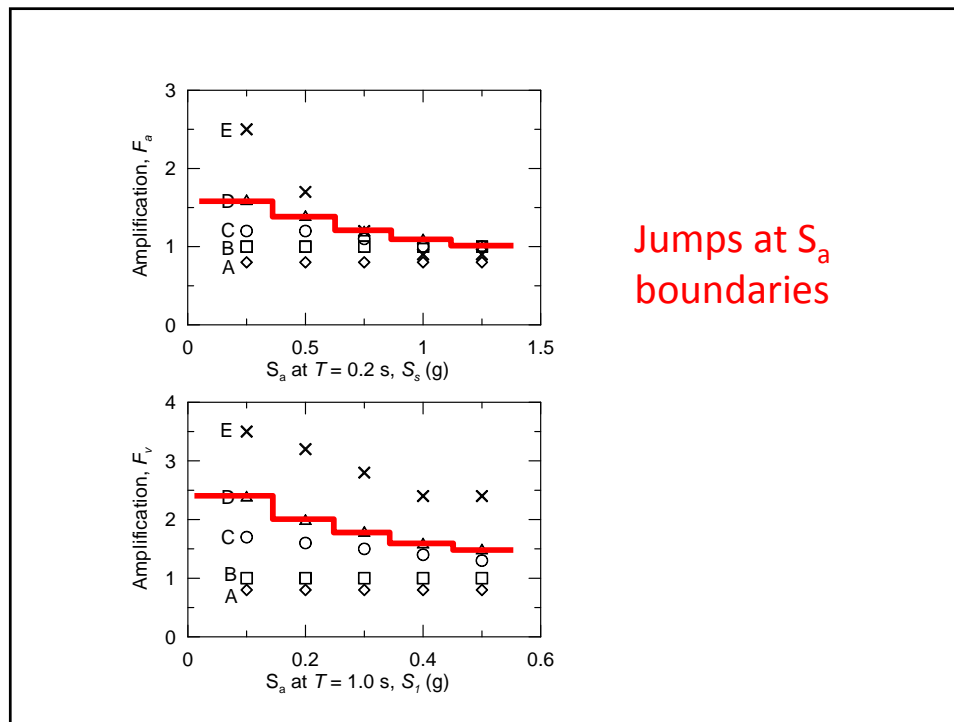
Site Factors

- Site classes A-E: site factors from V_{s30}
- Site class F: site specific study required
- Issues:
 - Jumps at velocity and S_a boundaries



Borcherdt, 1994

Jumps at velocity boundaries

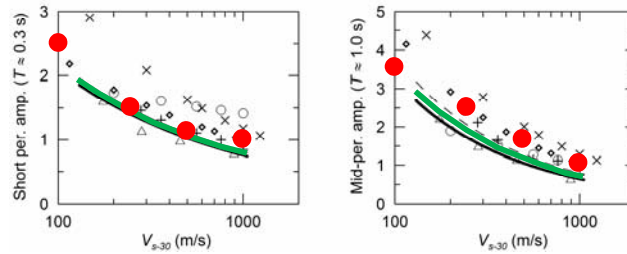


Site Factors

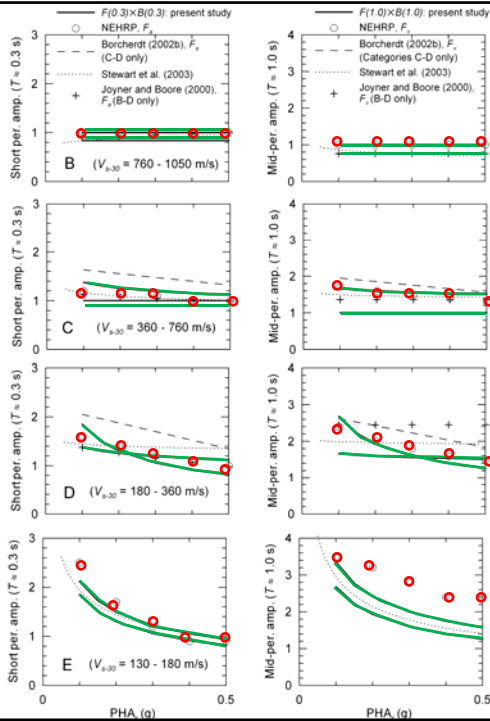
- Site classes A-E: site factors from V_{s30}
- Site class F: site specific study required
- Issues:
 - Sudden jumps at velocity boundaries
 - Apparent bias in some cases

Weak motion site factors

- × Harsen (1997), $f=2-6$ Hz and $0.5-1.5$ Hz
 - ◊ B&G (1994), F_a and F_v
 - Steidl (2000), $T = 0.3$ s and 1.0 s
 - + Field (2000), $T = 0.3$ s and 1.0 s
 - NEHRP (wk. motion)
 - △ Stewart et al. (2003), $T = 0.3$ s and 1.0 s
 - A1: $T = 0.3$ s and 1.0 s
 - A2: $T = 0.3$ s and 1.0 s
 - A3: $T = 0.3$ s and 1.0 s
- Data
● NEHRP



Choi and Stewart, 2005



NEHRP high for B

F_a : C-E ok

F_v : C-E high

Nonlinearity ok

Issues:

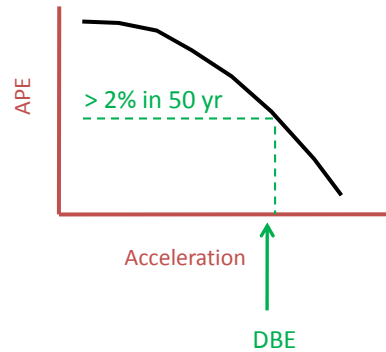
- Modify using recent data.
- Should factors be high?
- Tabular or equation form?

