CALENDAR ITEM
C58

A	Statewide	10/22/09 W9777.226
S	Statewide	M. Eskijian G. Gregory

PROPOSAL:

CONSIDER APPROVAL OF MINOR REVISIONS TO THE MARINE OIL TERMINAL ENGINEERING AND MAINTENANCE STANDARDS (MOTEMS). THIS PROPOSAL INVOLVES SOME MINOR CORRECTIONS AND CHANGES TO SPECIFIC PERFORMANCE STANDARDS.

BACKGROUND:

Under the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act of 1990 (the Act), the California State Lands Commission is mandated to adopt rules and regulations for the performance standards of marine oil terminals. In August 2004, the Commission approved the "Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS), which were adopted by the California Building Commission (BSC) in January 2005, and became Chapter 31F of the California Building Standards Code (Title 24, Part 2, Vol. 1) with an effective date of February 6, 2006. After this effective date, marine oil terminals throughout California, whether on land leased from the state, or within port authorities, must comply with all of the requirements of the MOTEMS. To date, 11 high risk terminals have submitted initial "audits" that provide an assessment of the terminal's fitness-for-purpose. During the next two years, 31 moderate and low risk terminals will submit their initial audits.

This proposal is to amend the existing MOTEMS, with some corrections and changes to specific performance standards. These proposed revisions have gone through two periods of public comment, with the final comment period ending September 30, 2009.

Seven sections of the proposed regulatory text that were originally noticed to the public and to the State's Interagency Oil Spill Committee were amended. The final regulatory text is shown in Exhibit "A".

STATUTORY AND OTHER REGULATIONS:

A. P.R.C. Sections 8750 through 8760.

OTHER PERTINENT INFORMATION:

1. Pursuant to the Commission's delegation of authority and the State CEQA Guidelines (14 Cal. Code Regs. §10561), the Commission Staff has determined that this activity is exempt from the requirements of the CEQA because the activity is not a "project" as defined by the CEQA and the State CEQA Guidelines.

   Authority: P.R.C. §21084 and 14 Cal. Code Regs. §15300.

2. The proposed regulatory amendments do not affect small businesses as defined in Gov. C. Section 11342.610, because all affected businesses are either petroleum refiners, as specified under Gov. C. Section11342, sub. (b)(9), or transportation and warehousing businesses having annual gross receipts of more than $1,500,000, as specified under Gov. C. Section 11342.610 sub. (c)(7).

Exhibit:

A. Proposed Express Terms.

IT IS RECOMMENDED THAT THE COMMISSION:

1. FIND THAT THE ACTIVITY IS EXEMPT FROM THE REQUIREMENTS OF CEQA PURSUANT TO TITLE14, CALIFORNIA CODE OF REGULATIONS, SECTION 15061 BECAUSE THE ACTIVITY IS NOT A PROJECT AS DEFINED BY PUBLIC RESOURCES CODE SECTION 21065 AND TITLE 14, CALIFORNIA CODE OF REGULATIONS, SECTION 15378

2. FIND THAT THE REGULATIORY AMENDMENTS DO NOT AFFECT SMALL BUSINESSES AS DEFINED IN GOV. C. SECTION 11342.610, BECAUSE ALL AFFECTED BUSINESSES ARE EITHER PETROLEUM REFINERS, AS SPECIFIED UNDER GOV. C. SECTION 11342.610(b)(9), OR TRANSPORTATION AND WAREHOUSING BUSINESSES HAVING ANNUAL GROSS RECEIPTS OF MORE THAN $1,500,000, AS SPECIFIED UNDER GOV. C. SECTION 1342.610(c)(7).

3. FIND THAT THE REGULATORY AMENDMENTS WILL NOT HAVE A SIGNIFICANT IMPACT ON THE CREATION OR ELIMINATION OF JOBS OR NEW OR EXISTING BUSINESSES WITHIN CALIFORNIA, NOR WILL THEY HAVE AN ADVERSE ECONOMIC IMPACT ON BUSINESS, INCLUDING THE

ABILITY OF CALIFORNIA BUSINESSES TO COMPETE WITH BUSINESSES IN OTHER STATES.

4. FIND THAT NO ALTERNATIVE WOULD BE MORE EFFECTIVE IN CARRYING OUT THE PURPOSE FOR WHICH THE REGULATION IS PROPOSED OR WOULD BE AS EFFECTIVE AND LESS BURDENSOME TO AFFECTED PRIVATE PERSONS THAN THE PROPOSED REGULATION.

5. DIRECT THE COMMISSION STAFF TO TAKE WHATEVER ACTION IS NECESSARY AND APPROPRIATE TO COMPLY WITH PROVISIONS OF THE GOVERNMENT CODE REGARDING ADOPTION OF REGULATIONS AND AMENDMENTS AND TO ENSURE THAT THE REGULATIONS BECOME EFFECTIVE.

6. APPROVE THE PROPOSED REVISIONS TO THE MOTEMS STANDARDS FOR SUBMISSION TO THE BUILDING STANDARDS COMMISSION FOR ADOPTION. THESE REVISIONS ARE IN THE FORM SET FORTH IN EXHIBIT "A" WHICH IS ON FILE AT THE OFFICE OF THE CALIFORNIA STATE LANDS COMMISSION.

7. AUTHORIZE THE COMMISSION STAFF TO MAKE NON SUBSTANTIVE MODIFICATIONS TO THE PROPOSED REVISIONS IN RESPONSE TO RECOMMENDATIONS BY THE CALIFORNIA BUILDING STANDARDS COMMISSION.

PROPOSED MODIFIED EXPRESS TERMS
FOR
BUILDING STANDARDS
OF THE
CALIFORNIA STATE LANDS COMMISSION

REGARDING AMENDMENTS TO
CHAPTER 31F, MARINE OIL TERMINALS
2007 CALIFORNIA CODE OF REGULATIONS, TITLE 24, PART 2

LEGEND FOR EXPRESS TERMS

1. Existing California amendments or code language being modified: All such language appears in *italics*, modified language is underlined.
2. New California amendments: All such language appears *underlined and in italics*.
3. Repealed text: All such language appears in ~~strikeout~~.

The CSLC has proposed changes to ninety-one (91) sections during the first comment period from 12/26/08 through 02/24/09. Pursuant to the comments received, changes were made to seven (7) sections of those originally proposed express terms. The second comment period was observed from 09/16/09 through 09/30/09 and no comments were received during this period. However, late comments are addressed in the Final Statement of Reasons.

EXPRESS TERMS

1. ***3102F.1.2 Audit and Inspections Types.***

TABLE 31F-2-1

INITIAL AUDIT REPORT SUBMISSION DEADLINE FOR EXISTING BERTHING SYSTEMS

RISK CLASSIFICATION[1]	*SUBMISSION DEADLINE[2]*
High	*30 Months*
Medium	*48 Months*
Low	*60 Months*

1 As defined in Table s 31F-4-1 ~~and 31F-5-1~~
2 From the effective date of this Chapter 31F

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

2. ***3102F.1.3. Berthing Systems.*** First paragraph, last sentence.

"…components that serve the berth ~~and the entire pipeline~~ and pipeline systems as defined in Title 2 CCR §2560 and 2561(n). ~~from the loading arm or manifold to the limit of SLC jurisdiction last valve before the pipeline enters a tank storage area.~~

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

3. ***3102F.3.4.8 Geotechnical Analyst.*** *A California registered Civil Engineer with a California authorization as a Geotechnical Engineer shall perform the geotechnical evaluation required for the audit and all other geotechnical evaluations.*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

4. ***3102F.3.2 Overview.*** 3rd paragraph.

~~Representative~~ A rational and representative underwater sampling of piles may be acceptable with Division approval, for cases of limited visibility, heavy marine growth, restricted inspection times because of environmental factors (currents, water temperatures, etc.) or a very large number of piles ~~[2.2]~~.
…

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

5. ***3102F.3.3.2 Subsequent Audits.*** 3rd paragraph

"…*defined purpose (see ~~subs~~ Section 3102F.3.6.1) of the berthing system, then…"*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

6. ***3102F.3.4.3 Structural Inspection Team.*** 2nd,3rd, & 4th paragraphs.

"…Certification in Engineering Technologies (NICET) shall also be acceptable [2.~~3~~2].

"…the underwater examination [2.~~3~~2].

"…lesser technical qualifications [2.~~3~~2].

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

7. ***3102F.3.5.2 Underwater Structural Inspection.*** 2nd Paragraph.

"...are described below, per [2.~~3~~2]:

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

8. ***3102F.3.5.2 Underwater Structural Inspection.***

TABLE 31F-2-3
UNDERWATER INSPECTION LEVELS OF EFFORT [2.~~3~~2]

LEVEL	PURPOSE	DETECTABLE DEFECTS			
		STEEL	CONCRETE	TIMBER	COMPOSITE
I	*General visual/tactile inspection to confirm as-built condition and detect severe damage*	*Extensive corrosion, holes* *Severe mechanical damage*	*Major spalling and cracking* *Severe reinforcement corrosion* *Broken piles*	*Major loss of section* *Broken piles and bracings* *Severe abrasion or marine borer attack*	*Permanent deformation* *Broken piles* *Major cracking or mechanical damage*
II	*To detect surface defects normally obscured by marine growth*	*Moderate mechanical damage* *Corrosion pitting and loss of section*	*Surface cracking and spalling* *Rust staining* *Exposed reinforcing steel and/or prestressing strands*	*External pile damage due to marine borers* *Splintered piles* *Loss of bolts and fasteners* *Rot or insect infestation*	*Cracking* *Delamination* *Material degradation*
III	*To detect hidden or interior damage, evaluate loss of cross-sectional area, or evaluate material homogeneity*	*Thickness of material* *Electrical potentials for cathodic protection*	*Location of reinforcing steel* *Beginning of corrosion of reinforcing steel* *Internal voids* *Change in material strength*	*Internal damage due to marine borers (internal voids)* *Decrease in material strength*	*N/A*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

9. *3102F.3.5.2 Underwater Structural Inspection.*

TABLE 31F-2-4

SCOPE OF UNDERWATER INSPECTIONS [2.~~3~~2]

