

Caltrans Seismic Research Workshop

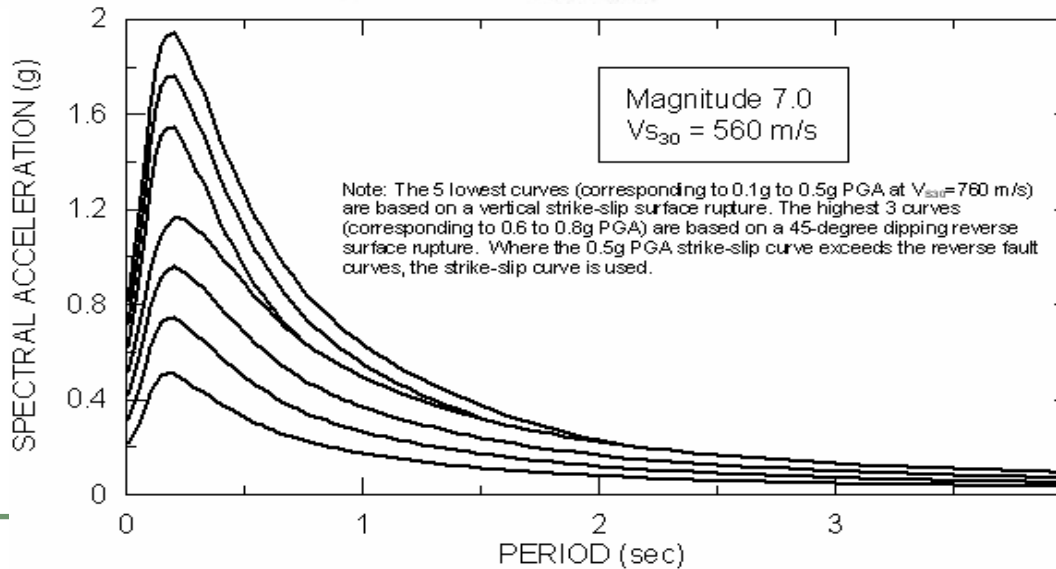
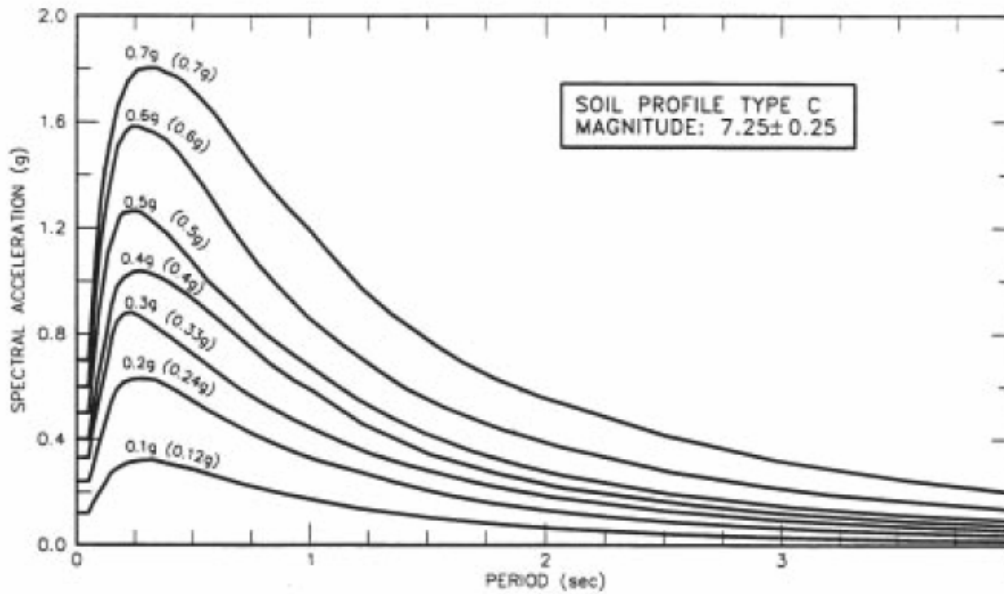
Implementation of NGA Models at Caltrans

