

Potential Design Mapping Updates

Workshop on Update of Pacific Northwest Portion of U.S. National Seismic Hazard Maps

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Discussion Topics

- Building Seismic Safety Council (BSSC) 2014 NEHRP Provisions Update Committee (PUC) *Design Mapping Issue Team* (Luco, Bachman, Crouse, Dolan, Harris, Hooper, Kircher)
- Risk-Targeted Maximum Considered Earthquake (MCE_R) ground motions in 2012 International Building Code (IBC)
- Potential duration-related increases in risk-targeted ground motions for subduction-zone vs. crustal earthquakes

BSSC PUC Design Mapping Tasks

- 1) Update *design* maps for *2014 Provisions* based on updates from USGS National Seismic *Hazard* Mapping Project
- 2) Prepare “supplemental” *design* values from additional USGS *hazard* values (e.g. for $V_{S30} \neq 760$) and compare with design maps
- 3) Review USGS-proposed scenarios for deterministic ground motion computations
- 4) Prepare Serviceability Level design maps analogous to MCE_R maps
- 5) Look into improvement of T_L map (probably waiting until next cycle)
- 6) Address S_S values greater than 3g (for equipment qualification)
- 7) Contribute to planning of USGS User’s Workshop
- 8) Consider reshaping design/ MCE_R spectrum with more spectral periods (than 0.2 & 1.0 seconds)
- 9) Design maps for American Samoa & Guam

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2) Supplemental Design Values

2008 NSHM Gridded Data

These files contain space-delimited, rectangular gridded data over the Conterminous 48 States in 0.05 degree increments (x-value) and latitude (y-value), starting from a northwest point at 50°N 125°W and ending at a southeast point at 24.6°N 6... are ordered starting in the northwest, proceeding east across longitude values keeping the latitude value the same until the most point for that latitude value is reached, then wrapping to next latitude value and restarting with the western-most long... This processes is repeated until the aforementioned grid is filled. See below for more information about the [format of these](#)

[Additional data at other spectral periods and/or other soil and rock site conditions](#)

