UPGRADE OF BERTHS 226-236 EVERPORT CONTAINER WHARF TERMINAL AT THE PORT OF LOS ANGELES

A. Lim, PE, SE

1 Senior Structural Engineer, Port of Los Angeles, Los Angeles, CA

Tuesday, June 26, 2018
THE PORT OF LA

7,500 acres
* 4,300 land and 3,200 water

43 miles of Waterfront
* Water depth of -53 ft

270 berths
* Includes 30 berths with Alternative Maritime Power™ (AMP™)

86 container cranes
* Includes 37 super Post-Panamax cranes and dual-trolley cranes

Public Amenities & Attractions
* Battleship IOWA and 2 other museums
* CRAFTED at the Port of Los Angeles marketplace
* Hotel, Restaurants & Retail
* 15 Marinas; 3,700+ recreational boat slips
A “Full Service” Port

Containers: 8,856,782 TEUs, +8.5%

Autos (WWL): 199,027 units, +21%

Liquid Bulk (Petroleum): 93,223,412 barrels, -15%

Steel (PASHA): 2,215,390 metric tons, -18%

Scrap Metal: 635,856 metric tons, -15%

Fruit (SSA): 79,386 metric tons, -12%

Cruise: 602,464 passengers in 2016, +1.7%

Visitors to LA Waterfront: 1.9 million in 2016, +19%
Port of Los Angeles Advantages
POLA Projects

- B. 121-131 Terminal Redevelopment
- MOTEMS Repairs
- B. 93 Customs Improvements
- B. 91-93 AMP Upgrade
- B. 84 Wharf Rehabilitation
- Sampson Way Intersection
- San Pedro Public Market Promenade & Town Square
- AltaSea
- B. 200 Rail Yard Track Connections Enhancements
- B. 196-200A Wharf Rehabilitation
- Avalon Promenade & Gateway
- Wilmington Promenade
- B. 214-220 ICTF Expansion
- B. 226-236 Terminal Redevelopment

Capital Improvement Projects
Berths 214-220 Yusen Terminal
COMPLETED 2017

**Project Elements**
- 2,600 LF wharf upgrade
- -53’, 47’ water depth
- Underwater bulkhead
- New landside crane girder

**Schedule**
- EIR certification: 10/16/14
- Start: 2015
- Completed: 2018
- Project Total: $58.0 Million
Berth 226-236 Everport Terminal

WHY?
Accommodate 14,000 TEU VESSEL
Operational Upgrade

- 2,800 LF wharf upgrade Berths (-53’, -47’ Depth)
- 1,500 LF Underwater bulkhead – deepening of mudline elevation
- Continuous sheet pile (AZ36-700N)
- 1.5 acre backland
- New bollards and fenders accommodate 14,000 TEU vessels
- Install 5 AMP
- Electrical upgrade for 3 Added Cranes
- Demolish two marine buildings
- 3,110 LF Panzer belt removal liner and replacement
- 1.5 Acres Expansion
- 8 Post Panamax cranes
- Design Complete July 2018
  (In House Project!)
- Construction Start Fall 2018
- Total Cost $65M
A 14,000 TEU vessel costs less per slot than a 4,800 TEU vessel.
11 cranes exist on the facility

Backlands consist of 205 acres
## Berthing & Mooring

ROPES software by Pinkster Marine Hydrodynamics (PMH BV) ship to ship interaction forces six degrees surge, sway, heave, roll, pitch and yaw.

