

# **HAZARD MAPS**

## **CEUS Workshop**

**May 9 – 10. 2006**

**Boston, MA**

**E. V. Leyendecker**

**U. S. Geological Survey / Emeritus**

# DESIGN MAPS

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- **BSSC Project 97 – USGS / FEMA**
  - Led to Recommendations for use of Design Ground Motion based on 2% PE in 50 yrs with deterministic constraints
- **Project 07 – USGS / FEMA**
  - Will review prior decisions and possibly lead to new or modified recommendations

# Project 97 Mission

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- Review all maps, including new USGS maps.
- Recommend what maps should be used in design practice, not what maps should be used by USGS.

# SEISMIC DESIGN PROCEDURE GROUP

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Ove Arup & Partners

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Degenkolb Engineers

Civil Engineering - University of Utah

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Consulting Structural Engineer

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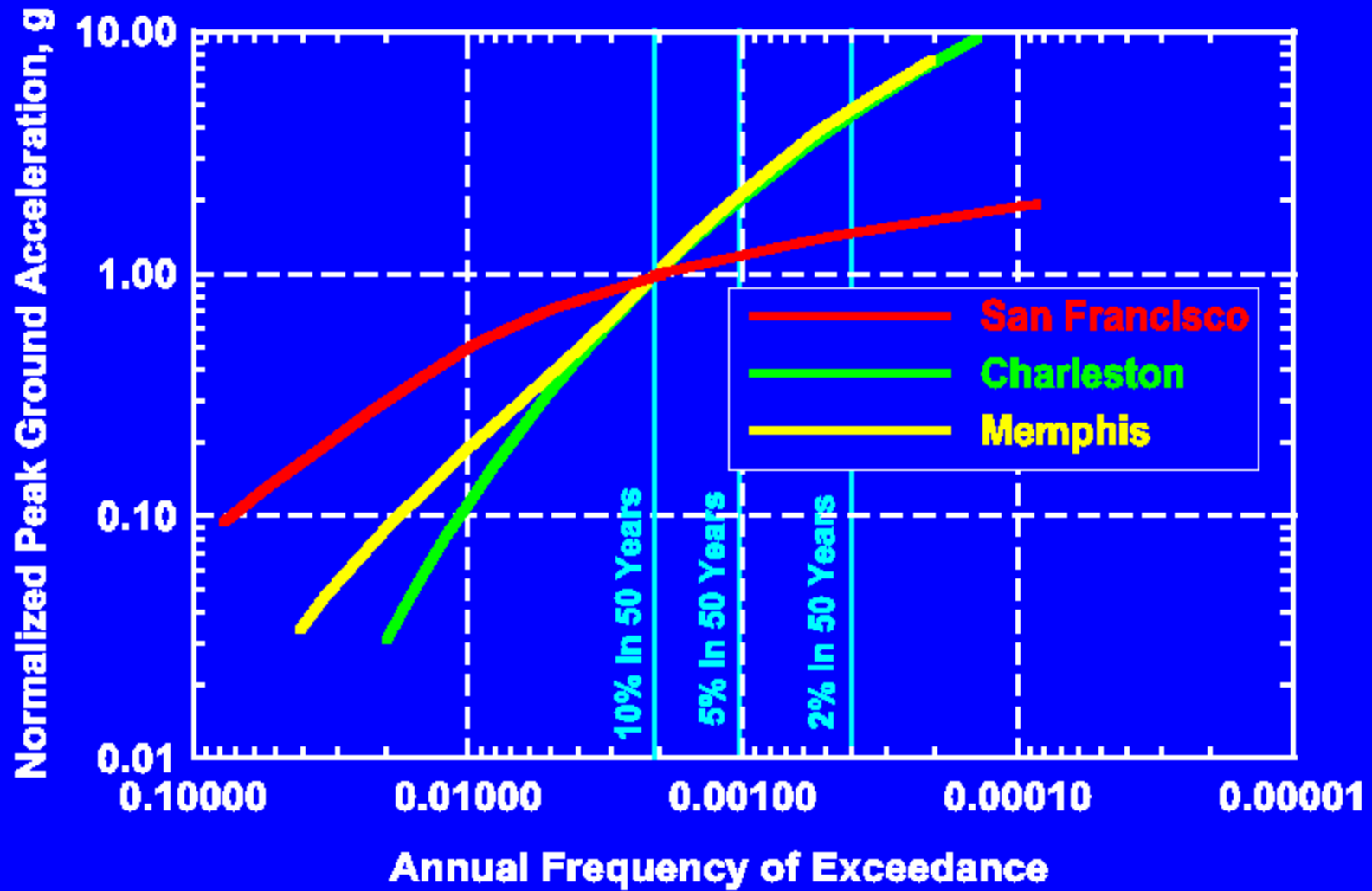
**WHY 2% P.E. IN 50  
YEARS?**