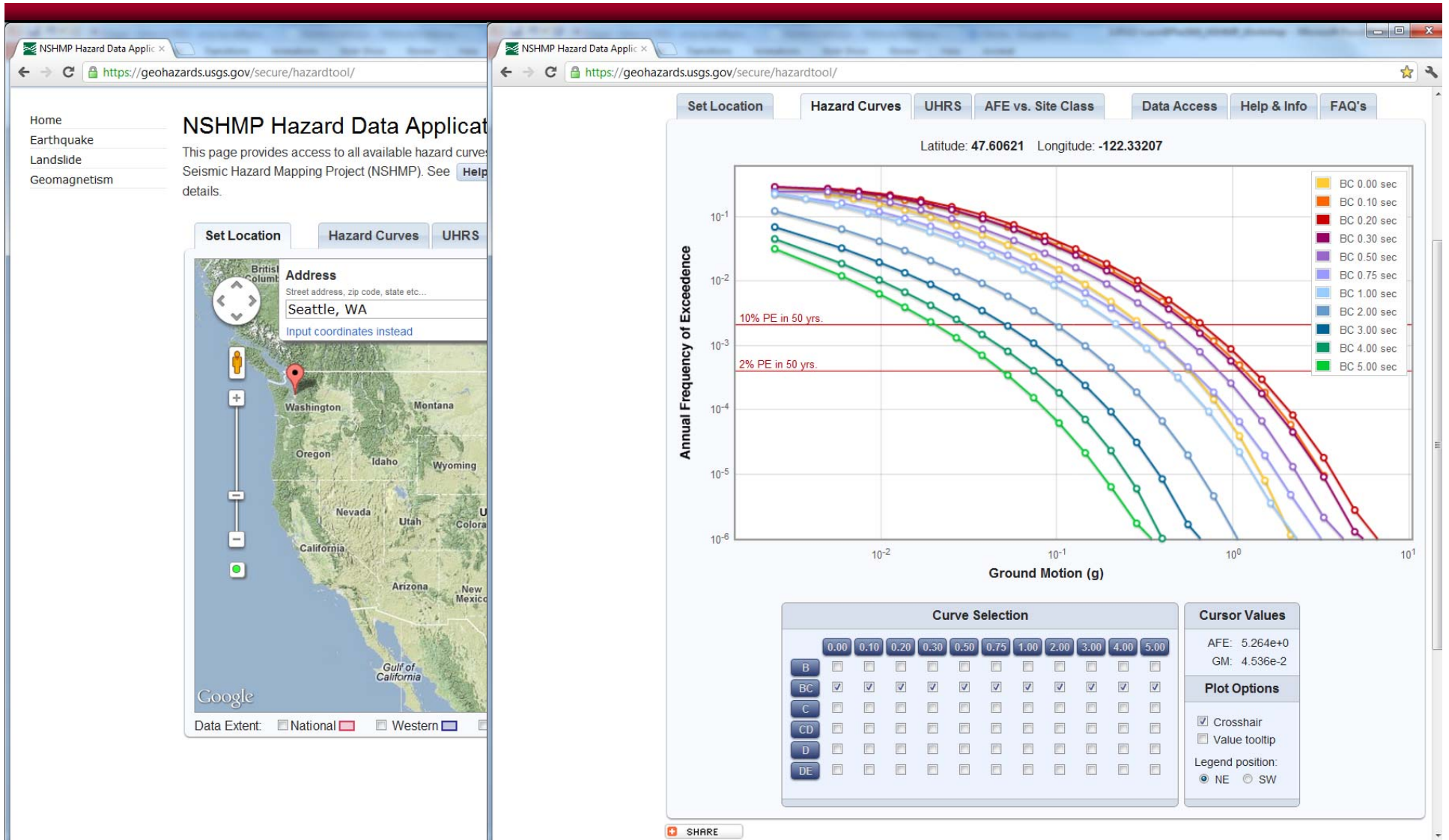
Download Data Files

Data Type	Spectral Acceleration	Probability of Exceedance	Download
Gridded Hazard Map	10Hz (0.1 Second)	10% in 50 Years	Text (3 Mb)
Gridded Hazard Map	10Hz (0.1 Second)	2% in 50 Years	Text (3 Mb)
Gridded Hazard Map	10Hz (0.1 Second)	5% in 50 Years	Text (3 Mb)
Gridded Hazard Map	1Hz (1.0 Second)	10% in 50 Years	Text (3 Mb)
Gridded Hazard Map	1Hz (1.0 Second)	2% in 50 Years	Text (3 Mb)
Gridded Hazard Map	1Hz (1.0 Second)	5% in 50 Years	Text (3 Mb)
Gridded Hazard Map	2Hz (0.5 Second)	10% in 50 Years	Text (3 Mb)
Gridded Hazard Map	2Hz (0.5 Second)	2% in 50 Years	Text (3 Mb)
Gridded Hazard Map	2Hz (0.5 Second)	5% in 50 Years	Text (3 Mb)
Gridded Hazard Map	0.5Hz (2.0 Second)	10% in 50 Years	Text (3 Mb)
Gridded Hazard Map	0.5Hz (2.0 Second)	2% in 50 Years	Text (3 Mb)
Gridded Hazard Map	0.5Hz (2.0 Second)	5% in 50 Years	Text (3 Mb)
Gridded Hazard Map	0.2Hz (0.5 Second)	10% in 50 Years	Text (3 Mb)

- **Hazard** values for other site classes (besides B-C) and other vibration periods (besides 0.2 & 1.0s) already available
- Prepare corresponding **design** (“MCE_R”) values? By 2014, probably not.