		SAMPLE SIZE AND METHODOLOGY ~~1, 2~~							
		Steel		***Concrete***		***Timber***		***Composite***	***Slope protection/ channel bottom or mudline-scour***
LEVEL		***Piles***	***Bulkheads/ Retaining Walls***	***Piles***	***Bulkheads/ Retaining Walls***	***Piles***	***Bulkheads/ Retaining Walls***	***Piles***	
I	***Sample Size:*** ***Method:***	*100%* *Visual/Tactile*	*100%* *Visual/Tactile*	*100%* *Visual/Tactile*	*100%* *Visual/Tactile*	*100%* *Visual/Tactile*	*100%* *Visual/Tactile*	*100%* *Visual/Tactile*	*100%* *Visual/Tactile*
II	***Sample Size:*** ***Method:***	*10%* *Visual: Removal of marine growth in 3 bands*	*Every 100 LF* *Visual: Removal of marine growth in 1 SF areas*	*10%* *Visual: Removal of marine growth in 3 bands*	*Every 100 LF* *Visual: Removal of marine growth in 1 SF areas*	*10%* *Visual: Removal of marine growth on 3 bands Measurement: Remaining diameter*	*Every 50 LF* *Visual: Removal of marine growth in 1 SF areas*	*10%* *Visual: Removal of marine growth in 3 bands*	*0%*
III	***Sample Size:*** ***Method:***	*5%* *Remaining thickness measurement; electrical potential measurement; corrosion profiling as necessary*	*Every 200 LF* *Remaining thickness measurement; electrical potential measurement; corrosion profiling as necessary*	*0%* *N/A*	*0%* *N/A*	*5%* *Internal marine borer infestation evaluation*	*Every 100 LF* *Internal marine borer infestation evaluation*	*0%*	*0%*

~~*1 The stated sample size may be reduced in the case of large structures where statistically representative sampling can be demonstrated to the Division in accordance with these standards. The sampling plan must be representative of all areas and component types (i.e. approach trestles, pier/wharf, dolphins, inboard, outboard, batter, vertical, concrete, steel, timber, etc.). Any reduced sampling plan proposed to the Division must include the Level I inspection of all piles around the perimeter of the facility where vessels may berth or where debris may impact or accumulate. If the reduced sampling plan proposes to conduct less than 100 percent Level I effort, then the results of the inspection must be carefully monitored. If significant deterioration is observed on any component, which could reasonably be expected to be present on additional components, and which could have a detrimental effect on the load bearing capacity of the structure either locally or globally, then the inspection scope shall be increased to include a 100 percent Level I effort. See reference [2.2].*~~

~~2~~1 The minimum inspection sampling size for small structures shall include at least two components.

LF = Linear Feet; SF = Square Feet; N/A = Not Applicable

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

10. *3102F3.6.3 Structure.* *"…in accordance with Sections ~~310F3~~ 3103F through 3107F. …"*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

11. ***3102F.3.6.3 Structure.***

TABLE 31F-2-5

CONDITION ASSESSMENT RATINGS (CAR) [2.~~3~~2]

RATING		***DESCRIPTION OF STRUCTURAL SYSTEMS, ABOVE AND BELOW WATER LINE***
6	***Good***	*No problems or only minor problems noted. Structural elements may show very minor deterioration, but no overstressing observed. The capacity of the structure meets the requirements of this standard.* *The structure should be considered fit-for-purpose. No repairs or upgrades are required.*
5	***Satisfactory***	*Limited minor to moderate defects or deterioration observed, but no overstressing observed. The capacity of the structure meets the requirements of this standard.* *The structure should be considered fit-for-purpose. No repairs or upgrades are required.*
4	***Fair***	*All primary structural elements are sound; but minor to moderate defects or deterioration observed. Localized areas of moderate to advanced deterioration may be present, but do not significantly reduce the load bearing capacity of the structure. The capacity of the structure is no more than 15 percent below the structural requirements of this standard, as determined from an engineering evaluation.* *The structure should be considered as marginal. Repair and/or upgrade measures may be required to remain operational. Facility may remain operational provided a plan and schedule for remedial action is presented to and accepted by the Division.*
3	***Poor***	*Advanced deterioration or overstressing observed on widespread portions of the structure, but does not significantly reduce the load bearing capacity of the structure. The capacity of the structure is no more than 25 percent below the structural requirements of this standard, as determined from an engineering evaluation.* *The structure is not fit-for-purpose. Repair and/or upgrade measures may be required to remain operational. The facility may be allowed to remain operational on a restricted or contingency basis until the deficiencies are corrected, provided a plan and schedule for such work is presented to and accepted by the Division.*
2	***Serious***	*Advanced deterioration, overstressing or breakage may have significantly affected the load bearing capacity of primary structural components. Local failures are possible and loading restrictions may be necessary. The capacity of the structure is more than 25 percent below than the structural requirements of this standard, as determined from an engineering evaluation.* *The structure is not fit-for-purpose. Repairs and/or upgrade measures may be required to remain operational. The facility may be allowed to remain operational on a restricted basis until the deficiencies are corrected, provided a plan and schedule for such work is presented to and accepted by the Division.*
1	***Critical***	*Very advanced deterioration, overstressing or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur and load restrictions should be implemented as necessary. The capacity of the structure is critically deficient relative to the structural requirements of this standard.* *The structure is not fit-for-purpose. The facility shall cease operations until deficiencies are corrected and accepted by the Division.*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

12. *3102F.3.7 Follow-up Actions.*

TABLE 31F-2-7

STRUCTURAL FOLLOW-UP ACTIONS [2.~~3~~2]

FOLLOW-UP ACTION	***DESCRIPTION***
Emergency Action	*Specified whenever a condition which poses an immediate threat to public health, safety or the environment is observed. Emergency Actions may consist of barricading or closing all or portions of the berthing system, limiting vessel size, placing load restrictions, evacuating product lines, ceasing transfer operations, etc.*
Engineering Evaluation	*Specified whenever structural damage or deficiencies are observed which require further investigation or evaluation, to determine appropriate follow-up actions.*
Repair Design Inspection	*Specified whenever damage or defects requiring repair are observed. The repair design inspection is performed to the level of detail necessary to prepare appropriate repair plans, specifications and estimates.*
Upgrade Design and Implementation	*Specified whenever the structural system requires upgrading in order to comply with the requirements of these standards and current applicable codes.*
Special Inspection	*Typically specified to determine the cause or significance of non-typical deterioration, usually prior to designing repairs. Special testing, laboratory analysis, monitoring or investigation using non-standard equipment or techniques are typically required.*
Develop and Implement Repair Plans	*Specified when the Repair Design Inspection and required Special Inspections have been completed. Indicates that the structure is ready to have repair plans prepared and implemented.*
No Action	*Specified when no further action is necessary until the next scheduled audit or inspection.*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

13. *3102F.4.4 Post-Event Ratings. A post-event rating [2.~~3~~2] shall be assigned…"*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

14. *3102F.4.4 Post-Event Ratings.*

TABLE 31F-2-8

POST-EVENT RATINGS AND REMEDIAL ACTIONS [2.~~3~~2]

RATING	***SUMMARY OF DAMAGE***	***REMEDIAL ACTIONS***
A	***No significant event-induced damage observed.***	***No further action required. The berthing system may continue operations.***
B	***Minor to moderate event-induced damage observed but all primary structural elements and electrical/mechanical systems are sound.***	***Repairs or mitigation may be required to remain operational. The berthing system may continue operations.***
C	***Moderate to major event-induced damage observed which may have significantly affected the load bearing capacity of primary structural elements or the functionality of key electrical/mechanical systems.***	***Repairs or mitigation may be necessary to resume or remain operational. The berthing system may be allowed to resume limited operations.***
D	***Major event-induced damage has resulted in localized or widespread failure of primary structural components; or the functionality of key electrical/mechanical systems has been significantly affected. Additional failures are possible or likely to occur.***	***The berthing system may not resume operations until the deficiencies are corrected.***

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

15. *3102F.5 References.*

~~*[2.2] Buslov, V., Heffron, R. and Martirossyan, A., 2001, "Choosing a Rational Sample Size for the Underwater Inspection of Marine Structures," Proceedings, Ports 2001, ASCE Conference, April 29-May 2, Norfolk, VA.*~~

[2.~~3~~2] Childs, K.M., editor, 2001, "Underwater Investigations - Standard Practice Manual," American Society of Civil Engineers, Reston, VA.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

16. ***3102F.3.6.1 Terminal Operating Limits. Figure 31F-2-1***

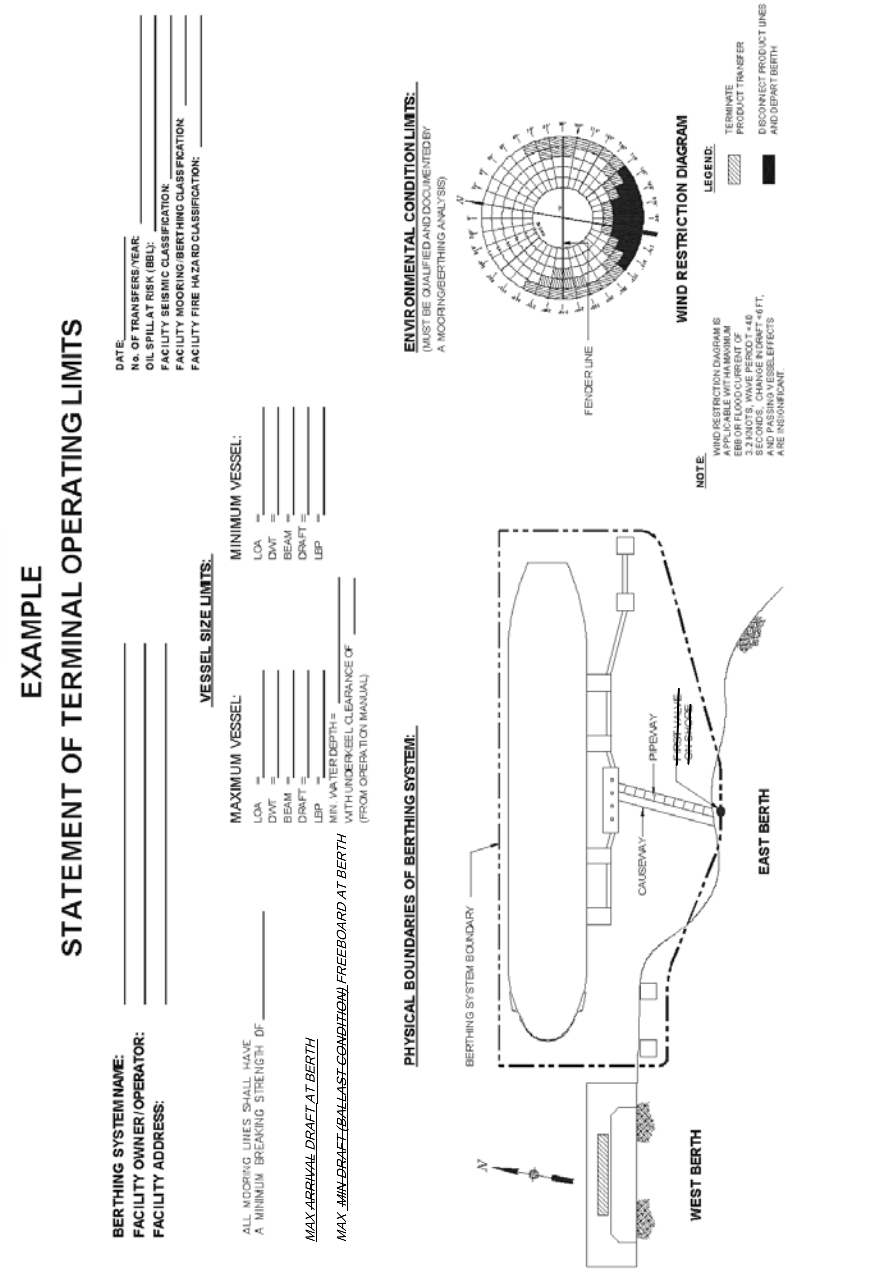


FIGURE 31F-2-1

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

17. ***3103F.4.2.2 Earthquake Motions from USGS Maps.*** "*…discussed in subsection 1.6.1 of [3.1], or the USGS web site: ~~online at~~ (~~http://geohazards.cr.usgs.gov/eq/html/canvmap.html~~) (http://earthquake.usgs.gov/research/hazmaps/) ~~or on CD ROM from the USGS~~. These are available…"*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

18. ***3103F.4.2.3 Earthquake Motions from Site-Specific Probabilistic Seismic Hazard Analyses.***

"…be obtained online at the following web site: (~~http://www.consrv.ca.gov/dmg/rghm/psha/Index.htm~~) (http://www.conservation.ca.gov/CGS/Pages/Index.aspx) [3.2].