Tom Shantz

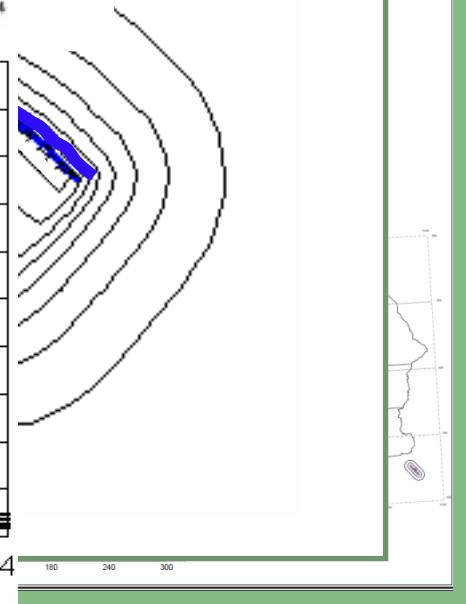
Division of Research and Innovation

June 2009

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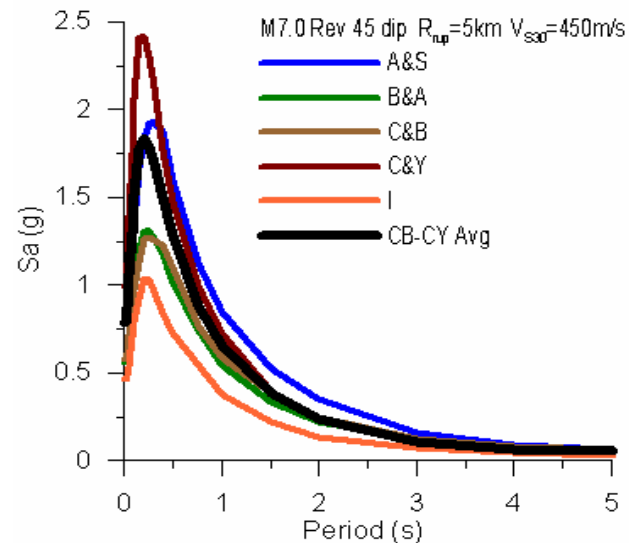
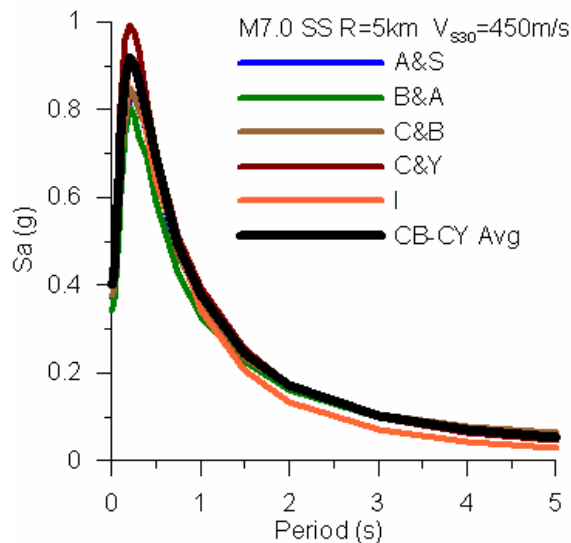


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Why only CB and CY?

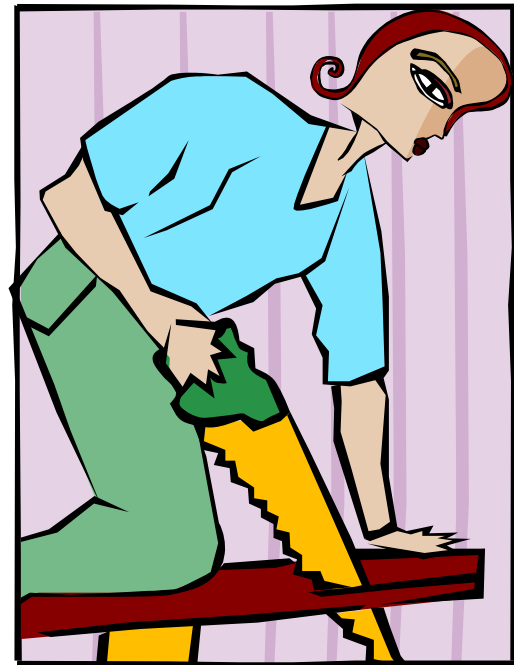
At the time, the CB and CY models were the only ones judged to be sufficiently mature and documented to implement.