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2) Supplemental Design Values



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2) Supplemental Design Values

USGS Open-File Report 20... x

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Seismic Hazard Maps for Seattle, Washington, Incorporating 3D Sedimentary Basin Effects, Nonlinear Site Response, and Rupture Directivity

By Arthur D. Frankel, William J. Stephenson, David L. Carver, Robert A. Williams, Jack K. Odum, and Susan Rhea

Abstract

This report presents probabilistic seismic hazard maps for Seattle, Washington, based on simulations of ground motions from scenario earthquakes. These maps include 3D sedimentary basin effects, nonlinear site response for soft-soil sites of fill and alluvium, and rupture directivity. The report describes the methodology for incorporating source and site dependent amplitude dependent probabilistic seismic hazard calculation. 3D simulations were conducted for the various seismic sources that can affect Seattle: Seattle fault zone, Cascadia subduction zone, South Whidbey Island, and distributed-earthquake sources as in the 2002 national seismic hazard maps. The 3D simulations were validated by modeling the amplitudes and waveforms of observed earthquakes in the region, including the 2001 M6.8 Nisqually earthquake. The probabilistic hazard maps presented here depict 1 Hz response spectral accelerations with 10%, 5%, and 2% probability in 50 years. The maps are based on determinations of seismic hazard for 7236 sites within the Seattle basin and along the inferred trace of the frontal fault zone. The next highest hazard is typically found for soft-soil sites in the Duwamish Valley basin. In general, stiff-soil sites in the Seattle basin exhibit higher hazard than stiff-soil sites with shallow bedrock outside the Seattle basin have the lowest estimated hazard.

Suggested citation:

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- “Urban” *hazard* values already available for Seattle (underway for other cities)
- Add corresponding *design* (“MCE_R”) values, with site response for B-C & other site classes?

2) Supplemental Design Values

<http://earthquake.usgs.gov/designmaps/usapp>

Upcoming U.S. Design Code Preview

- Web Application
- Batch Mode
- Min/Max for Regions
- Seismic Design for Engineers
- Buildings
- Bridges
- Seismic Hazards

U.S. Seismic "DesignMaps" Web Application

Caution: If you need earthquake ground motion values for building codes *presently used* in most jurisdictions, e.g. from 2009/2006/2003/2000 International Building/Residential Code (IBC/IRC) or the 2005/2002/1998 ASCE-7 Standard, **do not use this application**; instead use the [Java Ground Motion Parameter Calculator](#). The application below currently only outputs values for 2009 NEHRP Provisions, the 2010 ASCE-7 Standard, and the 2012 IBC. The incorporation of these reference documents into building codes is *still imminent* in most jurisdictions.

For batch mode, [click here](#)

Report Title (Optional)
This will appear at the top of the generated report.
Embassy Suites Burlingame

Site Class D - "Stiff Soil" (Default)

Structure Risk Category
Optional; if provided, is used to compute the seismic design category.
Please Select...

Site Address
Enter a street address, cross street, or other canonical location.
150 Anza Boulevard, Burlingame, CA
[Enter a latitude and longitude instead](#)

Compute Values

SHARE

References to non-U.S. Department of the Interior (DOI) products do not constitute an endorsement by the DOI. By viewing the Google Maps API, the user agrees to these [Terms of Service set forth by Google](#).

"DesignMaps" Summary Report - Google Chrome

<https://geohazards.usgs.gov/secure/designmaps/us/summary.php?template=minimal&latitude=37.591611&longitude=-122.31>

USGS "DesignMaps" Summary Report

[Print](#) [View Detailed Report](#)

User-Specified Input

Report Title Embassy Suites Burlingame
Thu September 15, 2011 16:24:17 UTC

Building Code Reference Document 2009 NEHRP Recommended Seismic Provisions
(which makes use of 2008 USGS hazard data)

Site Coordinates 37.59161°N, 122.34802°W
"150 Anza Boulevard, Burlingame, CA"

Site Soil Classification Site Class D - "Stiff Soil"

Site Risk Category None Supplied

USGS "DesignMaps" Summary Report

[Print](#) [View Detailed Report](#) [Supplemental Design Values](#)

USGS-Provided Output

$S_s = 1.968 \text{ g}$	$S_{MS} = 1.968 \text{ g}$	$S_{DS} = 1.312 \text{ g}$
$S_1 = 0.924 \text{ g}$	$S_{M1} = 1.386 \text{ g}$	$S_{D1} = 0.924 \text{ g}$

For information on how the S_s and S_1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please [view the detailed report](#).

