Building Seismic Safety Council
a council of the National Institute of Building Sciences

Planning Committee Project 17

Project '17: A Collaboration of the USGS National Seismic Hazard Mapping Project & Engineers to Develop Ground Motion Maps for the 2024 International Building Code

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science for a changing world

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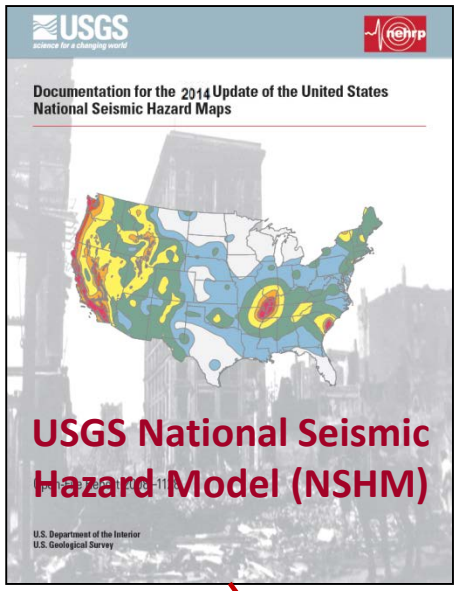
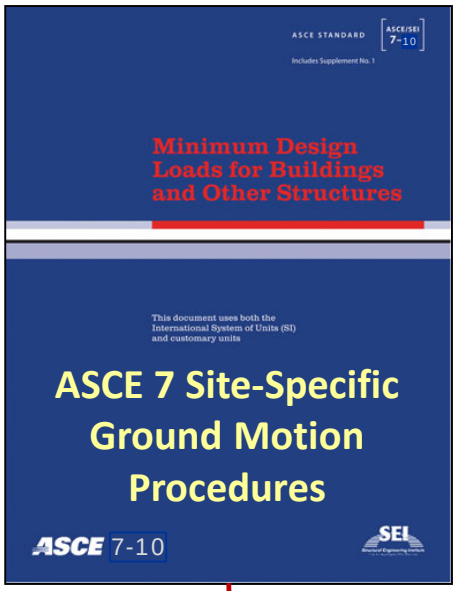
Background

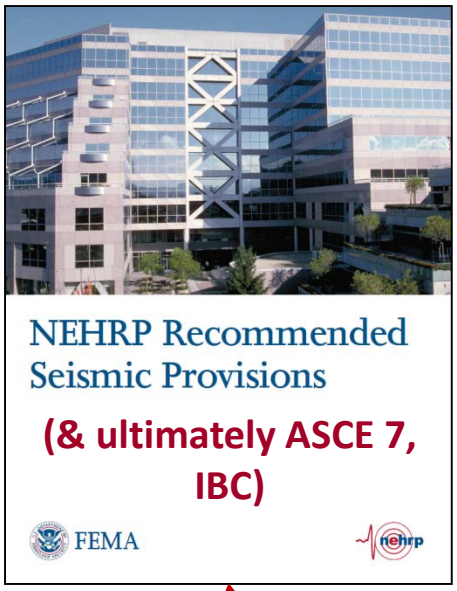
Planning Committee Project 17



USGS National Seismic Hazard Model (NSHM)



ASCE 7 Site-Specific Ground Motion Procedures



NEHRP Recommended Seismic Provisions

(& ultimately ASCE 7, IBC)

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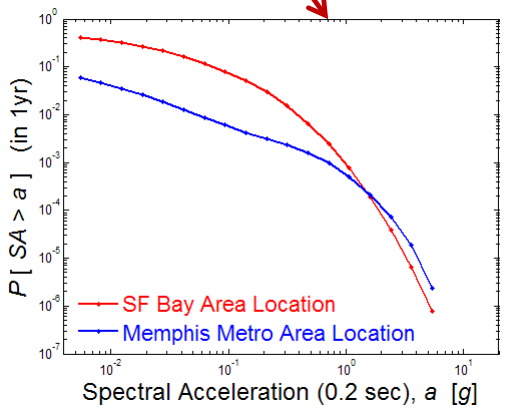

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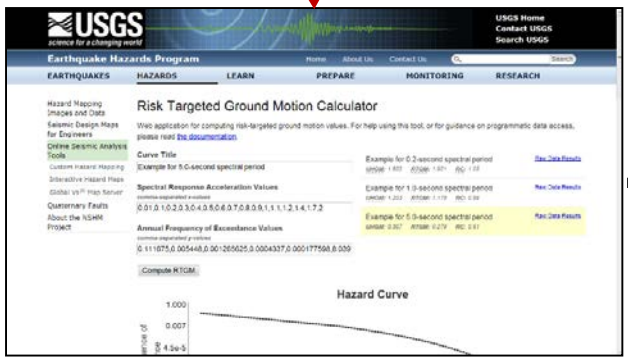

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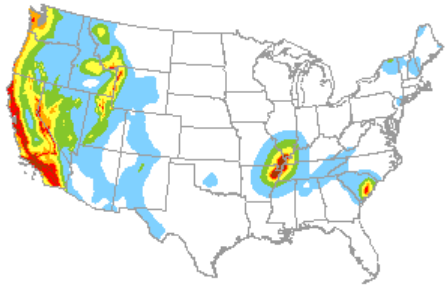
MCE_R Ground Motion Map



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Motivation

Design maps derived from 2014 USGS NSHM have been voted into the *2015 NEHRP Provisions*, but with several "no" votes, e.g., …

"The updates are generating significant fluctuations in seismic design criteria. These fluctuations imply to the design community that criteria are being set without adequate rigor. The fluctuations also create significant hardship for building owners who make significant structural changes and find that a building adequate under a previous code become substantially inadequate under the new code. Further discussion of the overall seismic map direction and its impact on users is needed."