…

~~PSHA have been developed for the Port of Los Angeles, Port of Long Beach and Port Hueneme. This assessment has included a review of onshore and offshore faulting and was performed by Lawrence Livermore National Laboratory [3.5]. Resulting response spectra are provided in Tables 31F-3-3, 31F-3-4 and Figures 31F-3-1 and 31F-3-2. Results are provided only for site classification "~~S_C~~" and five percent damping. These spectral values (DSA's) are the minimum acceptable and represent the subsurface only. To obtain appropriate values for piles and/or the mudline, the simplified procedures of subsection 3103F.4.2.4 may be used.~~

PSHA have been developed for the Ports of Los Angeles and Long Beach [3.5, 3.6] and provide site-specific information for seismic analyses. Table 31F-3-3 provides response spectra, for a 475 year return period earthquake and 5% critical damping. Figure 31F-3-1 provides the corresponding spectra for the two ports. Additionally, these references provide spectra for return periods from 72 to 2,500 years.

For the port of Port Hueneme, a PSHA was performed by Lawrence Livermore National Laboratory [3.7] and the results are shown in Table 31F-3-4 and Figure 31F-3-2. These results are provided only for site classification "S_c*" and five percent critical damping. To obtain appropriate values for piles and/or the mudline, the simplified procedures of Section 3103F.4.2.4 may be used.*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

19. ***3103F.4.2.3 Earthquake Motions from Site-Specific Probabilistic Seismic Hazard Analyses.***

~~TABLE 31F-3-3~~
~~RESPONSE SPECTRA FOR THE PORTS OF~~
~~LOS ANGELES AND LONG BEACH,~~
~~475 YEAR RETURN PERIOD (5% CRITICAL DAMPING~~)

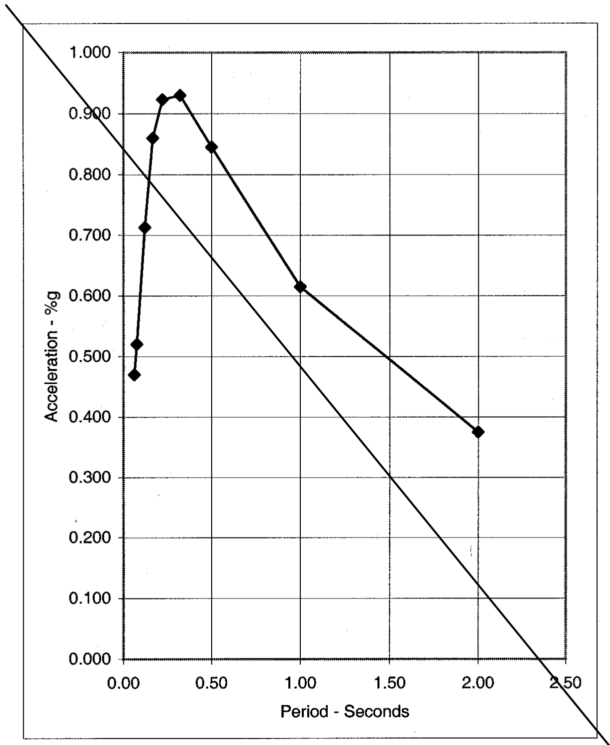
~~Site Class "C"~~ ***~~(Shear Wave Velocity from 1220-2500 ft/sec)~~***		
~~Period (sec)~~	*~~Frequency (Hz)~~*	*~~Spectral Acceleration (g's)~~*
~~0.03~~	*~~33.33~~*	*~~0.47~~*
~~0.05~~	*~~20.00~~*	*~~0.52~~*
~~0.10~~	*~~10.0~~*	*~~0.71~~*
~~0.15~~	*~~6.67~~*	*~~0.86~~*
~~0.20~~	*~~5.0~~*	*~~0.93~~*
~~0.30~~	*~~3.33~~*	*~~0.93~~*
~~0.50~~	*~~2.00~~*	*~~0.85~~*
~~1.0~~	*~~1.0~~*	*~~0.62~~*
~~2.0~~	*~~0.50~~*	*~~0.37~~*

TABLE 31F-3-3
DESIGN ACCELERATION RESPONSE SPECTRA FOR THE PORTS OF LOS ANGELES AND LONG BEACH, 475 YEAR RETURN PERIOD (5% Critical Damping)

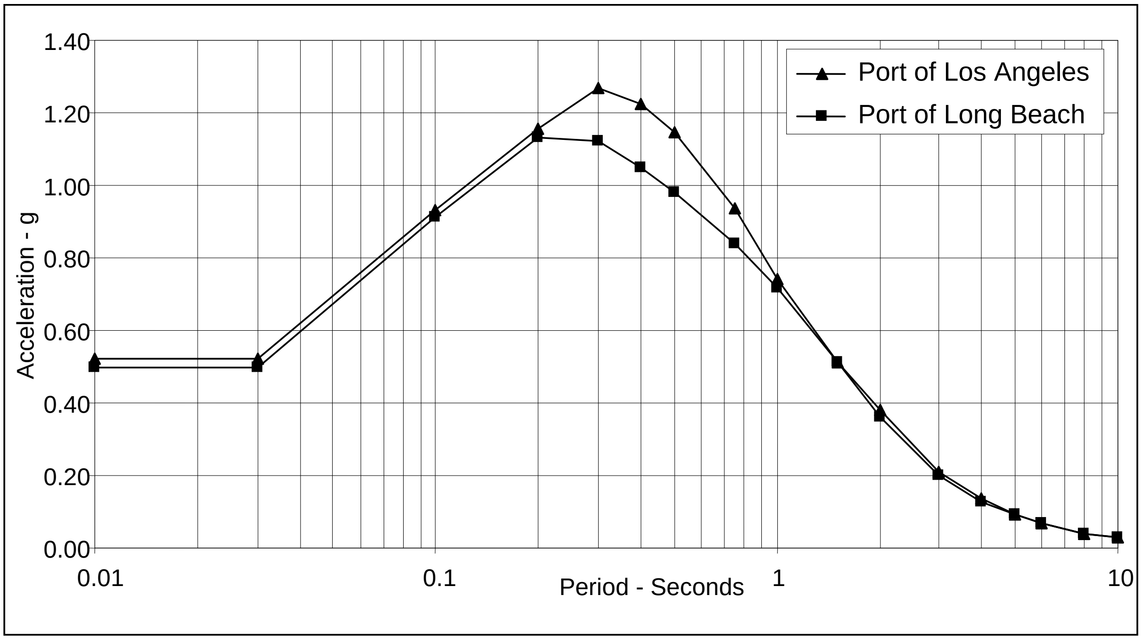
Period (sec)	*Spectral Acceleration (g's)*	
	Port of Los Angeles	*Port of Long Beach*
0.01	*0.520*	*0.500*
0.03	*0.520*	*0.500*
0.1	*0.931*	*0.910*
0.2	*1.154*	*1.132*
0.3	*1.270*	*1.121*
0.4	*1.223*	*1.050*
0.5	*1.148*	*0.980*
0.75	*0.937*	*0.840*
1.0	*0.740*	*0.717*
1.5	*0.510*	*0.510*
2.0	*0.380*	*0.362*
3.0	*0.210*	*0.199*
4.0	*0.135*	*0.128*
5.0	*0.094*	*0.091*
6.0	*0.069*	*0.068*
8.0	*0.041*	*0.041*
10.0	*0.027*	*0.027*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

20. ***3103F.4.2.3 Earthquake Motions from Site-Specific Probabilistic Seismic Hazard Analyses. Figure 31F-3-1***



~~*Figure 31F-3-1 Response Spectra for the Ports of Los Angeles and Long Beach, 475 Year Return Period (5% Critical Damping)*~~



<u>FIGURE 31F-3-1 - DESIGN ACCELERATION RESPONSE SPECTRA FOR THE PORTS OF LOS ANGELES AND LONG BEACH, 475 YEAR RETURN PERIOD (5% Critical Damping)</u>

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

21. ***3103F.4.2.5 Site-Specific Evaluation of Amplification Effects.*** 2nd paragraph.

"… for example, SHAKE91 [3.~~6~~ <u>8</u>] is acceptable…"
…

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

22 ***3103F.4.2.6 Directivity Effects.***

1. Directivity effects may be reflected in the spectral acceleration values in a deterministic manner by using, for example, the equation on pg. 213 (and Tables 6 and 7) of Somerville, et al. [3.~~7~~ <u>9</u>]. …"

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

23. ***3103F.4.2.7 Deterministic Earthquake Motions.*** 2nd paragraph.

~~Alternatively,~~ For comparison, the values of peak ground accelerations …"

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

24*.* ***3103F.5.1 General****.* 2nd paragraph.

"…draft, drift, and tide (2 CCR 2340 (c) (1)) [3.~~8~~ 10].

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

25. ***3103F.5.2.1.2 Survival Condition.*** 2nd & 3rd paragraphs.

"…within 30 minutes (see 2 CCR 2340 (c) (28)) [3.~~8~~ 10].

"…to be solid free-standing walls (~~Section~~ Chapter 6 of ASCE 7~~-98~~ [3.~~9~~ 11]).