### Vessel Class

<table>
<thead>
<tr>
<th>Vessel Class</th>
<th>18,000 TEU Container Carrier</th>
<th>13,800 TEU Container Carrier</th>
<th>8,000 TEU Container Carrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length Overall (LOA, ft)</td>
<td>1312.3</td>
<td>1208.6</td>
<td>1098.1</td>
</tr>
<tr>
<td>Length between Perpendiculars (LBP, ft)</td>
<td>1257.9</td>
<td>1154.6</td>
<td>1039.8</td>
</tr>
<tr>
<td>Width/Beam (ft)</td>
<td>192.9</td>
<td>167.3</td>
<td>150.2</td>
</tr>
<tr>
<td>Moulded Depth (ft)</td>
<td>107.9</td>
<td>97.9</td>
<td>82.0</td>
</tr>
<tr>
<td>Design Draft (ft)</td>
<td>47.6</td>
<td>47.6</td>
<td>44.3</td>
</tr>
<tr>
<td>Displacement (Metric tonne)</td>
<td>250,000</td>
<td>180,000</td>
<td>135,000</td>
</tr>
<tr>
<td>Loaded Lateral Wind Area (ft²)</td>
<td>190,670</td>
<td>158,700</td>
<td>110,290</td>
</tr>
<tr>
<td>Loaded Frontal Wind Area (ft²)</td>
<td>31,021</td>
<td>28,100</td>
<td>19,660</td>
</tr>
<tr>
<td>Number of Mooring Lines</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Mooring Line Type</td>
<td>TIMM Signal Master</td>
<td>Nylon</td>
<td>TIMM Signal Master</td>
</tr>
<tr>
<td>Mooring Line MBL (kips)</td>
<td>307</td>
<td>265</td>
<td>250</td>
</tr>
</tbody>
</table>
Everport, Berths 226-236, was designed for a mudline elevation near the US Pierhead (USPH) line of approximately -45 ft. Mean Lower Low Water (MLLW) near the USPH line.

For the wharf upgrade, the mudline elevation at B226-228 is being deepened to -53 ft. and at B230-232 deepened to -47 MLLW near the USPH line.
Design:
- Water & Landside girders from 20-25 klf to 35 klf
- UWB - underwater bulkhead
- Interferences
- Face of dock 2ft-6” clearances
- Sheet pile batter 1H:20V under water

New 3’ steel spacer
- Existing sheetwall
- New underwater bulkhead
UNDER WATER BULKHEAD

Existing King/Sheetpile System

New Sheetpile System

Special Connector

Existing A Row
SEISMIC RESISTING SYSTEM

- Seismic Pile
- Landside Rail
- Existing Concrete Wharf
- New Concrete Deck
- Landside Rail
- Landside Rail
- Landside Rail
- Landside Rail
- Tie-Beam
- Existing Concrete Deck
- Existing Concrete Deck
Existing tie beams and landside girder Design Criteria – 1995

POLA Seismic Code 2004


Underwater Bulkhead:
- Service/operational conditions
- Operational Level Earthquake (OLE) event (EQ having a 50 percent probability of exceedance in 50 years)

Design Codes

Adopted By

FEMA/NEHRP
ASCE7-10
IBC-2015
CBC-2016
LABC-2017

Code Titles:
- IBC - International Building Code
- CBC - California Building Code
- LABC - Los Angeles Building Code – Los Angeles Department of Building & Safety
Container Wharves at POLA

**POLA CODE 2010:**

**Operational Level Earthquake (OLE):** The seismic event that produces ground motions associated with a 72-year return period. The 72-year return period ground motions have a 50% probability of being exceeded in 50 years.

**Contingency Level Earthquake (CLE):** The seismic event that produces ground motions associated with a 475-year return period. The 475-year return period ground motions have a 10 percent [%] probability of being exceeded in 50 years.