NGA West-2 Study

Choi and Stewart, 2005

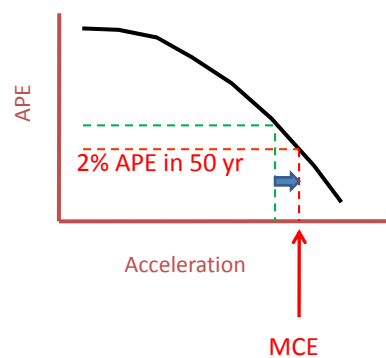
Ground Motion Level for Liquefaction

- Earlier provisions: use DBE ground motions (2/3 of 2475 yr R.P.)
- New provisions: use MCE ground motions (unscaled 2475 yr R.P.)



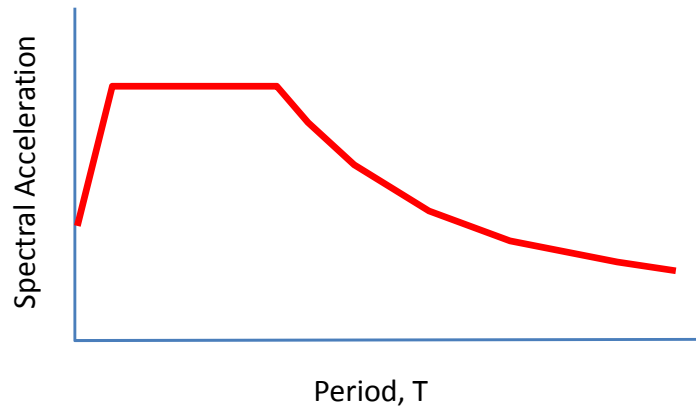
Ground Motion Level for Liquefaction

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- New provisions: use MCE ground motions (unscaled 2475 yr R.P.)
- Issues:
 - Requires more remediation
 - Can ground motion requirements be clarified?

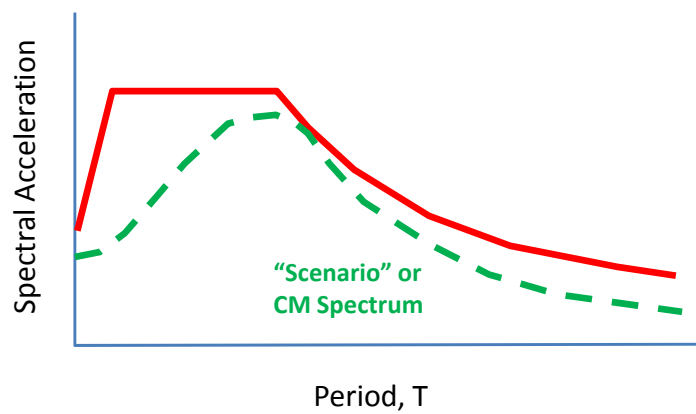


Intent was to "assure that the potential occurrence and effects of liquefaction during the MCE are considered in geotechnical and structural design"

UHS as Scaling Target



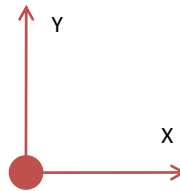
UHS as Scaling Target



Baker and Cornell, 2005

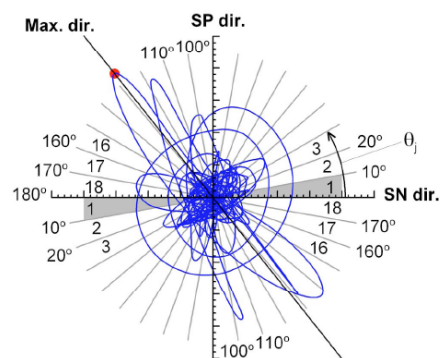
Max Direction Ground Motions

- Earlier provisions: used “average” horizontal component



Max Direction Ground Motions

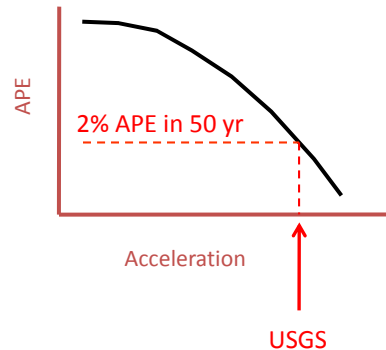
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Huang et al., 2009