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"Project '17"

- For development of design maps for *2020/21 NEHRP Provisions* (& 2024 *International Building Code*)
- Collaboration of FEMA (which funds Building Seismic Safety Council, BSSC) & USGS (NSHMP)
- Sequel to Project '97 (*2000 IBC*) & Project '07 (*2012 IBC*)
- Planning committee formed, to identify issues for potential proposals to change the existing design maps
- Final planning committee meeting to be held in August(2015)

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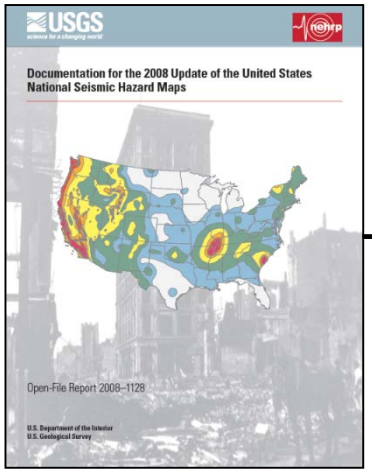
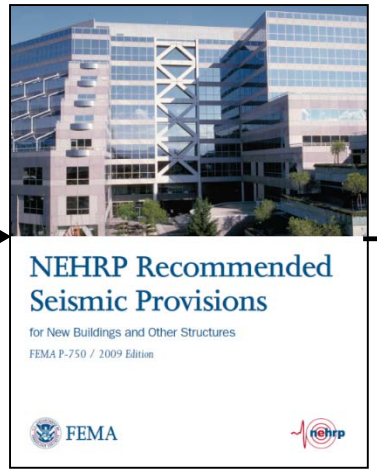
Current List of Issues

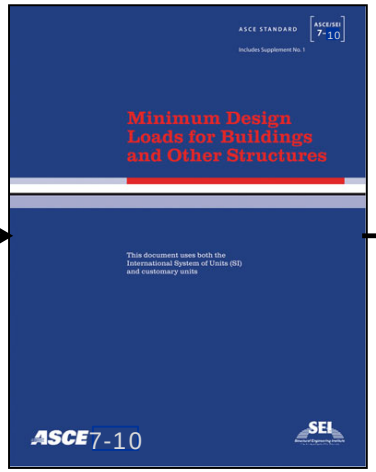
1. *Timing for updates*
2. *Medium for conveyance*
3. *Precision & uncertainty*
4. Acceptable collapse risk
5. Collapse fragility
6. Max-direction ground motions
7. *Multi-period spectra*
8. Duration effects
9. Damping levels
10. Vertical ground motions
11. *Deterministic caps*
12. Basin effects
13. *Use of 3-D simulations*

1. Timing for Updates

USGS NSHM	*NEHRP Provisions*	*ASCE 7 Standard*	*IBC*
1996	1997, 2000	1998, 2002	2000, 20003
2002	2003	2005	2006, 2009
2008	2009	2010	2012, 2015
2014	2015	2016	2018
2017/18	2020/21	2022	2024







1. Timing for Updates

- USGS debating whether to update National Seismic Hazard Model (NSHM) every 3 years.
- *Pro:* Reduced amount of modeling changes in each update.
- *Pro:* More frequent opportunities for external contributors to submit their information.
- *Con:* More overhead, e.g., for documentation.
- *Con:* Existence of "interim" updates that are not incorporated into NEHRP Provisions, etc.

1. Timing for Updates

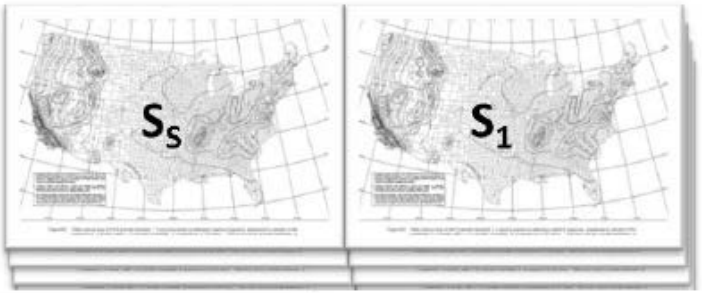
- *Importance* – Updated NSHM needed for several other potential Project 17 issues (e.g., multi-period spectra), so timing must be coordinated between USGS, its external contributors, and NEHRP Provisions.
- *Risks* – Only of not coordinating.
- *Resources* – Small issue team of managers, web conferences.
- *Schedule* – Beginning of Project '17.

