INNOVATIVE APPROACHES TO PORT CHALLENGES
September 14, 2006

PORT OF LOS ANGELES
SEISMIC ENGINEERING PROGRAM

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The Port of Los Angeles Today

- One of the largest manmade seaports in the world
- A diverse port
  - Containerized Cargo
  - Automobiles, coal, liquid bulk, “walking cargo”
  - Recreation
  - Fishing
The Port of Los Angeles

• 7,500 Acres
  » Land (4,200)
  » Water (3,300)
• 43 Miles of Waterfront
• 8 Major Container Terminals (Approximately 1,600 Acres)
• 33,000 LF of Container Wharf
• 10,000 LF of Recently Constructed State-of-the-art Wharves
Seismic Risk
1933 - Long Beach Earthquake
1962 – Start of Containerization
1971 – San Fernando Earthquake
1981 - POLA State-of-the-art Container Berthing Study
1984 - 2020 Plan
POLA Risk Strategies – 2020 Plan

POLA 2020 Plan:
- Large increase in container traffic was predicted over the next 30 years
- Major port expansion is planned
- Needs deeper water and larger wharves to accommodate the growth
2020 Plan Resolution:

- A seismic design guideline with uniformed approach was necessary
- The call for a seismic workshop to establish such criteria
In The Workshop:

• Look at the Port as a system and perform a seismic risk analysis.

• Define the seismic hazard.

• Develop engineering procedures for the seismic design and retrofit of port facilities.
Look at the Port as a system and perform a seismic risk analysis

Seismic Risk Analysis

Initialization

- Identify/Assess Seismic Hazards
- Assess Component Vulnerabilities
- Assess System Performance

Is Performance Acceptable?

- Yes: FINISH
- No: Modify System?

Modify System?

- Yes: Define System
  - Define Seismic Improvement Options
  - Define Performance Metrics
  - Define Target Performance
- No: Modify Components?

Modify Components?

- Yes: Accept Performance Level
- No: No

Yes: Accept Performance Level

Yes: Accept Performance Level

No: No

No: No
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Define the Seismic Hazard

Seismic Hazard Evaluation

San Andreas Fault approx. 50+ miles from POLA
In The Workshop:

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• Develop engineering procedures for the seismic design and retrofit of port facilities.
Develop Engineering Procedures for the Seismic Design and Retrofit of Port Facilities

Current Design Criteria

- Operating Level Earthquake (OLE)
  - Hazard criteria 50% probability of exceedance in 50 years (72-year recurrence interval)
  - Insignificant damage

- Contingency Level Earthquake (CLE)
  - Hazard criteria 10% probability of exceedance in 50 years (475-year recurrence interval)
  - No collapse of wharf
Develop Engineering Procedures for the Seismic Design and Retrofit of Port Facilities

Categorization of Existing Facilities

Category 1 – Wharves with full seismic strength

Category 2 – Wharves with near full seismic strength

Category 3 – Post 1980’s wharves with partial seismic strength

Category 4 – Wharves prior to 1980’s with little or no seismic strength
Seismic Code Objectives

• Use as guideline for design and construction of container wharves at POLA
• FEMA recognized code for post disaster recovery reimbursement
Develop Engineering Procedures for the Seismic Design and Retrofit of Port Facilities

Seismic Code Development

- Technical Advisory Board
- Port funded experimental program at UCSD
- POLA/COPRI co-sponsored seismic workshop to present first version of code
- Port-wide ground motion study
- Code revision currently in process
Develop Engineering Procedures for the Seismic Design and Retrofit of Port Facilities

Seismic Code Publication

- Latest version of code and commentary
- Background information on theory behind the code
- Design examples
- Experimental program findings