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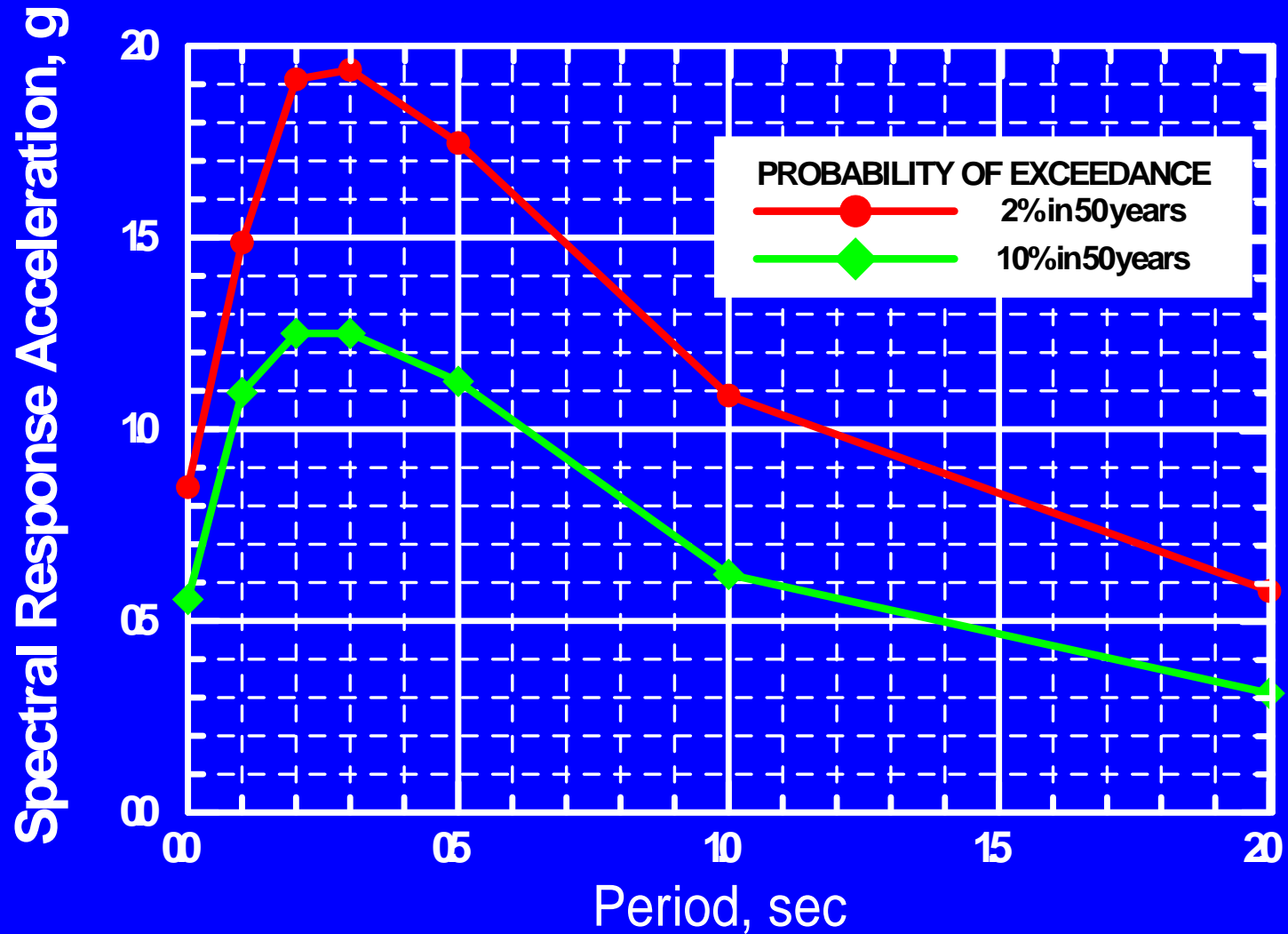
# PROBABILITIES CONSIDERED

- C 10% P.E. in 50 years
- C 5% P.E. in 50 years
- C 2% P.E. in 50 years

# NORMALIZED HAZARD CURVES FOR SELECTED CITIES



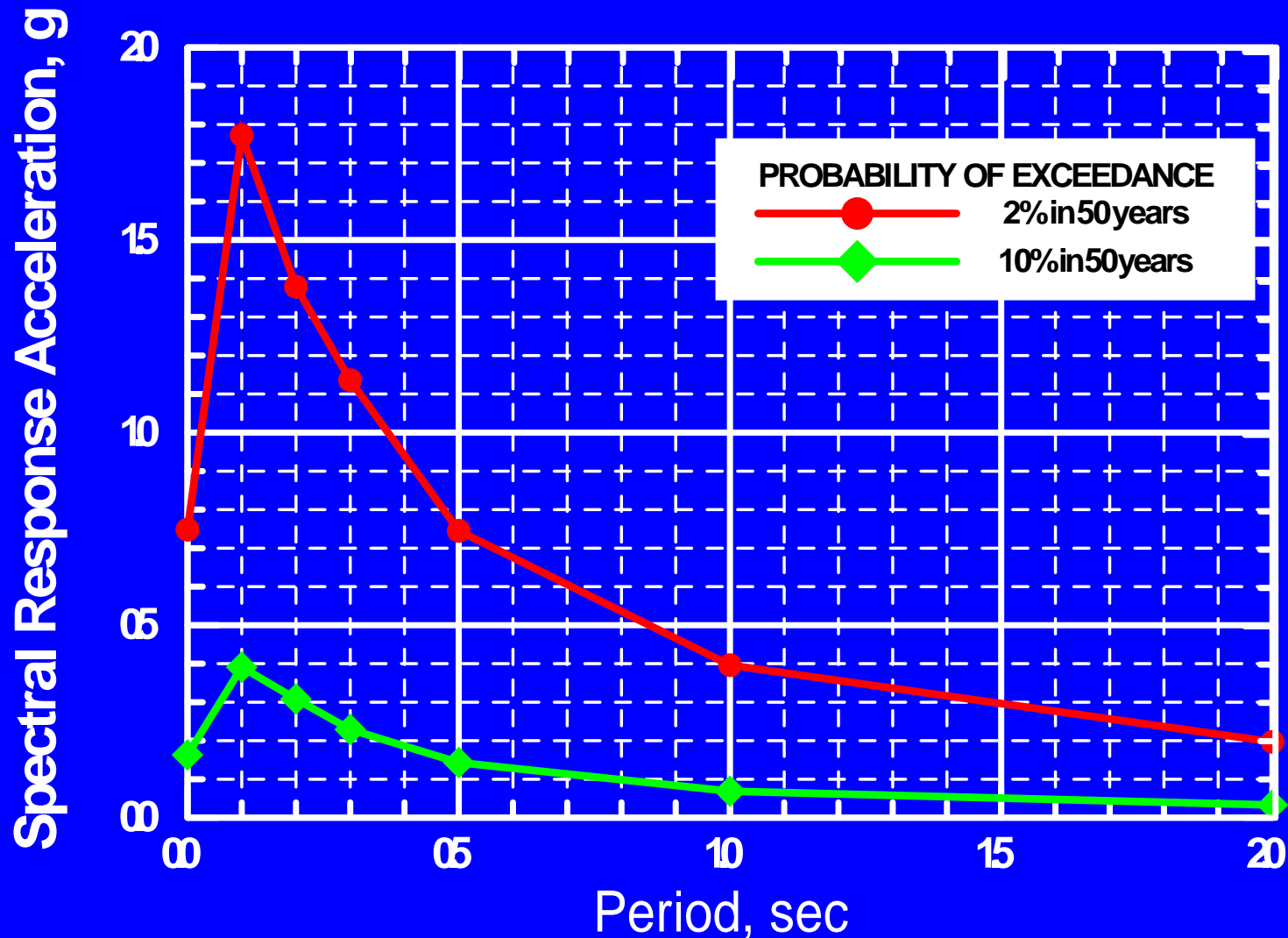
# UNIFORM HAZARD RESPONSE SPECTRA San Francisco, CA