2. Design Value Conveyance

1991

1 Map

2000



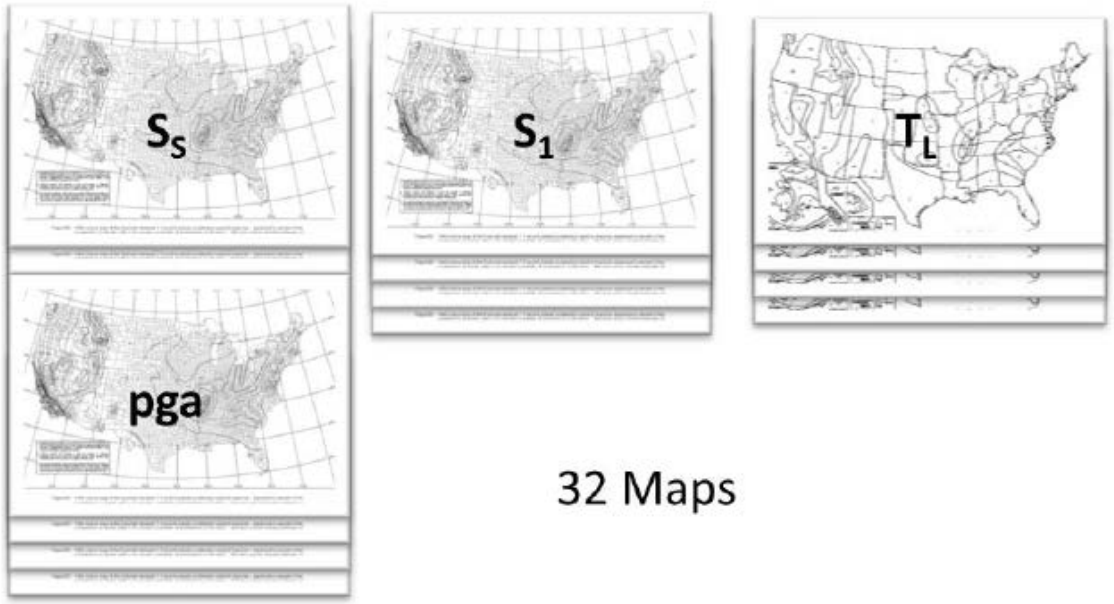
14 Maps

2005

20 Maps

2. Design Value Conveyance

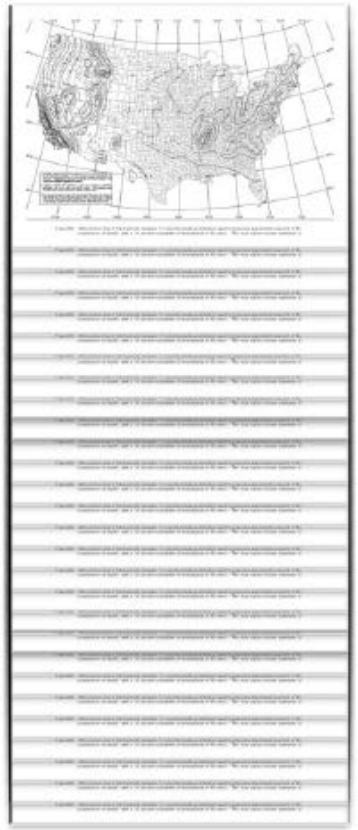
2010



32 Maps

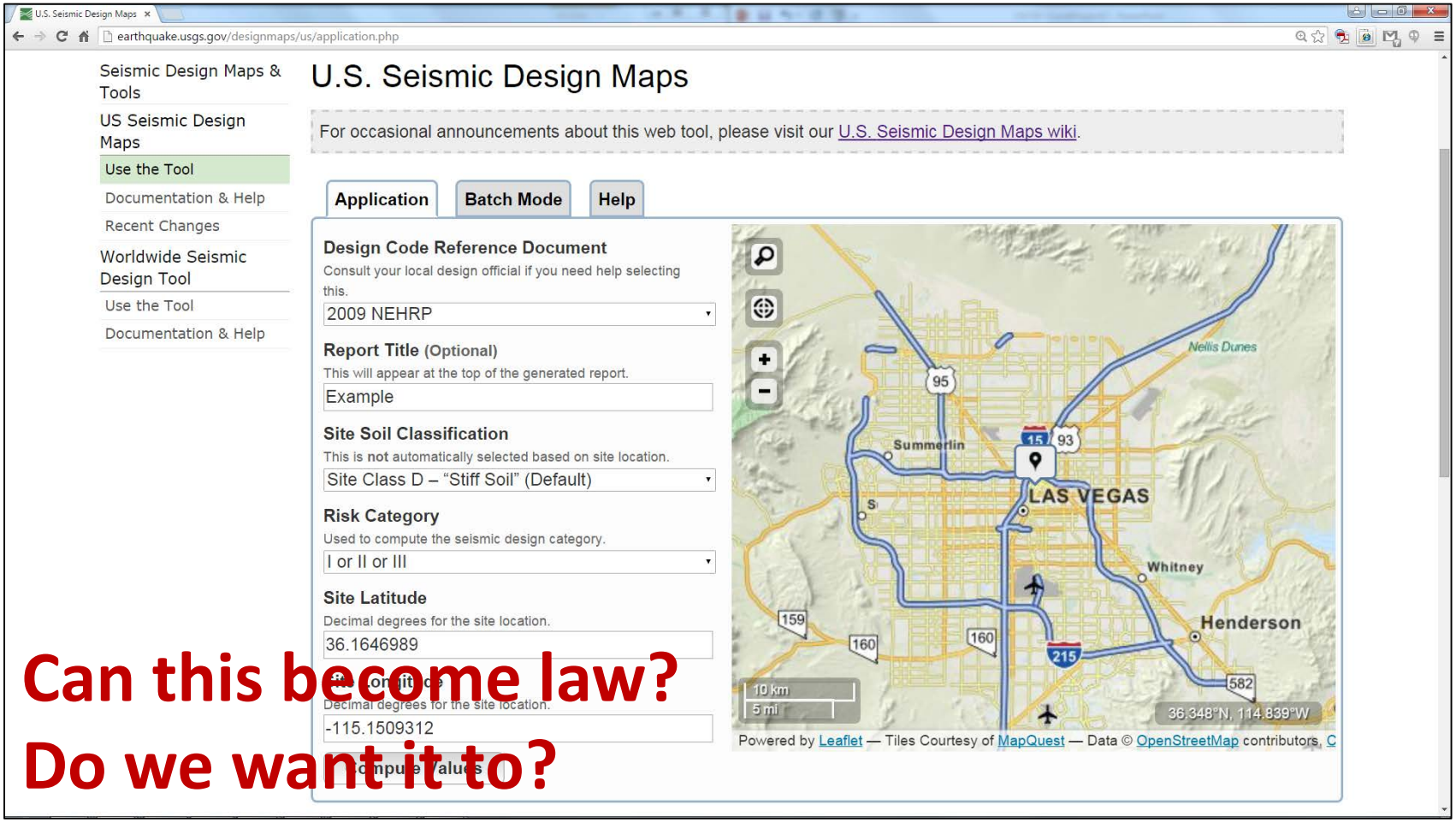
2. Design Value Conveyance

2022



- Maps for:
  - 0 sec, 0.2 sec, 0.5 sed, 1 sec, 2sec, 2.5 sec, 3 sec….9 sec, 10sec.
  - V_{s30}: <200m/s, 300m/s, 400 m/s, 500 m/s, 1000 m/s, >2000m/s
  - Damping .5%, 2.5%, 5%, 10%, 15%, 20%, 25%

2. Design Value Conveyance



Can this become law?

Do we want it to?