While we're remodeling...

... now is a good time to establish to a probabilistic floor to the design spectrum

Probabilistic floor based on USGS 2008 5% in 50 years (975 yrs) National Hazard Map



Where's the updated design criteria?

All design spectrum criteria and guidelines have been consolidated into a single document:

Appendix B of Caltrans Seismic Design Criteria (SDC)

SDC design spectrum in a nutshell...

Design spectrum = Envelope of the deterministic spectrum and the probabilistic spectrum

Deterministic spectrum based on average of Campbell and Bozorgnia (CB) and Chiou and Youngs (CY)

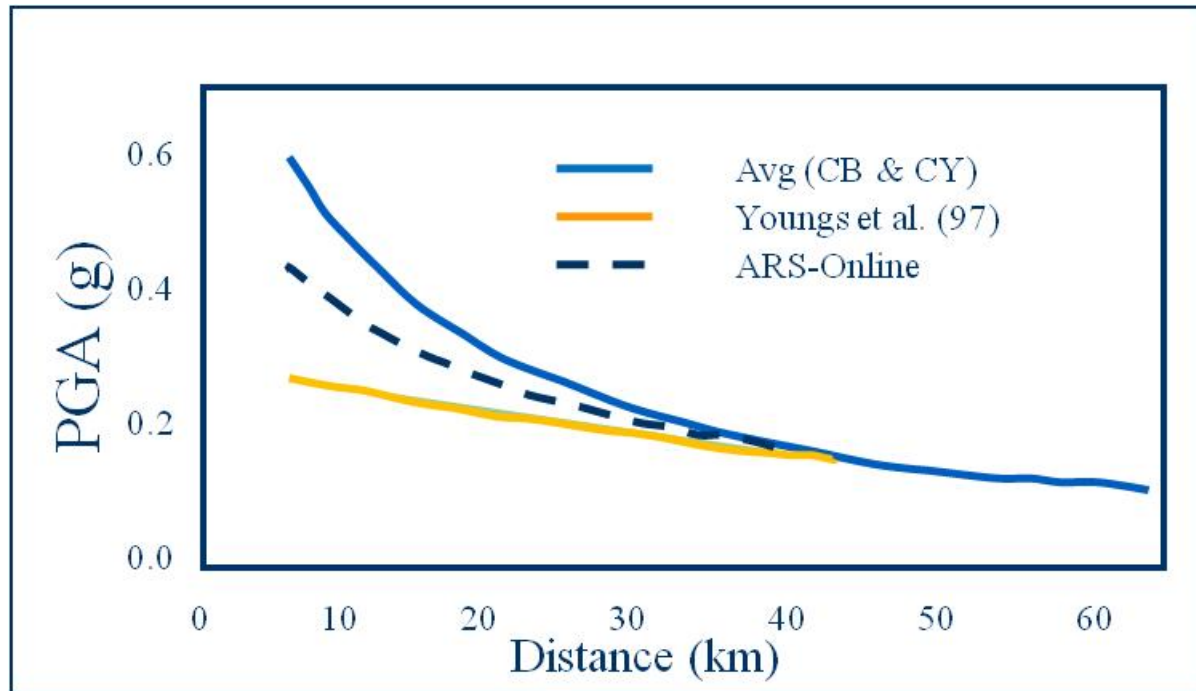
Probabilistic spectrum based on 5% in 50 year hazard (per USGS)

Deterministic spectrum details...

- **Average of CB & CY**
- **Applied to late Quaternary faults ($M \geq 6$)**
- **Statewide floor defined by M 6.5 at 12 km**
- **Youngs et al. (1997) – CBCY hybrid for Cascadia subduction zone**
- **Eastern Shear Zone (M 7.6 at 10 km floor)**

Deterministic spectrum details...

Cascadia subduction zone attenuation model



Deterministic spectrum details...

