NOTICE OF
CHANGE

MIL-HDBK-1025/1
NOTICE 2
28 February 1992

MILITARY HANDBOOK

PIERS AND WHARVES

TO ALL HOLDERS OF MIL-HDBK-1025/1:

1. THE FOLLOWING PAGES OF MIL-HDBK-1025/1 HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
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2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-HDBK-1025/1 will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the military handbook is completely revised or cancelled.

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FIGURES

When berthing is made with separators, only one separator should be assumed to be in contact at the time of impact, with a minimum of two separators installed per berth. Where the separators are guided by fender piles, all the piles may be assumed to be effective in sharing the energy. When free-floating separators are used, not all the piles backing the separator will be effective. Local experience should dictate and a more conservative assumption should be made.

5.4.4.2 Allowable Hull Pressure. When the ship's energy is resisted through foam-filled or pneumatic fenders, the resulting force is concentrated in a small area of the ship's hull. In such cases, the allowable pressure on the ship's hull becomes a critical design issue. Most fast combatants have a thin hull plating with a low allowable hull pressure. Table 7 lists typical values for some ship types. For more specific information on the ships being berthed, NAVSEASYSCOM should be consulted. The values in Table 7 are based on yielding of the hull plating and include a 1.5 safety factor. Consequently, when checking for an accidental condition, the allowable value may be increased by up to 50 percent.

5.4.4.3 Allowable Stresses. Since ship berthing is a short-term impact type of loading, the following increases over published values (MIL-HDBK-1002/5, MIL-HDBK-1002/6, MIL-HDBK-1002/3 and NAVFAC DM-2.04) are permitted The fender system may be designed as a Class B structure.

a) Timber. For operating condition, the allowable stress in flexure (tension and compression) may be taken as 0.67 X modulas of rupture or the published allowable values increased by a factor of 2.0, whichever is less. For the accidental condition, the stress-strain curve may be assumed to be linear up to 0.9 X modulas of rupture, which should be taken as the limit.

b) Steel. For operating condition, the allowable stress in flexure (tension and compression) may be taken as 0.8 X yield stress. For the accidental condition, full yield stress may be used. However, the sections used should satisfy compactness requirements or the allowable stress reduced proportionately. Members should be sufficiently braced for development of the yield strength.

c) Concrete. Reinforced and prestressed concrete members not intended for energy absorption should be designed with a load factor of 1.7 over forces developed due to operating condition. When designed thus, they will be satisfactory for the accidental condition. Further prestressed members should not be allowed to develop tensile stresses in excess of 12 X square root of 28-day compressive strength in the precompressed zone. Prestressed concrete members specifically designed for energy absorption may not conform to the above requirements and are beyond the scope of this manual.

Table 7
Maximum Allowable Hull Contact Pressures*

Typical Vessel Type (psi)	Designation	Class	Max. Allowable Hull Contact Pressure at Waterline
Battleship	BB 61	Iowa	17.3
Guided missile cruiser	CG 26	Belknap	17.3
Guided missile cruiser	CG 47	Ticonderoga	9.3
Guided missile cruiser	CGN 36	California	19.0
Guided missile cruiser	CGN 38	Virginia	18.7
Aircraft carrier	CV 66	Kitty Hawk	34.8
Aircraft carrier	CVN 68	Nimitz	28.9
Destroyer	DD 963	Spruance	9.3
Guided missile destroyer	DDG 2	Adams	32.0
Guided missile destroyer	DDG 37	Farragut	30.0
Guided missile destroyer	DDG 993	Kidd	9.3
Frigate	FF 1052	Knox	10.0
Guided missile frigate	FFG 7	Oliver Hazard Perry	9.3
Submarine	SSN 637	Sturgeon	15.2
Submarine	SSN 688	Los Angeles	27.2
Ballistic missile submarine	SSBN 616	Lafayette	15.2
Ballistic missile submarine	SSBN 726	Ohio	30.3
Minesweeper	MSO 427	Constant	4.7**
Amphibious cargo ship	LKA 113	Charleston	12.6
Amphibious transport dock	LPD 4	Austin	12.8
Amphibious assault ship	LHA 1	Tarawa	17.6
Dock landing ship	LSD 36	Anchorage	18.5
Tank landing ship	LST 1179	Newport	10.0
Destroyer tender	AD 37	Samuel Gompers	9.4
Ammunition ship	AE 26	Kilauea	14.6
Combat store ship	AFS 1	Mars	18.1
Fast combat support ship	AOE 1	Sacramento	17.6
Oiler	AO 177	Cimarron	21.0
Oiler	AO 187	Henry J. Kaiser	19.9
Replenishment oiler	AOR 1	Wichita	27.7
Salvage ship	ARS 38	Bolster	13.4
Salvage ship	ARS 50	Safeguard	13.4
Submarine tender	AS 36	L.Y. Spear	9.2
Repair ship	AR 5	Volcan	11.8

* The allowable pressure is based on contact at the middle 60 percent of ship's length at waterline.

** Assumbed value. MSO has a wooden hull capable of accepting high contact pressures.

5.4.4.4 Coefficient of Friction. As the ship is berthed against the fender system, there will be force components developed in the longitudinal and vertical directions also. As the coefficient of friction between rubber and steel is very high, special fender front panels have been developed with reduced friction coefficient. Ultra high molecular weight (UHMW) plastic rubbing strips have been successfully used in front of timber piles. The following friction coefficients may be used in the design of fender systems.