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

26. ***3103F.5.2.3 Static Wind Loads on Vessels.*** *The "Prediction of Wind and Current Loads on VLCC's" [3.1~~1~~ 3] or the "British Standard Code of Practice for Maritime Structures" [3.1~~2~~ 4] shall be used to determine the wind loads for all tank vessels.*

Alternatively, wind loads for any type of vessel may be calculated using the guidelines in Ferritto et al, 1999 [3.1~~3~~ 5].

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

27. 3103F.5.3.1 Design Current Velocity. 2nd paragraph.

"…obtained from NOAA [3.1~~4~~ 6] or other sources, but…"

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

28. ***3103F.5.2.2 Wind Speed Corrections. Figure 31F-3-3 Caption***

FIGURE 31F-3-3—WIND SPEED CONVERSION FACTOR [3.1~~0~~ 2]

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

29. ***3103F.5.3.2 Current Velocity Adjustment Factors. Figure 31F-3-4 Caption***

FIGURE 31F-3-4—CURRENT VELOCITY CORRECTION FACTOR (p. 4~~11~~23, OCIMF, 1997 [3.1~~11~~3]

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

30. ***3103F.5.3.3 Static Current Loads.*** *The OCIMF [3.1~~1~~ 3], the British Standard [3.1~~2~~ 4] or the ~~Mil-HDBK-1026/4A~~ UFC 4-159-03 [3.1~~5~~ 7] procedures shall be used to determine current loads for moored tank vessels.*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

31. ***3103F.5.3.4 Sea Level Rise (SLR).*** *All MOTs shall consider the predicted SLR over the remaining life of the terminal, due to subsidence or climate change combined with maximum high tide and storm surge. Consideration shall include but not be limited to variation in fender locations, additional berthing loads (deeper draft vessels) and any components near the splash zone.*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

32. ***3103F.5.4 Wave Loads.*** 2nd paragraph.

"…. The Froude-Krylov method discussed in Chakrabarti's Chapter 7 [3.1~~6~~8] may be used …"

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

33. ***3103F.5.5 Passing Vessels.*** Last paragraph.

"…forces due to a passing vessel. ~~Any of~~ Either the ~~following~~ method~~s~~ of Krieble [3.19] or Wang [3.20] may be used to determine forces on a moored vessel.~~:~~ ~~Wang [3.17], Flory [3.18] or Seelig [3.19]~~. Kriebel's recent wave tank study improves on an earlier work of Seelig [3.21].

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

34. ***3103F.5.7 Tsunamis.*** *"…a tank vessel moored alongside the MOT wharf. ~~Table 31F-3-8 provides estimated tsunami run-up values for specific areas of California.~~*

Tsunamis can be generated either by a distant or near source. A tsunami generated by a distant source (far field event) may allow operators to have an adequate warning for mitigating the risk by having the tank vessel depart~~ing~~ the MOT and go~~ing~~ into deep water. For near-field events, with sources less than 500 miles away, the vessel may not have adequate time to depart. Each MOT shall have a "tsunami plan" describing what actions will be performed, in the event of a distant tsunami.

Recent tsunami studies have been completed for both Southern and Northern California. For the Ports of Los Angeles and Long Beach, one of those recent studies focused on near field tsunamis with predicted return periods of 5,000 to 10,000 years [3.22]. These maximum water levels (run-up) would not normally be used for MOT design. However, because the study also provides actual tidal records from recent distant tsunamis, it should be used for design.

The run-up value for Port Hueneme was obtained from an earlier study by Synolakis et al. [3.23].

Run up-values: Port of Los Angeles and Long Beach = 8 ft.
Port Hueneme = 11 ft.

For the San Francisco Bay, a recent study provides the maximum credible tsunami water levels and current speeds. These results are deterministic and are based on the most severe seismic sources that could reasonably impact MOTs in the San Francisco Bay [3.24]. Table 31F-3-8 provides values for the marine oil terminal locations within San Francisco Bay. Water levels could be positive or negative and current velocities may vary in direction. In order to determine the maximum run-up at a MOT, the largest values should be added to the ~~maximum~~ mean *high tide. Further details are available in [3.24].*

Loads from tsunami-induced waves can be calculated for various structural configurations [3.2~~2~~5]. Tsunami wave heights in shallow water and particle kinematics can also be obtained. Other structural considerations include uplift and debris impact.

~~TABLE 31F-3-8~~

~~TSUNAMI RUN-UP VALUES [ft.] in CALIFORNIA [3.20], [3.21]~~

~~LOCATION~~	~~100 YEAR RETURN PERIOD~~	~~500 YEAR RETURN PERIOD~~
~~W. Carquinez Strait~~	~~3.3~~	~~4.0~~
~~Richmond Harbor Channel~~	~~7.6~~	~~13.5~~
~~Richmond Inner Harbor~~	~~5.9~~	~~10.6~~
~~Oakland Inner Harbor~~	~~4.7-5.5~~	~~7.5-9.5~~
~~Oakland Middle Harbor~~	~~5.9~~	~~10.5~~
~~Oakland Outer Harbor~~	~~7.9-9.1~~	~~15.1-17.6~~
~~Hunters Point~~	~~3.9-5.3~~	~~5.0-8.7~~
~~San Francisco – S. of Bay Bridge~~	~~4.5-5.0~~	~~7.5-8.4~~
~~Ports of Los Angeles and Long Beach~~	~~8.0~~	~~15.0~~
~~Port Hueneme~~	~~11.0~~	~~21.0~~

Table 31F-3-8
Tsunami run-up values (ft) and current speeds (ft/sec) in the San Francisco Bay Area [after 3.24]

S.F. Bay locale	*Maximum Water Levels (ft.)*	*Current Velocity (ft/sec)*
Richmond, outer	*7.5*	*4.9*
Richmond, inner	*7.9*	*8.9*
Martinez	*2.3*	*1.3*
Selby	*2.6*	*1.6*
Rodeo	*2.6*	*2.0*
Benicia	*2.0*	*1.0*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

35. ***3103F.6.1 General.*** *"…are based on those in ~~Mil-HDBK-1025/1~~ UFC 4-152-01, "Piers and Wharves" [3.2~~3~~6]. An alternate procedure is presented in PIANC [3.2~~4~~7].*
…

The approximate displacement of the vessel (when only partially loaded) at impact, DT, can be determined from an extension of an equation from Gaythwaite [3.2~~5~~8]:
…

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Co

36. ***3103F.6.3 Geometric Coefficient (C_g).*** "*…the straight side [3.2~~3~~6].*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

37. ***3103F.6.5 Configuration Coefficient (C_c).*** Last sentence.

For berths with different conditions, C_c may be interpolated between these values [3.2~~3~~ 6].

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

38. ***3103F.6.6 Effective Mass or Virtual Mass Coefficient (C_m).*** Last sentence.

The value of C_m for use in design should be a minimum of 1.5 and need not exceed 2.0 [3.2~~3~~6].

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

39. ***3103F.6.7 Berthing Velocity and Angle.*** *2*rd paragraph.

"… of the PIANC guidelines [3.2~~4~~7].

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

40. ***3103F.7.2 Wind Loads.*** *~~Section~~ Chapter 6 of ASCE 7 [3.~~9~~11] shall be used to establish minimum wind loads on the structure. Additional information about wind loads may be obtained from Simiu and Scanlan [3.2~~6~~ 9].*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

41. ***3103F.8 Load Combinations****. As a minimum, ~~E~~ each component of the structure shall be analyzed for all applicable load combinations given in table 31F-3-12 or 31F-3-13, depending on component type. For additional load combinations see "Piers and Wharves," DOD UFC 4-152-01[3.26].*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

42. ***3103F.8 Load Combinations.***

TABLE 31F-3-12

LRFD LOAD FACTORS FOR LOAD COMBINATIONS [3.~~13~~ 26]

Load Type	Vacant Condition		Mooring & Breasting Condition	Berthing Condition	Earthquake Condition[3]	
Dead Load (D)	1.2 ~~4~~[~~1~~]	0.9	1.2	1.2	1.2+k[1] ~~1±k~~[~~3~~]	~~1~~ .9-k[1]
Live Load (L)	1.6 ~~7~~[~~2~~]		1.6[2] ~~7~~	1.0	1.0	
Buoyancy (B)	1.2 ~~3~~	0.9	1.2 ~~3~~	1.2 ~~3~~	1.2[1]	0.9[1]
Wind on Structure (W)	1.6 ~~3~~	1.6	1.6 ~~3~~	1.6 ~~0~~		
Current on Structure (C)	1.2 ~~3~~	0.9	1.2 ~~3~~	1.2 ~~0~~	1.2	0.9
Earth Pressure on the Structure (H)	1.6	1.6	1.6	1.6	1.6[4] ~~0~~	1.6[4]
Mooring/Breasting Load (M)			1.6 ~~3~~			
Berthing Load (B_e)				1.6 ~~7~~		
Earthquake Load (E)					1.0	1.0

1. k = 0.50 (PGA) The k factor (k=0.5(PGA)) and Buoyancy (B) shall be applied to the vertical dead load (D) only, and not to the inertial mass of the structure. ~~Reduce load factor for dead load (D) to 0.9 to check components for minimum axial load and maximum moment.~~
2. The load factor for live load (L) may be reduced to 1.3 for the maximum outrigger float load from a truck crane.
3. ~~3. k = 0.50 (PGA)~~ For Level 1 and 2 earthquake conditions with strain levels defined in Division 7, the Current on Structure (C) may not be required.
4. An Earth Pressure on the Structure factor (H) of 1.0 may be used for pile or bulkhead structure.

Authority Cited: Sections 8755, and 8757, Public Resources Code
Reference(s) Cited: Sections 8750, 8751, 8755, and 8757, Public Resources Code

43. ***3103F.8 Load Combinations.***

TABLE 31F-3-13

SERVICE or ASD LOAD FACTORS FOR LOAD COMBINATIONS [3.26]

Load Type	Vacant Condition	Mooring & Breasting Condition	Berthing Condition	Earthquake Condition	
Dead Load (D)	1.0	1.0	1.0	1+0.7k[1] ~~1±0.7k[1]~~	1-0.7k[1]
Live Load (L)	1.0	1.0	0.75		
Buoyancy (B)	1.0	1.0	1.0	1.0	0.6
Wind on Structure (W)	1.0	1.0	~~1.0~~ 0.75		~~1.0~~
Current on Structure (C)	1.0	1.0	1.0		
Earth Pressure on the structure (H)	1.0	1.0	1.0	1.0	1.0
Mooring/Breasting Load (M)		1.0			
Berthing Load (B_e)			1.0		
Earthquake Load (E)				0.7	0.7
% Allowable Stress	100	100	100	~~133~~ 100[2]	

1. k = 0.5 (PGA)
2. *Increase in allowable stress shall not be used with these load combinations unless it can be demonstrated that such increase is justified by structural behavior caused by rate or duration of load. See ASCE 7 [3.11]*

Authority Cited: Sections 8755, and 8757, Public Resources Code
Reference(s) Cited: Sections 8750, 8751, 8755, and 8757, Public Resources Code

44. ***3103F.10.1 Quick Release Hooks.*** *For new MOTs, or Berthing Systems a minimum of three quick-release hooks are required for each breasting line location for tankers larger than 50,000 DWT. At least two hooks at each location shall be provided for breasting lines for tankers less than 50,000 DWT.*

All hooks and supporting structures shall withstand the minimum breaking load (MBL) of the strongest line with a Safety Factor of 1.2 or greater. Only one mooring line shall be placed on each quick release hook.