MCE_R Spectrum Sa Vs T

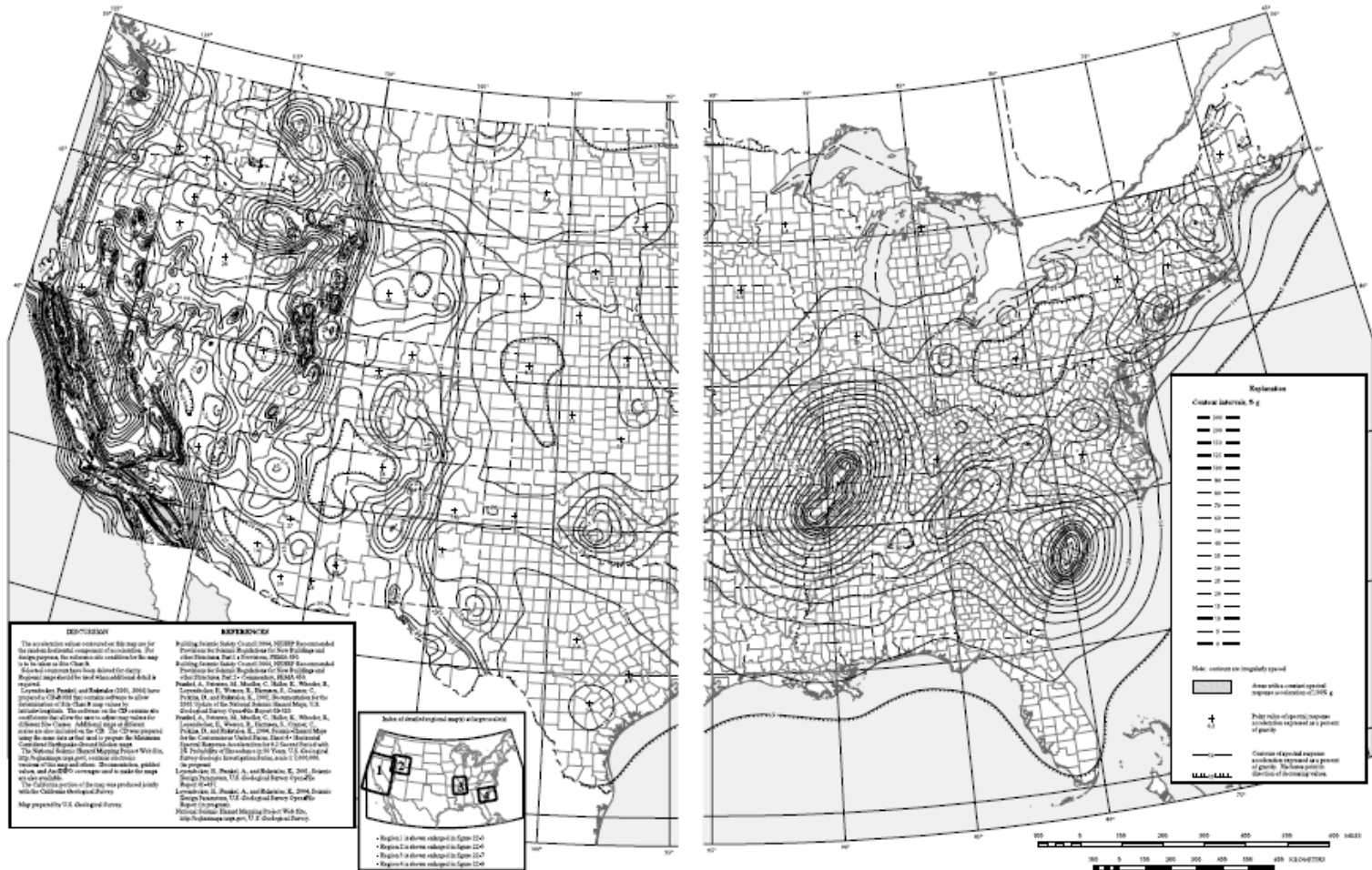
Design Response Spectrum

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2012 International Building Code



