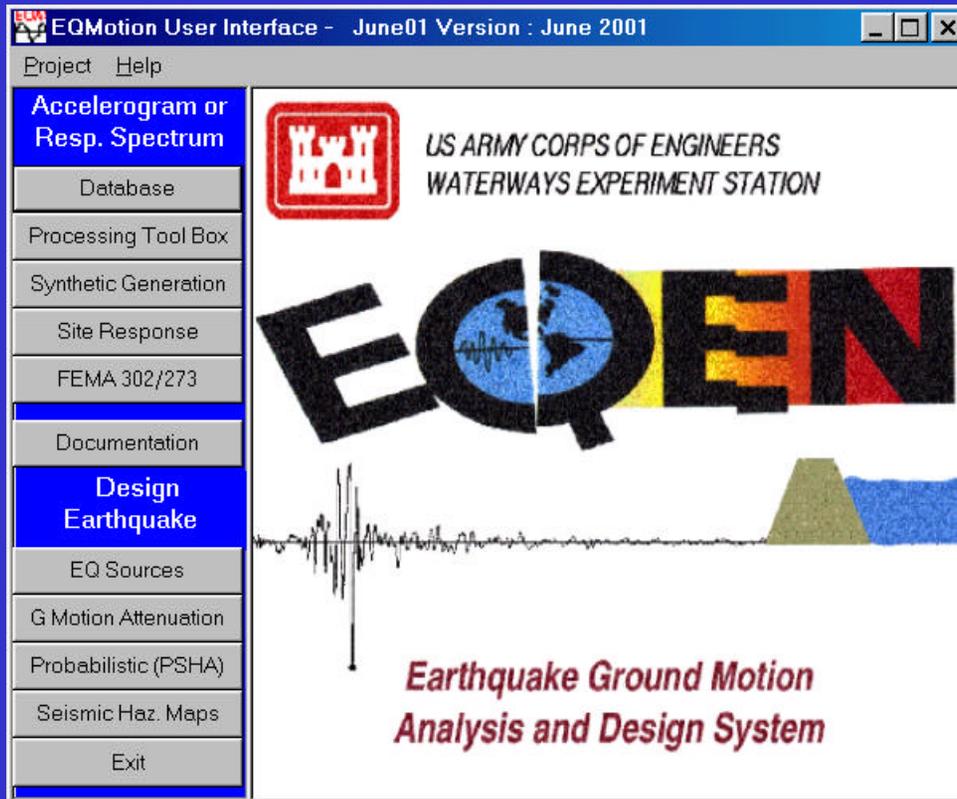


Project Investigators

Don Yule
Raju Kala



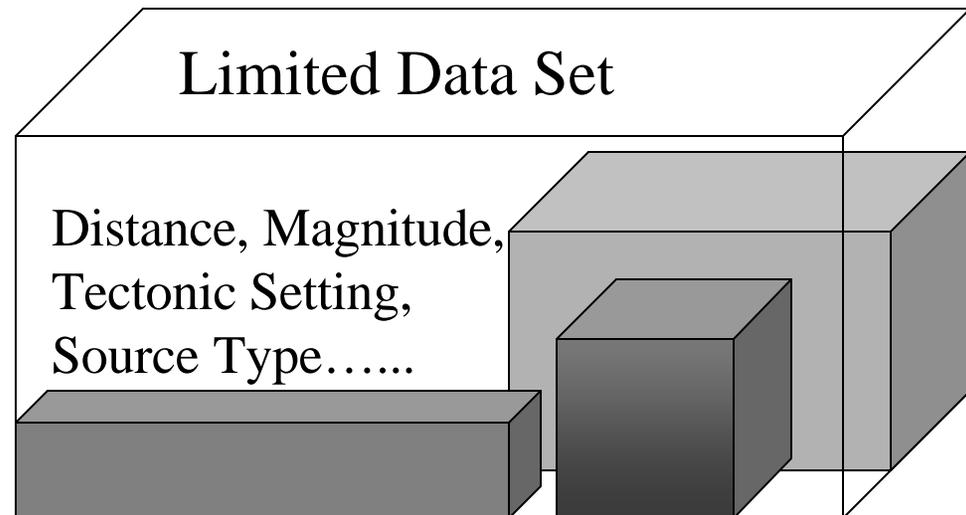
Earthquake Engineering Research Program
Field Review Group Meeting
June 2001

Problem

- Needs**
- Tools to assist Seismic Safety Evaluations and develop site specific design earthquakes**
 - Implement Corps regulations and design practices**
 - Maintain Corps corporate knowledge**
- Scope**
- Design earthquakes - 3 Levels**
MCE-MDE-OBE
 - National infrastructure –**
Western and CEUS Tectonic settings

Problem

Uncertainty
Uncertainty



Rely on Empirical Correlation and Analogous Data
All Existing and New Data Needs To Be Used

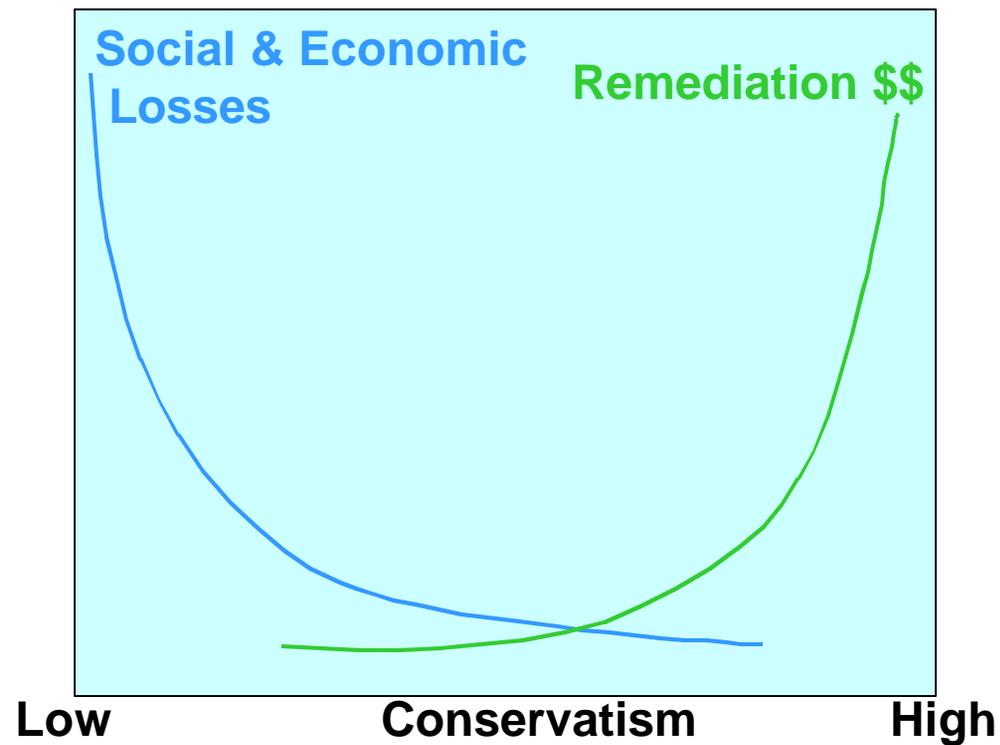
Engineering Seismology *Still* Advancing

And Expedient

Advanced Analysis Needs

PROBLEM

As Owners of Large and Critical Structures



Need Best Estimates of Seismic Hazards and Level of Conservatism



APPROACH

Review and adopt relevant new developments

Access to integrated and current:

Data (data driven process)

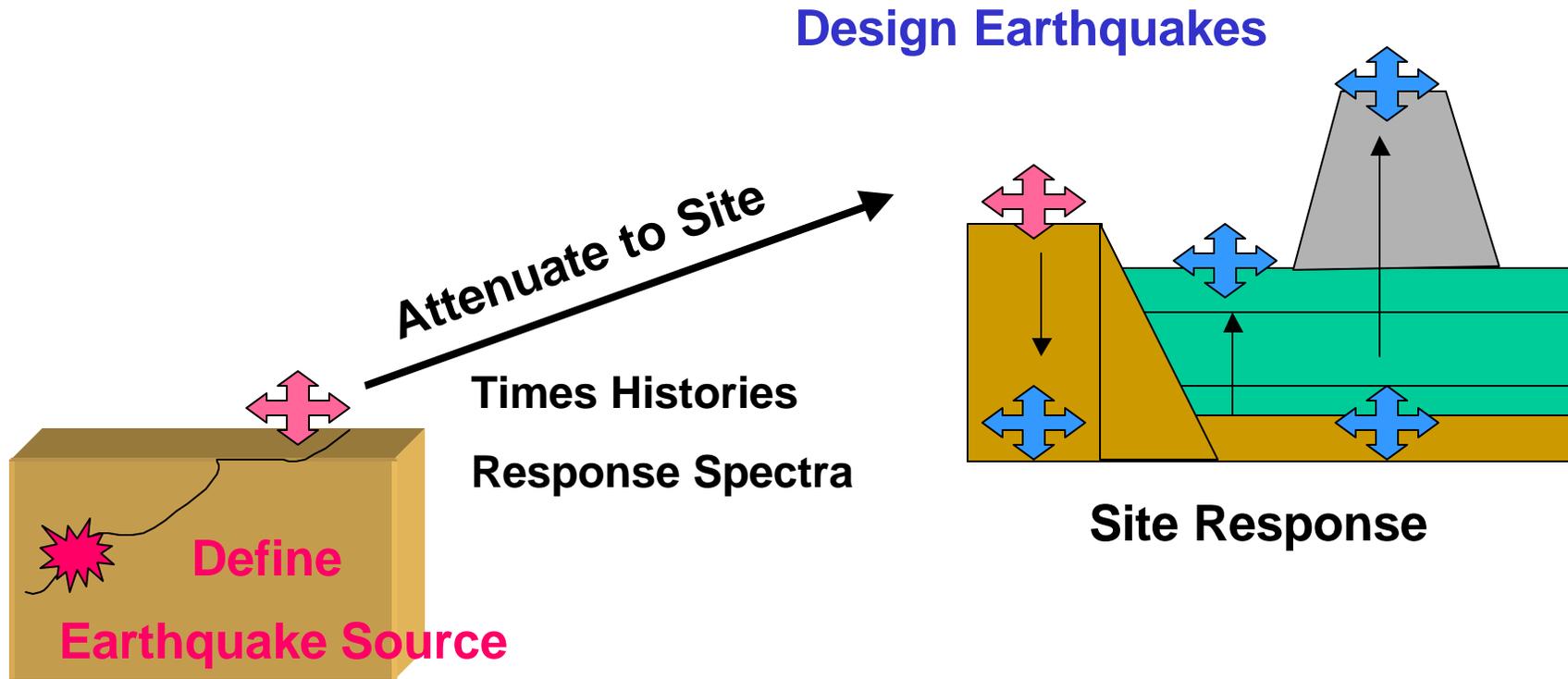
Procedures & relationships

Numerical tools

ER, EM's

Technical Objectives

To Determine Site Seismic Hazard



System Objectives

Modular Design

Maintainable

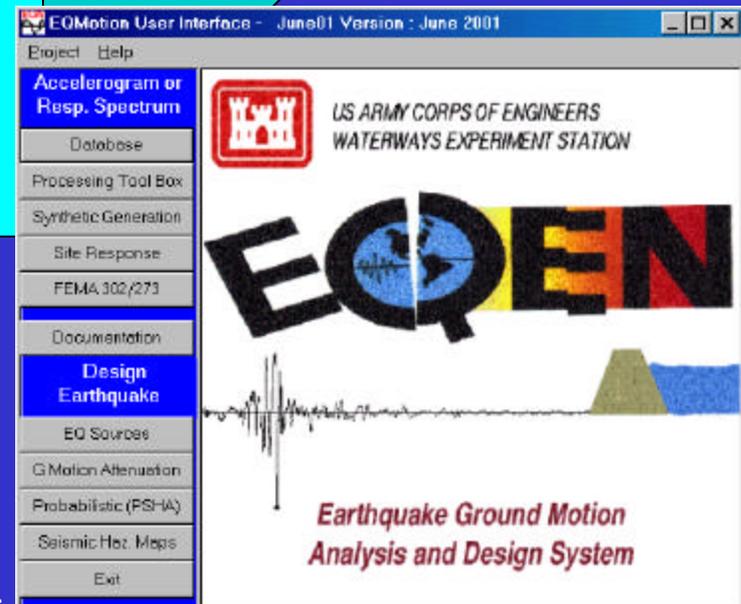
Integrated Procedures and Tools

Implement Policy

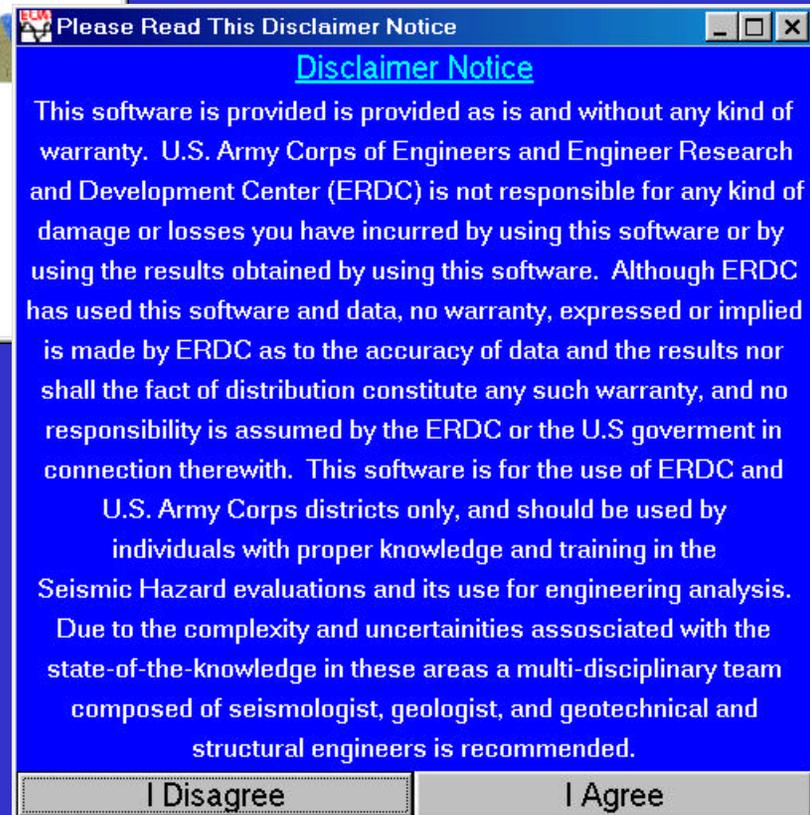
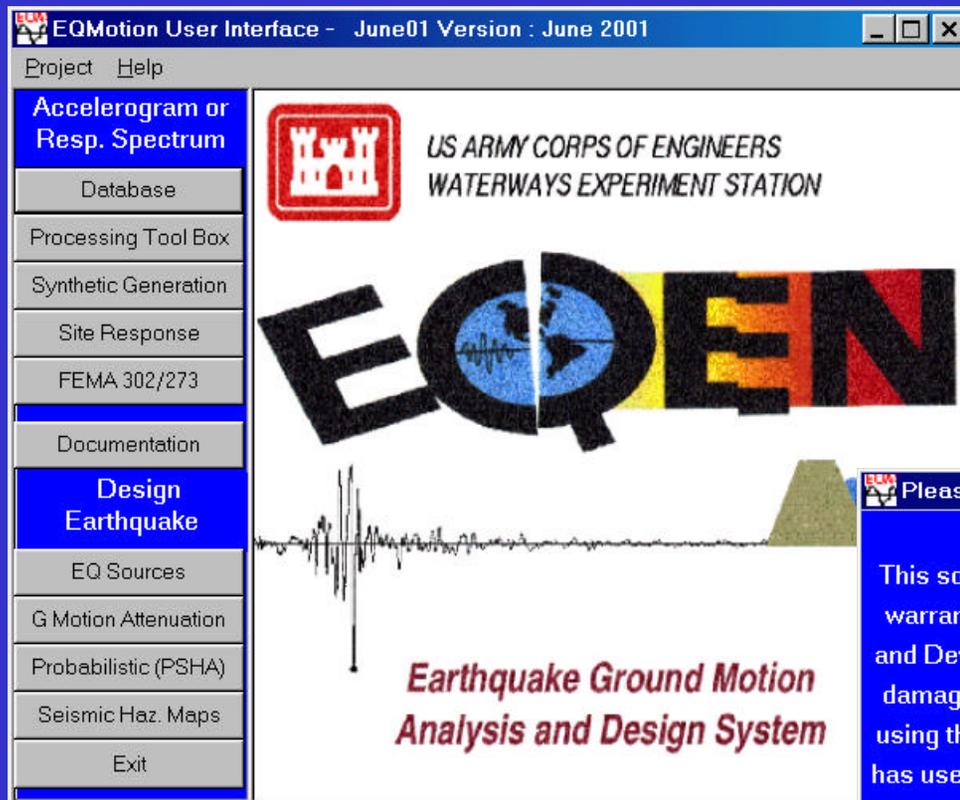
Support Engineering Studies and R&D

Training

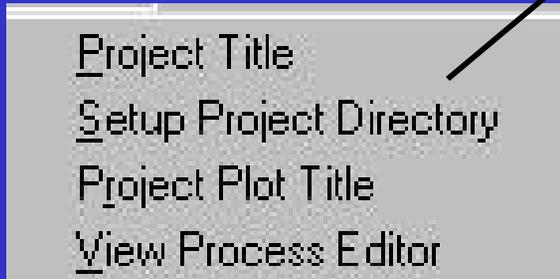
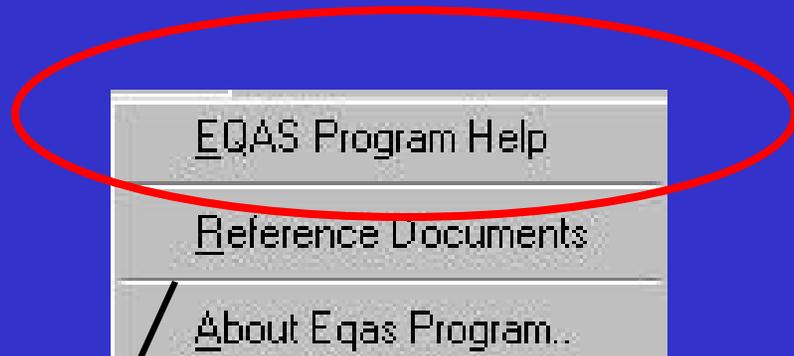
Technology Transfer