For multiple quick release hooks, the minimum horizontal load for the design of the tie-down shall be:

$$F_d = 1.2 \times MBL \times [\, 1 + 0.75\,(n-1)] \qquad (3\text{-}21)$$

F_d = Minimum factored demand for assembly tie-down
n = Number of hooks on the assembly.

The capacity of the supporting structures must be larger than F_d (See Section 3107F.4.3).

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

45. ***3103F.10.2 Other Fittings.***

TABLE 31F-3-15

ALLOWABLE WORKING LOADS

Type of Fittings	*No. of Bolts*	*Bolt Size (in)*	*Working Load (kips)*
30 in. Cleat	*4*	*1-1/8*	*20*
42 in. Cleat	*6*	*1-1/8*	*40*
Low Bitt	*10*	*1-5/8*	*60 per column*
High Bitt	*10*	*1-3/4*	*75 per column*
44-1/2 in. Ht. Bollard	*4*	*1-3/4*	*70*
44-1/2 in. Ht. Bollard	*8*	*2-1/4*	*200*
48 in. Ht. Bollard	*12*	*2-3/4*	*450*

Note: This table is modified from Table ~~48~~ 6-11, ~~MIL-HDBK-1026/4A~~ UFC 4-159-03 [3.1~~5~~7]

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

46. 3103F.13 References.

[3.2] California Geological Survey, ~~1998~~ 2003, "~~Probabilistic Seismic Hazard Map of~~ Seismic Shaking Hazards in California," ~~(website: www.consrv.ca.gov/dmg/rghm/psha/index.htm) ,~~ Sacramento, CA.

[3.5] Earth Mechanics, Inc., "Port-Wide Ground Motion and Palos Verdes Fault Study – Port of Los Angeles, California, FINAL REPORT", December 22, 2006, Fountain Valley, CA.

[3.6] Earth Mechanics, Inc., "Port-Wide Ground Motion Study – Port of Long Beach, California, FINAL REPORT", August 7, 2006, Fountain Valley, CA.

[3.~~5~~7] Savy, J. and Foxall, W, 2002, "Probabilistic Seismic Hazard Analysis for Southern California Coastal Facilities," 2003, Lawrence Livermore National Laboratory.

[3.~~6~~8] Idriss, I.M. and Sun, J.I., 1992, "User's Manual for SHAKE91, A Computer Program for Conducting Equivalent Linear Seismic Response Analyses of Horizontally Layered Soil Deposits," Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, CA.

[3.~~7~~9] Somerville, Paul G., Smith, Nancy F., Graves, Robert W., and Abrahamson, Norman A., 1997, "Modification of Empirical Strong Ground Motion Attenuation Relations to Include the Amplitude and Duration Effects of Rupture Directivity", Seismological Research Letters, Volume 68, Number 1, pp.199 - 222.

[3.~~8~~10] *California Code of Regulations, "Marine Terminals, Inspection and Monitoring," Title 2, Division 3, Chapter 1, Article 5. California State Lands Commission, Sacramento, CA.*

[3.~~9~~11] *American Society of Civil Engineers, Jan. 2005 ~~0~~, "Minimum Design Loads for Buildings and Other Structures," ASCE 7-05 ~~98~~, Revision of ~~ANSI/~~ ASCE/SEI 7-02 ~~9-95~~, Reston, VA.*

[3.1~~0~~2] *Pile Buck Production, 1992, "Mooring Systems," Pile Buck Inc., Jupiter, Florida.*

[3.1~~1~~3] *Oil Companies International Marine Forum (OCIMF), 199~~7~~7, "Prediction of Wind and Current Loads on VLCCs," London, England.*

[3.1~~2~~4] *British Standards Institution, 2000, "British Standard Code of Practice for Maritime Structures - Part 1 General Criteria" BS6349, Part 1, London, England.*

[3.1~~3~~5] *Ferritto, J., Dickenson, S., Priestley N., Werner, S., Taylor, C., Burke D., Seelig W., and Kelly, S., 1999, "Seismic Criteria for California Marine Oil Terminals," Vol.1 and Vol.2, Technical Report TR-2103-SHR, Naval Facilities Engineering Service Center, Port Hueneme, CA.*

[3.1~~4~~6] *National Oceanic and Atmospheric Administration, Contact: National PORTS Program Manager, Center for Operational Oceanographic Products and Services, 1305 EW Highway, Silver Spring, MD 20910, web page: http://co-ops.nos.noaa.gov/ports.html ~~http://co-ops.nos.noaa.gov/d_ports.html~~*

[3.1~~5~~7] *Dept. of Defense, ~~1 July 1999, "Mooring Design," Mil-HDBK-1026/4A~~ 3 October 2005, Unified Facilities Criteria (UFC) 4-159-03, "Moorings," Washington, D.C.*

[3.1~~6~~8] *Chakrabarti, S. K., 1987, "Hydrodynamics of Offshore Structures," Computational Mechanics.*

~~*[3.18] Flory, John. F., 2001, "A Method for Estimating Passing Ship Effects," Proceedings, Ports 2001, ASCE Conference April 29-May 2, Norfolk, Virginia.*~~

[3.19] *Kriebel, David, "Mooring Loads Due to Parallel Passing Ships", Technical Report TR-6056-OCN, US Naval Academy, 30 September 2005.*

[3.1~~7~~20] *Wang, Shen, August 1975, "Dynamic Effects of Ship Passage on Moored Vessels," Journal of the Waterways, Harbors and Coastal Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 101, WW3, Reston, VA.*

[3.~~19~~21] *Seelig, William N., 20 November 2001, "Passing Ship Effects on Moored Ships," Technical Report TR-6027-OCN, Naval Facilities Engineering Service Center, Washington, D.C.*

~~*[3.20] Garcia, A. W. and Houston, J. R., November, 1975, "Type 16 Flood Insurance Study: Tsunami Predictions for Monterey and San Francisco Bays and Puget Sound," Technical Report H-75-17, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.*~~

[3.22] *Moffatt & Nichol, April 2007, "Tsunami Hazard Assessment for the Ports of Long Beach and Los Angeles – FINAL REPORT", prepared for the Ports of Long Beach and Los Angeles.*

[3.2~~1~~3] *Synolakis, C., "Tsunami and Seiche," Chapter 9 in Earthquake Engineering Handbook, Chen, W., Scawthorn, C. S. and Arros, J. K., editors, 2002, CRC Press, Boca Raton, FL.*

[3.24] *Borrero, Jose, Dengler, Lori, Uslu, Burak and Synolakis, Costas, June 2006, "Numerical Modeling of Tsunami Effects at Marine Oil Terminals in San Francisco Bay," Report for the Marine Facilities Division of the California State Lands Commission.*

[3.2~~2~~5] Camfield, Frederick E., February 1980, "Tsunami Engineering," U.S. Army, Corps of Engineers, Coastal Research Center, Special Report No. 6, Vicksburg, MS.

[3.2~~3~~6] Dept. of Defense, ~~30 June 1994, Military Handbook~~ "Piers and Wharves," ~~Mil-HDBK-1025/1,~~ Unified Facilities Criteria (UFC) 4-152-01, 28 July 2005, Washington, D.C.

[3.2~~4~~7] Permanent International Association of Navigation Congresses (PIANC), 2002, "Guidelines for the Design of Fender Systems: 2002," Brussels.

[3.2~~5~~8] Gaythwaite, John, 2004, "Design of Marine Facilities for the Berthing, Mooring and Repair of Vessels," American Society of Civil Engineers (ASCE Press), Reston, VA.

[3.2~~6~~9] Simiu E. and Scanlan R., 1978, "Wind Effects on Structures: An Introduction to Wind Engineering," Wiley-Interscience Publications, New York.

[3.~~27~~30] Oil Companies International Marine Forum (OCIMF), 1997, "Mooring equipment Guidelines," 2nd ed., London, England.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

47. ***3104F.2.3.2 Nonlinear Static Demand Procedure.*** *"…classifications. The following ~~subs~~ Sections (3104F.2.3.2.1 thru 3104F.2.3.4) describe the procedure of ~~reference~~ Priestley et al. [4.1]; an alternate procedure is presented in ATC 40 [4.2], which is improved in FEMA 440 [4.3]. A linear …"*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

48. ***3104F.2.3.2.5 Refined Analyses.***

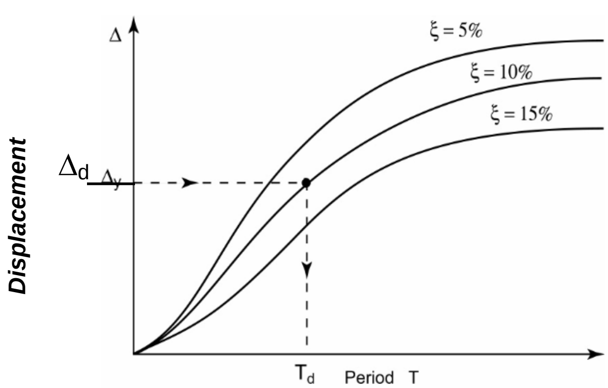


Figure 31F-4-4--Design Displacement Response Spectra

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

49. ***3104F.4.5 Shear Key Forces.*** *"…to the shear key force [4.<u>4</u>~~3~~]) shall be …"*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

50*.* ***3104F.4.7 Batter Piles.*** *"…or by pile pull out. (p. 3-83 of [4.<u>4</u> ~~3~~]).*
…

"…thereby increasing the displacement ductility [4.<u>4</u> ~~3~~].

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

51. ***3104F.8 References.***

<u>[4.3] Applied Technology Council (ATC-55 project), June 2005, "FEMA 440 Improvement of Nonlinear Static Seismic Analysis Procedures," prepared for Department of Homeland Security, Federal Emergency Management Agency, Redwood City, CA.</u>

[4.<u>4</u>~~3~~] Ferritto, J., Dickenson, S., Priestley N., Werner, S., Taylor, C., Burke D., Seelig W., and Kelly, S., 1999, "Seismic Criteria for California Marine Oil Terminals," Vol.1 and Vol.2, Technical Report TR-2103-SHR, Naval Facilities Engineering Service Center, Port Hueneme, CA.