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Preparation of Seismic Design Maps for Codes \$45.00

[DL-NGA01-NL]

Presented by:
 Nicolas Luco, Research Structural Engineer
 USGS, Golden, Colorado


Nicolas Luco, Research Structural Engineer
 USGS, Golden, Colorado

[Click to enlarge](#)

About this Seminar Series

Next Generation Attenuation (NGA) Models
 This seminar informs structural and geotechnical engineers about the implications for engineering practice of the recently developed next generation attenuation (NGA) models. Significant changes are coming to the USGS Hazard Maps and Seismic Design Maps that are part of the ASCE 7 and IBC design process. These changes need to be understood by geotechnical, seismological, and structural engineers; not only will they impact site-specific studies, but they will also become a part of the 2010 ASCE 7 and 2012 IBC design provisions. This seminar provides the background and basis for the NGA models and how they impact the new USGS Hazard Maps. It also summarizes the technical basis of the three major changes to Seismic Design Maps. It provides examples of applications of the new NGA models.

The NGA models that are now incorporated in the new USGS Hazard Maps were developed by the Pacific Earthquake Engineering Research (PEER) Center over a five-year period to update the ground motion predictive equations for shallow crustal earthquakes in the western United States and similar active tectonic regions. The expansion of the strong motion database

Preparation of New Seismic Design Maps for Building Codes

EERI Seminar on Next Generation Attenuation Models

Nicolas Luco, Research Structural Engineer
USGS, Golden, Colorado







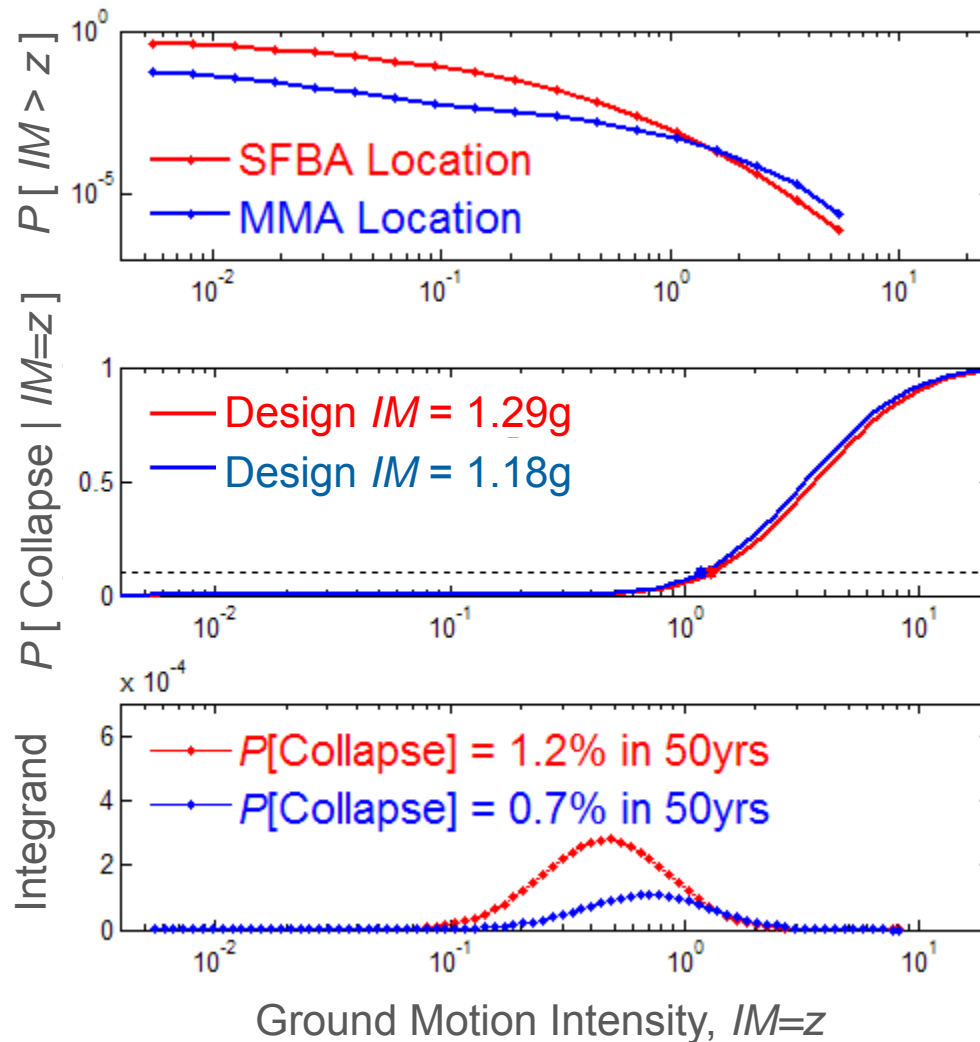
Google “EERI NGA Seminar Presentations” for Video or email nluco@usgs.gov for just PowerPoint