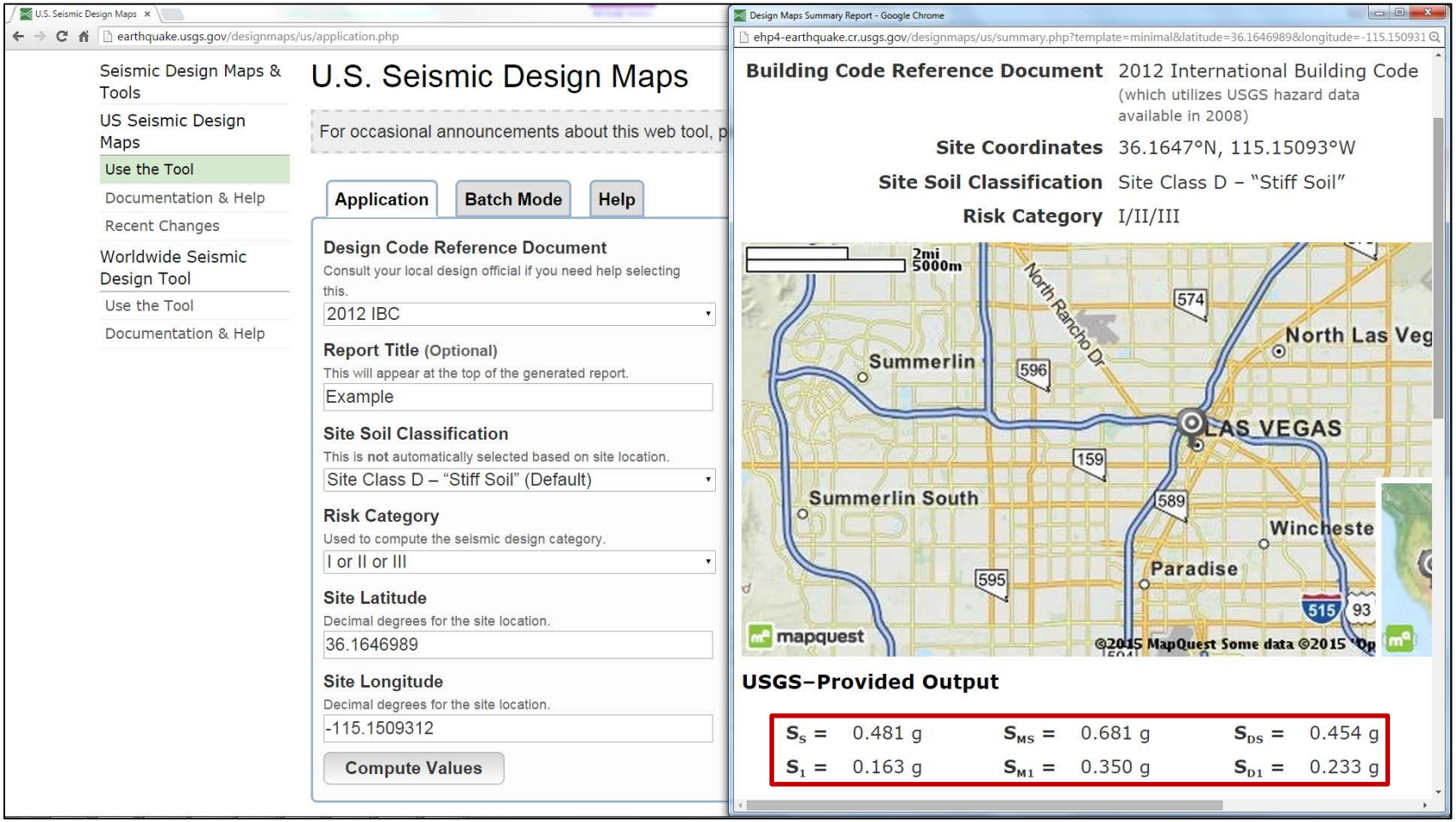
2. Design Value Conveyance

- During development of 2015 Provisions, addition of design maps for T=1.5, 2, & 3 seconds was considered.
- *"S_T = the MCE_R spectral response accelerations … at periods of 1.5 s, 2 s, and 3 s, which shall be developed in accordance with Section 21.2.3, using the same probabilistic and deterministic ground motion hazard analysis models that are the bases for the mapped MCE_R spectral response accelerations of Chapter 22."*

2. Design Value Conveyance

- *Importance* – Preparation, publication, and use of very large number of maps impractical.
- *Risks* – Increased reliance on web tool.
- *Resources* – Issue team of ICC, ANSI, and ASCE representative, in-person meetings. Web development.
- *Schedule* – First 6 months of Project '17.