# UNIFORM HAZARD RESPONSE SPECTRA

## Charleston, SC



# DESIGN GOAL

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**Resistance  $\geq$  Applied Loads**

**Resistance and Loads Must be  
Compatible**

# Where did 2/3 come from?

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**COLLAPSE RESISTANCE  $\geq$  COLLAPSE LOAD**

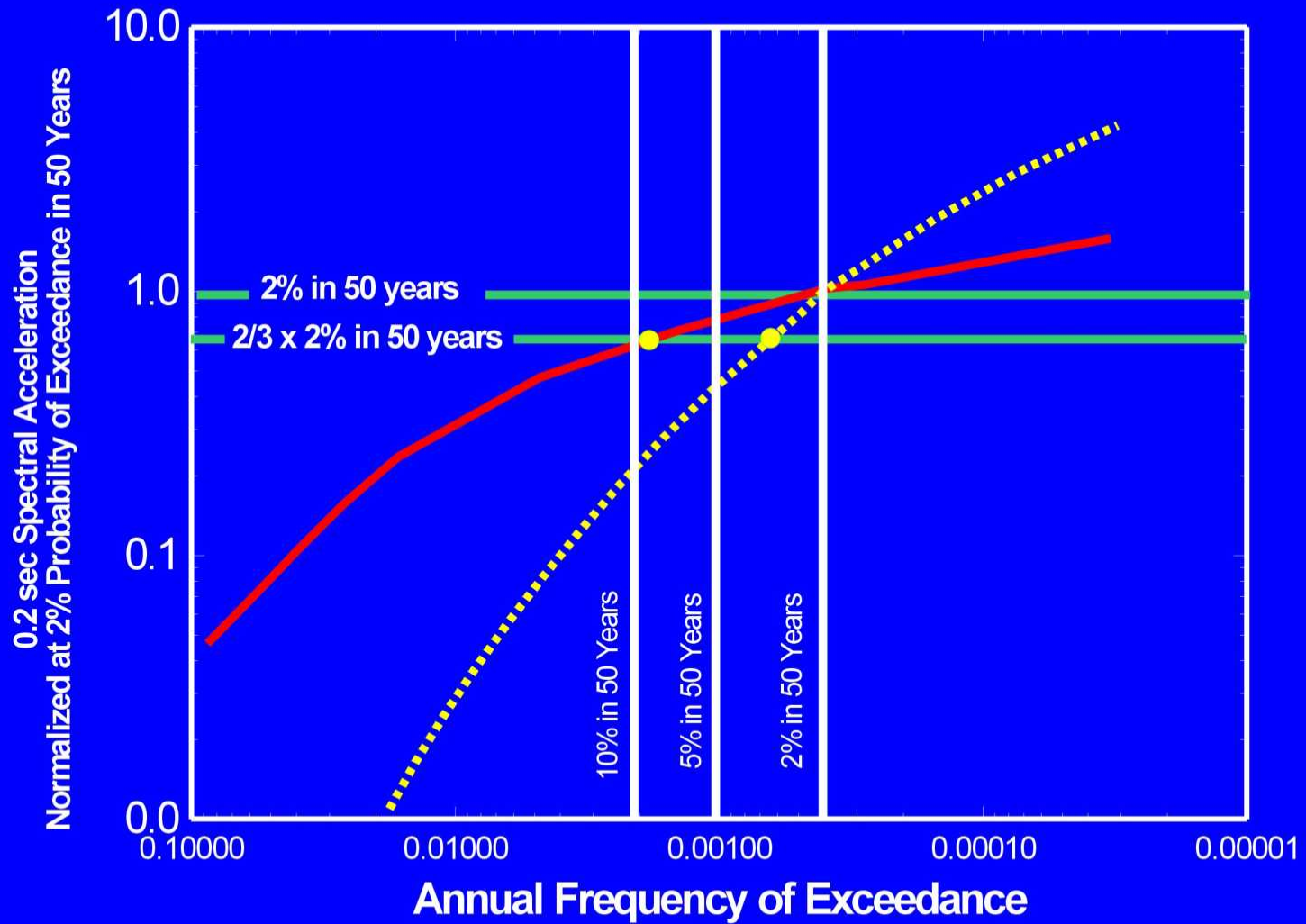
**Collapse Resistance  $\geq$  1.5 x Typical Code Resistance**