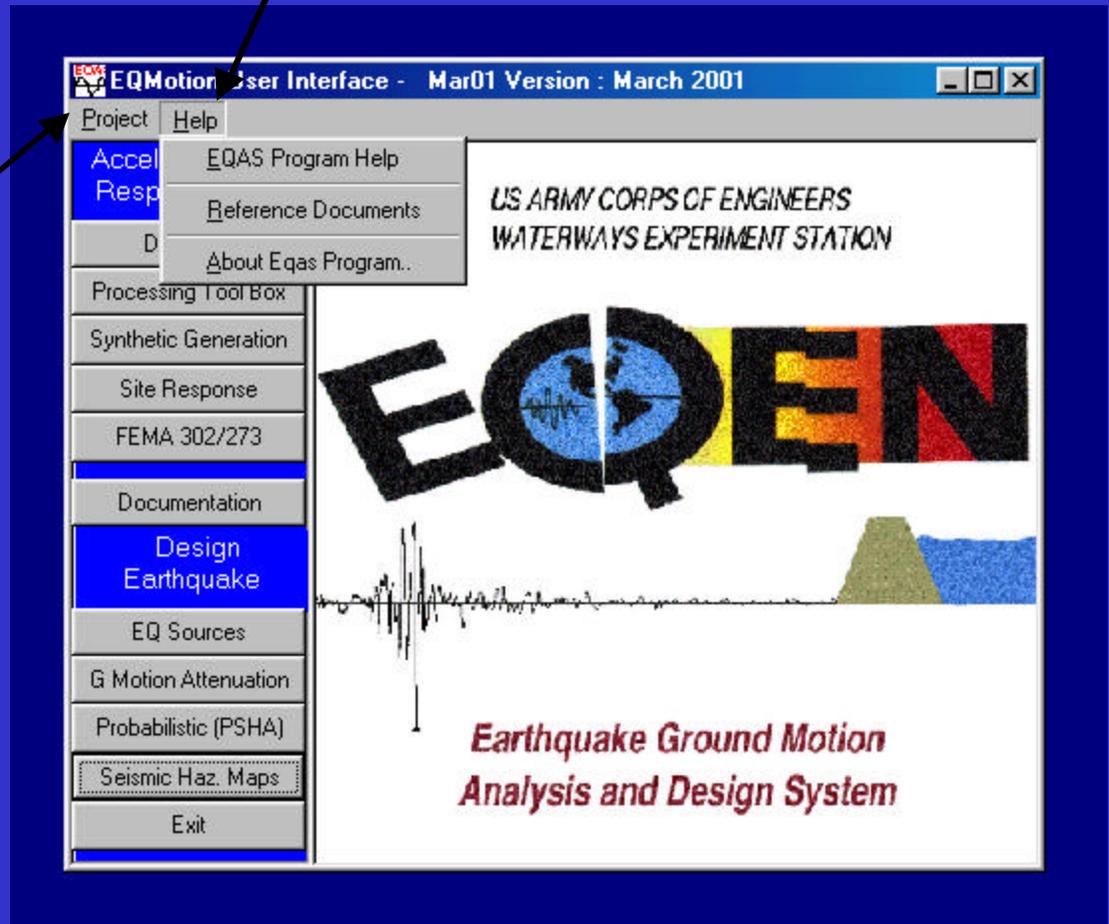
 **The System**



Program Documentation



User Aids



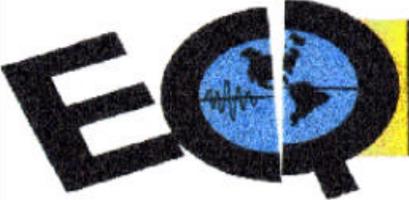
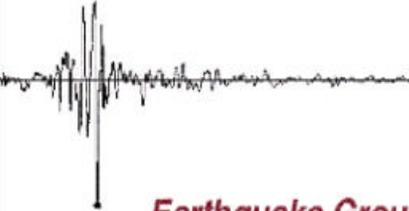
EQMotion User Interface - June01 Version : June 2001

Project Help

- Accelerogram or Resp. Spectrum
- Database
- Processing Tool Box
- Synthetic Generation
- Site Response
- FEMA 302/273
- Documentation
- Design Earthquake**
- EQ Sources
- G Motion Attenuation
- Probabilistic (PSHA)
- Seismic Haz. Maps
- Exit



US ARMY CORPS OF ENGINEERS
WATERWAYS EXPERIMENT STATION

**Earthquake Ground
Analysis and Design**

Acrobat Reader - [ER1806.pdf]

File Edit Document View Window Help

CECW-ED
CECW-EG

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

ER 1110-2-1806

Regulation
No. 1110-2-1806

31 July 1995

**Engineering and Design
EARTHQUAKE DESIGN AND EVALUATION FOR CIVIL WORKS PROJECTS**

1. Purpose

This regulation provides guidance and direction for the seismic design and evaluation for all civil works projects.

2. Applicability

This regulation is applicable to all HQUSACE elements and USACE commands having responsibilities for the planning, design, and construction of civil works

3. Policy

The seismic design for new projects and the seismic evaluation or reevaluation for existing projects should be

of confidence in the final conclusions. Survival of operating equipment and utility lines is as essential as survival of the structural and geotechnical features of the project. When justifying circumstances exist, requests for departures from this policy should be submitted by the District Commander through the Division Commander to HQUSACE (CECW-E).

5. General Provisions

a. Project hazard potential. The classification in Appendix B is related to the consequences of project failure. Critical features are the engineering structures, natural site conditions, or operating equipment and utilities at high hazard projects whose failure during or immediately following an earthquake could result in loss of life. Such a catastrophic loss of life could result directly from failure or indirectly from flooding damage to a lifeline facility, or could pose an irreversible threat to human life due to release or inundation of hazardous, toxic, or radioactive materials. Project hazard potential should consider the population at risk, the downstream flood wave depth and velocity, and the probability of

129% 2 of 26 8.5 x 11 in

Integrated Engineering Regulations and Manuals

Determine Probabilistic Site Seismic Hazard



US ARMY CORPS OF ENGINEERS
WATERWAYS EXPERIMENT STATION

Accelerogram or
Resp. Spectrum

Database

Processing Tool Box

Synthetic Generation

Hazard Map

Site R

HazmapsForm

FEMA

National Seismic Hazard Mapping Project

USGS - 1996

(15 NOV1996)

Site Location

Docum

D

Earth

EQ S

G Motion

Probabili

Seismic

National

California and Nevada

Central and Eastern United States

Alaska

Peak or Spectral Acceleration

PGA 0.2 0.3 1.0 All

Probability of Exceedence in 50 years

10 % 5 % 2 % All

View

Document

Figures

Tables

Site Query (Lat-Long in Decimal Degrees)

Longitude

Latitude

Process Query

Seis. Haz. Curve

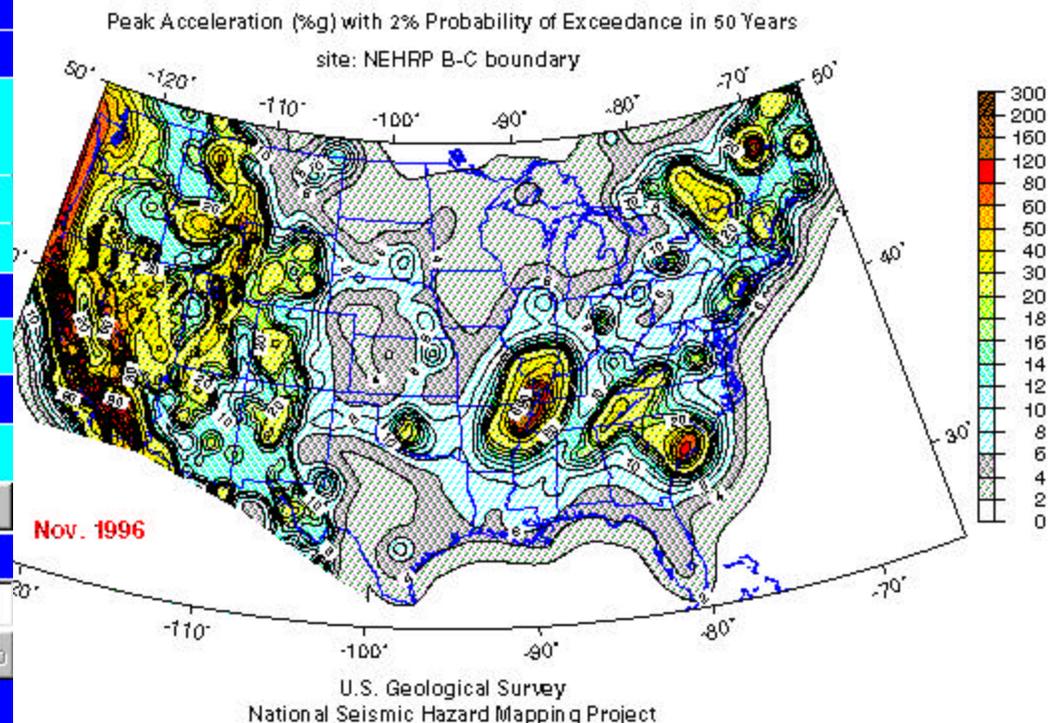
Eq. Haz. Res. Sp

Query Info

Displayed Here

Cancel

Done



- Project Help
- Accelerogram or Resp. Spectrum
 - Database
 - Processing Tool Box
 - Synthetic Generation
 - Site Response
 - FEMA 302/273
 - Documentation
- Design Earthquake**
 - EQ Sources
 - G Motion Attenuation
 - Probabilistic (PSHA)
 - Seismic Haz. Maps
 - Exit



Probabilistic Seismic Hazard Curve

File Edit Print Parameters

Peak Ground Acceleration and Spectral Acceleration

Acceleration (g's) Vs. Frequency of Exceedence (or) Return Period (Yrs)

Project

Query NEHRP National Data Set

Site Title (Max = 25) Project

Longitude (125W - 65W) 120

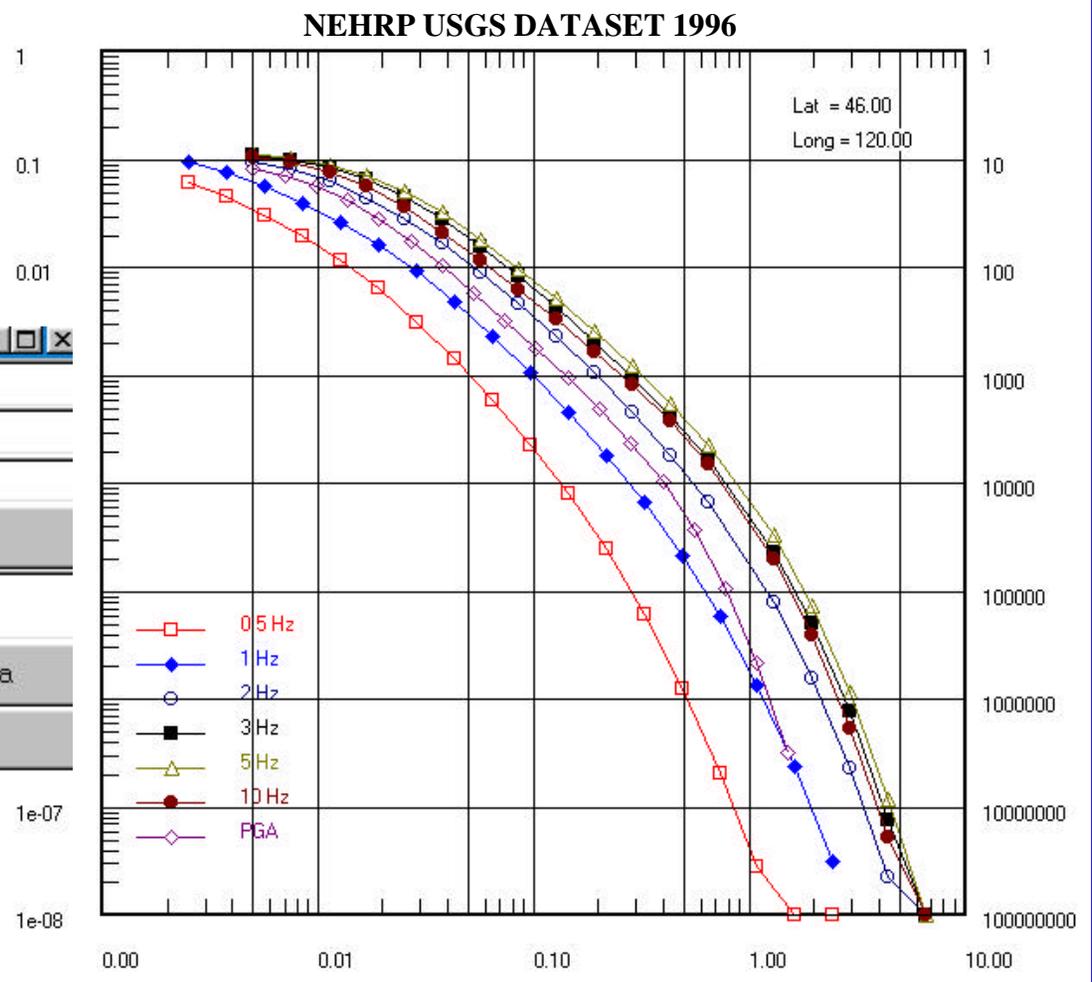
Latitude (50 to 24.6) 46

Plot Seismic Hazard Curve

Return Period (10 - 1000000 Yrs) 144

Plot Equal Hazard Response Spectra

Cancel Done



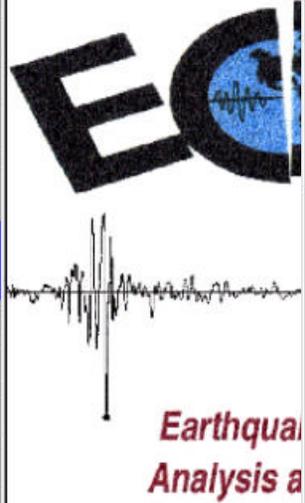
Site Probabilistic Seismic Hazard Curves

EQMotion User Interface - June01 Version : June 2001

- Project Help
- Accelerogram or Resp. Spectrum
- Database
- Processing Tool Box
- Synthetic Generation
- Site Response
- FEMA 302/273
- Documentation
- Design Earthquake**
- EQ Sources
- G Motion Attenuation
- Probabilistic (PSHA)
- Seismic Haz. Maps
- Exit

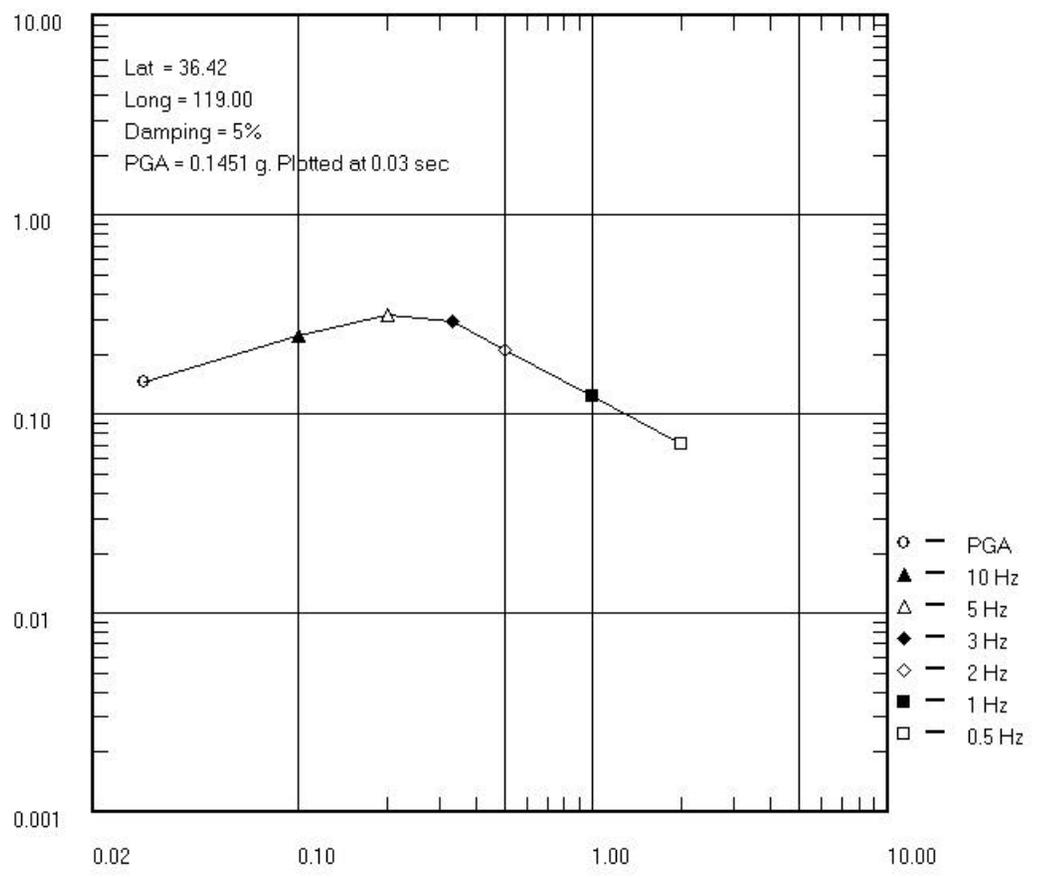


US ARMY CORPS OF ENGINEERS
WATERWAYS EXPERIMENT STATION



Equal Hazard Response Spectra

Terminus Dam
Period (sec) Vs. Acceleration (g's)
Return Period = 1000 Yrs



Query NEHRP National Data Set

Site Title (Max = 25)	Terminus Dam
Longitude (125W - 65W)	119.0
Latitude (50 to 24.6)	36.42
Plot Seismic Hazard Curve	
Return Period (10 - 1000000 Yrs)	1000
Plot Equal Hazard Response Spectra	
Cancel	Done

Query Dam for Disaggregation Data

Project About Help

Accelerogram or Resp. Spectrum

Database

Processing Tool Box

Synthetic Generation

Site Response

Help

Documentation

Design Earthquake

USA ADIAC CORP OF ENGINEERS

Deagg Query Form

Longitude	99.14
Latitude	33.76
Return Period	144 Yrs
Frequency	PGA
Show Example	Query