Timber to steel .... 0.4 to 0.6
Urethane to steel .... 0.4 to 0.6
Steel to steel 0.25
Rubber to steel .... 0.6 to 0.7
UHMW to steel .... 0.1 to 0.2

5.4.4.5 Temperature Effects. Fender piles, backing members, etc., are not affected by temperature fluctuations and can be expected to perform normally. However, in colder temperatures, rubber fender units become stiffer and their performance will be affected significantly. Hence, the energy-absorbing capability of the rubber unit and the fender system as a whole should be evaluated based on the lowest operating temperature expected. UHMW rubbing strips which have a significantly higher rate of expansion than steel or concrete should also be carefully designed and detailed to operate effectively.

5.4.5 Corner Protection. All corners of piers and wharves and entrances to slips should be provided with fender piles, rubbing strips, and rubber fenders for accidental contact with ships or routine contact with tugs. See Figure 57 for typical details.

5.4.6 Support Chains. Chains are commonly used in fender systems when a tension member is needed. Chains are used in continuous fender systems and large buckling and cell type units to resist the sudden energy released. For pneumatic and foam-filled resilient fender units, the chain is used to suspend the units. Chain smaller than 3/8 inch is not recommended. For better corrosion resistance, zinc coating is preferred. A common weldless high-test chain is usually more cost-effective than the stud link variety.

REFERENCES

NOTE: THE FOLLOWING REFERENCED DOCUMENTS FORM A PART OF THIS HANDBOOK TO THE EXTENT SPECIFIED HEREIN. USERS OF THIS HANDBOOK SHOULD REFER TO THE LATEST REVISIONS OF CITED DOCUMENTS UNLESS OTHERWISE DIRECTED.

MILITARY HANDBOOKS

Unless otherwise indicated, copies are available from the Standardization Document Order Desk, Building 7D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-HDBK-1002/1	Structural Engineering General Requirements
MIL-HDBK-1002/2	Loads
MIL-HDBK-1002/3	Steel Structures
MIL-HDBK-1002/5	Timber Structures
MIL-HDBK-1002/6	Aluminum Structures, Masonry Structures, Composite and Other Structural Materials
MIL-HDBK-1005/3	Drainage Systems
MIL-HDBK-1005/7	Water Supply Systems
MIL-HDBK-1005/8	Domestic Wastewater Control
MIL-HDBK-1025/2	Dockside Utilities for Ships Service
MIL-HDBK-1025/4	Seawalls, Bulkheads and Quaywalls
MIL-HDBK-1025/6	General Criteria for Waterfront Construction

NAVFAC DESIGN MANUALS AND P-PUBLICATIONS

Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 Attn: Defense Publications; phone: (703) 487-4684; Fax: (703) 487-4841.

DM-2.04	Concrete Structures
DM-5.04	Pavements
DM-5.06	Trackage
DM-5.10	Solid Waste Disposal
DM-7.01	Soil Mechanics
DM-7.02	Foundations and Earth Structures
MD-7.03	Soil Dynamics, Deep Stabilization, and Special Geotechnical Construction
DM-26.01	Harbors
DM-26.02	Coastal Protection
DM-26.06	Mooring Design Physical and Empirical Data
DM-38.01	Weight Handling Equipment
P-80	Facility Planning Criteria for Navy and Marine Shore Installations
P-401	Pontoon Systems Manual

ENGINEERING AND DESIGN TEXTBOOKS

Information on these documents can be obtained from Commander, Naval Facilities Engineering Command, Code DS02, 200 Stovall Street, Alexandria, VA 22332.

Cargo Handling Facilities	(Formerly MIL-HDBK-1025/3)
Ferry Terminals and Small Craft Berthing Facilities	(Formerly MIL-HDBK-1025/5)

OTHER GOVERNMENT DOCUMENTS AND PUBLICATIONS

Ammunition and Explosives Ashore, NAVSEA OP 5, Vol. 1, Naval Sea Systems Command, Washington, DC 20362

Code of Federal Regulations, CFR 33, Series 1 to 199, General Services Administration, National Archives and Records Service, Office of the Federal Register, Washington, DC 20004

Ice Pressure on Engineering Structures, Bernard Michel, Monogram III-Bib, U.S. Army Cold Regions Engineering Laboratory, Hanover, NH, 1970

Naval Civil Engineering Laboratory (NCEL) Technical Reports, available from National Technical Information Service, Springfield, VA 22151.

R 605	Reinforced Plastic Landing Float and Brow
TM 5	Advanced Pier Concepts, Users Data Package
TM 51-85-19	Development of Prestressed Concrete Fender Piles - Preliminary Tests
UG-0007	Advanced Pier Concepts, Users Guide

Seismic Design of Piers, Vols. I-III, Tudor/PMB Consulting Engineers, Naval Facilities Engineering Command, Alexandria, VA 22332, August 1976

NON-GOVERNMENT PUBLICATIONS

Dynamic Ice Forces on Piers and Piles, Charles R. Neil, Canadian Journal of Civil Engineering, Vol. 3, Research Journals, National Research Council of Canada, Ottawa, ONT K1A, 1976

Influence Surfaces for Elastic Plates, Adolf Pucher, Springer-Verlag-Wien, 175 Fifth Avenue, New York, NY 10001, 1977

PCI Design Handbook, Prestressed Concrete Institute, 175 West Jackson Blvd, Chicago, IL 60604

Pile Bending During Earthquakes, Edward Margason, Proceedings of Seminar on Design, Construction and Performance of Deep Foundations, College of Engineering, University of California, Berkeley, CA, August 1975

Rules for Building and Classing Offshore Installations - Part 1 Structures, American Bureau of Shipping (ABS), New York, NY 10006, 1983

Standard Specifications for Highway Bridges, H20-78, American Association of State Highway and Transportation Officials (AASHTO), Washington, DC 20004

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