Risk-Targeted GM Example

Hazard

Fragility

Risk



$$P[\text{Collapse}] = \int_0^{\infty} \frac{dP[\text{Collapse} | IM = z]}{dz} P[IM > z] dz$$

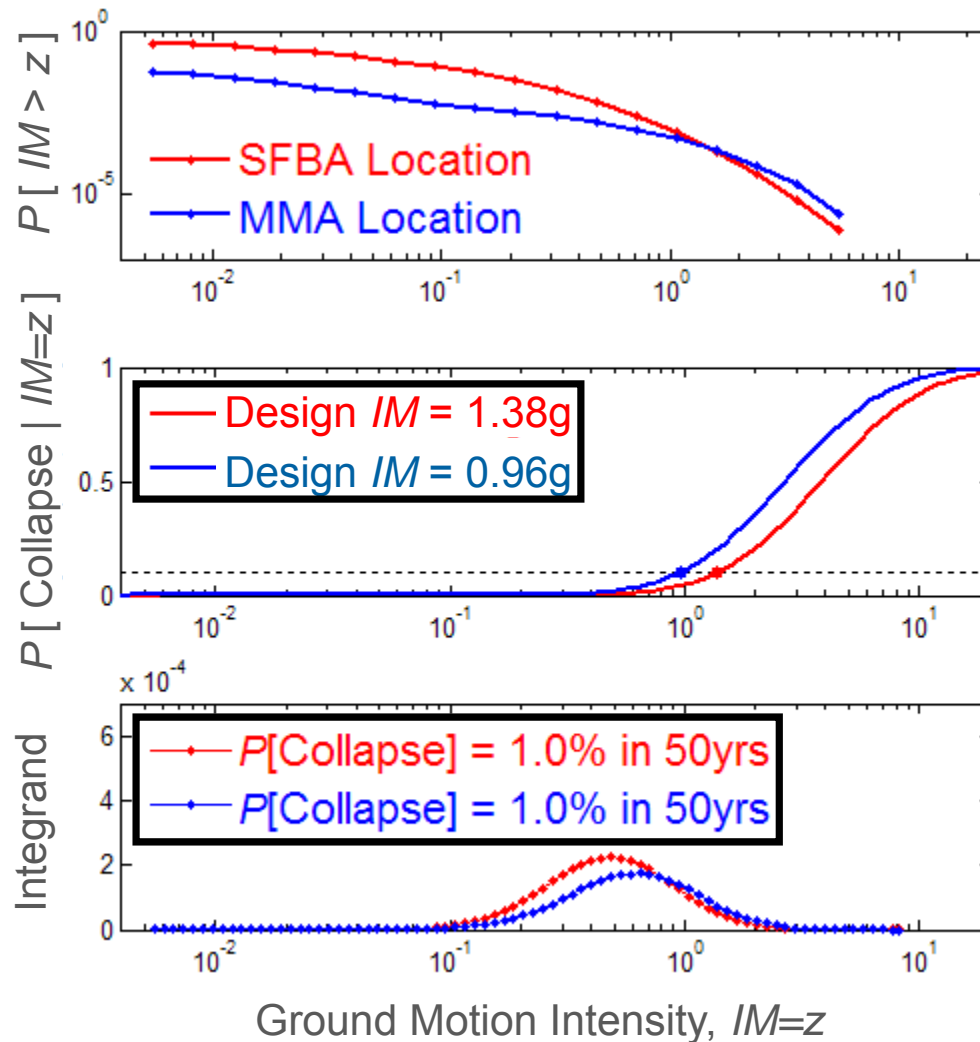