LAKE KEMP

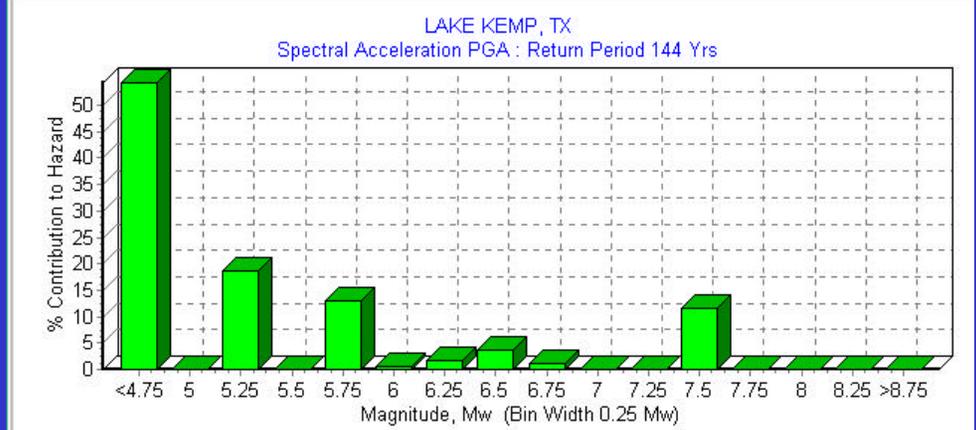
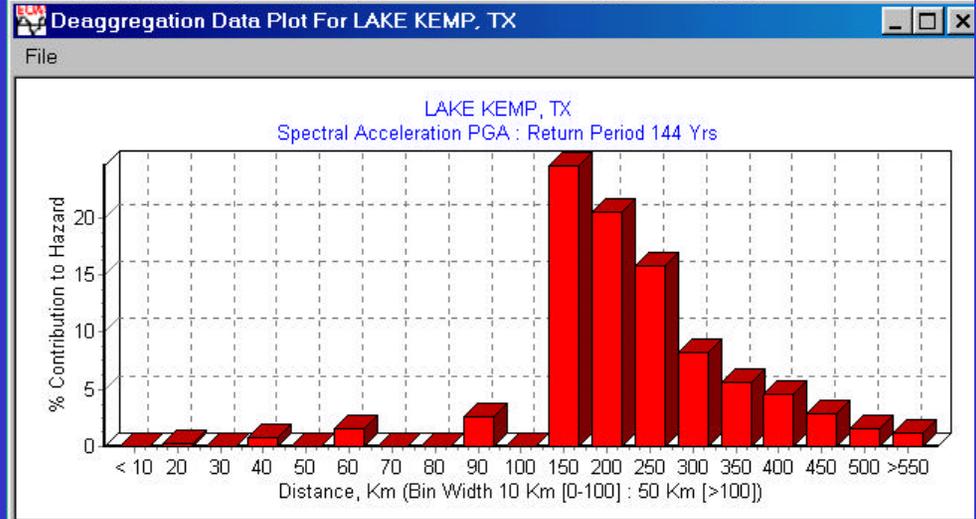
LAKEK_TX

Map Coordinates

LAKE KEMP Lat = 33.76 Long = 99.14

OK

Find Dam location by clicking on the map



EQ Source Charecterization

Earthquake Sources	Fault Relationships
<input checked="" type="radio"/> US Crustal Faults	<input type="radio"/> Mo from Fault Slip & Type
<input type="radio"/> CEUS Seismic Zones	<input type="radio"/> Mo from Avg. & Max. Disp
<input type="radio"/> Cascadia Subduction Zone	<input type="radio"/>
Cancel	Continue

EQMotion User Interface - June01 Version : June 2001

Project Help

Accelerogram or Resp. Spectrum

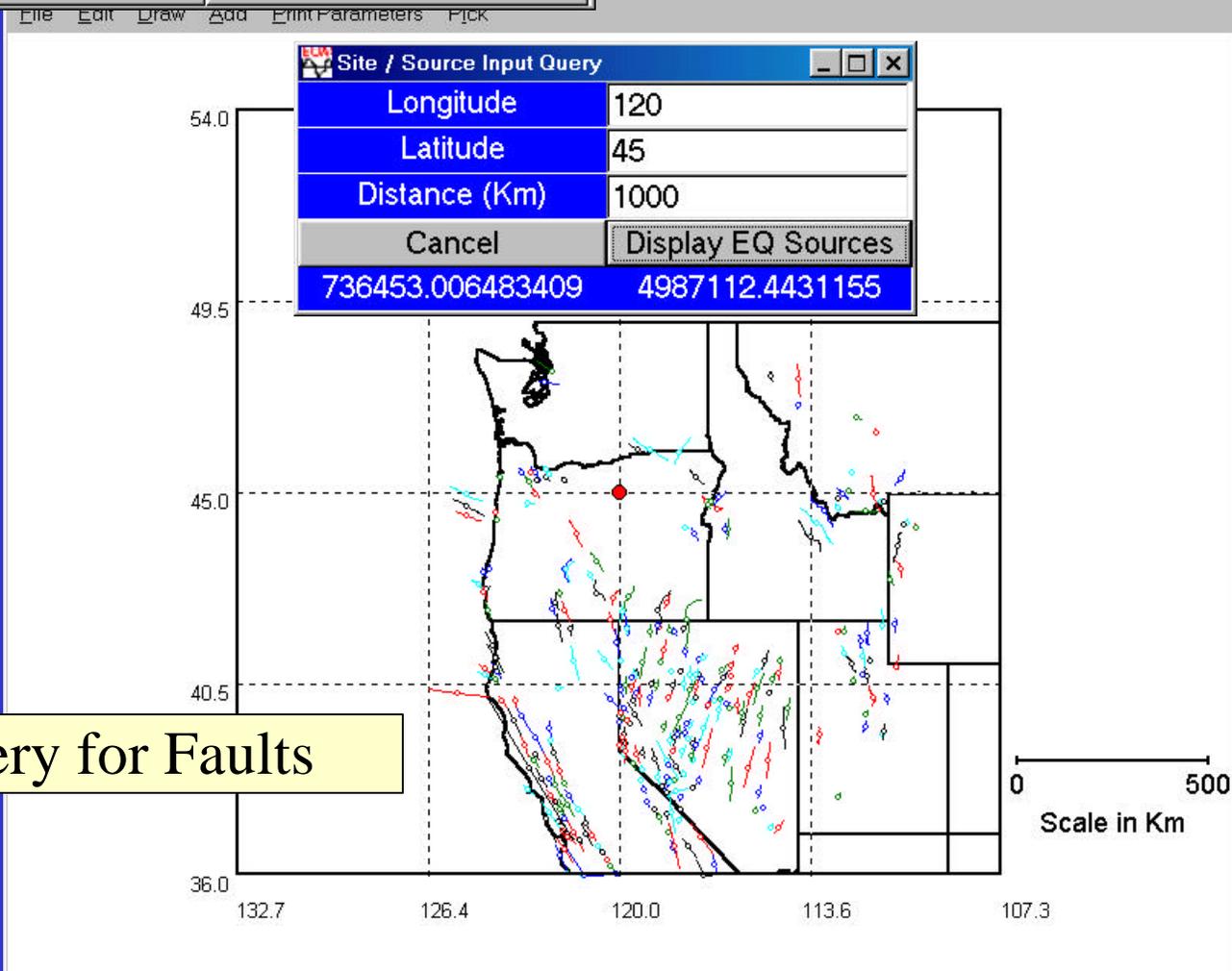
Database

Processing Tool Box

Synthetic Generation

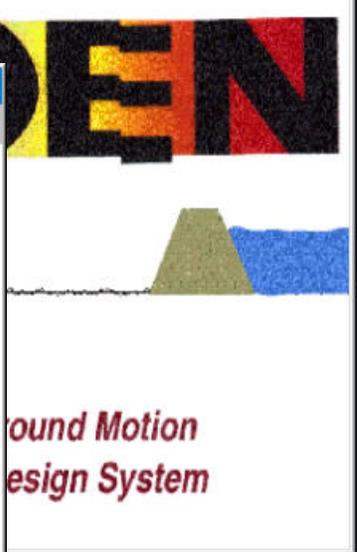


US ARMY CORPS OF ENGINEERS
WATERWAYS EXPERIMENT STATION



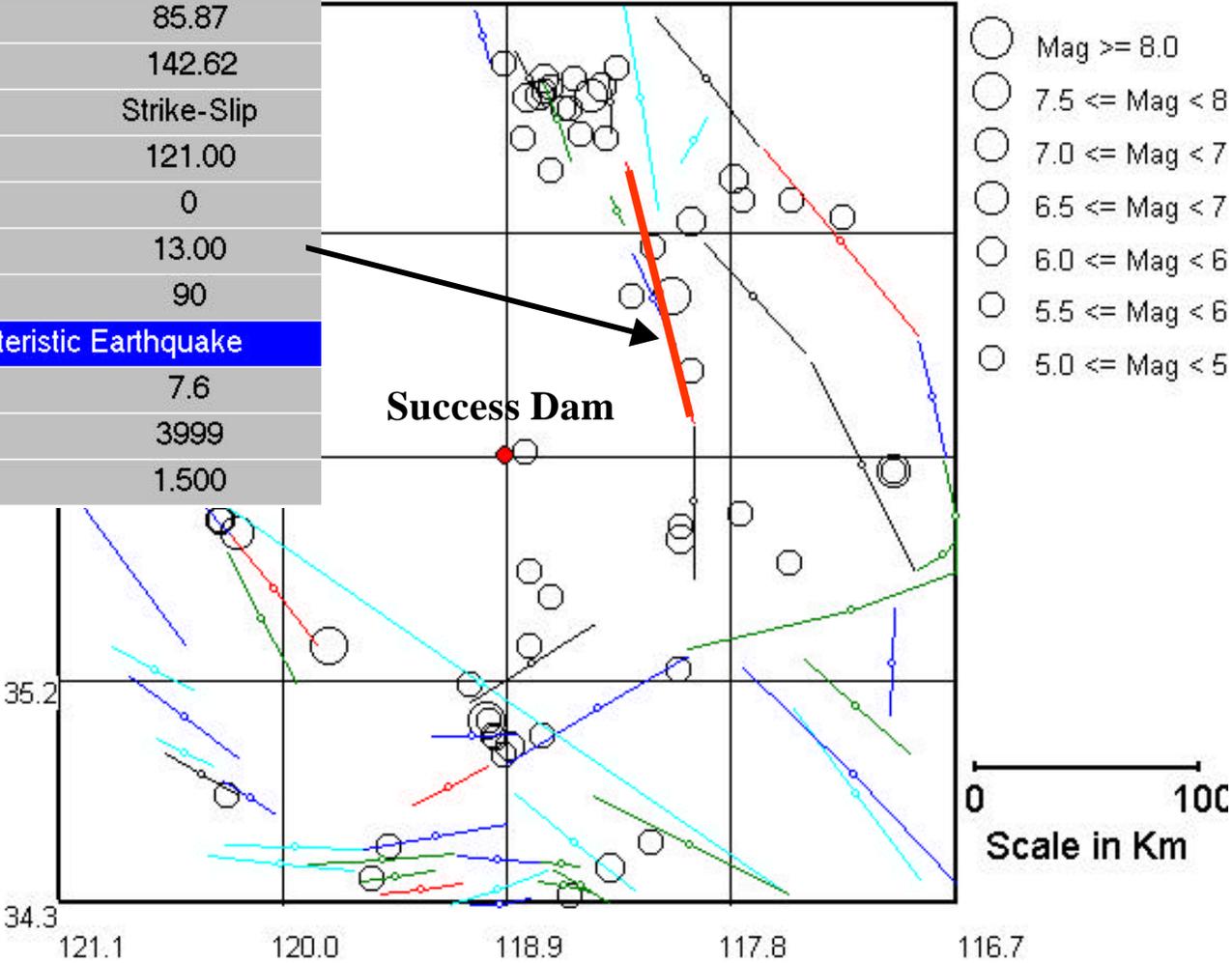
Query for Faults

Data within 1000 Km range from Long = 120.00 , Lat = 45.00



Display Fault Information

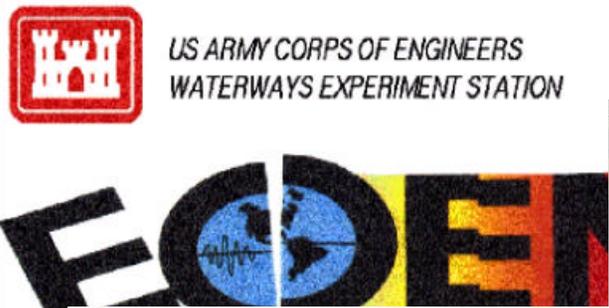
Fault	Owens Valley Fault
State	California
Min. Distance	85.87
Max. Distance	142.62
Type	Strike-Slip
Length (Km)	121.00
Top Depth (Km)	0
Width (Km)	13.00
Dip	90
Characteristic Earthquake	
Magnitude Mw	7.6
Recurrence (Yrs)	3999
Slip Rate (mm/yr)	1.500



Data within 200 Km range from Long = 118.92, Lat = 36.06

Attenuate Source to Site

- Project Help
- Accelerogram or Resp. Spectrum
- Database
- Processing Tool Box
- Synthetic Generation
- Site Response
- FEMA 302/273
- Documentation
- Design Earthquake**
- EQ Sources
- G Motion Attenuation
- Probabilistic (PSHA)
- Seismic Haz. Maps
- Exit

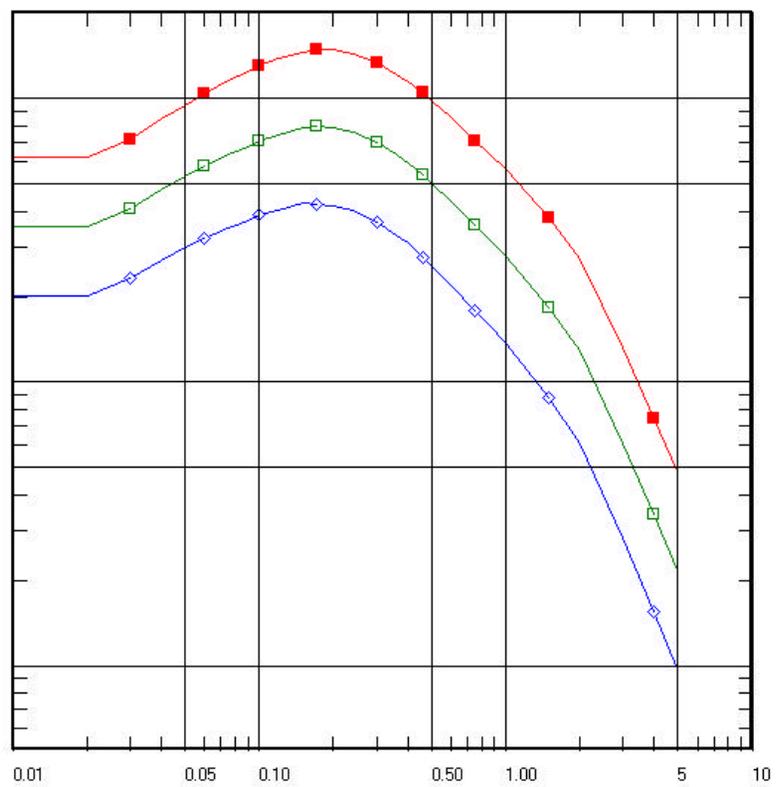


Ground Motion Attenuation Relationships

Tectonic Environment

Shallow Crustal Active Tectonic Regions	Stable Continental Regions	Subduction Zones
CA Based (Primarily) (6) Western N.America (1) World Wide Active, Near Source <= 60 Km Extensive Regions, Basin & Range (3)	Central and Eastern N.America (8) MidContinent Sub Region (9) Gulf Coast Sub Region (9)	Northwest N.America Cacadia Region (11)
<input type="radio"/> Boore, Joyner, Fumal	<input type="radio"/> Atkinson, Boore 1995	<input type="radio"/> Atkinson, Boore 1995
<input checked="" type="radio"/> Abrahamson & Silva	<input type="radio"/> Toro, Schneider, Abh...	<input type="radio"/> Anderson & Lei
		<input type="radio"/> Youngs et al 1996
		<input type="radio"/> Krinitzsky, Chang (M&S)

Response Spectra
 File Edit Modify View Print Parameters
 Period (secs) Vs Acceleration (cm/sec^2) : Mo = 6.0; Distance = 50 Km; H Component; Strike Slip; On F



Abrahamson & Silva 1997.

Magnitude (Mw)

Distance to Rupture (Km)