**Collapse Load = 2% PE in 50 yrs GM**

**1.5 x Typical Code Resistance  $\geq$  2% PE in 50 yrs GM**

**Typical Code Resistance  $\geq$  2/3 x (2% PE in 50 yrs GM)**

# Effect of Multiplying by 2/3

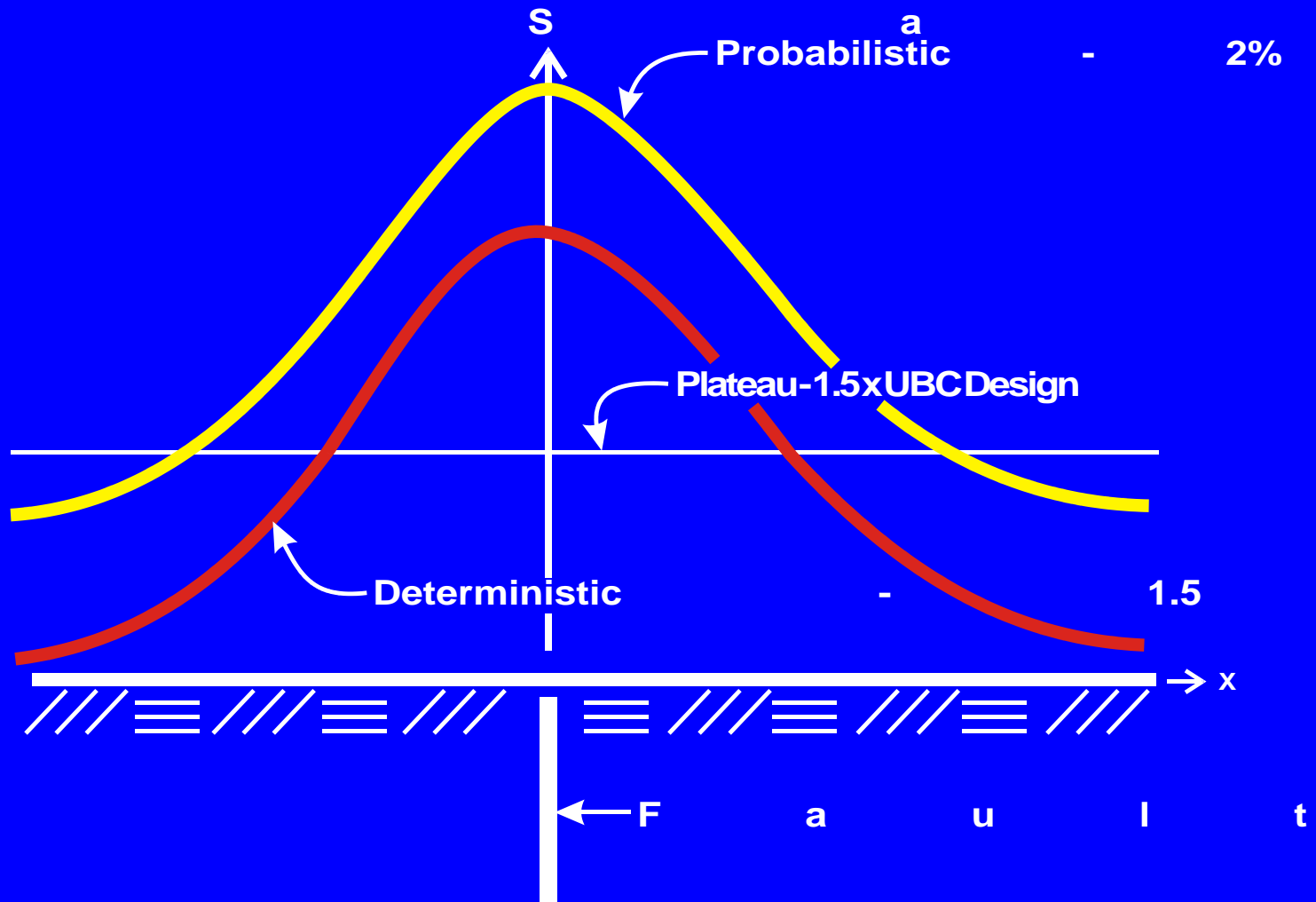


# CONSTRAINTS

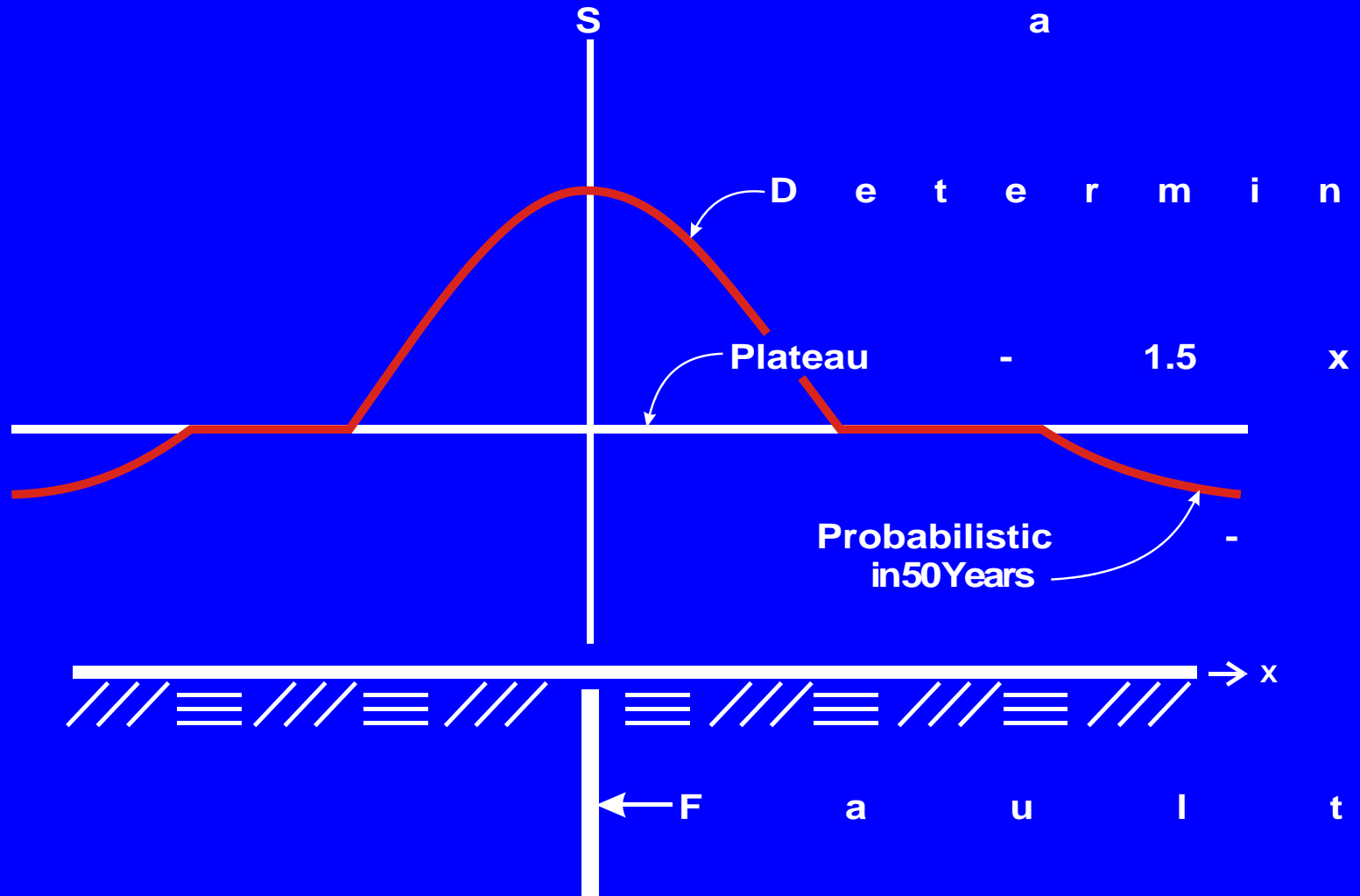
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- C** Near well-defined faults transition from probabilistic ground motion (GM) to deterministic GM
- C** Use the median GM times 1.5 (intended to approximate one sigma) as the deterministic GM for the maps