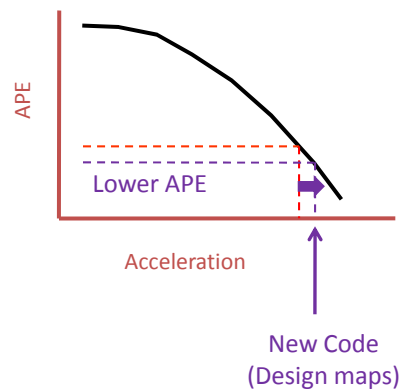
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- New provisions: uses max direction
- Many disagree with change



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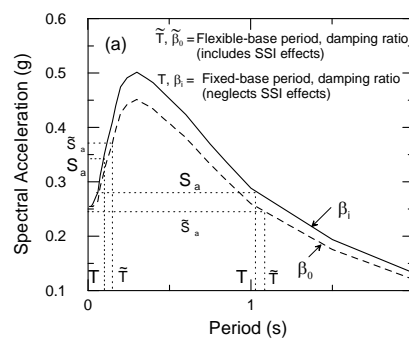


Max Direction Ground Motions

- Earlier provisions: used “average” horizontal component
- New provisions: uses max direction
- Many disagree with change
- Further study likely

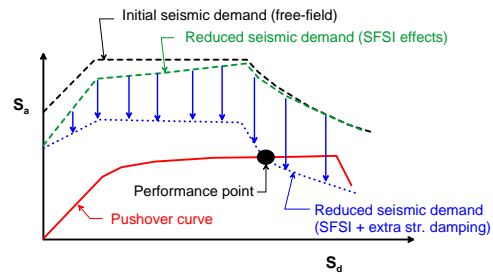
Soil-Structure Interaction

- NEHRP: Force-based procedure



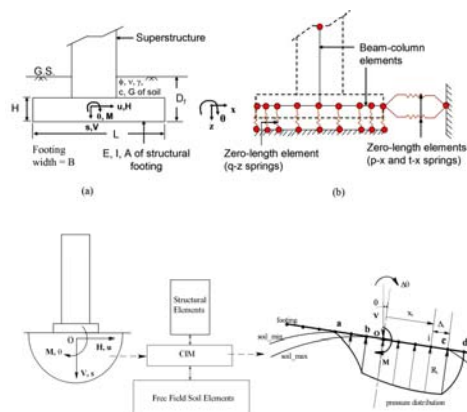
Soil-Structure Interaction

- NEHRP: Force-based procedure
- FEMA 440/ASCE 41: Displacement-based procedure

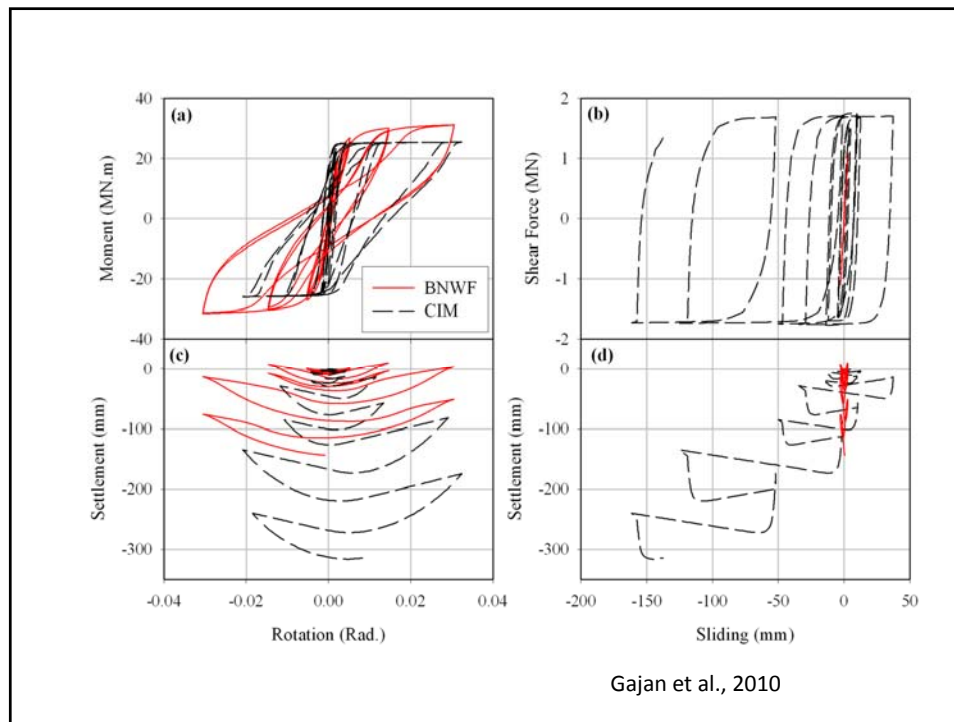


Soil-Structure Interaction

- NEHRP: Force-based procedure
- FEMA 440/ASCE 41: Displacement-based procedure
- Future: response history analysis
- ATC study



Gajan et al., 2010



Soil-Structure Interaction

Possible topics:

- Commentary/provisions on SFSI for pushover and response history analysis
- Introduction of provisions/commentary on kinematic interaction effects