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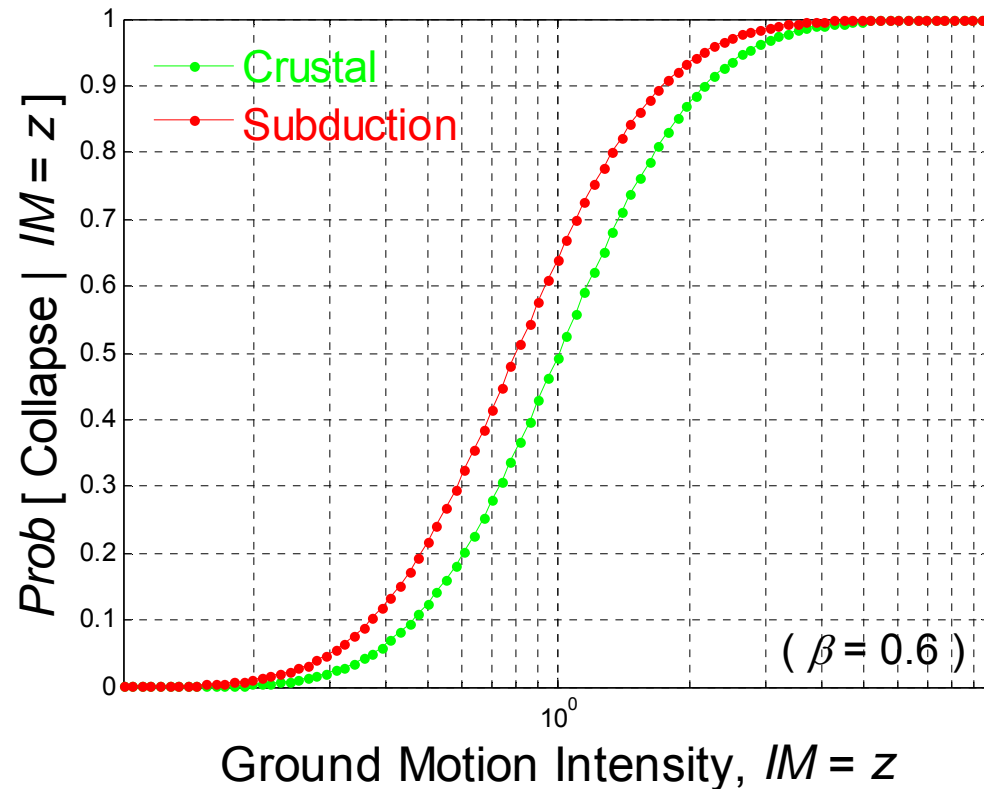
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Subduction vs. Crustal Fragility Curves