# Near-Fault Criteria



# Near-Fault MCE

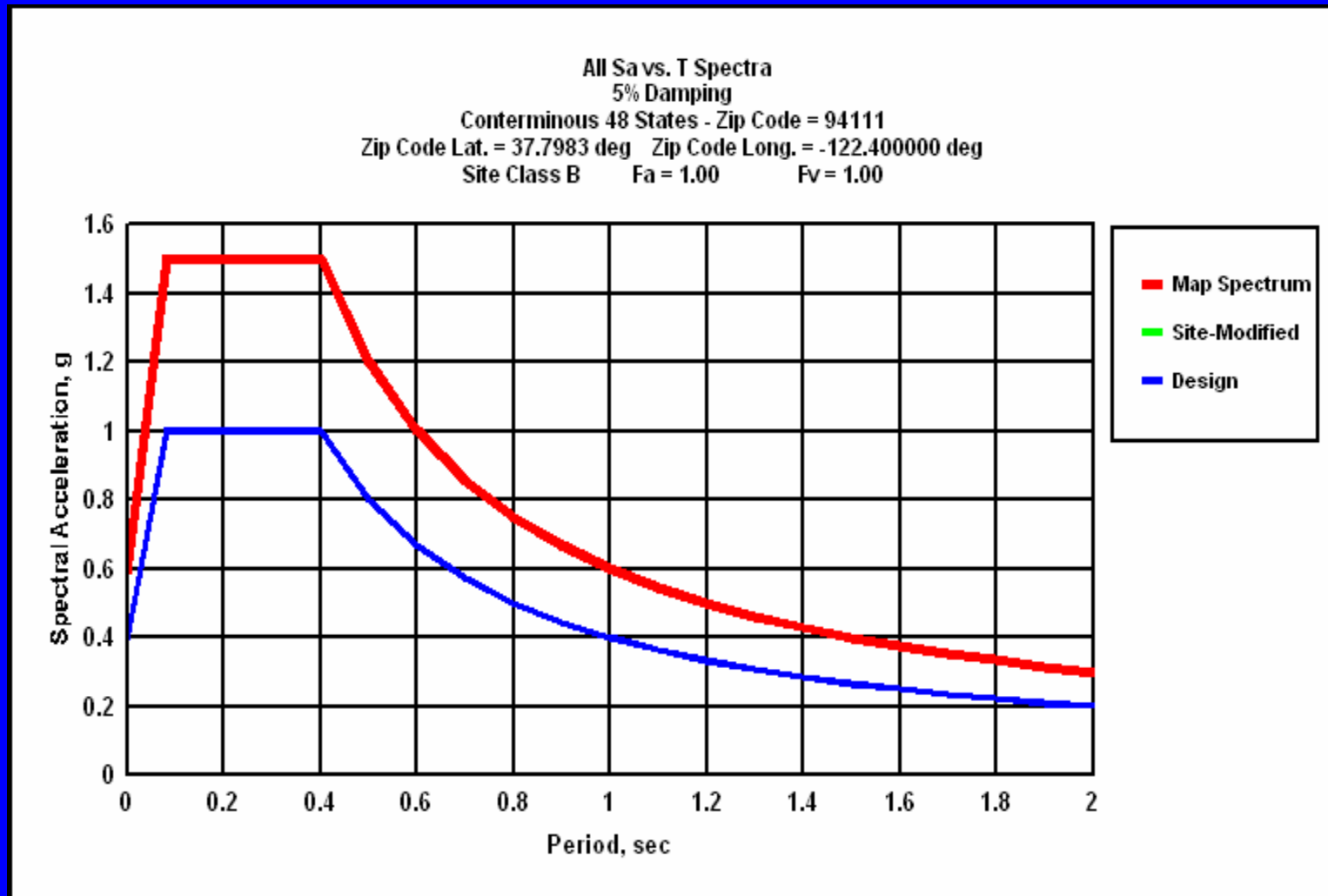




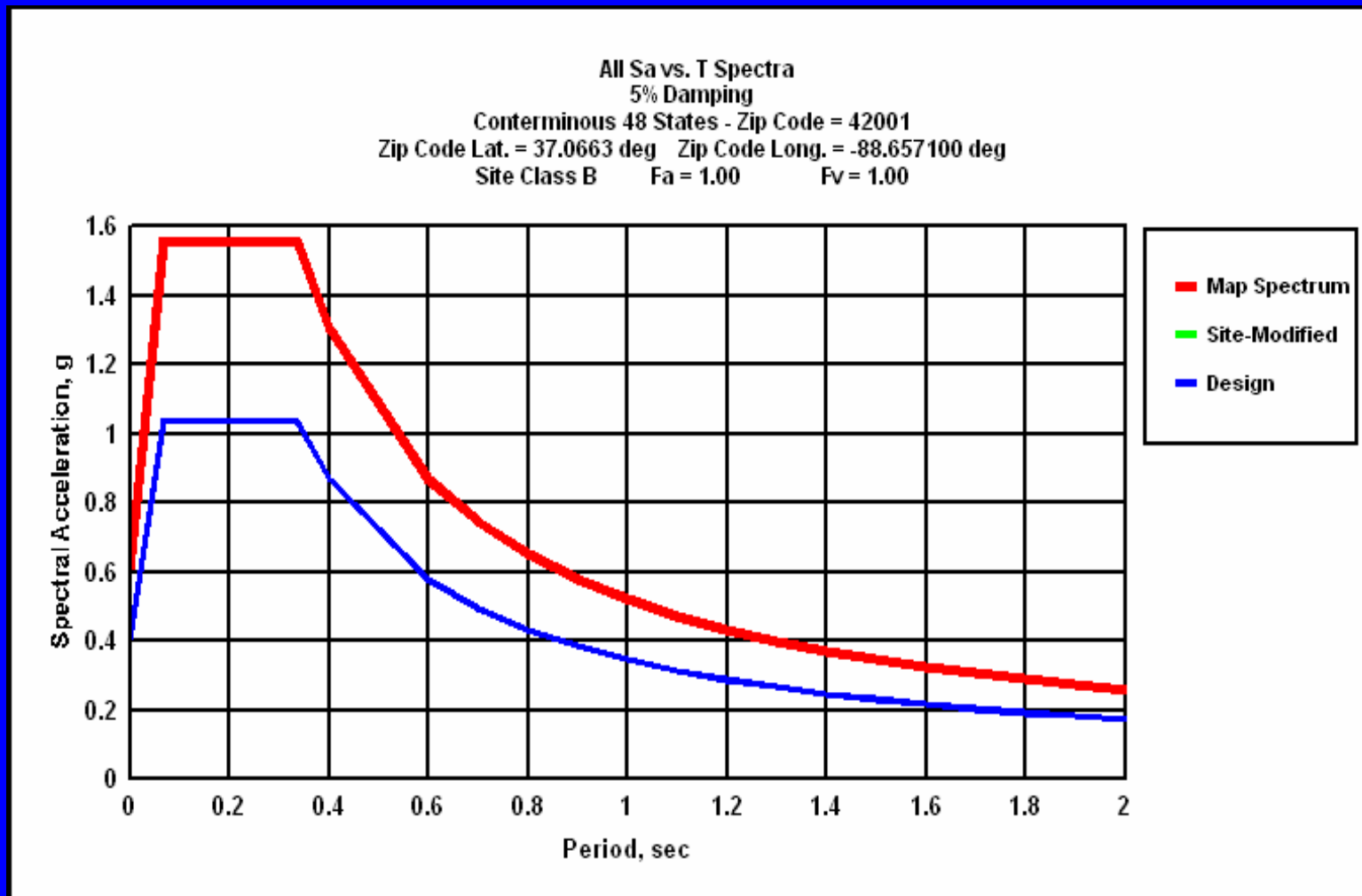
0.2 sec



# San Francisco

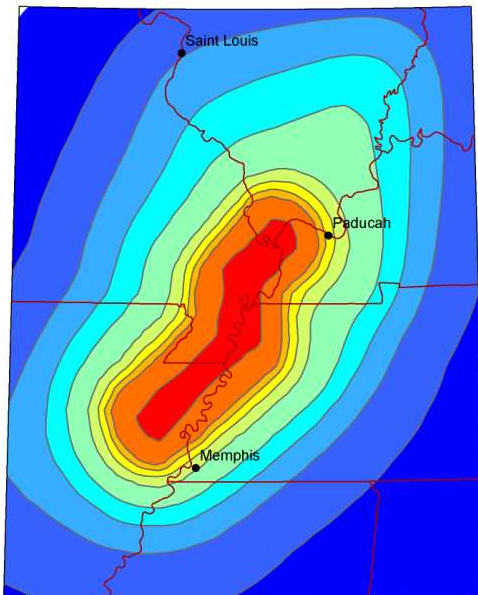


# Paducah

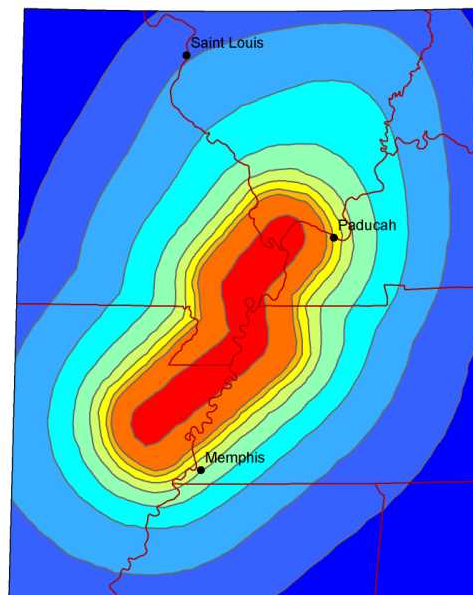


# Spectral response acceleration for 0.2 sec spectral ordinate

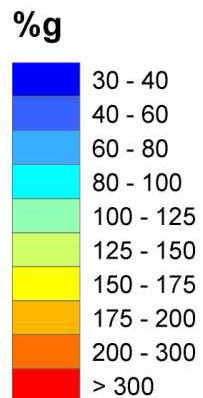
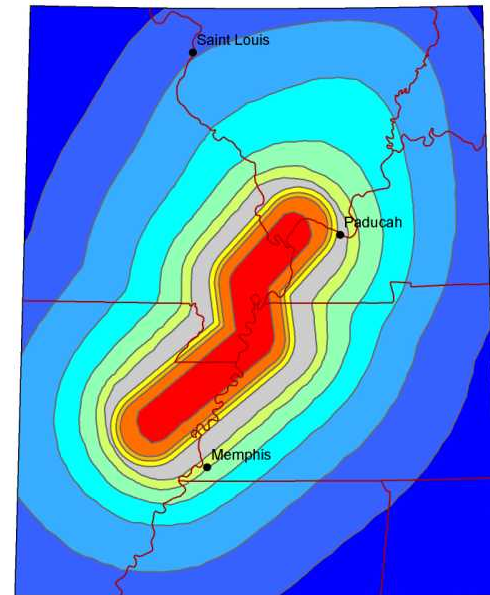
## Maximum Considered Earthquake Ground Motion 1996



## 2% probability of exceedance in 50 years Ground Motion - 2003



## Maximum Considered Earthquake Ground Motion 2003

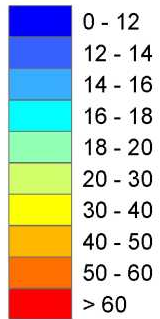