Eastern Shear Zone (M 7.6 at 10 km floor)

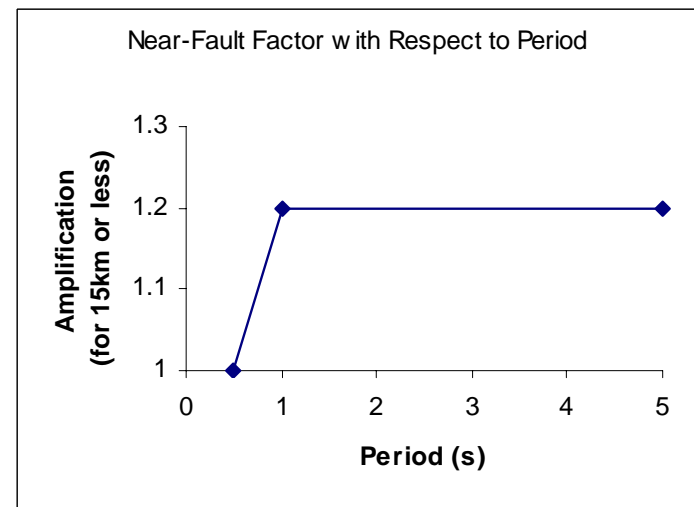
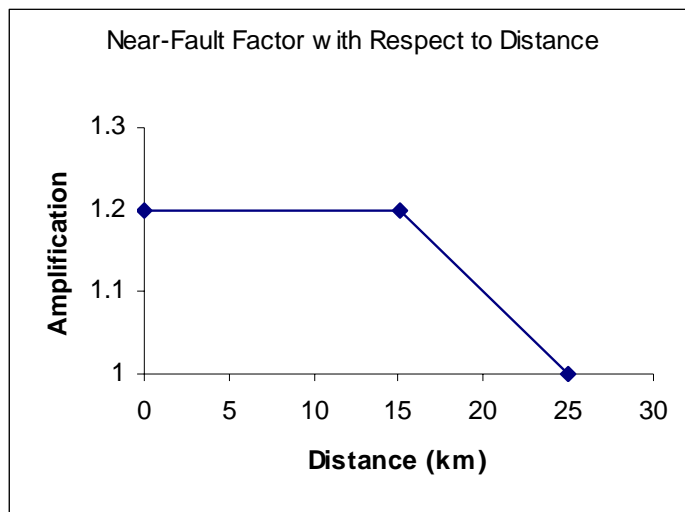


Probabilistic spectrum details...

- **Spectrum based on USGS 5% in 50 year (975-year) hazard data ($V_{S30} = 760$ m/s)**
- **Soil amplification factors are applied based on an average of Boore-Atkinson, Campbell-Bozorgnia, and Chiou-Youngs soil amplification models**

Spectrum adjustment factors...

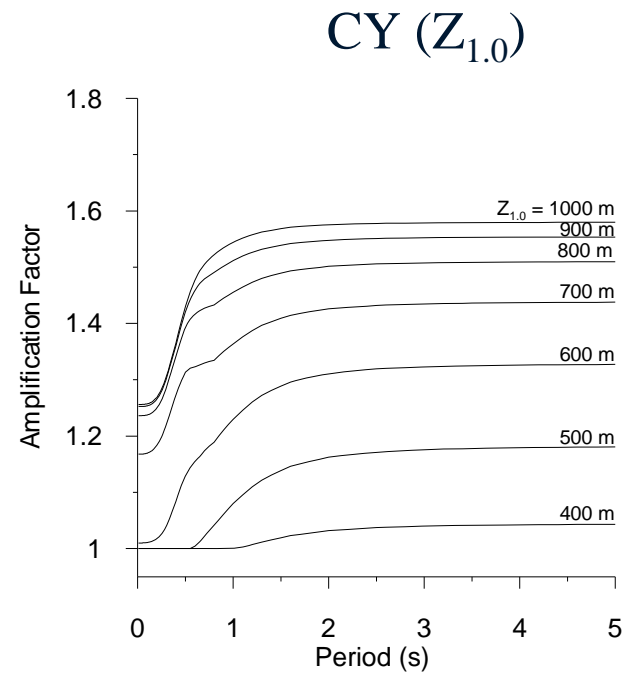
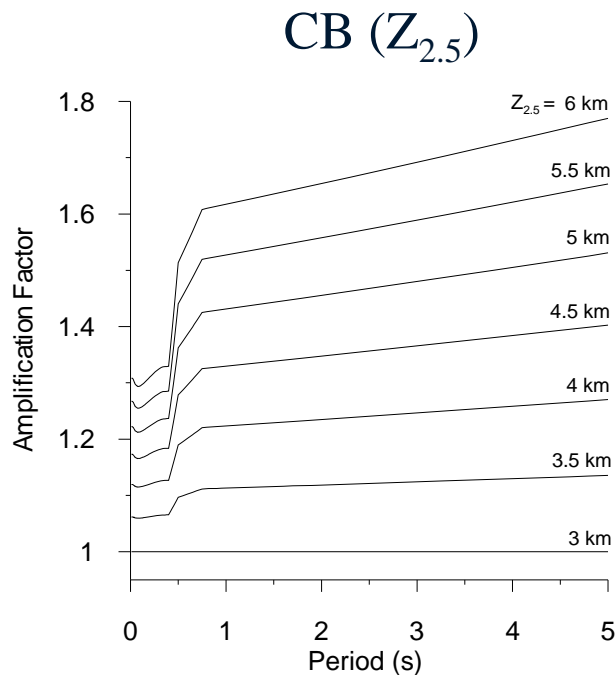
Near- Fault adjustment factor