3. Precision & Uncertainty



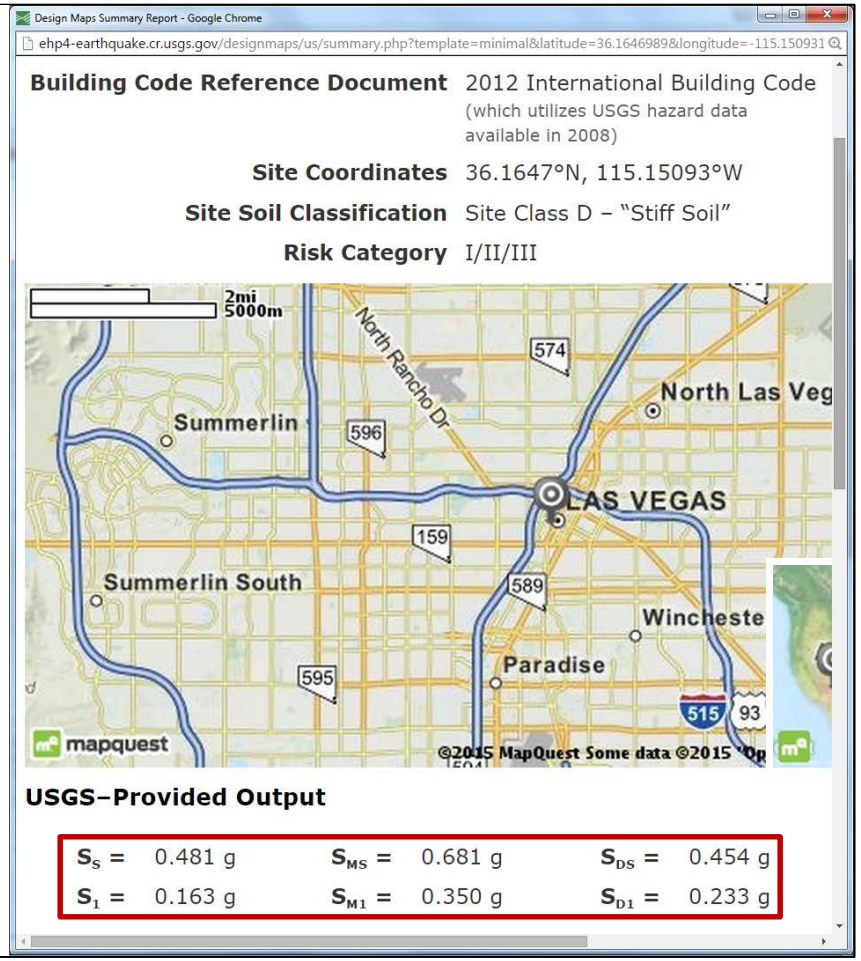
3. Precision & Uncertainty

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

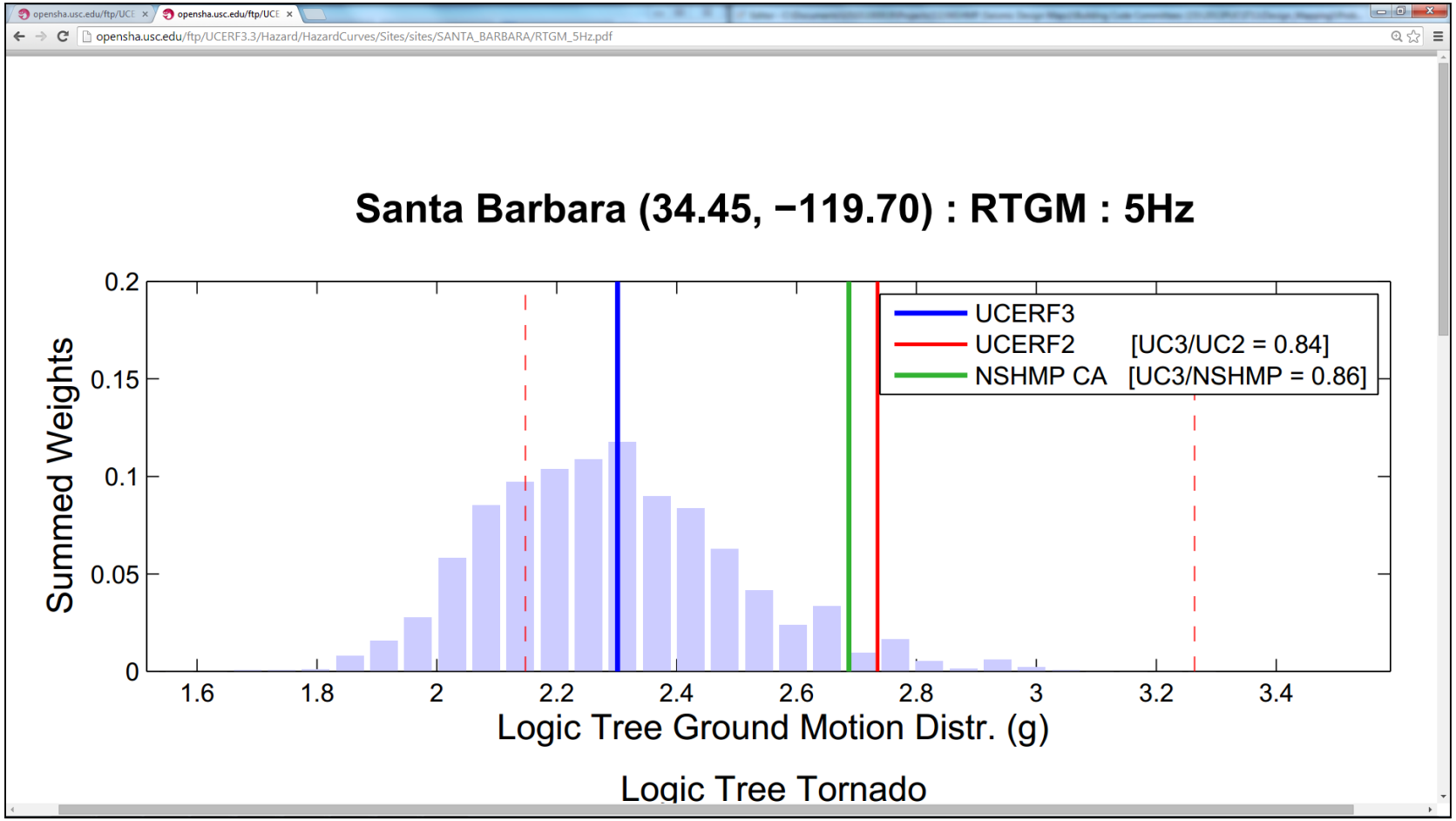
Value of S_{DS}	Risk Category I or II or III	Risk Category IV
$S_{DS} < 0.167$	A	A
$0.167 \le S_{DS} < 0.33$	B	C