Authority Cited: Sections 8755 and 8757, Public Resources Code.
Reference(s) Cited: Sections 8750, 8751, 8755 and 8757, Public Resources Code.

52. ***3105F.1.5 Analysis and Design of Mooring Components.*** *…*

"…in accordance with ACI 318 [5.1], AISC~~-LRFD~~ [5.2] and ANSI/AF&PA NDS~~-1997~~ [5.3], as applicable.

Authority Cited: Sections 8755 and 8757, Public Resources Code.
Reference(s) Cited: Sections 8750, 8751, 8755 and 8757, Public Resources Code.

53. ***3105F.2 Mooring Analyses.*** 2nd paragraph.

"…Department of Defense "Mooring<u>s</u> ~~Design~~" document [5.6]. The manual procedure (~~subs~~<u>S</u>ection 3105F.2.1) may be used for barges.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

54. ***3105F.3.2 Passing Vessels.*** 5th paragraph.

"…established in the ~~Navy's "Harbors Design Manual,"~~ <u>Department of Defense, UFC 4-150-06,</u> Figure ~~27~~ <u>5-17</u> [5.7] for interior channels may be used. The "vertical bank" in Figure ~~27~~ <u>5-17</u> of [5.7] shall be replaced by the side of the moored vessel when establishing the distance, "L".

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

55. ***3105F.3.3 Seiche.*** 4th paragraph.

1. *"…seaward end. Use Chapter 2 of ~~the formula provided (Eqn. 2-1, page 26.1-40) in the Navy's "Harbor Design Manual"~~ UFC 4-150-06 [5.7], to calculate …"*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

56. ***3105F.4 Berthing Analysis and Design***. 2ND Paragraph.

"…safety factors defined in Sections 3103F.8 and 3103F.9 and in accordance with ACI 318 [5.1], AISC~~-LRFD~~ [5.2], and ANSI/AF&PA NDS~~-1997~~ [5.3], as applicable.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

57. ***3105F.4.5 Design and Selection of New Fender Systems.*** *For guidelines on new fender designs, refer to the Department of Defense ~~Navy's~~ "Piers and Wharves" document (UFC 4-152-01) ~~handbook~~ [5.9] and the PIANC Guidelines for the Design of Fenders Systems: 2002 [5.10].*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

58. **3105F.7 References.**

[5.1] American Concrete Institute, ACI 318-0~~2~~5, 200~~2~~5, "Building Code Requirements for Structural Concrete (318-0~~2~~5) and Commentary (318R-0~~2~~5)," Farmington Hills, Michigan.

[5.2] American Institute of Steel Construction Inc. (AISC), 200~~1~~5, "~~Manual of~~ Steel Construction Manual, ~~Load and Resistance Factor Design (LRFD),~~" ~~3rd~~ Thirteenth Ed., Chicago, IL.

[5.3] American Forest & Paper Association, ~~1999~~ 2005, "~~ASD Manual -~~ National Design Specification for Wood Construction," ANSI/AF&PA NDS~~-1997~~ 2005, Washington, D.C.

[5.6] Department of Defense, ~~1 July 1999, "Mooring Design," Handbook, MIL-HDBK-1026/4A, Alexandria, VA,~~ 3 October 2005, "Moorings", Unified Facilities Criteria (UFC) 4-152-03, Washington D.C., USA.

[5.7] Department of ~~the Navy, Dec. 1984, "Harbors Design Manual," NAVFAC DM-26.1, Alexandria, VA,~~ Defense, 12 December 2001, "Military Harbors and Coastal Facilities", Unified Facilities Criteria (UFC) 4-150-06, Washington D.C., USA.

[5.9] Department of ~~the Navy, 30 October 1987,~~ Defense, 28 July 2005, "Piers and Wharves," Unified Facilities Criteria (UFC), 4-152-01, ~~Military Handbook, MIL-HDBK-1025/1, Alexandria, VA,~~ Washington D.C., USA.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

59. ***3106F.4.2 Simplified Ground Movement Analysis.*** Add 5th paragraph.

"… can be used to estimate the seismically induced ground movement for other earthquake magnitudes."

For the Ports of Los Angeles and Long Beach, Newmark displacement curves are available and are site-specific [3.5, 3.6]. Curves are provided for both Level 1 and level 2 earthquakes, and plot yield acceleration versus lateral displacement.

"For screening purposes only, lateral spreading shall be evaluated, …"
…

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

60. ***3106F.5.1 Soil Parameters****.* 2nd & 3rd paragraphs.

"…and deep foundations shall be evaluated using Section 6 ~~G~~ of API RP 2A-WSD ~~LRFD~~ [6.10] including the consideration of pile group effects. Equivalent springs (and dashpots) representing the degrading properties of soils may be developed.

"…is presented in Chapter 4 ~~5~~ of the ~~Naval Design Manual 7.02~~ UFC 3-220-01A [6.11] and provides deflection and moment for an isolated pile, subject to a lateral load.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

61. ***3106F.8 References.***

[6.10] American Petroleum Institute, December 2000 ~~July 1993~~, Recommended Practice 2A-~~LRFD~~ WSD (API RP 2A-~~LRFD~~ WSD), "Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design ~~Load and Resistance Factor Design~~," Washington, D.C.

[6.11] Department of Defense, 16 January 2004, Unified Facilities Criteria (UFC) 3-220-01A, "Deep Foundations", Washington, D.C. ~~"Foundations and Earth Structures", Design Manual 7.02, Chapter 5, 1986, Naval Facilities Engineering Command, Alexandria, VA.~~

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

62. ***3107F.1.2 Applicability.*** Add item 5.

4. "…steel pipe piles.

5. Retaining structures constructed of steel, concrete sheet piles or reinforced concrete.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

63. ***3107F.2.1.1 Material Properties.*** *"…the following methodology.*

~~The strength of structural components shall be evaluated based on realistic upper bound estimates of material properties, except for non-ductile components, which shall be evaluated based on design material properties. The following values shall be substituted~~ The strength of structural components shall be evaluated based on the following values (Section 5.3 of [7.1] and p. 3-73 & 3-74 of [7.2]):

~~Non-ductile components (shear):~~ Specified material strength shall be used for non-ductile components (shear controlled), all mechanical, electrical and mooring equipment (attachments to the deck) and for all non seismic load combinations:

$$f'_c = 1.0\, f'_c \qquad (7\text{-}1a)$$
$$f_y = 1.0\, f_y \qquad (7\text{-}1b)$$
$$f_p = 1.0\, f_p \qquad (7\text{-}1c)$$

In addition these values (7-1a, 7-1b & 7-1c) may be used conservatively as alternatives to determine the nominal strength of ductile components (N).

~~Other components (moment, axial):~~ Expected lower bound estimates of material strength shall be used for determination of moment-curvature relations and nominal strength of all ductile components:

$$f'_c = 1.3f'_c \qquad (7\text{-}2a)$$
$$f_y = 1.1f_y \qquad (7\text{-}2b)$$
$$f_p = 1.0\, f_p \qquad (7\text{-}2c)$$

~~Capacity protected members, such as pile caps and joints (maximum demand):~~ Upper bound estimates of material strength shall be used for the determination of moment-curvature relations, to obtain the feasible maximum demand on capacity protected members:

$$f'_c = 1.7f'_c \qquad (7\text{-}3a)$$
$$f_y = 1.3f_y \qquad (7\text{-}3b)$$
$$f_p = 1.1f_p \qquad (7\text{-}3c)$$

where:

f'_c = *Specified c~~C~~ompressive strength of concrete*
f_y = *Specified y~~Y~~ield strength of reinforcement or specified minimum yield stress steel*
f_p = *Specified y~~Y~~ield strength of prestress strands*

"Capacity Design" (Section 5.3 of [7.1]) ensures that the strength at protected components (such as pile caps and decks), joints and actions (such as shear), ~~locations are~~ is greater than the maximum feasible demand (over strength), based on realistic upper bound estimates of plastic hinge flexural strength. ~~In addition, a series of pushover~~ An additional series of nonlinear analyses using moment curvature characteristics of pile hinges may be required.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

64. *3107F.2.1.1 Material Properties.*

TABLE 31F-7-2

TENSILE AND YIELD PROPERTIES OF REINFORCING BARS FOR VARIOUS ASTM SPECIFICATIONS AND PERIODS

(after Table 6-2 of [7.3])

				Structual[1]	*Intermediate[1]*	*Hard[1]*			
			Grade	*33*	*40*	*50*	*60*	*70*	*75*
			Minimum Yield[2] (psi)	*33,000*	*40,000*	*50,000*	*60,000*	*70,000*	*75,000*
ASTM	*Steel Type*	*Year Range[3]*	*Minimum Tensile[2] (psi)*	*55,000*	*70,000*	*80,000*	*90,000*	~~*80,000*~~ *95,000*	*100,000*
A15	***Billet***	***1911-1966***		***X***	***X***	***X***			
A16	***Rail[4]***	***1913-1966***				***X***			
A61	***Rail[4]***	***1963-1966***					***X***		
A160	***Axle***	***1936-1964***		***X***	***X***	***X***			
A160	***Axle***	***1965-1966***		***X***	***X***	***X***	***X***		
A408	***Billet***	***1957-1966***		***X***	***X***	***X***			
A431	***Billet***	***1959-1966***							***X***
A432	***Billet***	***1959-1966***					***X***		
A615	***Billet***	***1968-1972***			***X***		***X***		***X***
A615	***Billet***	***1974-1986***			***X***		***X***		
A615	***Billet***	***1987-1997***			***X***		***X***		***X***
A616	***Rail[4]***	***1968-1997***				***X***	***X***		
A617	***Axle***	***1968-1997***			***X***		***X***		
A706	***Low-Alloy[5]***	***1974-1997***						***X***	
A955	***Stainless***	***1996-1997***			***X***		***X***		***X***

General Note: An entry "X" indicates that grade was available in those years.

1. The terms structural, intermediate, and hard became obsolete in 1968.

2. Actual yield and tensile strengths may exceed minimum values.

3. Until about 1920, a variety of proprietary reinforcing steels were used. Yield strengths are likely to be in the range from 33,000 psi to 55,000 psi, but higher values are possible. Plain and twisted square bars were sometimes used between 1900 and 1949.