Note that a distance for the probabilistic spectrum will require a deaggregation analysis

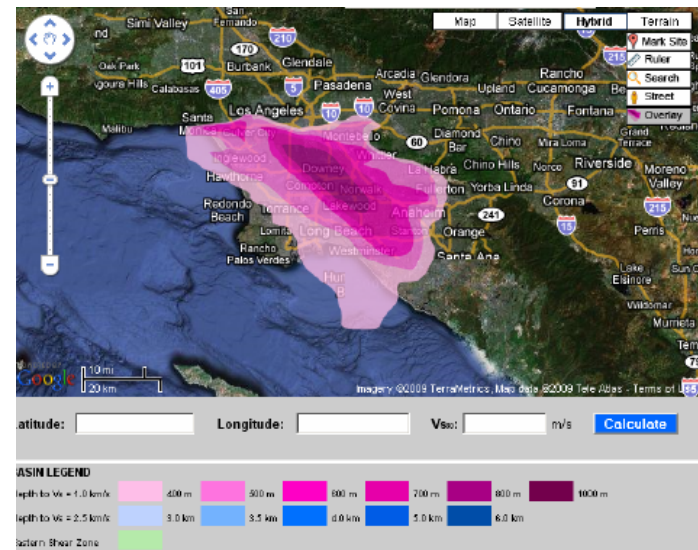
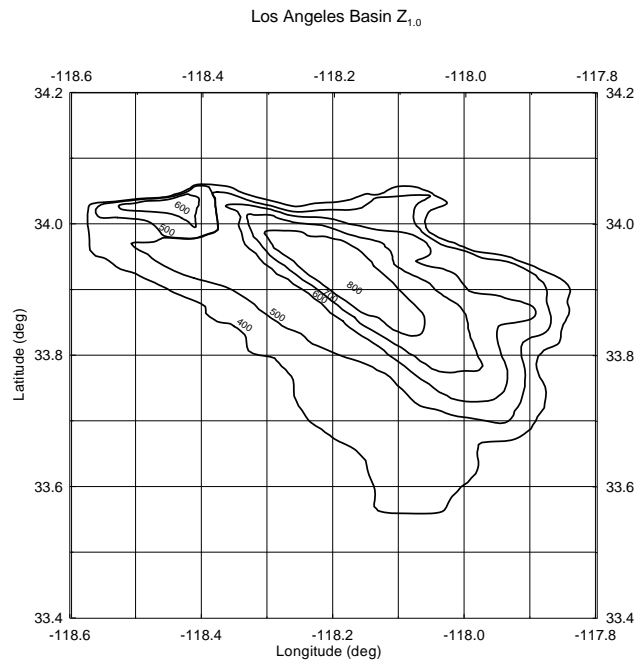
Spectrum adjustment factors...

Basin amplification factor



Spectrum adjustment factors...