Fault Type Reverse Oblique Strike Slip

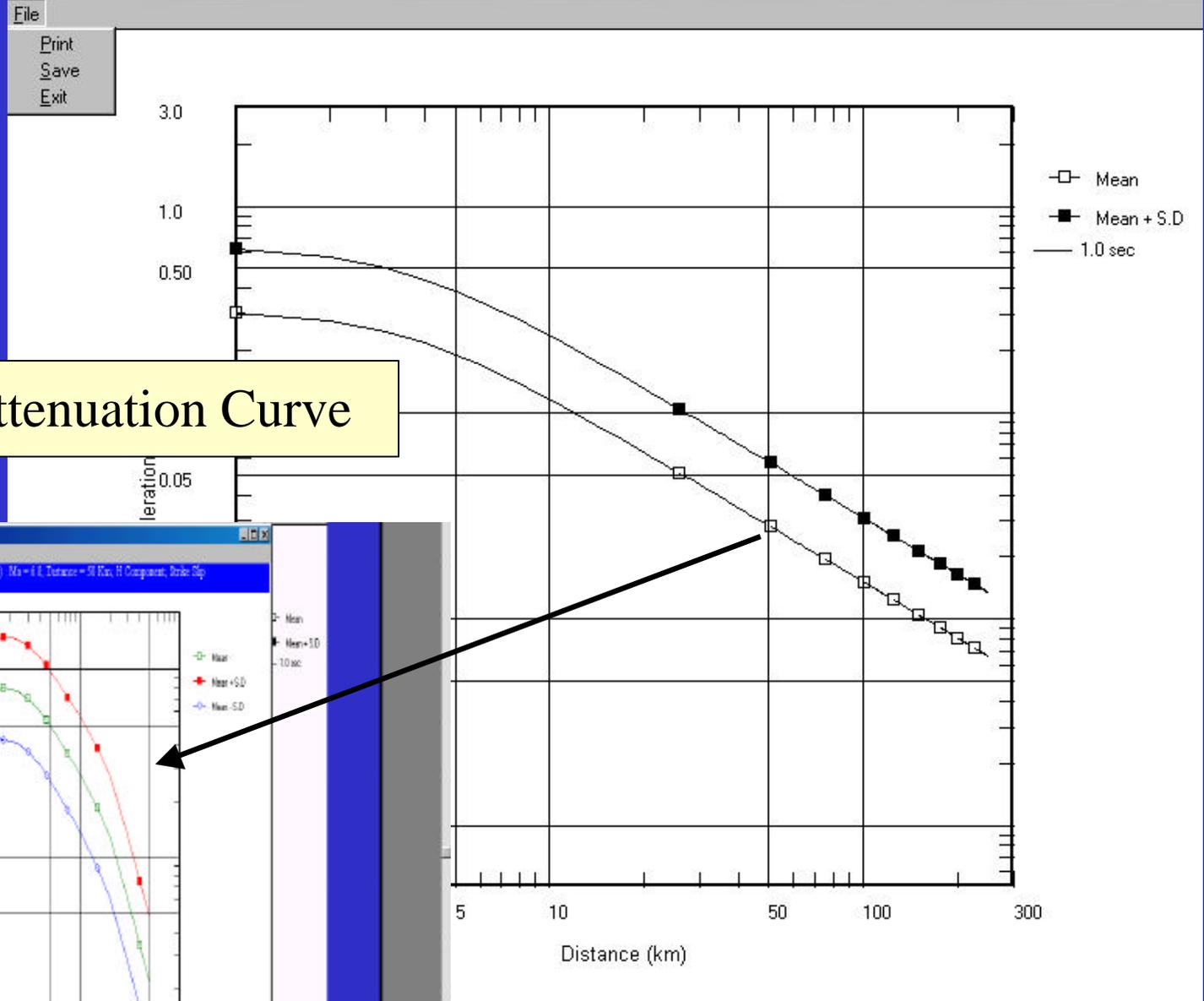
Hanging Wall On Hanging Other Cases

Component Horizontal Vertical

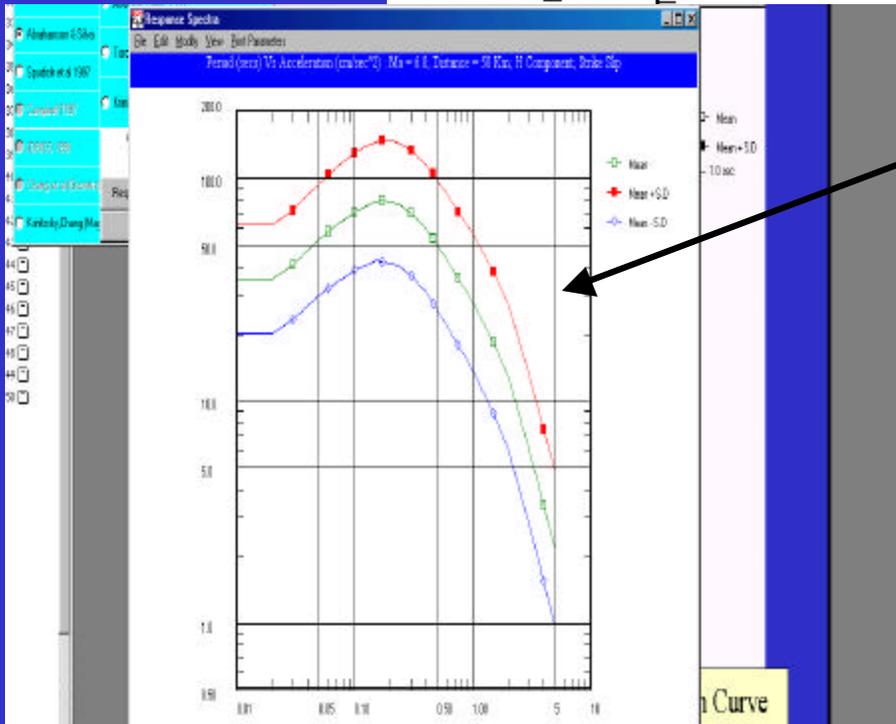
Cancel Calculate

Acceleration Velocity

Deterministic Response Spectra

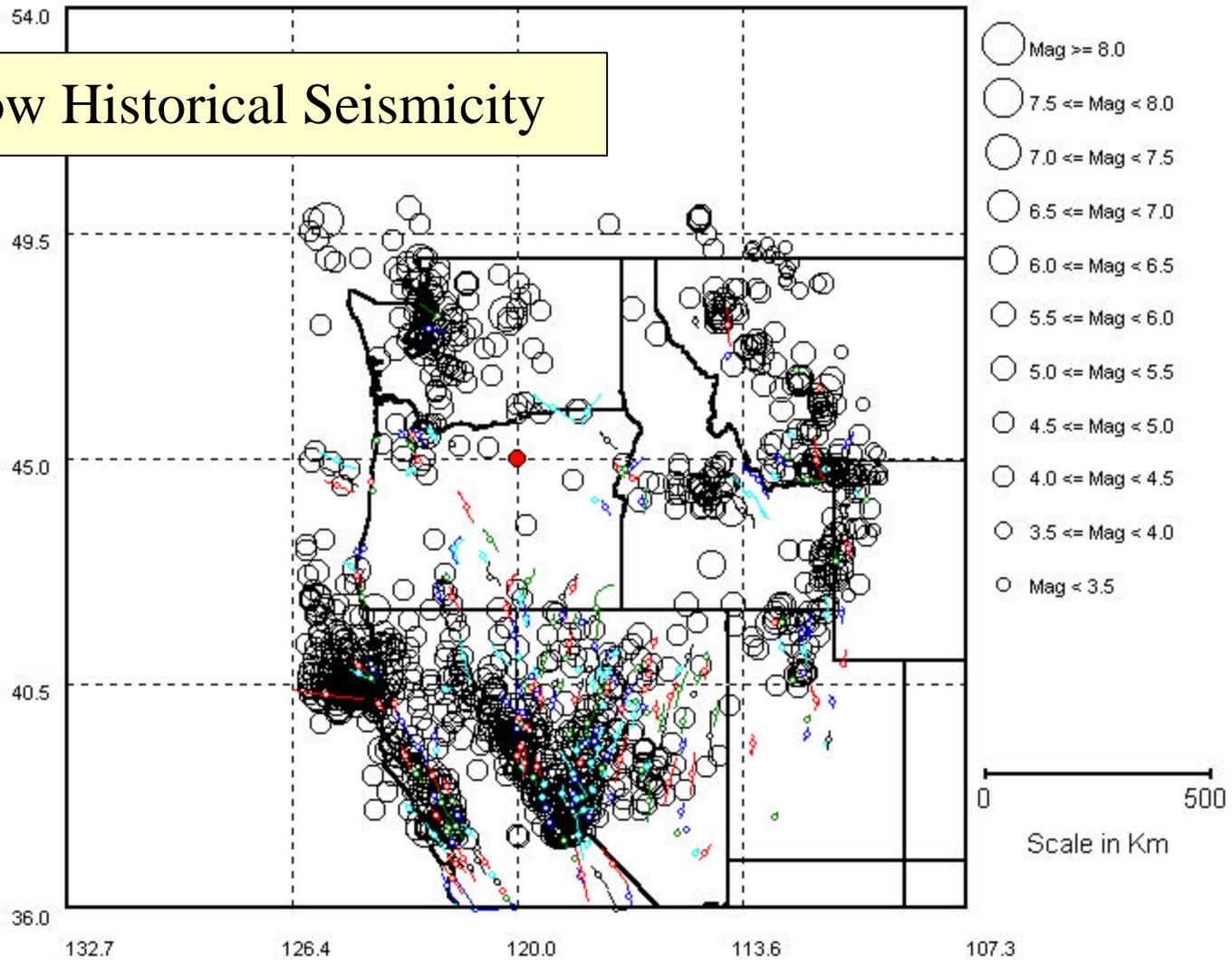


Compute Attenuation Curve



Attenuate Source to Site

Show Historical Seismicity



Data within 1000 Km range from Long = 120.00 , Lat = 45.00

EQMotion User Interface - June01 Version : June 2001

Project Help

Accelerogram or Resp. Spectrum

Database

Processing Tool Box

Synthetic Generation

Site Response

FEMA 302/273

Documentation

Design Earthquake

EQ Sources

G Motion Attenuation

Probabilistic (PSHA)

Seismic Haz. Maps

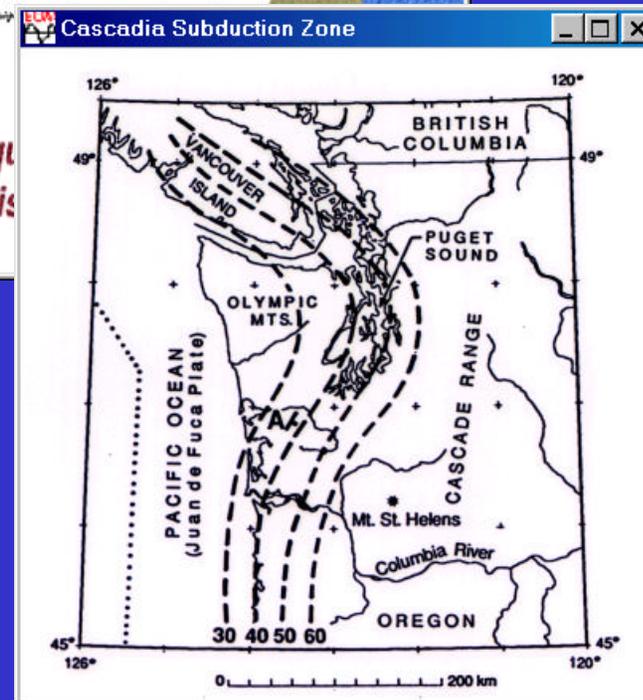
Exit

US ARMY CORPS OF ENGINEERS
WATERWAYS EXPERIMENT STATION

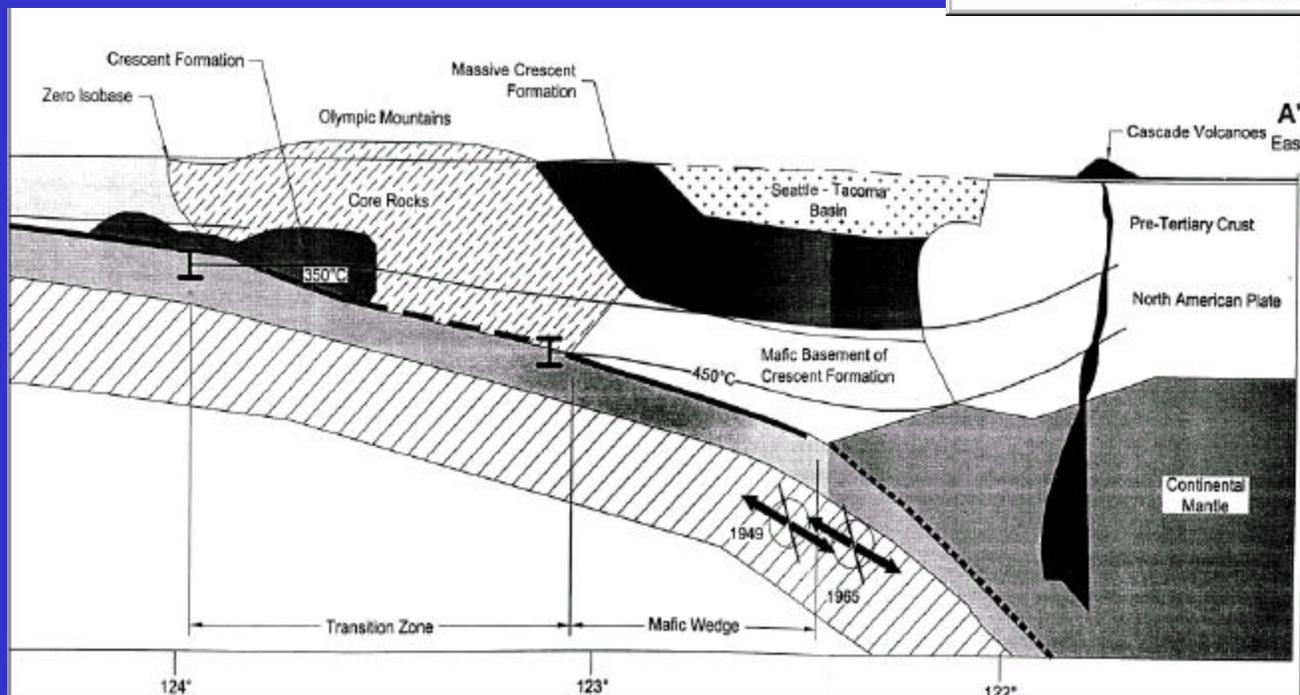
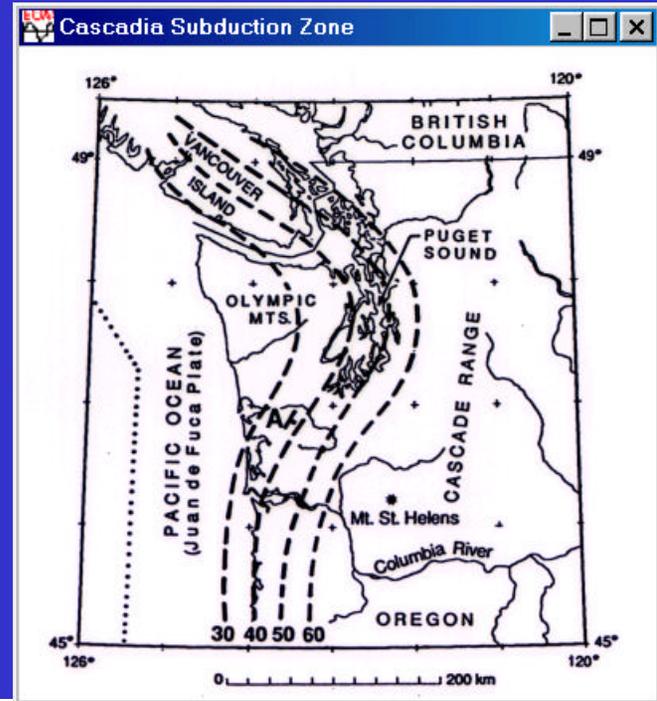
Earthquake Analysis

EQ Source Charecterization

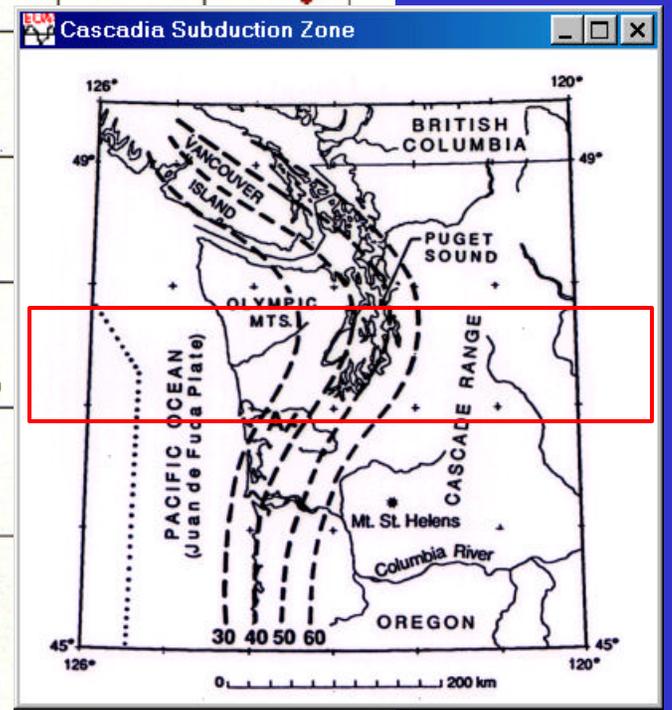
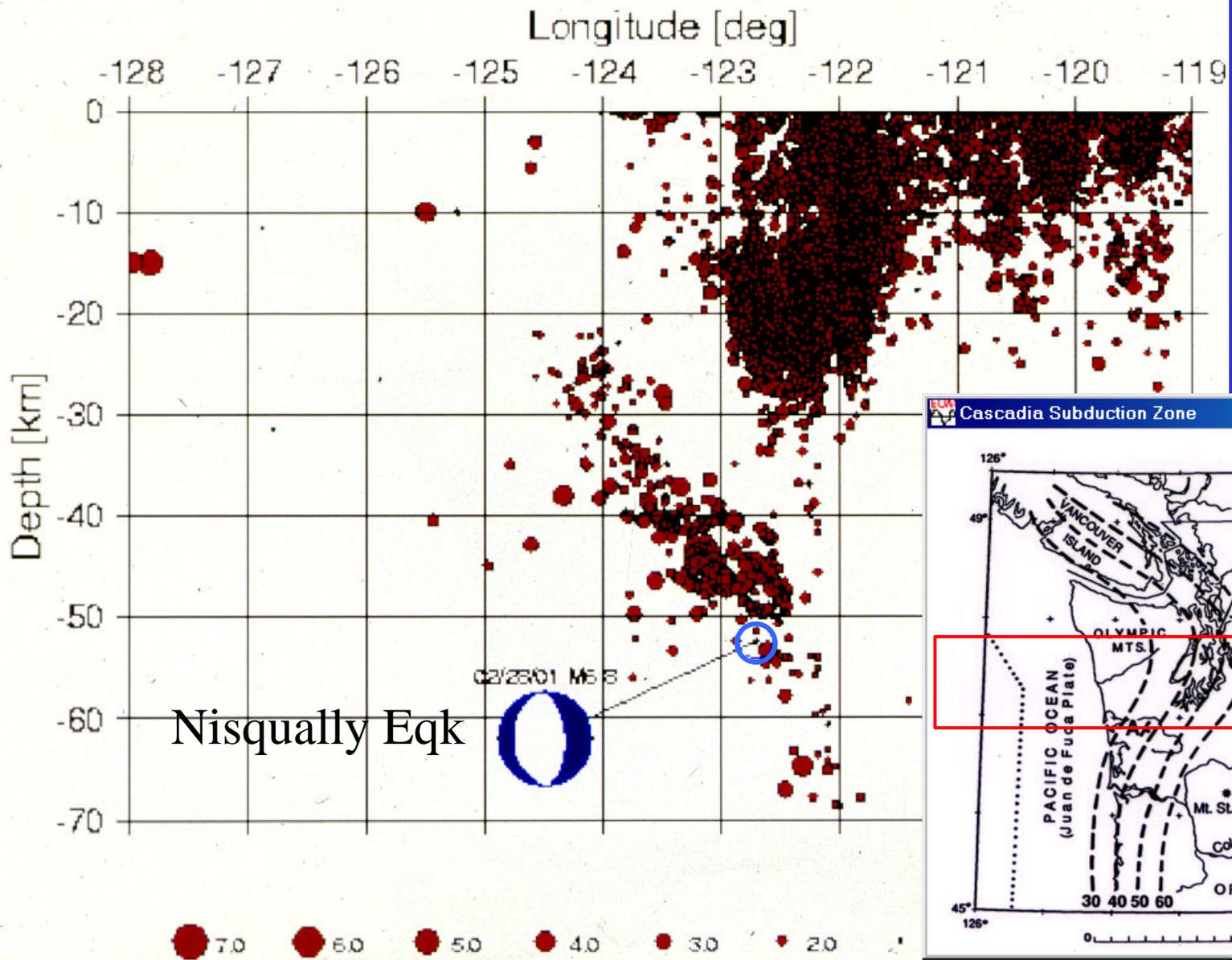
Earthquake Sources	Fault Relationships
<input type="radio"/> US Crustal Faults	<input type="radio"/> Mo from Fault Slip &Type
<input type="radio"/> CEUS Seismic Zones	<input type="radio"/> Mo from Avg. & Max. Disp
<input checked="" type="radio"/> Cascadia Subduction Zone	<input type="radio"/>
Cancel	Continue