**Design Earthquake (DE):** Design earthquake as defined in ASCE 7-05 Section 11.2.
<table>
<thead>
<tr>
<th>Code/Criteria</th>
<th>Specified Ground Motion</th>
<th>Applicable Structures</th>
<th>PGA(g)</th>
<th>Ground Motion Used in Analysis of Structures</th>
<th>Liquefaction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POLA Code for Seismic Design, Upgrade and Repair of Container Wharves</strong></td>
<td>OLE – Operating Level Earthquake: 72-Year Return Period. No significant structural damage.</td>
<td>Container Wharves</td>
<td>0.23</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>CLE – Contingency Level Earthquake: 475-Year Return Period. Reparable damage with controlled inelastic structural behavior.</td>
<td>Container Wharves</td>
<td>0.52</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>DE – Design Earthquake as defined in ASCE 7-05 11.2. Safeguard life and against major structural failures.</td>
<td>Highway Bridges</td>
<td>0.59</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Caltrans Seismic Design Criteria</strong></td>
<td>DE – Design Earthquake: Greater of earthquake with maximum of 975-Year Return Period or deterministic earthquake.</td>
<td>Highway Bridges</td>
<td>0.50</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>CBC 2010 (ASCE 7-05)</strong></td>
<td>DE – Design Earthquake as defined in ASCE 7-05 11.2. Safeguard life and against major structural failures.</td>
<td>Buildings</td>
<td>0.59</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>ASCE 7-10</strong></td>
<td>DE – Design Earthquake as defined in ASCE 7-10 11.2. Safeguard life and against major structural failures.</td>
<td>Buildings</td>
<td>0.59</td>
<td>✓</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.89</td>
<td>-</td>
<td>✓</td>
</tr>
</tbody>
</table>
Current and Future Activities

Wharf upgrades and expansion to accommodate larger vessels

Inspection and rehabilitation of existing facilities

Further research –
  ◦ Update POLA code
  ◦ Check discrete/consecutive earthquakes requirements - Non linear time history analysis to verify different wharves configuration and soil conditions
  ◦ Verify linked wharf and crane-wharf interaction requirements
  ◦ Seismic Instrumentation Plan
## POLA Infrastructure Maintenance Program

<table>
<thead>
<tr>
<th>Infrastructure Type</th>
<th>Inventory (as of June 2016)</th>
<th>Develop Assessment Criteria</th>
<th>Initial Assessment Completion (%)</th>
<th>Projects Programmed ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timber Wharves</td>
<td>13,000 LF</td>
<td>✓</td>
<td>✓</td>
<td>15%</td>
</tr>
<tr>
<td>Concrete Wharves</td>
<td>61,000 LF</td>
<td>✓</td>
<td>✓</td>
<td>16%</td>
</tr>
<tr>
<td>MOTEMS Wharves</td>
<td>7,100 LF</td>
<td>✓</td>
<td>✓</td>
<td>94%</td>
</tr>
<tr>
<td>Bridges – Rail, Road, and Pedestrian</td>
<td>25 Bridges</td>
<td>✓</td>
<td>✓</td>
<td>36%</td>
</tr>
<tr>
<td>Waterways</td>
<td>670 Acres/ 140,000 LF</td>
<td>✓</td>
<td>✓</td>
<td>15%</td>
</tr>
<tr>
<td>Roadways</td>
<td>27 miles</td>
<td>✓</td>
<td>✓</td>
<td>100%</td>
</tr>
<tr>
<td>Sidewalks</td>
<td>115,000 LF</td>
<td>✓</td>
<td>✓</td>
<td>100%</td>
</tr>
<tr>
<td>Electrical Systems – AMP</td>
<td>74 Vaults/3 Mobiles</td>
<td>✓</td>
<td>✓</td>
<td>100%</td>
</tr>
<tr>
<td>Electrical Systems – Switchgears</td>
<td>270 Units</td>
<td>✓</td>
<td>✓</td>
<td>25%</td>
</tr>
<tr>
<td>Water Systems – Backflow Preventers</td>
<td>1,095 Units</td>
<td>✓</td>
<td>✓</td>
<td>100%</td>
</tr>
<tr>
<td>Water Systems – Meters</td>
<td>339 meters*</td>
<td>✓</td>
<td>✓</td>
<td>100%</td>
</tr>
</tbody>
</table>

* Meters are DWP owned, but within the Port property

✓ Completed items
Acknowledgements

Marco Sanchez [msanchez@portla.org]
Brian Correa [bcorrea@portla.org]
Omar Jaradat [ojaradat@moffatnichol.com]
Arul Arulmoli [arulmoli@earthmech.com]
Monica Martinez-Maruri [mmaruri@moffatnichol.com]

Thank you!