$0.33 \le S_{DS} < 0.50$	C	D
$0.50 \le S_{DS}$	D	D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

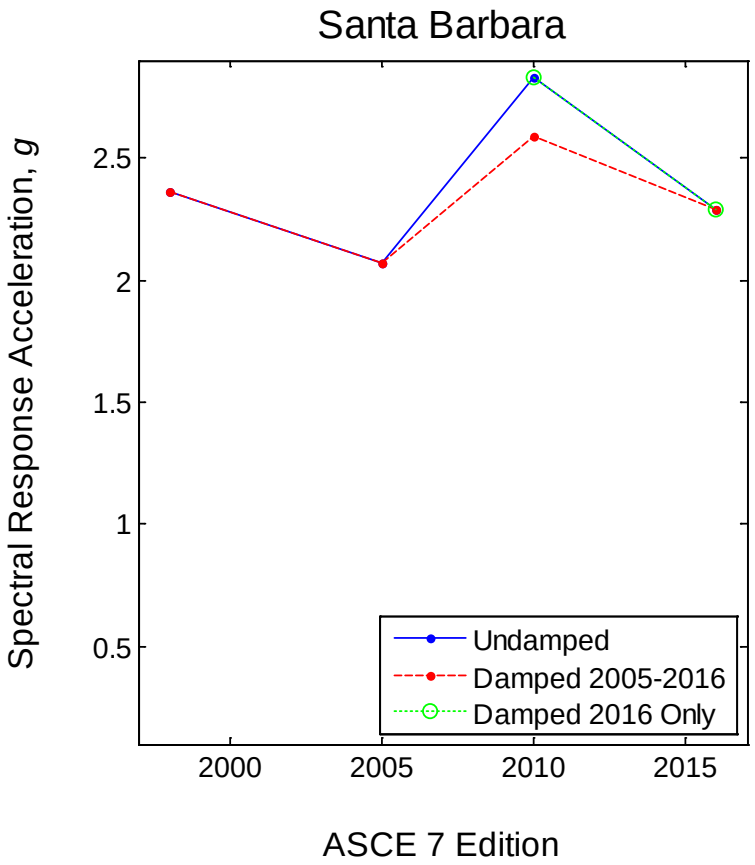
Value of S_{D1}	Risk Category I or II or III	Risk Category IV
$S_{D1} < 0.067$	A	A
$0.067 \le S_{D1} < 0.133$	B	C
$0.133 \le S_{D1} < 0.20$	C	D
$0.20 \le S_{D1}$	D	D