4. Rail bars should be marked with the letter "R."

5. ASTM steel is marked with the letter "W."

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

65. *3107F.2.5.5.2 Confined concrete piles~~:~~ .* *Equation (7-12)*

Ultimate concrete compressive strain [7.1]:

$\varepsilon_{cu} = 0.004 + (1.4\rho_s f_{yh}\varepsilon_{sm})/f'_{cc} \geq 0.005$ *(7-12)*

ε_{cu} ≤ ~~*0.035*~~ *0.025*

WHERE:

ρ_s = *effective volume ratio of confining steel*
f_{yh} = *yield stress of confining steel*

ε_{sm} = strain at peak stress of confining reinforcement, 0.15 for grade 40, 0.1~~2~~0 for grade 60 ~~and 0.10 for A82 grade 70 plain spiral~~

f'_{cc} = *confined strength of concrete approximated by* $1.5 f'_c$

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

66. ***3107F.2.5.4 Plastic Rotation.***

TABLE 31F-7-5

LIMITS OF STRAIN

Component Strain	Level 1	Level 2
MCCS Pile/deck hinge	$\varepsilon_c \le$ 0.00~~5~~ 4	$\varepsilon_c \le 0.025$
MCCS In-ground hinge	$\varepsilon_c \le$ 0.00~~5~~ 4	$\varepsilon_c \le 0.008$
MRSTS Pile/deck hinge	$\varepsilon_s \le 0.01$	$\varepsilon_s \le 0.05$
MRSTS In-ground hinge	$\varepsilon_s \le 0.01$	$\varepsilon_s \le$ ~~0.01~~ 0.025
MPSTS In-ground hinge	$\varepsilon_p \le 0.005$ (incremental)	$\varepsilon_p \le$ ~~0.0 4 15~~ 0.025 (total strain)

MCCS = Maximum Concrete Compression Strain, ε_c

MRSTS = Maximum Reinforcing Steel Tension Strain, ε_s

MPSTS = Maximum Prestressing Steel Tension Strain, ε_p

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

67. ***3107F.2.5.7 Shear ~~Capacity (Strength)~~ Design.*** *~~Shear strength shall be based on nominal material strengths, and reduction factors according to ACI-318 [7.5].~~ If expected lower bound of material strength Section 3107F.2.1.1 equations (7-2a, 7-2b, 7-2c) are used in obtaining the nominal shear strength, a new nonlinear analysis utilizing the upper bound estimate of material strength Section 3107F.2.1.1 equations (7-3a, 7-3b, 7-3c) shall be used to obtain the plastic hinge shear demand. An alternative conservative approach is to multiply the maximum shear demand, V_{max} from the original analysis by 1.4 (Section 8.16.4.4.2 of ATC-32 [7.6]):*

~~To account for material strength uncertainties, maximum shear demand, $V_{max,push}$ established from nonlinear pushover analyses shall be multiplied by 1.4 (Section 8.16.4.4.2 of ATC-32 [7.6]):~~

$$V_{design} = 1.4V_{max,\cancel{push}} \qquad (7\text{-}13)$$

If moment curvature analysis that takes into account strain-hardening, an uncertainty factor of 1.25 may be used:

$$V_{design} = 1.25V_{max,\cancel{push}} \qquad (7\text{-}14)$$

~~If the factors defined in Section 3107F-7.2.1.1 are used, the above uncertainty factors need not be applied.~~

Shear capacity shall be based on nominal material strengths, and reduction factors according to ACI-318 [7.5].
As an alternative, the method of Kowalski and Priestley [7.7] may be used. ~~This~~ Their method is based on a three-parameter model with separate contributions to shear strength from concrete (V_c), transverse reinforcement (V_s), and axial load (V_p) to obtain nominal shear strength (V_n):

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

68. ***3107F.2.6.2 Stability.*** *Section 310~~2~~7F.2.5.2 applies to steel piles.*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

69. ***3107F.2.6.5 Component Acceptance/Damage Criteria.*** 2nd paragraph.

Steel components for non-compact hollow piles (D_P /t < 0.07 x E/f_y) and for all nonseismic loading combinations shall be designed in accordance with AISC~~-LRFD~~ [7.8].

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

70. ***3107F.2.6.6 Shear Design ~~Capacity (Strength)~~.*** *The procedures of Section 3107F.2.5.7, which are used to establish V_{design} are applicable to steel piles ~~(Equations 7-13 and 7-14)~~. ~~If the factors defined in Section 3107F.2.1.1 are used, the knowledge factor need not be applied.~~*

The shear capacity shall be established from the AISC~~-LRFD~~ [7.8]. For concrete filled pipe, equation (7-15) may be used to determine shear capacity; however, $V_{\cancel{shell}\ pile}$ must be substituted for V_s . ~~it thus becomes:~~

$$V_{\cancel{shell}\ pile} = (\pi/2)\, t\, f_{y,\cancel{shell}\ pile} (D_p - c - c_0) \cot\theta \qquad (7\text{-}21)$$

WHERE:
t = ~~shell~~ steel pile wall thickness
$f_{y,\cancel{shell}\ pile}$ = yield strength of steel ~~shell~~ pile
c_o = distance from outside of steel pipe to center of hoop or spiral
(All other terms are as listed for equation (7-18)).

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

71. ***3107F.2.7.1 Joint Shear Capacity.***

WHERE:
v_j = Nominal shear stress
M_p = Over strength moment demand of the plastic hinge (the maximum possible moment in the pile) as determined from the procedure of Section 3107F.2.5.7. ~~a pushover analysis at displacements corresponding to the damage control limit state (1.25 M_n when established from moment curvature and 1.3 and 1.1 over-strength factors are applied to f'_c and f_y, respectively, 1.4 otherwise.)~~
l_{dv} = Vertical development length, see Figure 31F-7-9
D_p = Diameter of pile

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

72. ***3107F.2.9 Concrete Pile Caps with Concrete Deck.*** *Pile caps and decks are capacity protected components. Use the procedure of Section 3107F.2.5.7 to establish the over strength demand of the plastic hinges. Component capacity shall be based on nominal material strengths, and reduction factors according to ACI-318 [7.5].*

~~***3107F.2.9.1 General.*** *The moment-curvature and moment-rotation relationships shall be computed for pile caps using the methodology previously described. When the deck and the pile cap behave monolithically, an appropriate width of the deck may be included as part of the pile cap cross-section as per ACI-318 [7.5].*~~

~~***3107F.2.9.2 Plastic Hinge Length.*** *The plastic hinge length* L_P*, for existing pile caps may be taken as:*~~

~~$L_P = 0.5D_c$ (7-34)~~

~~*where* D_c *is the pile cap depth.*~~

~~***3107F.2.9.3 Ultimate Concrete and Steel Flexural Strains.*** *The ultimate strain limits defined in subsection 3107F.2.5.5 shall also apply to pile caps and deck.*~~

~~*All concrete shall be treated as unconfined concrete unless it can be demonstrated that adequate confinement steel is present.*~~

3107F.2.9.~~4~~ 1 Component Acceptance/Damage Criteria.

3107F.2.9.~~5~~ 2 Shear Capacity (Strength).

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

73. ***3107F.3.1 Component Strength.*** 2nd, 3rd & 5th paragraphs and *Table 31F-7-7*.

…

Section 3104F.2.2 discusses existing material properties. At a minimum, the type and grade of wood shall be established. The ~~published~~ adjusted design stress values in the ANSI/AF&PA NDS [7.9] may be used as default values by replacing the Format Conversion Factor of ANSI/AF&PA NDS [7.9] with the factor 2.8 divided by the Resistance Factor (Table N1 [7.9]). ~~and shall be multiplied by a factor of 2.8 to convert from allowable stress levels to yield or ultimate values for seismic loading.~~

For deck components, the ~~allowable~~ adjusted design stresses shall be limited to the values of ~~published in the~~ ANSI/AF&PA NDS [7.9] ~~increased by a factor of 2.0~~. Piling deformation limits shall be calculated based on the strain limits in accordance with Section 3107F.3.3.3.

…

The modulus of elasticity shall be based on tests or the ANSI/AF&PA NDS Tables 6A and 6B [7.9]. Alternatively the values shown in Table 31F-7-7 may be used for typical timber piles~~:~~ .

TABLE 31F-7-7 <u>(after [7.9])</u> ***MODULUS OF ELASTICITY (E) FOR TYPICAL TIMBER PILES***	
Species	E *(psi)*
Pacific Coast Douglas Fir	*1,500,000*
Red Oak	*1,250,000*
Red Pine	*1,280,000*
Southern Pine	*1,500,000*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

74. ***3107F.3.3.2 Displacement Capacity.*** *"... vertical piles, ~~two~~ <u>three</u> simplified procedures to determine fixity or displacement capacity are described in ~~MIL-HDBK-1025/6~~ <u>UFC 4-151-10</u> [7.10]<u>,</u> ~~or the Navy Design Manual 7.02~~ <u>UFC 3-220-01A</u> [7.11]~~, respectively~~ <u>and Chai [7.12]</u> .*

The displacement capacity, Δ , for a pile pinned at the top, with effective length, L <u>(see Table 31F-7-8 and UFC 4-151-10[7.10])</u>, and *moment, M , ~~using Table 31F-7-8 or MIL-HDBK-1025/6 [7.10]~~ is:*

$$\Delta = \frac{ML^2}{3EI} \qquad (7\text{-}3\underline{4}\ \cancel{5})$$

Where:

E = *Modulus of elasticity*
I = *Moment of inertia*

Assuming linear curvature distribution along the pile, the allowable curvature, ϕ_a, can be established from:

$$\phi_a = \frac{\varepsilon_a}{c_u} \qquad (7\text{-}3\underline{5}\ \cancel{6})$$

where:
ε_a = *allowable strain limit according to Section 3107F.3.3.3*
c_u = *distance to neutral axis which can be taken as $D_p/2$, where D_p is the diameter of the pile*

The curvature is defined as:

$$\phi = \frac{M}{EI} \qquad (7\text{-}3\underline{6}\ \cancel{7})$$

The maximum allowable moment therefore becomes:

$$M = \frac{2\varepsilon_a}{D_p} EI \qquad (7\text{-}3\underline{7}\ \cancel{8})$$

The displacement capacity is therefore given by:

$$\Delta = \frac{2\varepsilon_a L^2}{3D_p} \qquad (7\text{-}3\underline{8}\ \cancel{9})$$

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

75. ***3107F.3.3.3.***

Table 31F-7-9
LIMITING STRAIN VALUES FOR TIMBER

Earthquake Level	***Max. Timber Strain***
Level 1	*0.00~~4~~ 2*
Level 2	*0.00~~8~~ 4*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

76. ***3107F.3.3.3 Component Acceptance/Damage Criteria.*** …

For new and ~~A~~alternatively, for existing structures ANSI/AF&PA NDS [7.9] may be used.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

77. ***3107F.3.3.4 Shear Design ~~Capacity~~.*** *To account for material strength uncertainties, the maximum shear demand, $V_{max,\cancel{push}}$, established from the single pile lateral analysis shall be multiplied by 1.2:*

$$V_{demand\ \cancel{design}} = 1.2V_{max\ \cancel{,push}} \qquad (7\text{-}39\ \cancel{40})$$