constant value 150% g

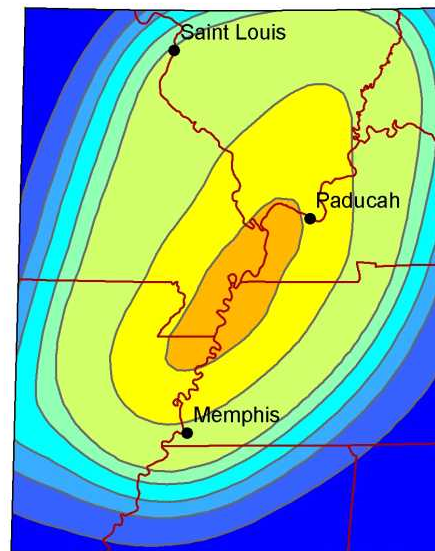


## Spectral response acceleration for 0.2 sec spectral ordinate

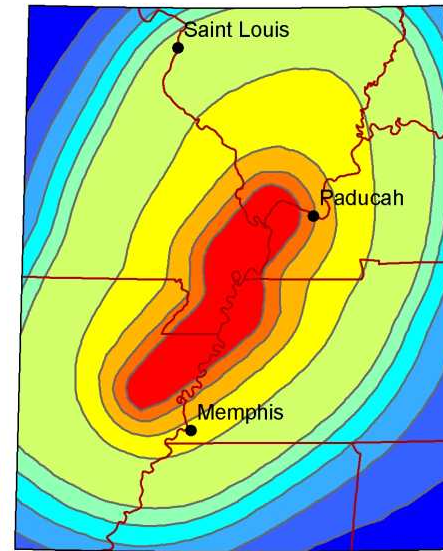
%g



10% Probability of Exceedance in 50 years  
Ground Motion - 1996



10% Probability of Exceedance in 50 years  
Ground Motion - 2002



0 45 90 180 270 360 Kilometers

# Memphis/Shelby County Building Code

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- C** IBC 2003 with 1996 10%/50 year maps for normal buildings.
- C** Or IBC 2003 with Standard Building Code ground motions.