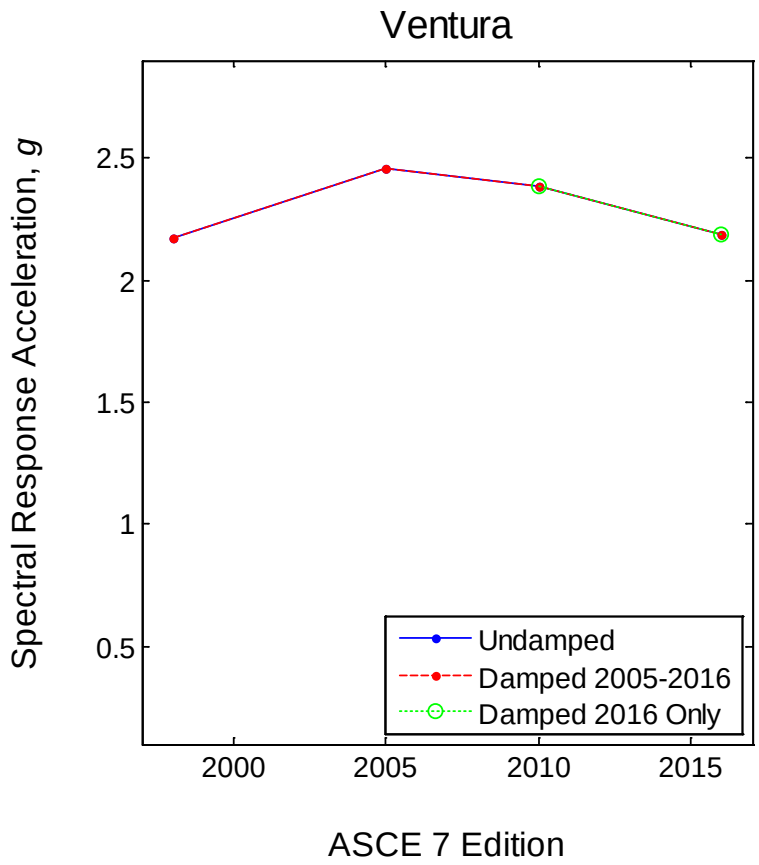


3. Precision & Uncertainty



3. Precision & Uncertainty



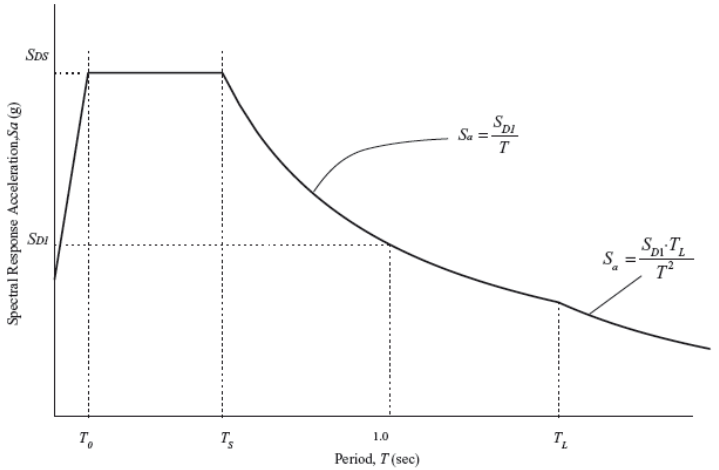


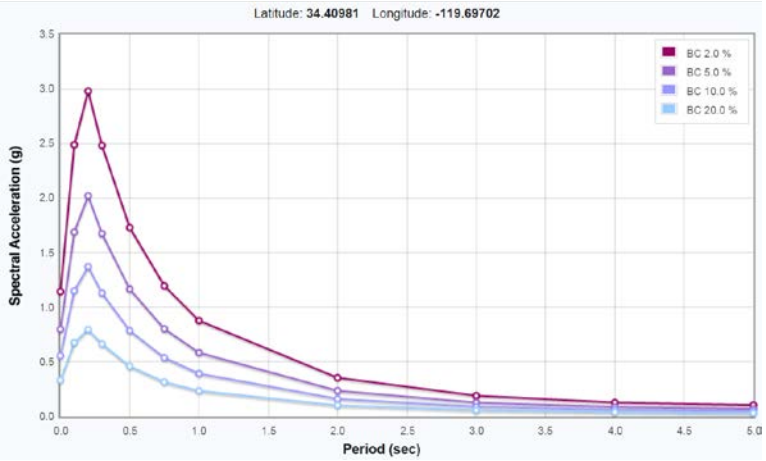
3. Precision & Uncertainty

- *Importance* – Apparent instability of design maps can lead to rejection of updates based on USGS NSHM.
- *Risks* – Discrepancies between design maps and site-specific values (from NSHM).
- *Resources* – Issue team of engineers (structural and geotechnical) and scientists, in-person meetings. Preparation of "samples".
- *Schedule* – First ~1 year of Project '17.