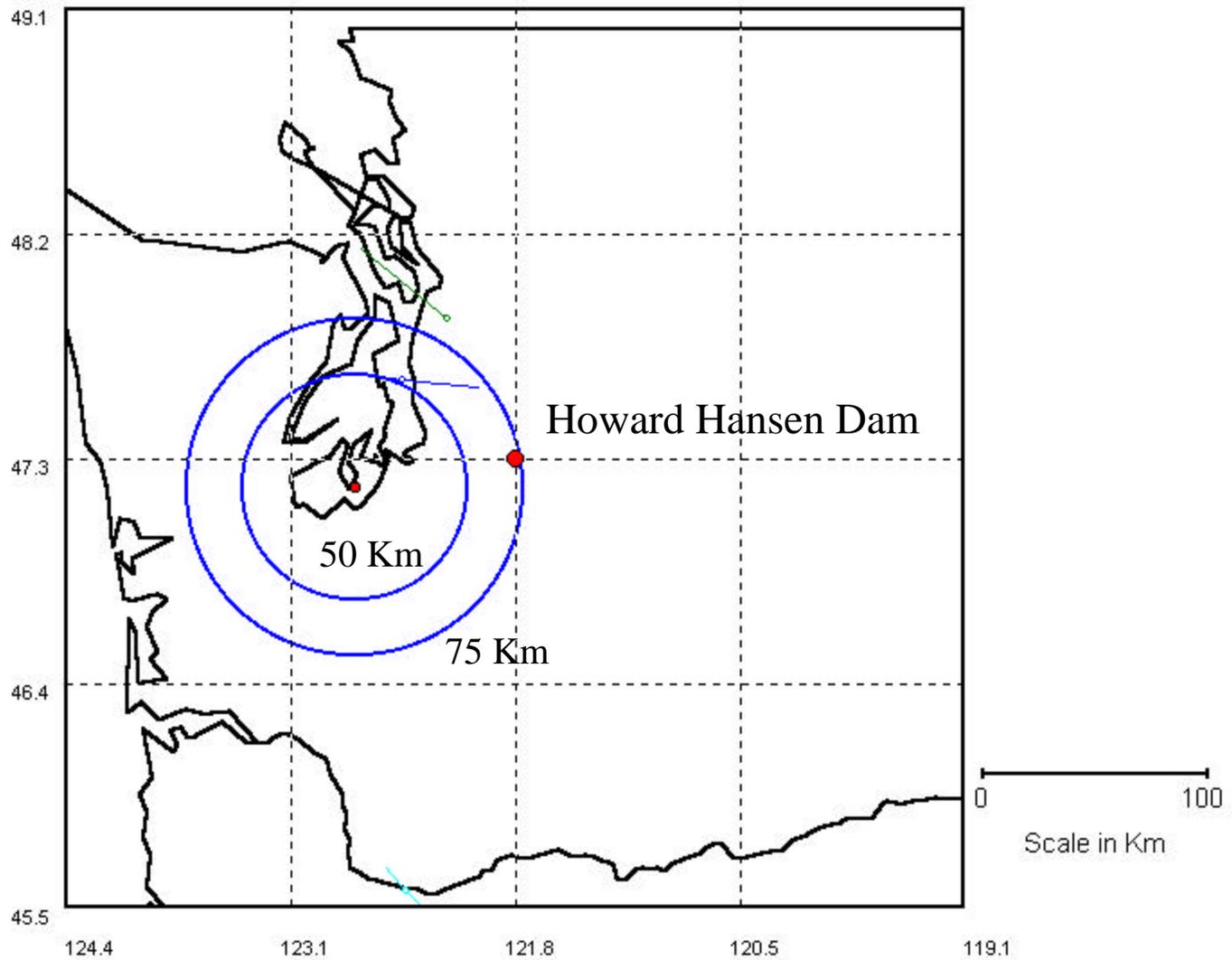
Cascadia Subduction Zone



1970-2001, $M \geq 1.0$, Lat. 46.7-47.7N



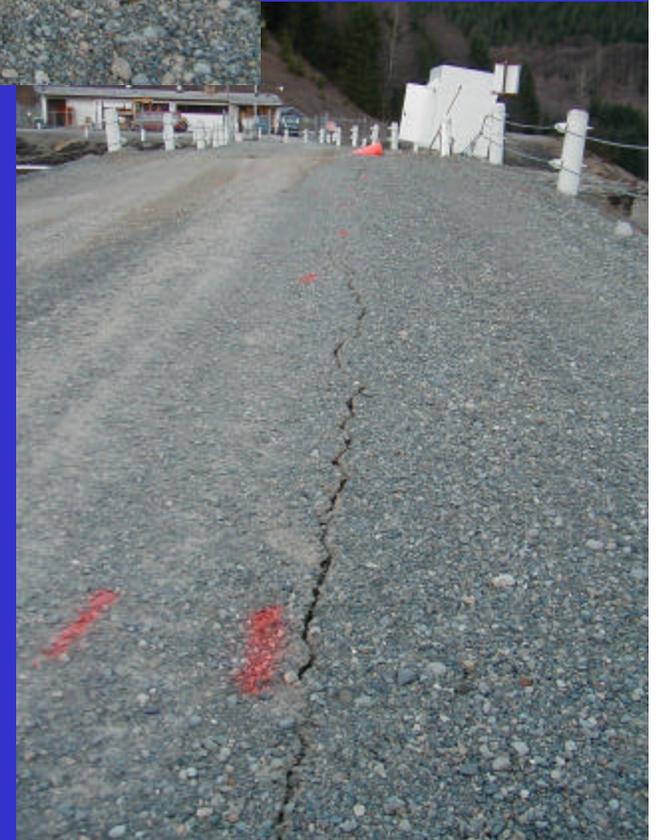
Nisqually Earthquake M=6.8

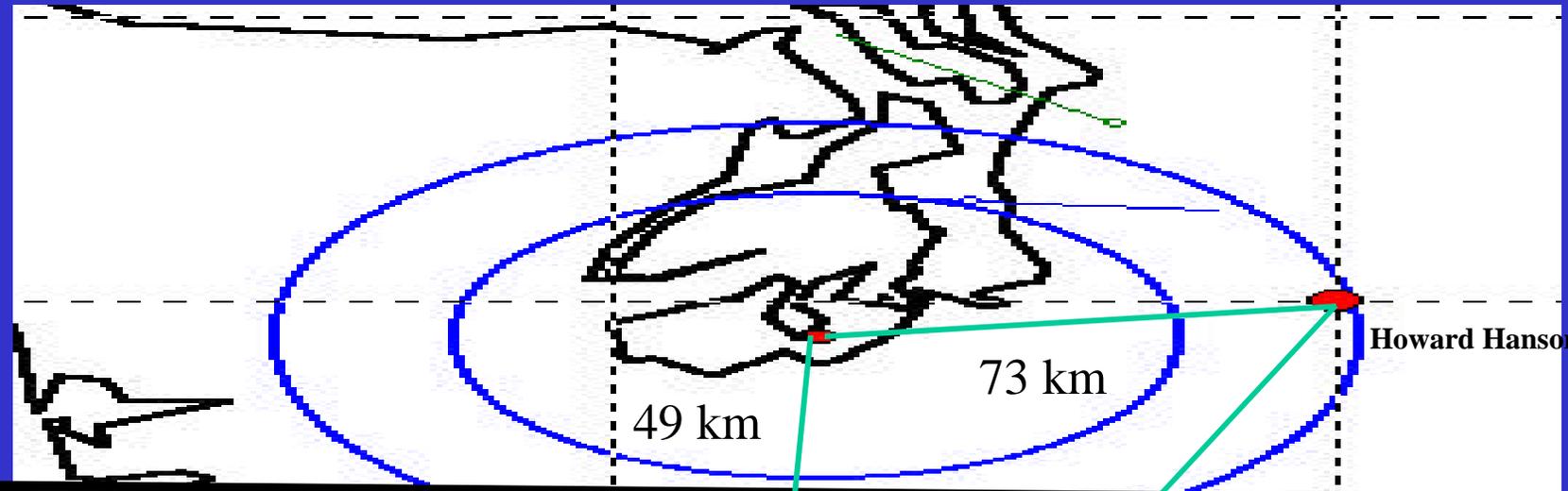


Data within 200 Km range from Long = 121.79 , Lat = 47.28



**Howard Hanson Dam
Nisqually Earthquake Damage**

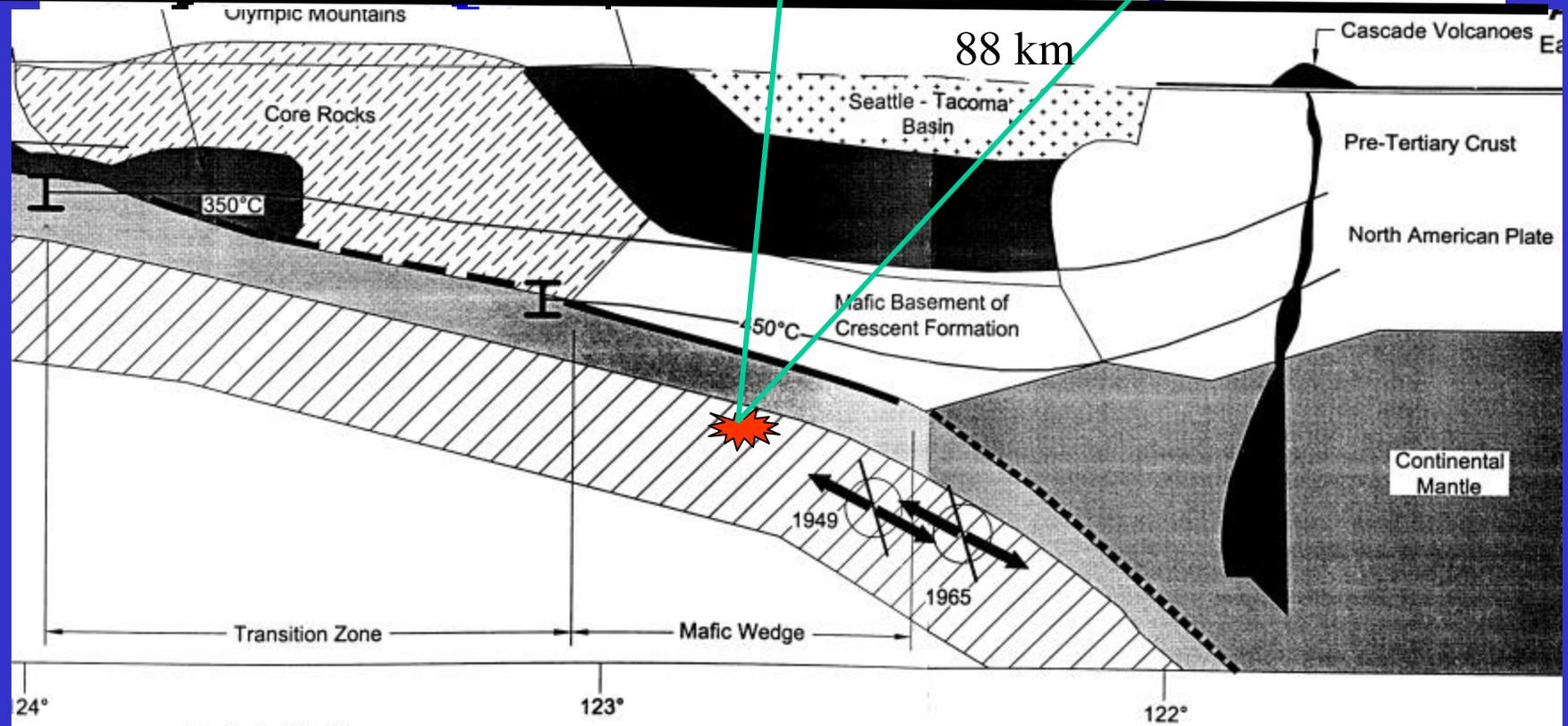




Howard Hanson Dam

49 km

73 km



Olympic mountains

Core Rocks

350°C

88 km

Seattle - Tacoma Basin

Cascade Volcanoes

Pre-Tertiary Crust

North American Plate

Mafic Basement of Crescent Formation

450°C

Continental Mantle

Transition Zone

Mafic Wedge

1949

1965

124°

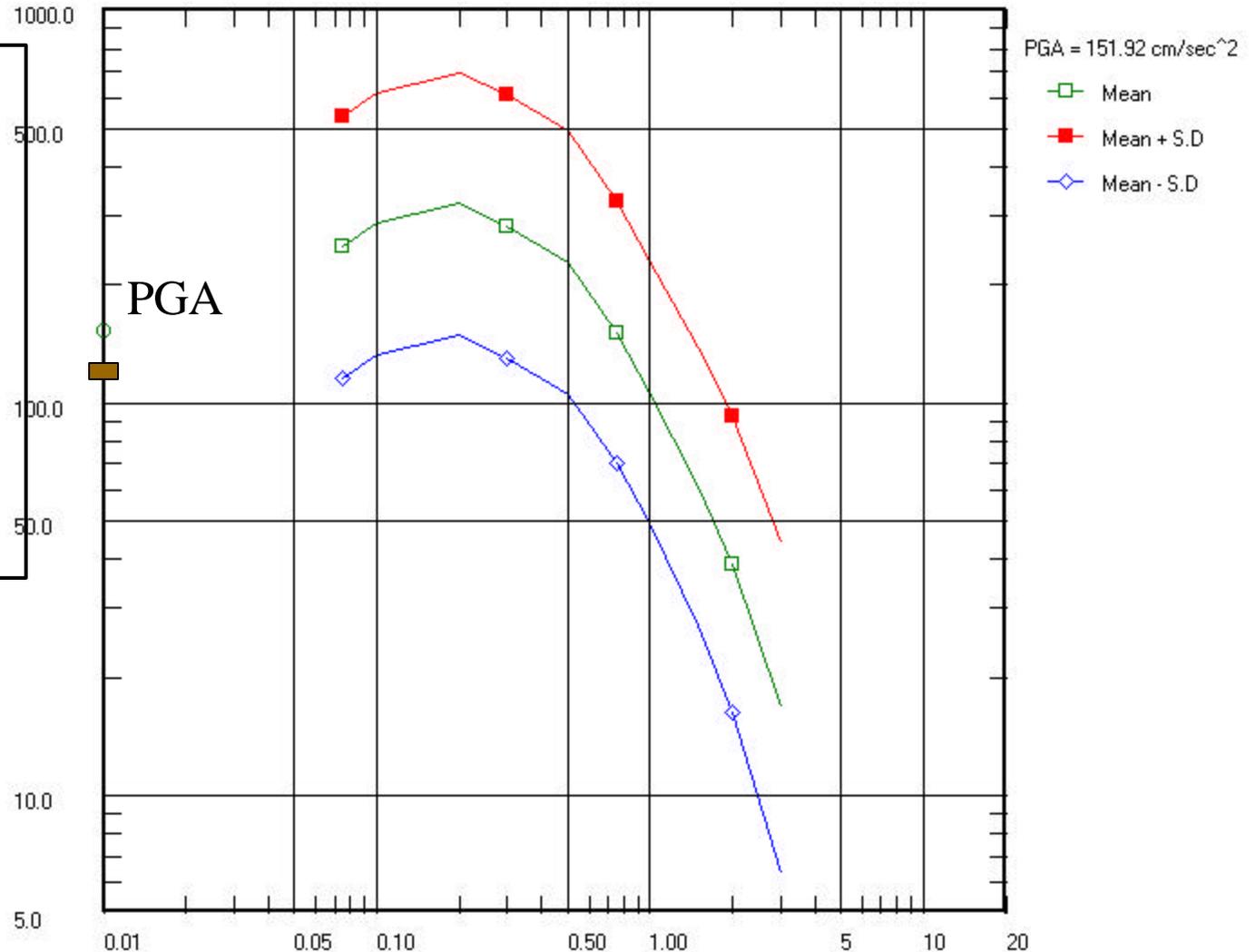
123°

122°

Comparison of Recorded to Predicted Accelerations for a Earthquake of this type, size, and location

Period (secs) Vs Acceleration (cm/sec²) : M = 6.8; Distance = 73 Km ; Depth = 49 Km; Intraslab

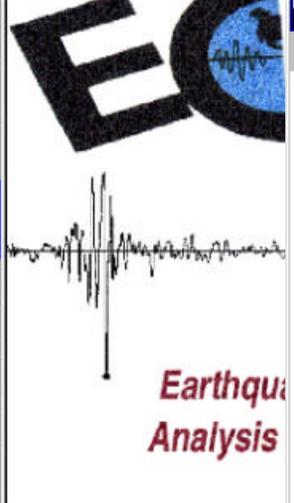
Howard Hanson Dam
Recorded Accelerations
PGA (cm/s²)
103 Left Abut.
108
88 Toe
32
549 Crest
1345



Site / Source Input Query

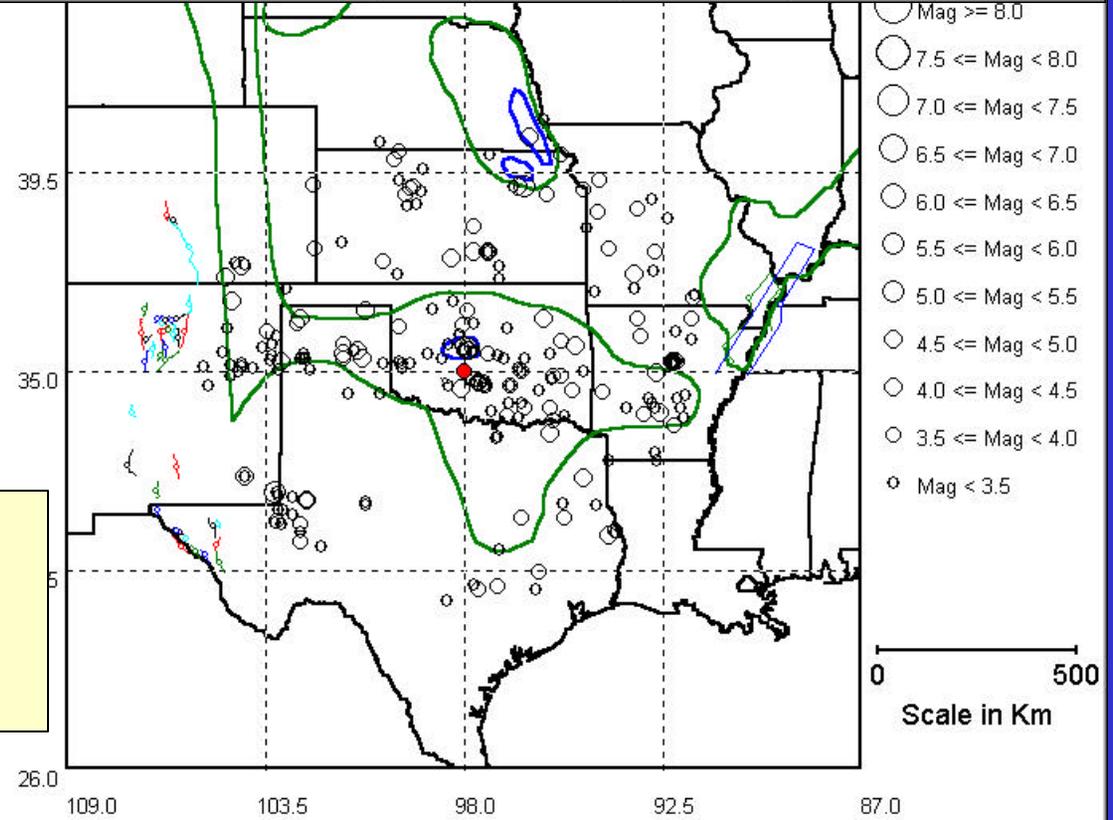
Longitude	98
Latitude	35
Distance (Km)	1000
Cancel	Display EQ Sources
591255.363368937	3873302.29715872