# Comparison of Short Period $S_{DS}$

Code	Memphis City Hall
Deterministic - Median	0.60g
SBC ( $2.5 A_a$ – early 1970 data)	0.50g
IBC 2003	0.92g
IBC 2006	0.93g
1996 10%/50	0.25g
2002 10%/50	0.35g

# Codes and Standards



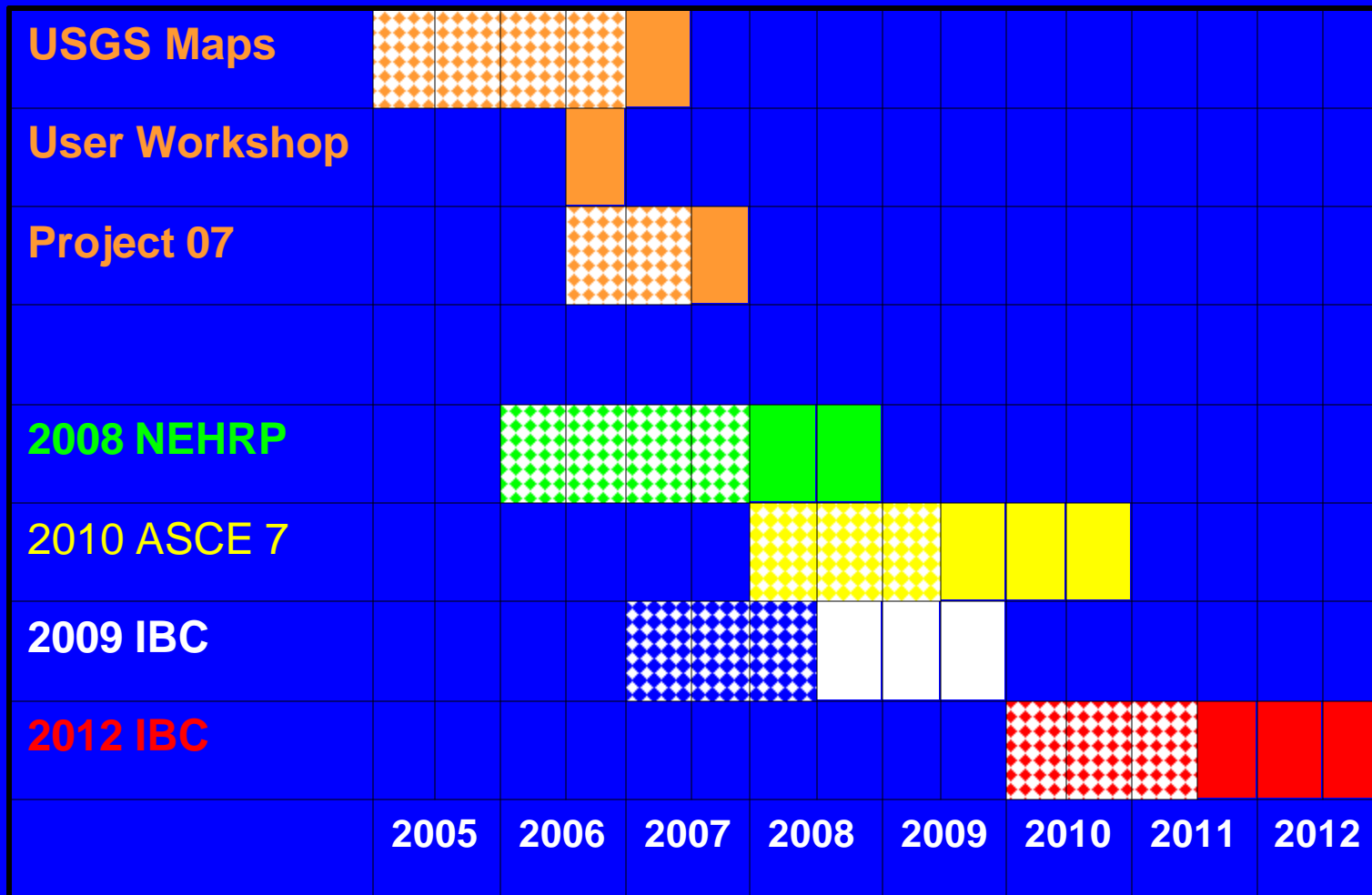
**NEHRP Recommended  
Seismic Design Provisions**

**ASCE 7 Minimum  
Design Loads**



**IBC – International  
Building Code**

# Codes and Standards Schedule





# PROJECT 007 – License to Build

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- **First Meeting will be this summer – Set objectives, etc**
- **One conclusion could be no changes from Project 97**
- **Site conditions**
- **Constant Risk**
- **No foregone conclusions**

# GROUND MOTION TOOL

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[http://earthquake.usgs.gov/  
research/hazmaps/](http://earthquake.usgs.gov/research/hazmaps/)



## SEISMIC DESIGN VALUES FOR BUILDINGS

Ss and S1, Hazard Curves, Uniform Hazard Spectra, and Residential Design Category