7. Multi-Period Spectra

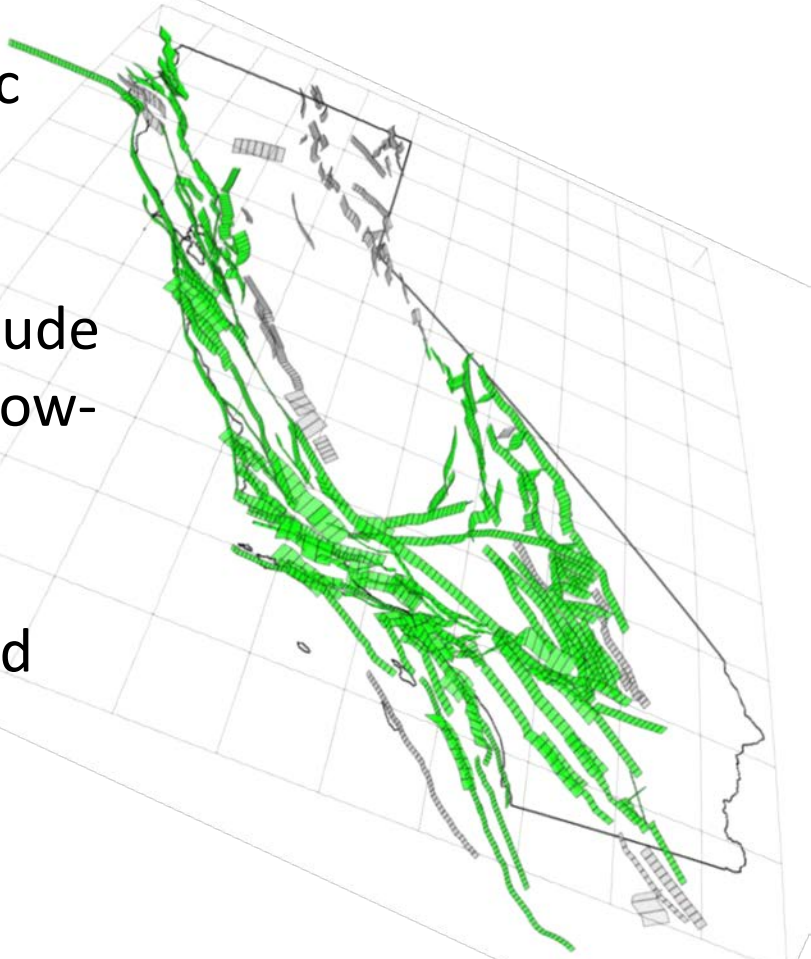
- *ASCE 7-10 & 2015 NEHRP Provisions* use two-point design spectra, for v_{S30} = 760 m/s
- USGS NSHM has provided results for many periods & v_{S30}'s
- Long-period results are sensitive to basin effects, & short-period results impact numerous design provisions





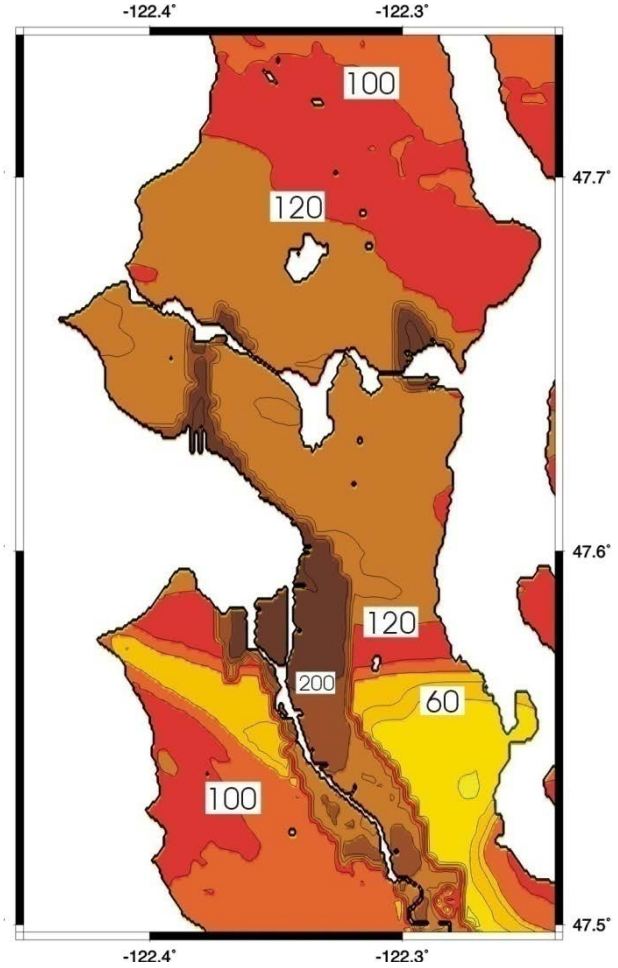
11. Deterministic Caps

- *ASCE 7-10* calls for "characteristic earthquakes on all known active faults"
- UCERF3 & 2014 USGS NSHM include multi-fault (M8+) ruptures, and low-slip-rate (≤0.1mm/yr) faults
- For *2015 NEHRP Provisions*, *ASCE 7-10* definition was retained
- Project '17 could reassess how/ whether deterministic caps are calculated



13. Use of 3-D Simulations

- USGS "urban" SHM for Seattle (Frankel, 2007) used by engineers but not incorporated into NSHM & design maps
- SCEC UGMS Committee (Crouse et al) exploring use of "CyberShake" SHM for Los Angeles design maps
- *Project '17 could also incorporate simulation-based SHM being developed by USGS for Salt Lake City*



Next Steps

- *Next 2 weeks:* Webinars to solicit public comments.
- *Next month:* Prioritize issues.
- *Next few months:* Select issues and form issue teams.
- *Next calendar year:* Start work on selected issues.

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