- Site Response
- FEMA 302/273
- Documentation
- Design Earthquake**
- EQ Sources
- G Motion Attenuation
- Probabilistic (PSHA)
- Seismic Haz. Maps
- Exit



Earthquake Zone Query Results. Zone Definition Reference : Krinitzsky 1986

Zone Name	Mw	Epicentral Intensity	In / Out of Zone	Distance in Km	
				Min	Max
-	4.8	VI	-	-	-
Front Range & Ouachita	5.4	VII	Inside	132.64	1339.50
El Reno Oklahoma	6.1	VIII	Outside	35.16	717.29
-	6.8	IX	-	-	-
-	6.8	X	-	-	-
-	7.4	XI	-	-	-



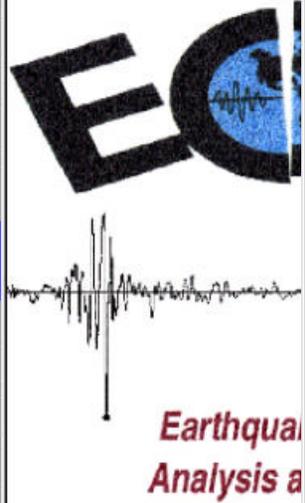
Central & Eastern US
Seismic Source Zones

Data within 1000 Km range from Long = 98.00 , Lat = 35.00

- Project Help
- Accelerogram or Resp. Spectrum
- Database
- Processing Tool Box
- Synthetic Generation
- Site Response
- FEMA 302/273
- Documentation
- Design Earthquake**
- EQ Sources
- G Motion Attenuation
- Probabilistic (PSHA)
- Seismic Haz. Maps
- Exit

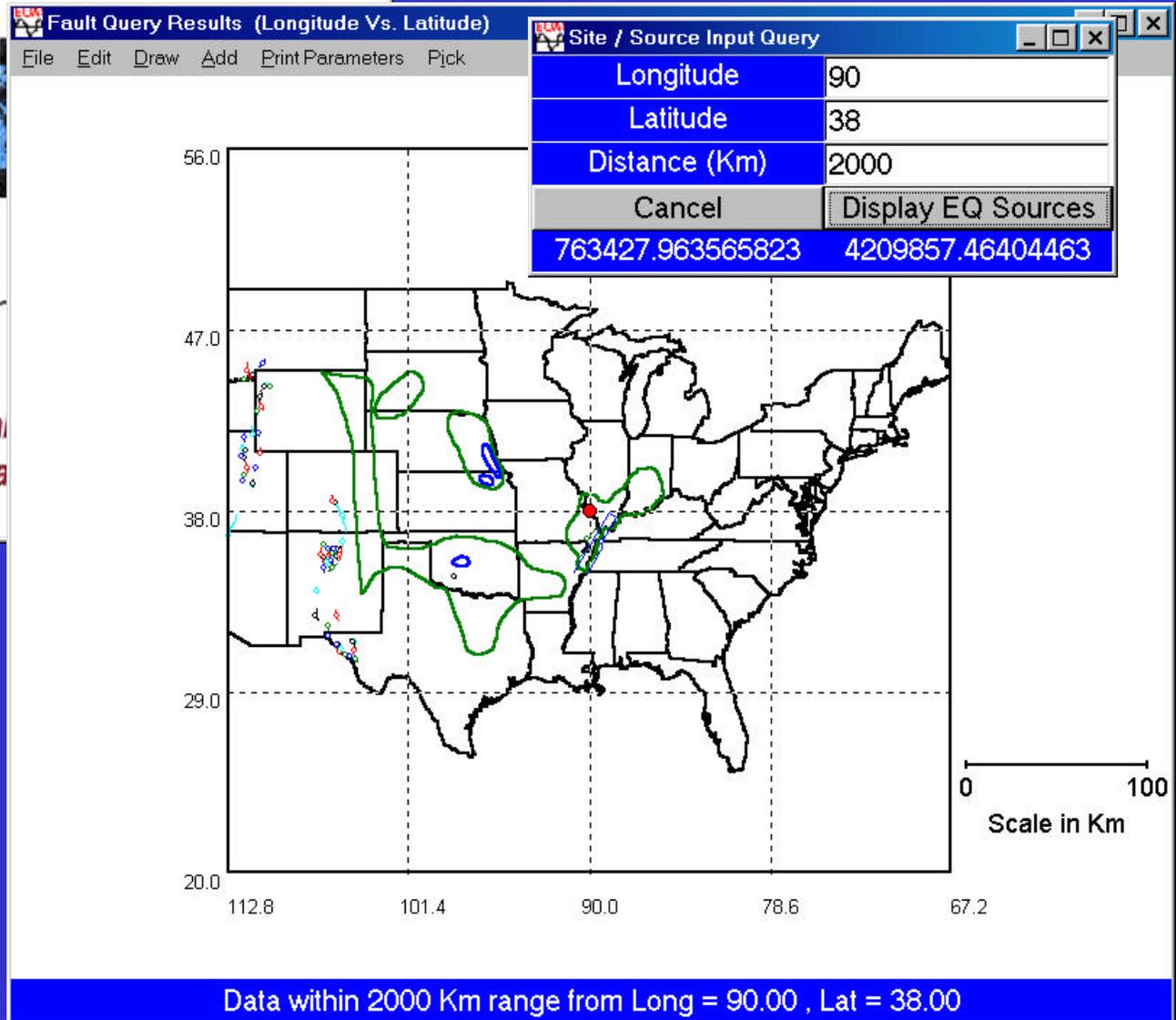


US ARMY CORPS OF ENGINEERS
WATERWAYS EXPERIMENT STATION



Earthquake
Analysis a

Seismic Source Zones



Krinitzsky, Chang, Nuttuli, 1987 Attenuation Curves and Recommended Accelerograms

EQMotion User Interface - Beta Version

About

- Accelerogram or Resp. Spectrum
- Database
- Processing Tool Box
- Synthetic Generation
- Site Response
- Help
- Documentation
- Design Earthquake
- Faults
- G Motion Attenuation
- Probabilistic (PSHA)
- Seismic Haz. Maps
- Exit

Ground Motion Attenuation

Tectonics

- Shallow Crustal Active Regions
- Primarily (6) America (1) Active, Distance <= 60 Km Regions, Range (3)
- Abrahamson & Silva
- Spudich et al 1997
- Campbell 1997
- IDRISS 1991
- Chang et al (Ge)
- Krinitzsky, Chang**

Select EQ Motions - KCN Magnitude Based

Enter the MCE (Magnitude)

- Intraplate Area
- Plate Boundary
- Near Field
- Far Field
- Shallow
- Deep
- Hard Site
- Soft Site

KCN Magnitude Chart

File

Distance, Km Vs Horizontal Acceleration cm/sec²

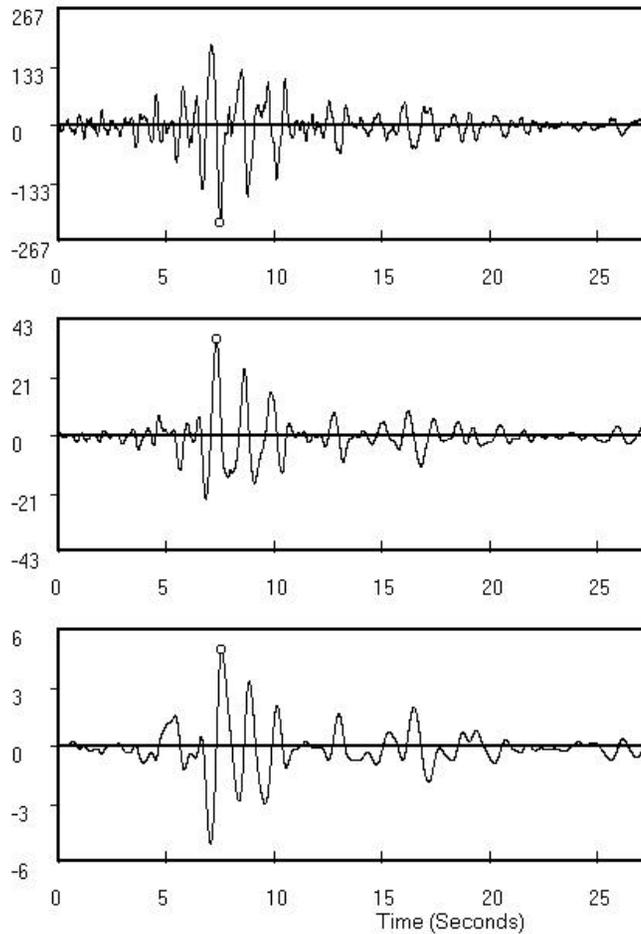
Hard Sites Plate Boundary <= 19 Km Focal Depth M = 7.5

Database Viewer

File

Record Number	Record ID	EQ Date	EQ Time	Epicenter latitude	Epicenter longitude
2351	CAN 9	851223	51603.5	62.19	-124.24

Time History Plots for LOMA PRIETA, EARTHQUAKE



Project About Help

Accelerogram or Resp. Spectrum

Database

Processing Tool Box

EQAS [X]

Number of dbase hits = 72

OK

US ARMY COAST & GEODISURVEILLANCE CENTER

WATERWAYS

Query Smcat Data

Select	Query Item	Minimum	Maximum	Query Constraints	
<input checked="" type="checkbox"/>	Magnitude	7.1	7.5	<input checked="" type="radio"/> AND	<input type="radio"/> OR
<input type="checkbox"/>	Intensity			<input type="radio"/> AND	<input type="radio"/> OR
<input checked="" type="checkbox"/>	Epi Distance	50	200	<input checked="" type="radio"/> AND	<input type="radio"/> OR
<input checked="" type="checkbox"/>	Acceleration	100	250	<input type="radio"/> AND	<input type="radio"/> OR
<input type="checkbox"/>	Velocity			<input type="radio"/> AND	<input type="radio"/> OR
<input type="checkbox"/>	A/V			<input type="radio"/> AND	<input type="radio"/> OR
<input type="checkbox"/>	Depth			<input type="radio"/> AND	<input type="radio"/> OR
<input type="checkbox"/>	Site Coefficient	<input type="checkbox"/> S1	<input type="checkbox"/> S2	<input type="checkbox"/> S3	<input type="checkbox"/> S4
<input checked="" type="checkbox"/>	Component	<input checked="" type="radio"/> Horizontal <input type="radio"/> Vertical		<input checked="" type="radio"/> AND	<input type="radio"/> OR
<input type="checkbox"/>	Site Geology	<input checked="" type="radio"/> Rock <input type="radio"/> Soft		<input type="radio"/> AND	<input type="radio"/> OR
<input type="checkbox"/>	Structure			<input type="radio"/> AND	<input type="radio"/> OR
Always Reject the Records above the Floor :					1

Process Query
Reset Query
Exit Query

891018	402	37.037	-121.883	LOMA PRIETA, EARTHQUAKE
891018	402	37.037	-121.883	LOMA PRIETA, EARTHQUAKE
891018	402	37.037	-121.883	LOMA PRIETA, EARTHQUAKE
891018	402	37.037	-121.883	LOMA PRIETA, EARTHQUAKE
891018	402	37.037	-121.883	LOMA PRIETA, EARTHQUAKE
790228	212700	60.64	-141.59	OUTHEASTERN ALASKA EARTHQUAKE
790228	212700	60.64	-141.59	OUTHEASTERN ALASKA EARTHQUAKE
730130	210112.5	18.48	-102.99	MEXICAN EARTHQUAKE
741109	125949.8	-12.5	-77.78	PERU COAST
891018	402	37.037	-121.883	LOMA PRIETA, EARTHQUAKE
891018	402	37.037	-121.883	LOMA PRIETA, EARTHQUAKE

Enter the Location of Smcat Data (Drive or Directory) c: []

Eqas
Acrobat4

Plot Time History
Plot Response Spectra
Query Data Base
Clear All Queries
Plot Query

**Query for Analogous
Records and View
Time Histories**

EQMotion User Interface - June01 Version : June 2001

Project Help

Accelerogram or
Resp. Spectrum

Database

Processing Tool Box

Synthetic Generation

Site Response

FEMA 302/273

Documentation

Design
Earthquake

EQ Sources

G Motion Attenuation

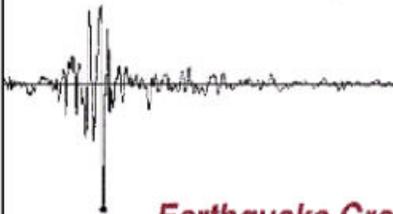
Probabilistic (PSHA)

Seismic Haz. Maps

Exit



US ARMY CORPS OF
WATERWAYS EXPERIMENTAL



Earthquake Ground
Motion Analysis and Design

Download Data from Web

File View

COSMOS VIRTUAL DATA CENTER

Consortium of Organizations for Strong-Motion Observation Systems

Home · Login/Logoff · Download · About Us · Contact · Mirror Sites
Earthquakes · Stations · Search · Map · Adv. Search

Home

Welcome to the COSMOS Virtual Data Center. This site gives access to a relational database of strong ground motion parameters. Data identified through the database may be downloaded from various agencies' FTP and Web sites.

To access the virtual data center, use the image links at the top of this page or the identical text links at the bottom of the page. For additional information, please visit the [COSMOS web site](#).

Data provided by cooperating networks



[U. S. Geological Survey](#)



[California Division of
Mines and Geology](#)



[U. S. Army Corps of
Engineers](#)



[U. S. Bureau of
Reclamation](#)

Developmental support for the Virtual Data Center provided by the Core members of
COSMOS
and the [Southern California Earthquake Center](#) is gratefully acknowledged.

SC/EC

Processing Tools

Calculate Response Spectra

Time History Tools

Download External Data

Reformat External Data

Exit

Access External Data Sources

EQMotion User Interface - June01 Version : June 2001

Project Help

Accelerogram or Resp. Spectrum

Database

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Site Response

FEMA 302/273

Documentation

Design Earthquake

EQ Sources

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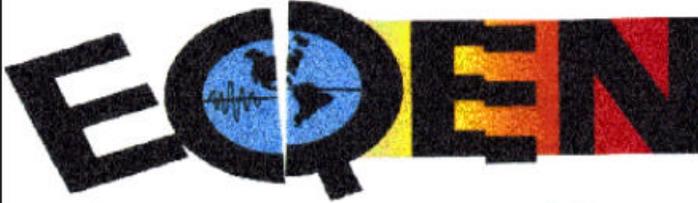
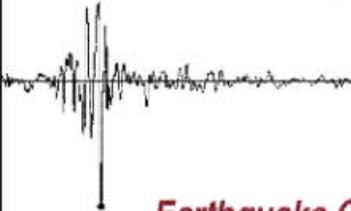
Probabilistic (PSHA)

Seismic Haz. Maps

Exit



US ARMY CORPS OF ENGINEERS
WATERWAYS EXPERIMENT STATION

*Earthquake G
Analysis and L*

Reformat External Data

Select Acceleration File	Select File
# of Header Lines	7
Enter time step	0.005
Number of Points	3765
# of Points Per Line	10
Scaling Factor	1.0
Earthquake Name	Earthquake
Select Input Units	<input type="radio"/> g's <input checked="" type="radio"/> cms/sec ²
Cancel	View File
Reformat	Save Data

View File

File

```

FRANKLIN FALLS DAM, NEW HAMPSHIRE:
45 DEGREES
EARTHQUAKE OF JANUARY 19, 1982, 0014
BUTTERWORTH AT .330 HZ, N=4
YEAR=1982 JULIAN DAY= 19 HOUR= 0 MINUTE=14 SECOND=42 COMPONENT= 45
SAMPLES/SEC=200 FILTER TYPE=BUTTERWORTH CORNER= 0.33 ORDER=4 DATA TYPE=AC
NO OF POINTS= 3765, UNITS=CM/SEC**2, CM/SEC, AND CM
-23.72 -10.02 6.63 -1.59 -0.83 -2.38 -17.20 -17.26 -11.01 -11.64
11.18 24.79 4.30 4.68 9.75 0.95 -2.55 -2.48 -0.17 -3.98
8.28 31.36 27.73 25.26 30.55 21.14 -9.30 -8.98 -8.57 -25.33
-5.17 14.66 17.93 22.62 25.12 13.50 -1.50 -8.29 -9.32 -14.66
-11.91 -5.45 -2.97 -6.04 -11.97 -11.42 -10.60 -11.69 -17.68 -19.39
-12.93 -8.16 -8.14 -11.99 -11.08 -6.38 -6.00 0.09 8.87 7.31
3.27 0.55 -6.23 -12.64 -14.63 -11.19 -4.23 0.56 5.06 0.50
-7.62 -2.48 2.39 6.21 11.66 7.59 3.49 -1.16 -2.53 5.26
2.41 -5.71 -2.46 4.53 3.66 -5.45 -16.15 -14.02 0.40 7.27
-0.74 -4.05 8.03 14.39 8.00 2.75 5.61 8.82 9.37 6.27
-0.53 -4.16 -15.64 -29.31 -23.78 6.19 27.47 23.67 19.92 19.44
2.70 -17.89 -6.18 10.90 28.58 26.65 1.66 -0.24 -6.18 -22.93
-19.18 -9.25 -10.48 -9.98 -8.13 -14.82 -20.43 -16.33 -3.15 14.85
14.91 5.94 1.10 -1.55 3.12 2.09 -0.87 3.66 3.02 -5.68
-12.78 -12.78 -4.20 2.05 -5.45 -18.14 -31.83 -38.20 -33.97 -30.08
-26.92 -14.82 7.05 15.67 12.97 3.57 -25.94 -47.56 -45.51 -52.45
-33.15 8.17 1.39 4.10 -5.30 -46.20 -40.43 -45.87 -50.33 -8.24
14.04 29.41 34.67 22.79 37.15 41.88 44.55 58.11 52.63 44.95
39.74 38.00 44.00 45.77 48.85 51.34 49.47 30.72 -5.52 0.88
-6.48 -43.08 -16.05 -7.94 -27.20 -2.00 29.37 22.59 8.01 11.93
-1.37 -8.46 -6.11 -3.16 3.94 7.17 -17.01 -64.09 -57.72 -44.59
-48.43 -22.54 26.28 58.32 42.78 16.16 -9.95 -41.63 -61.02 15.79
86.91 41.45 29.87 24.97 -60.65 -117.65 -123.96 -38.90 49.99 2.91
-19.63 23.07 28.80 10.20 21.91 24.73 -17.03 -85.96 -107.19 -73.26
-93.62 -73.81 -25.27 -17.27 26.16 48.10 74.65 97.50 69.44 60.46
47.53 21.41 33.38 32.73 -2.27 -10.80 -11.29 -17.85 -11.93 1.74
10.17 2.71 3.71 22.15 35.59 24.91 14.34 11.88 7.59 -2.58