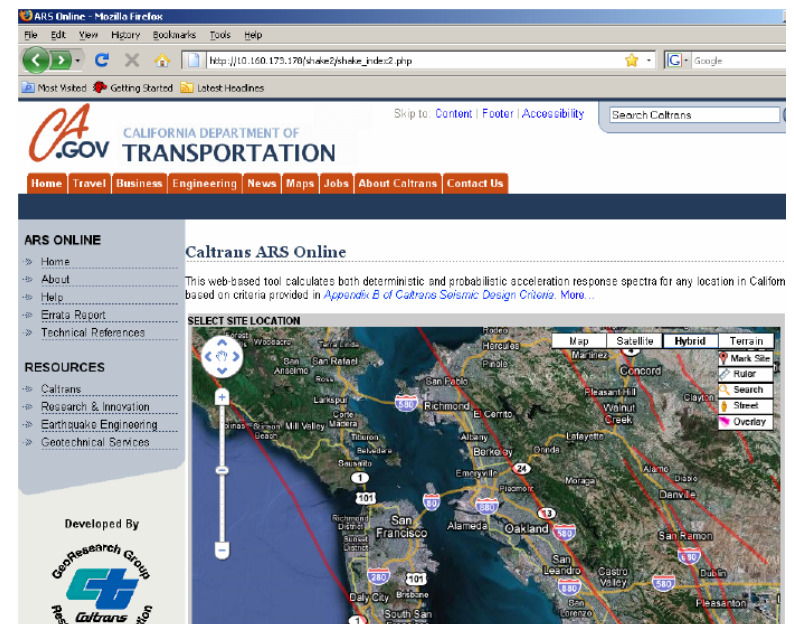
Where do you get $Z_{1.0}$ and $Z_{2.5}$?



New Design Tool...

Caltrans ARS Online

- Google Maps based
- Operates from a web browser
- No need for special software
- Publicly accessible



ARS - Online

SELECT SITE

CALCULATE

SITE DATA

Shear Wave Velocity, V_{s0} : 270 m/s

Latitude: 37.634

Longitude: -122.1

Fault ID: 354

Fault Name: Hayward fault zone (Southern Hayward section)

Maximum Magnitude (MMax): 7.3

Fault Type: RLSS

Fault Dip: 90 Deg

Dip: γ

Direction: γ

Top of Rupture Plane: 0 km

Bottom of Rupture Plane: 12 km

DETERMINISTIC

Hayward fault zone (Southern Hayward section)

Fault ID:	354
Maximum Magnitude (MMax):	7.3
Fault Type:	RLSS
Fault Dip:	90 Deg
Dip Direction:	γ
Bottom of Rupture Plane:	12.00 km
Top of Rupture Plane (Ztop):	0.00 km
Rrup:	3.84 km
Rjb:	3.84 km
Rx:	3.84 km
Fnorm:	0
Frev:	0

70m/s

Deterministic Spectrum

Southern Hayward section

10 years hazard (2008)

View Tabular Data

Envelope Only

Near Fault Adjustment

Axis Scale 2/0

Print

View

California Basins



ARS Online

Bridge locations are shown on the map (zoom level 5 or higher) with pop-up metadata

SELECT SITE LOCATION

The screenshot displays a Google Maps interface with a satellite view of a residential area. A yellow line representing a bridge is highlighted on the map. A pop-up window is open over the bridge, displaying the following metadata:

Bridge Name:	ORCHARD AVENUE UNDERPASS
Bridge Number:	33 0093
Dist-City:	04-ALA-092-126-HAY
Rta-PM:	
Structure:	2-span, Steel;
Type:	Stringer/Multi-beam or Girder
Owner:	State
HBI:	302
Classification:	
HAZUS:	HWB25

At the bottom of the interface, there are input fields for Latitude: 37.655937, Longitude: -122.0879005, and Vs: 360 m/s, along with a Calculate button.

ARS Online - Links

External users:

http://dap3.dot.ca.gov/shake_stable/

Caltrans users:

http://10.160.173.178/shake2/shake_index2.php



Thank You!

When does the new criteria take effect?

*Unofficially... bridges that reach type selection by
September 1 or later must use the new criteria*

Design Spectrum Recap...

Design spectrum =

**Max(det spec, prob spec₇₆₀ * soil amp) *
near-fault factor * basin factor**

where...

det spec = Max (Avg (CB, CY), M 6.5 at 12 km)