The factored maximum shear stress demand τ_{max}, in a circular pile can then be determined:

$$\tau_{max} = \frac{10}{9}\frac{V_{\cancel{max,\ push}\,demand}}{\pi \cdot r^2} \qquad (7\text{-}40\ \cancel{1})$$

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

78. ***3107F.4 Retaining Structures.*** *Retaining structures constructed of steel or concrete shall conform to AISC [7.8] or ACI 318 [7.5] respectively. For the determination of static and seismic loads on the sheet pile and sheet pile behavior, the following references are acceptable: NCEL [7.13], Strom and Ebeling [7.14], and PIANC TC-7(Technical Commentary - 7) [7.15]. The applied loads and analysis methodology shall be determined by a California Registered Geotechnical Engineer, and* ~~are~~ may be subject to peer review ~~prior to submission to the Division.~~

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

79. ***3107F.5 ~~4~~ Mooring and Berthing Components.***
…

3107F.5 ~~4~~.1 Component Strength.
…

3107F.5 ~~4~~.2 Mooring and Berthing Component Demand.
…

3107F.5 ~~4~~ .3 Capacity of Mooring and Berthing Components.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

80. ***3107F.6 ~~5~~ Symbols.***

$f_{y,\cancel{shell}\ pile}$	=	*Yield strength of steel ~~shell~~ pile*
t	=	~~Shell~~ Pile wall thickness
$V_{max,\cancel{push}}$	=	*Maximum shear demand*
$V_{pile\ \cancel{shell}}$	=	*Shear strength ~~capacity for~~ of* steel *pile ~~pipe~~*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

81. ***3107F.7 ~~6~~ References.***

[7.1] *~~M.J.N.~~ Priestley, M.J.N., Seible, F.~~rieder~~, ~~Gian Michele~~ and Calvi,G.M., "Seismic Design and Retrofit of Bridges," 1996, New York.*

[7.5] American Concrete Institute, ACI 318-0~~2~~5, 200~~2~~5, "Building Code Requirements for Structural Concrete (318-0~~2~~5) and Commentary (318R-0~~2~~5)," Farmington Hills, Michigan.

[7.8] American Institute of Steel Construction (AISC), 200~~1~~5, "~~Manual of~~ Steel Construction Manual, ~~Load and Resistance Factor Design (LRFD),~~" ~~Third~~ Thirteenth Ed., Chicago, IL.

[7.9] American Forest & Paper Association, 200 ~~1~~ 5, "National Design Specification for Wood Construction," ANSI/AF&PA NDS-200~~1~~5, Washington, D.C.

[7.10] Department of Defense, ~~1988, MIL-HDBK-1025/6,~~ 10 September 2001, Unified Facilities Criteria (UFC) 4-151-10, "General Criteria for Waterfront Construction ~~1025/6,~~" ~~15 May 1988,~~ Washington, D.C.

[7.11] ~~Naval Facilities Engineering Command, 1986, "Foundations and Earth Structures," Design Manual 7.02, Alexandria, VA.~~ Department of Defense, 16 January 2004, Unified Facilities Criteria (UFC) 3-220-01A, "Deep Foundations," Washington, D.C.

[7.12] Chai, Y.H., "Flexural Strength and Ductility of Extended Pile-Shafts, I: Analytical Model", Journal of Structural Engineering, May 2002, pgs.586-594.

[7.13] Ebeling, Robert M. and Morrison, Ernest E., Jr., "The Seismic Design of Waterfront Retaining Structures", U.S. Army Technical Report ITL-92-11/U.S. Navy Technical Report NCEL TR 939, Dept. of Army, Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, November 1992.

[7.14] Strom, Ralph W. and Robert M. Ebeling, "State of the Practice in the Design of Tall, Stiff, and Flexible Tieback Retaining Walls", Information Technology Laboratory, Engineer Research and Development Center, US Army Corps of Engineers, Vicksburg, MS, December 2001.

[7.15] Permanent International Association of Navigation Congresses (PIANC), "Seismic Design Guidelines for Port Structures," Technical Commentary-7, Working Group No. 34 of the Maritime Navigation Commission International Navigation Association, A.A. Balkema, Lisse, Netherlands. 2001.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

82. ***3108F.2.2 Fire Plan (N/E).***

…

9. Requirements for fire drills, training of ~~wharf~~ personnel, and the use of ~~nonfixed~~ equipment.

…

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

83. ***3108F.2.3 Cargo Liquid and Fire Hazard Classifications (N/E).***

TABLE 31F-8-1

CARGO LIQUID HAZARD CLASS

CLASS	***CRITERION***	***REFERENCE***	***EXAMPLES***
Low (L_C)	*Flash Point ≥ 140°F*	*ISGOTT (Chapter 1~~5~~, [8.4]) – Non-Volatile*	*#6 Heavy Fuel Oil, residuals, bunker*
High (H_C)	*Flash Point <140°F*	*ISGOTT (Chapter 1~~5~~, [8.4]) – Volatile*	*Gasoline, JP4, crude oils*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

84. ***3108F.6 Fire Suppression.***

TABLE 31F-8-3

MINIMUM FIRE SUPPRESSION PROVISIONS (N/E)

Fire Hazard Classification (From Table 31F-8-2)	***Vessel and Cargo Liquid Hazard Class (From Table 31F-8-1)***	***MINIMUM PROVISIONS***
LOW	*Barge with* $\boldsymbol{L_C}$ *(including drums)*	***500 gpm of water*** *2 x 20 lb. portable dry chemical and 2 x 110 lb. wheeled dry chemical extinguishers or the equivalent.*
LOW	*Barge with* $\boldsymbol{H_C}$ *(including drums)* *Tankers < 50 KDWT, handling* $\boldsymbol{L_C}$ *or* $\boldsymbol{H_C}$	***1,500 gpm of water*** *2 x 20 lb. portable dry chemical and 2 x 165 lb. wheeled dry chemical extinguishers or the equivalent.*
MEDIUM	*Tankers < 50 KDWT handling* $\boldsymbol{L_C}$	***1,500 gpm of water*** *2 x 20 lb. portable dry chemical and 2 x 165 lb. wheeled dry chemical extinguishers or the equivalent.*
MEDIUM	*Tankers < 50 KDWT, handling* $\boldsymbol{H_C}$	***2,000 gpm of water*** *4 x 20 lb. portable dry chemical and 2 x 165 lb. wheeled dry chemical extinguishers or the equivalent.*
HIGH	*Tankers < 50 KDWT, handling* $\boldsymbol{L_C}$ *or* $\boldsymbol{H_C}$	***3,000 gpm of water*** *4 x 20 lb. portable dry chemical and 2 x 165 lb. wheeled dry chemical extinguishers or the equivalent. .*
LOW, MEDIUM, HIGH	*Tankers > 50 KDWT, handling* $\boldsymbol{L_C}$ *or* $\boldsymbol{H_C}$	***3,000 gpm of water*** *6 x 20 lb. portable dry chemical and 4 x 1<u>65</u> ~~10~~ lb. wheeled dry chemical extinguishers or the equivalent.*
Notes: $\boldsymbol{L_C}$ *and* $\boldsymbol{H_C}$ *are defined in Table 31F-8-1.* *KDWT = Dead Weight Tons (Thousands)*		

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

85. ***3108F.6.2 Fire Hydrants.*** *Hydrants shall be located not greater than <u>150</u> ~~300~~ ft. apart, along the wharf and <u>not more than 300 ft. apart on the</u> approach trestle ~~[Section 4.2.3 of API 2001~~ [8.~~1~~ <u>4</u>]. <u>(N)</u> Additional hose connections shall be provided at the base of fixed monitors and upstream of the water and foam isolation valves. Connections shall be accessible to fire trucks or mutual aid equipment as identified in the Fire Plan ~~(N)~~.*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

86. ***3108F.6.3 Fire Water.*** "…

4. Hose connections for fireboats or tugboats shall be provided on the MOT fire water line<u>, and at least one connection shall be an international shore fire connection at each berth [8.4]</u>. Connections shall be installed at a safe access distance from the high-risk areas such as sump<u>s</u>, manifold<u>s</u> and loading arms (N/E)

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

87. ***3108F.7 References.***

[8.4] International Chamber of Shipping (ICS), Oil Companies International Marine Forum (OCIMF), International Association of Ports and Harbors (IAPH), ~~1996~~ 2006, "International Safety Guide for Oil Tankers and Terminals (ISGOTT)," 5 4th ed., Witherby, London.

[8.7] National Fire Protection Association 200~~2~~8, NFPA 70 (Article 500), "National Electric Code," Quincy, MA.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

88. 3109F.7 ***References.***

[9.6] CalARP Program Seismic Guidance Committee, ~~1998~~ January 2004, "Guidance for California Accidental Release Prevention (CalARP) Program Seismic Assessments", Sacramento, CA.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

89. ***3110F.5 Shore-To-Vessel Access for Personnel*****.** 2nd paragraph.

Shore-to-vessel access for personnel shall conform to 29 CFR 1918.22 ~~1915.74~~ [10.19], Sections 19(b) and 21(b) of [10.20], Chapter 16.4 of [10.21] and the following:

…

7. *The walkway surface, including self-leveling treads, if so equipped, shall be finished with a safe non-slip footing accommodating all operating gangway inclinations ~~[10.21]~~(N/E).*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

90. 3110F.8 Equipment Anchors and Supports. "*…the methods of Section 6.4 ~~2~~ of FEMA 450 ~~368~~ [10.26]. The design for load transfer to the wharf deck shall use the same procedures as for mooring and berthing components (see Section 3107F.5 ~~4~~.3).*

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code

91. ***3110F.9 References.***

[10.19] 29 CFR ~~1015.74~~ 1918.22, Title 29 Code of Federal Regulations Section ~~1015.74~~ 1918.22, ~~Access to Vessels~~ Gangways.

[10.21] ~~29 CFR 1918.22, Title 29 Code of Federal Regulations, Section 1918.22.~~ Chapter 16.4, Ship/Shore Access, International Safety Guide for Oil Tankers and Terminals, 5th ed. 2006, Witherby, London.

[10.26] Federal Emergency Management Agency, 2003 ~~1~~, ~~FEMA 368,~~ "NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures (FEMA 450)", Part 1 – Provisions, Washington D.C.

[10.27] CalARP Program Seismic Guidance Committee, ~~1998~~ January 2004, "Guidance for California Accidental Release Prevention (CalARP) Program Seismic Assessments," Sacramento, CA.

Authority Cited: Section 8755 and 8757, Public Resources Code
Reference(s) Cited: Section 8750, 8751, 8755 and 8757, Public Resources Code