```

Line : 8 of 1152 : 52

Processing Tools

Calculate Response Spectra

Time History Tools

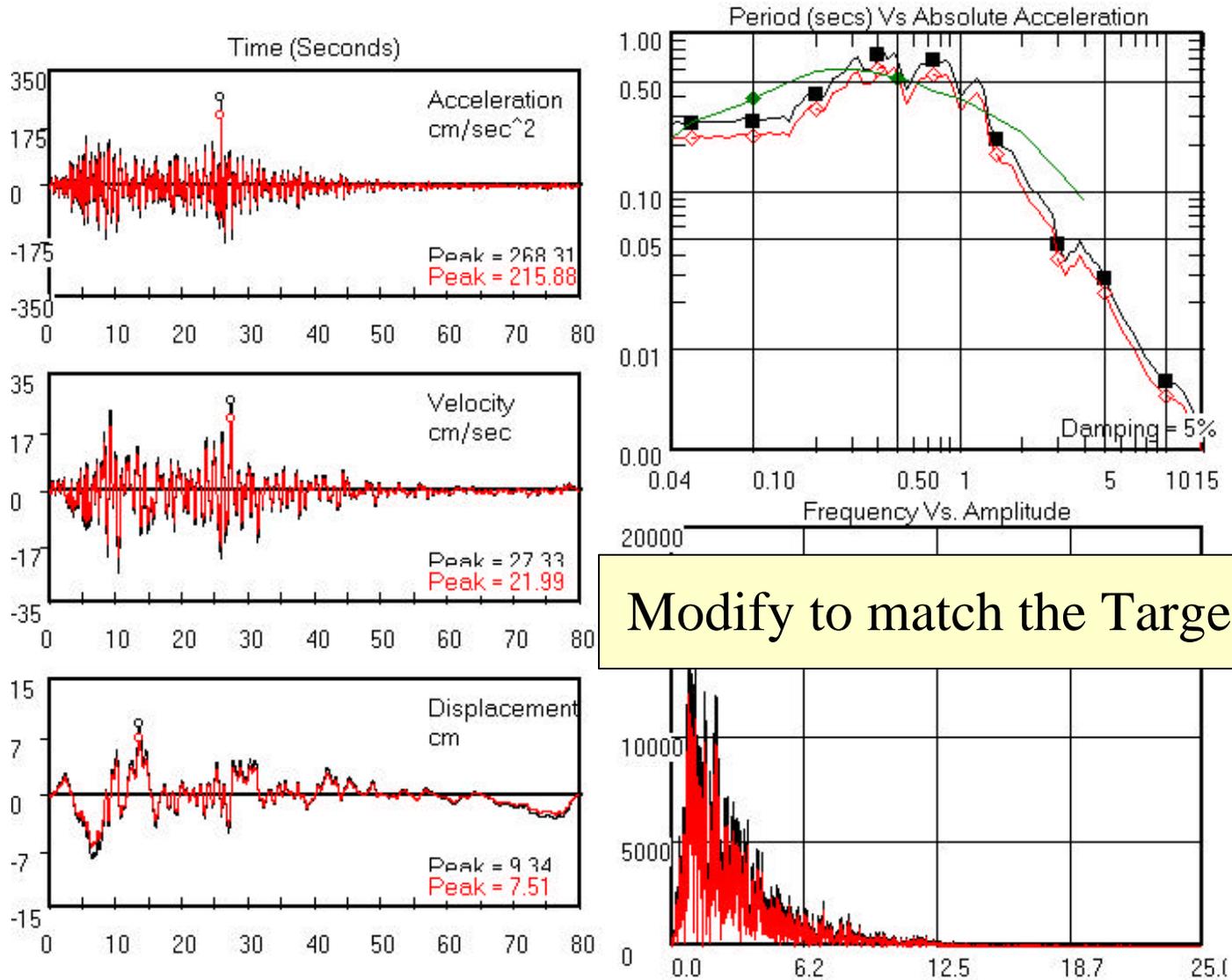
Download External Data

Reformat External Data

Exit

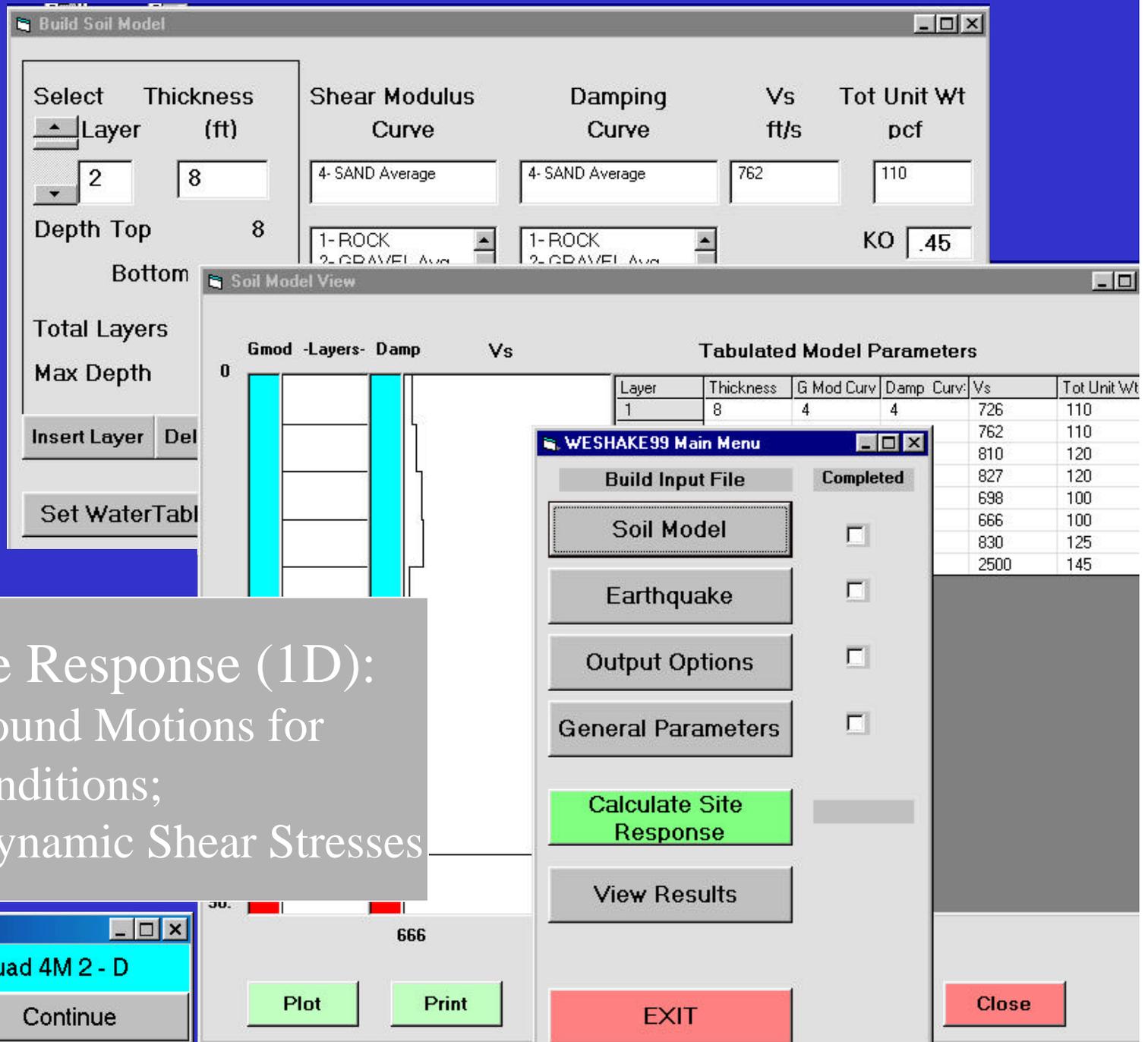
Time History and
Data Formatting Tools

Original — Scaled — Target Response Spectra —

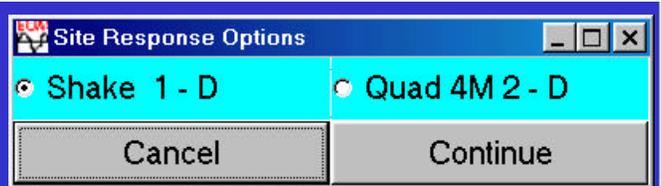


Modify to match the Target Spectra

Landers Earthquake Joshua Tree Fire Station



Dynamic Site Response (1D):
 Modify Ground Motions for
 Site Conditions;
 Estimate Dynamic Shear Stresses



Plot

Print

EXIT

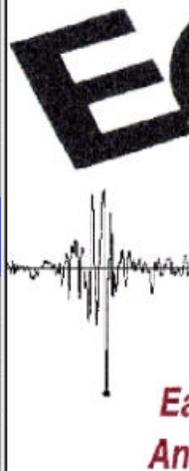
Close

Project Help

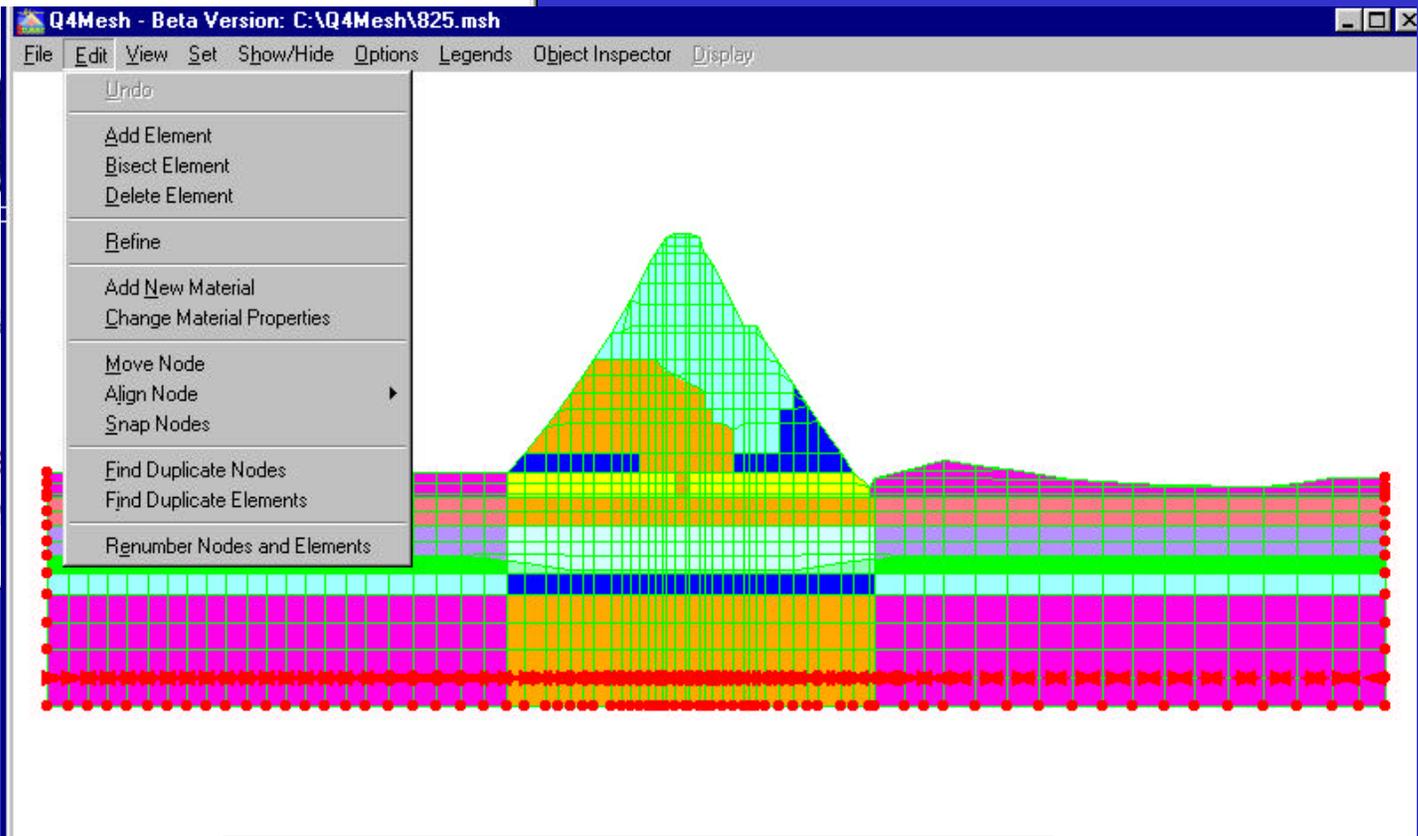
- Accelerogram or Resp. Spectrum
- Database
- Processing Tool Box
- Synthetic Generation
- Site Response
- FEMA 302/273
- Documentation
- Design Earthquake**
- EQ Sources
- G Motion Attenuation
- Probabilistic (PSHA)
- Seismic Haz. Maps
- Exit



US ARMY CORPS OF ENGINEERS
WATERWAYS EXPERIMENT STATION



Compute 2-D Site Response



Site Response Options

Shake 1 - D **Quad 4M 2 - D**

Cancel Continue

Quad4M Pre- Post- Processor

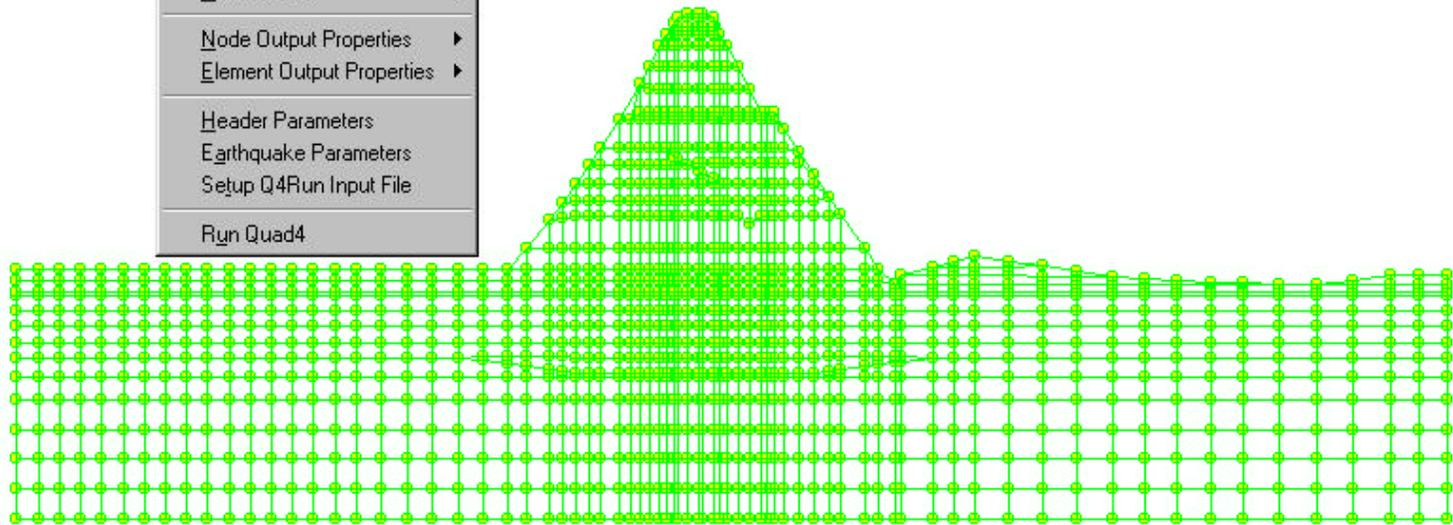
Use Left Mouse Button to Draw a Box. Press ESC to End Zoom

-487.740 309.179

Q4Mesh - Beta Version: C:\Q4Mesh\825.msh

File Edit View Set Show/Hide Options Legends Object Inspector Display

- Boundary Conditions ▶
- Segment Block ▶
- Material
- Refine Mode ▶
- Node Output Properties ▶
- Element Output Properties ▶
- Header Parameters
- Earthquake Parameters
- Setup Q4Run Input File
- Run Quad4



Use Left Mouse Button to Draw a Box. Press ESC to End Zoom

-487.740 . 311.644

Compute 2-D Dynamic Site Response

Q4Mesh - Beta Version: C:\Q4Mesh\825.msh

File Edit View Set Show/Hide Options Legends Object Inspector Display

- Boundary Conditions ▶
- Segment Block ▶
- Material
- Refine Mode ▶
- Node Output Properties ▶**
 - X Acl Output
 - Y Acl Output
 - Both XY Acl Output
 - Clear All
- Element Output Properties ▶
- Header Parameters
- Earthquake Parameters
- Setup Q4Run Input File
- Run Quad4

Node Information

Node Number	1161
X Coordinate	9
Y Coordinate	217.888
Boundary Conditions / Degrees of Freedom	
FREE	
Node Data (Post Processing)	
Peak X Acceleration	
Peak Y Acceleration	
Peak X Acceleration Time	
Peak Y Acceleration Time	
Close Information Window	

```

QUAD4M
10 x 20
ELEMENT 263, TAU XY IN FILE: 82502.04S
NODE 263, X DIR IN FILE: 82500.04A
NODE 263, Y DIR IN FILE: 82501.04A
NODE 267, X DIR IN FILE: 82502.04A
NODE 267, Y DIR IN FILE: 82503.04A

ITERATION NO. 1

SET UP STIFFNESS MATRIX AND COMPUTE EIGENVALUE

DAMPING SET AT THE FOLLOWING TWO FREQUENCIES:
THE FIRST NATURAL FREQUENCY: CIRC FREQ= 11.535; PERIOD= .545 SEC
1 TIMES THE NATURAL FREQ.: CIRC FREQ= 11.535; PERIOD= .545 SEC

TIME REQUIRED FOR FORMATION AND TRIANGULIZATION OF MATRICES = 17. SEC
TRIANGULARIZE EFFECTIVE STIFFNESS MATRIX
START DYNAMIC COMPUTATION

** IT = 1 STEP NO. = 48 AT TIME = .2400
    
```