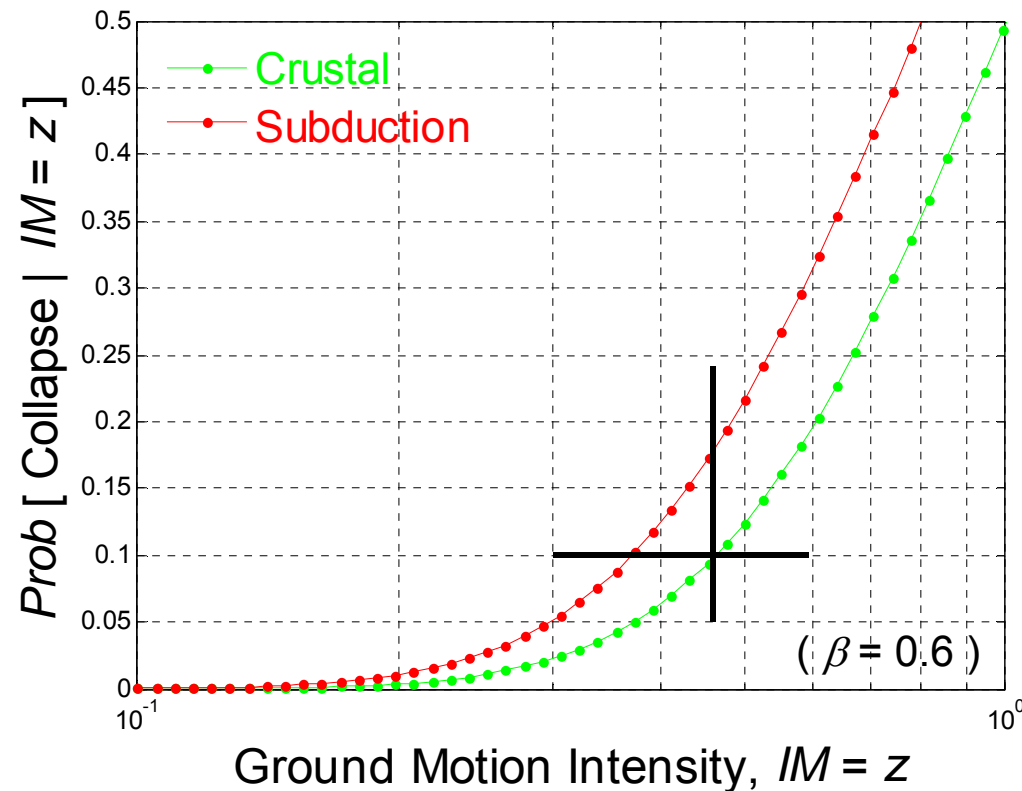
- Assuming 20% decrease in median ground motion intensity that causes collapse (minimum from Liel's presentation) ...



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Subduction vs. Crustal Fragility Curves

- Assuming 20% decrease in median ground motion intensity that causes collapse (minimum from Liel's presentation) ...



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Subduction vs. Crustal Fragility Curves

- Assuming 20% decrease in median ground motion intensity that causes collapse (minimum from Liel's presentation) ...

City	Crustal RTGM & C _R		Subduction		Subduction/Crustal	
	RTGM	C _R	RTGM	C _R	RTGM	C _R
Seattle	1.29g (0.92)	0.51g (0.91)	1.61g (1.14)	0.64g (1.13)	+25%	+25%
Tacoma	1.21g (0.93)	0.48g (0.92)	1.51g (1.16)	0.60g (1.14)	+25%	+25%
Everett	1.22g (0.91)	0.47g (0.90)	1.52g (1.14)	0.58g (1.13)	+25%	+23%
Portland	0.97g (0.89)	0.42g (0.88)	1.21g (1.11)	0.53g (1.10)	+25%	+26%

- Actual duration-related increases in risk-targeted ground motions for subduction-zone earthquakes would depend on their relative contribution to total hazard

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