ESC to End Zoom

EQMotion User Interface - Beta Version

About

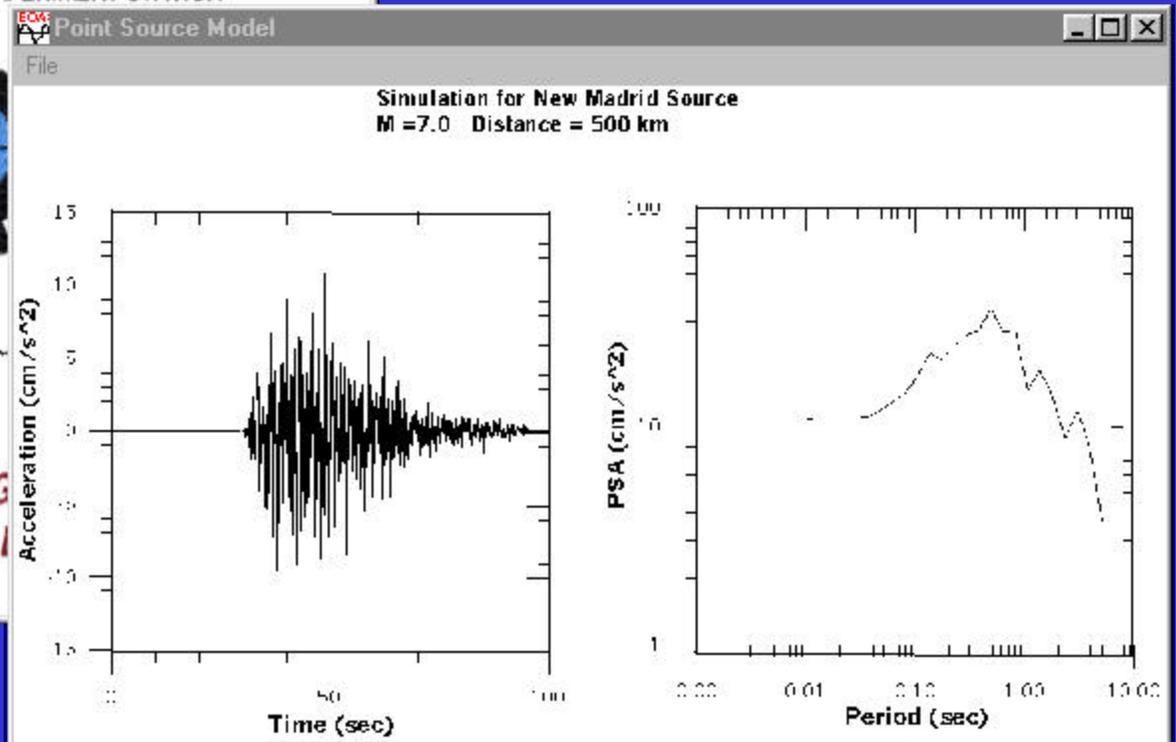
- Accelerogram or Resp. Spectrum
- Database
- Processing Tool Box
- Synthetic Generation
- Site Response
- Help
- Documentation
- Design Earthquake
- Faults
- G Motion Attenuation
- Probabilistic (Seismic Haz.)
- Exit

US ARMY CORPS OF ENGINEERS
WATERWAYS EXPERIMENT STATION




Synthetic Generation

- Statistical
- Floating Earthquake
- Spectrum Matching
- Frequency Domain
- Time Domain
- Modeling
- Point Source
- Finite Fault
- Exit



Synthetics: Finite Fault Modeling

EQMotion User Interface - Beta Version

Project About Help

Accelerogram or Resp. Spectrum

Database

Processing Tool Box

Synthetic Generation

Site Response

Help

Circular Zone Parameters

Circular Zone

Source Zone Radius 50

Ring Increment Radius 10

Cancel Continue

Synthetic Generation

Statistical

Floating Earthquake

Spectrum Matching

Frequency Domain

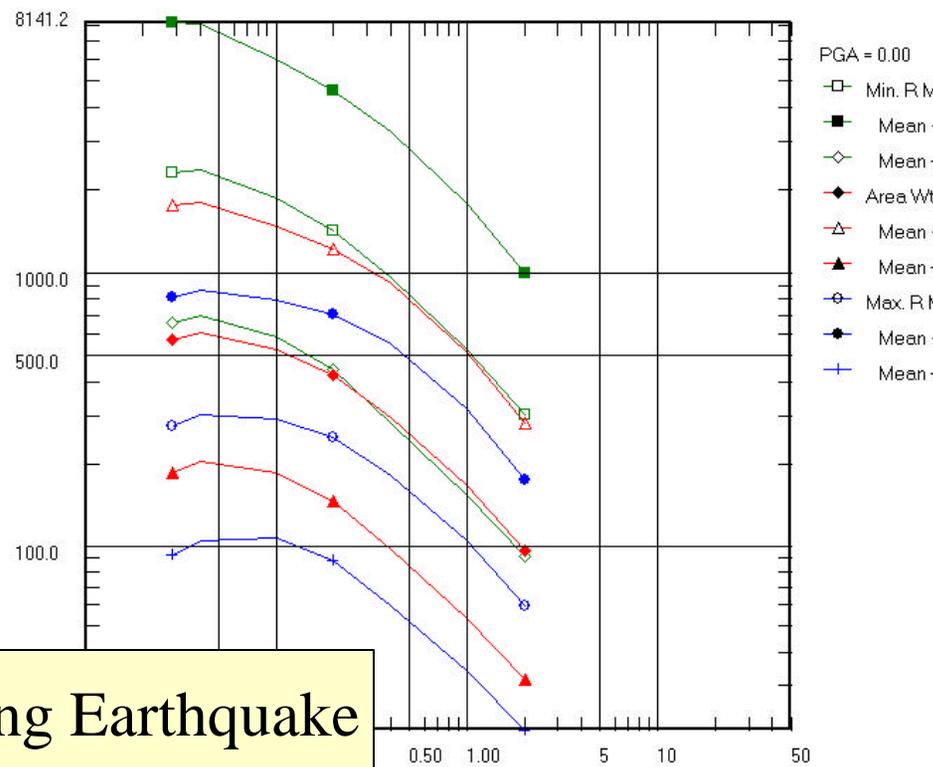
Time Domain

Modeling

Floating Earthquake Response Spectra

File Modify

Period (secs) Vs Acceleration : Floating EQ - Source Radius = 50 - Ring Increment = 10



Synthetics: Floating Earthquake

Acceleration

Velocity

Progress FY01

- ❑ **Database-** External Link and Formatter for web databases
- ❑ **Deagg Data** - Deaggregation data now available for 600 Corps dams.
(Added 500+ dams this FY)
New Plotting Capabilities for Deagg Data of Corps Dams
- ❑ **DSHA-** updating CEUS source zones, Cascadia subduction zone
- ❑ **Fault relationships, fault and earthquake database**
- ❑ **Updated ground motion attenuation relationships**
- ❑ **Updated reference documents (PDF format)**
- ❑ **Developed new and easier installation techniques for data and the program**

Progress FY01

The “whole enchilada” - *continues*

 **Time History and Spectra Toolbox**

Spectral and time based scaling

Spectrum modification

Acceleration corrections (baseline)

**Facilitates one stop comparison of spectrum
time history, and spectrum of three spectra**

Spectrum smoothing

Time history extraction

.....

.....

Technology Transfer

Windows Version fielded

Training Platform for Prospect Course
(Seismic Analysis: June of 98, 99 & 00)

Presented the program at Corps Geotechnical
Conference, Portland

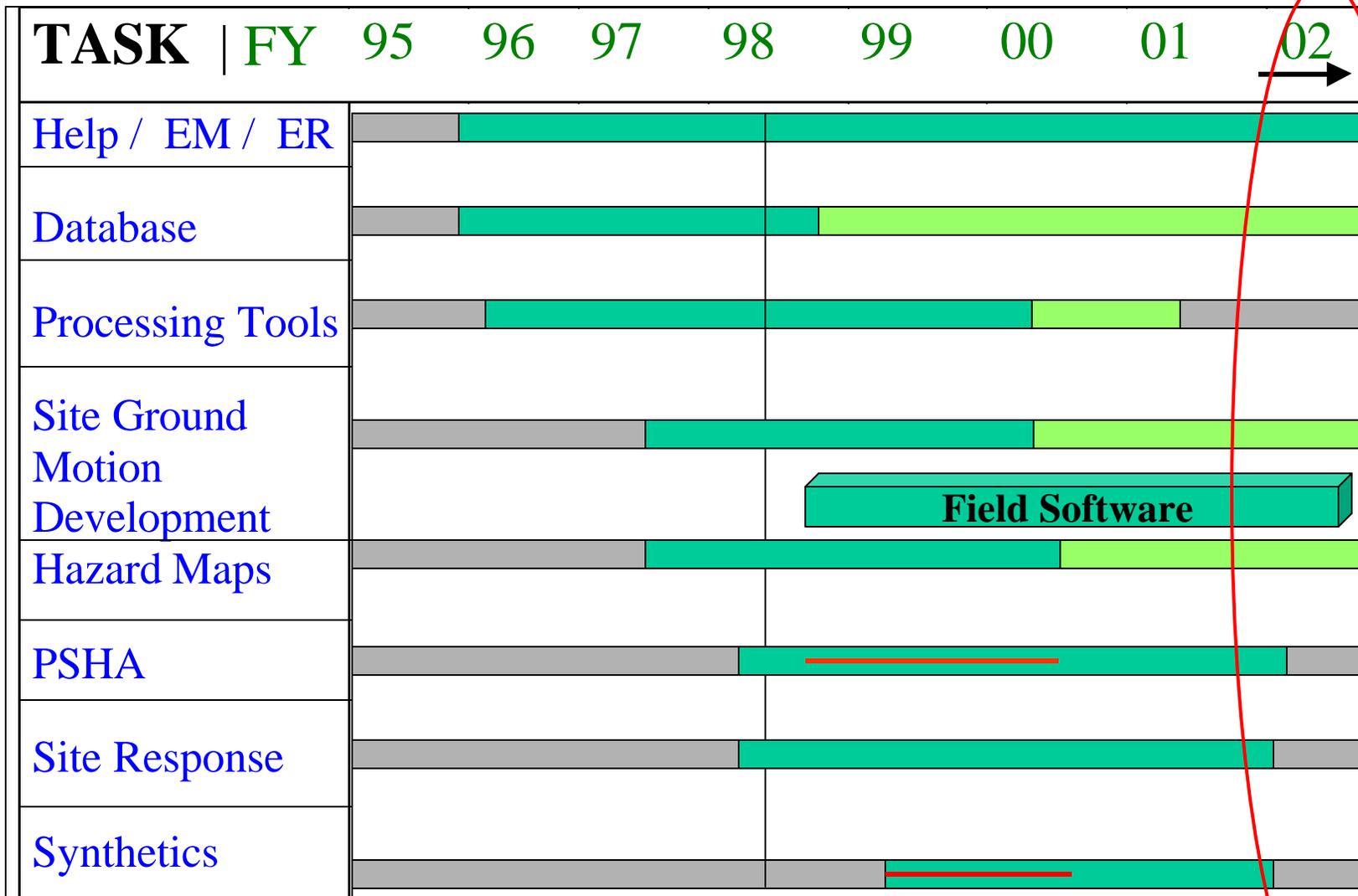
Seminar and Demo at EQEN II FOC Workshop

Next Stop:

Corps Infrastructure Conference, Reno

Project Support

- **Districts Seismic Safety Evaluations**
 - Vicksburg**
 - Sacramento**
 - New England (30 dams)**
 - Albuquerque**
 - Los Angeles**
 - Portland**
 - Tulsa (30 dams)**
- **Portfolio Risk Assessments**
 - Huntington**



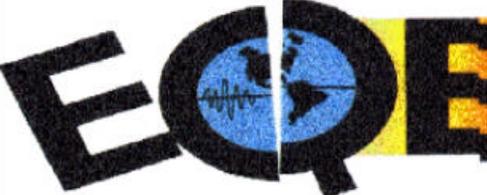
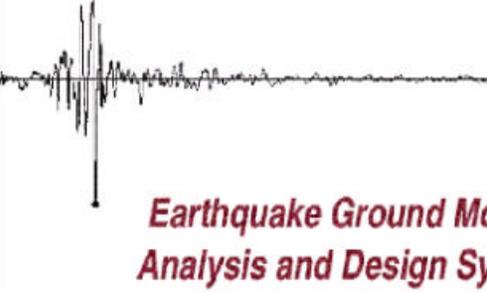
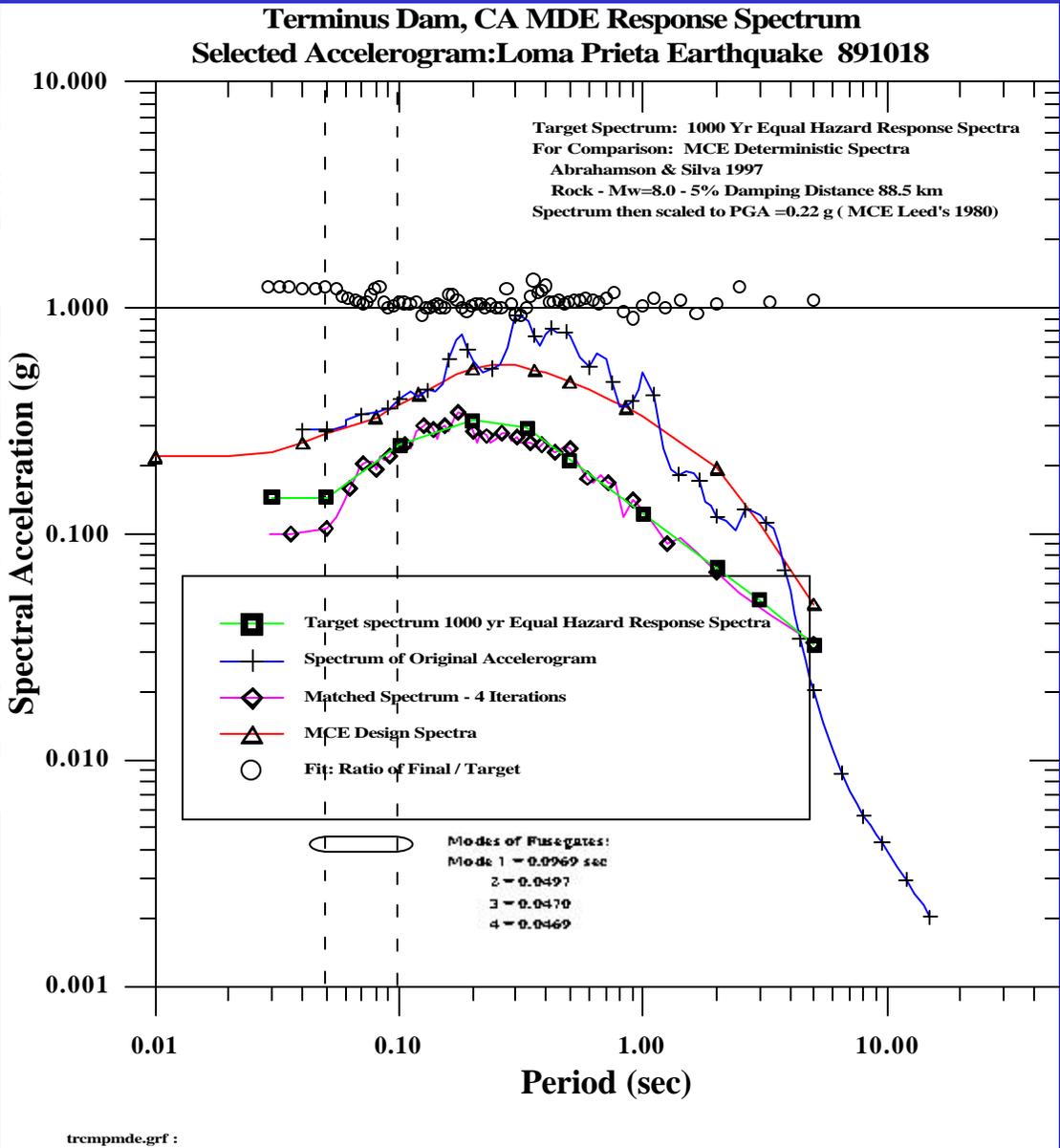
Score Card ?

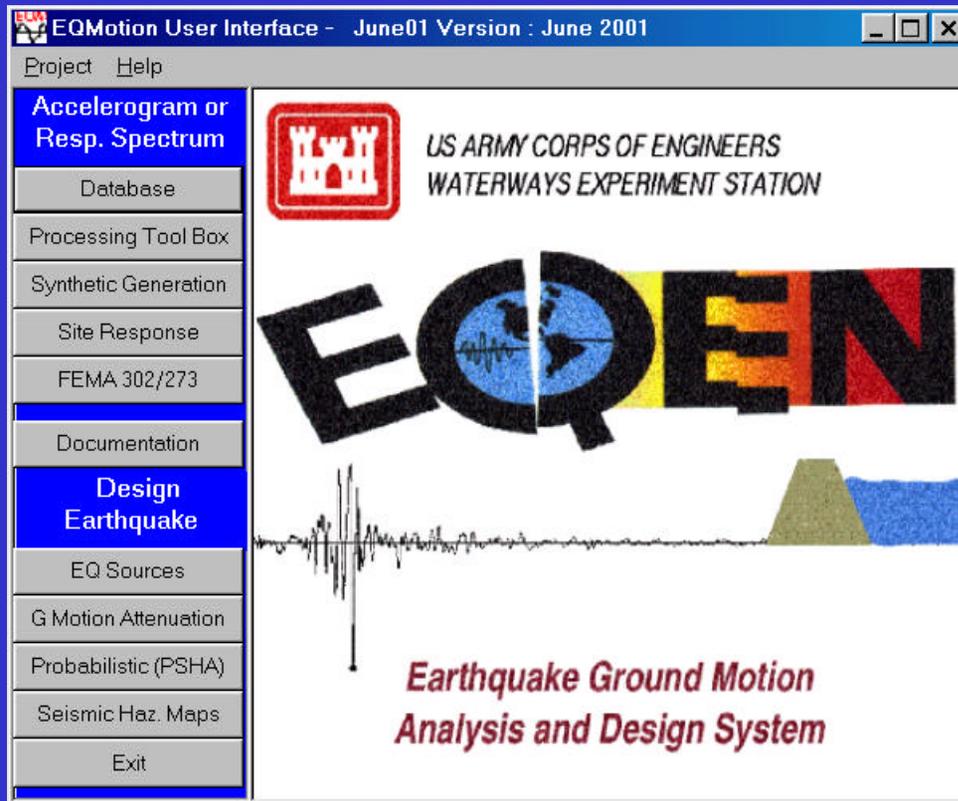
Development of Deterministic and Probabilistic Spectral Matched Earthquake Ground Motions

EQMotion User Interface - June01 Version : June 2001

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End of Presentation