

## 151 PIERS

A pier is a structure that extends out from shore into navigable water and is designed for the berthing of vessels for repair, fueling, and other essential services, such as fresh water, electric power, compressed air, waste disposal and communications facilities. A pier is oriented either perpendicular to or at an angle with the shore and normally accommodates berthing on both sides for its entire length although there are instances where only one side is used because of site conditions or because there is no need for additional berthing space. Code 151 includes all piers regardless of function served, protective dolphins at pier heads, original dredging performed specifically for the purpose of providing the pier facility, all trackage on the pier, and all supporting utilities and services.

Piers provide a transfer point for cargoes and/or passengers between water carriers and land transport. Separate facilities should be maintained where service involves large volumes of both cargo and passengers. Where one service is subsidiary to another, consideration should be given to the feasibility of accommodating both services at one facility.

In countries outside the United States, a pier is often referred to as a jetty, or a mole when of solid fill construction, and a wharf is referred to as a quay or a jetty. In the United States, the term jetty refers to a solid fill structure, located on an open seacoast at the mouth of a river or tidal inlet, designed to prevent shoaling of a channel by littoral materials and to direct and confine stream or tidal flow.

For original dredging not directly related to the construction of the pier, such as channel and turning basin dredging, see category code 165-10. For utilities and services landward of the inboard end of the pier, see NAVPAC DM-25. For crane and railroad trackage on shore, see Civil Engineering and Utilities, NAVFAC DM-5. For transit sheds on piers, see category code 156-10; and for fixed crane structures, see category code 213-40.

Piers are classified according to their primary function and are described under their respective category codes.

**BERTHING.** Piers are used to provide either multipurpose berths or special purpose berths. Piers providing multipurpose berthing are used to service several classes of vessels so that ships will have the option of utilizing any one of several berthing facilities at a port. Berth selection depends upon the need to match available space, utilities and support services with the requirements of an incoming ship. It is not economically feasible to develop a single facility to accommodate and service all classes of Vessels. Special berths are provided when berthing arrangements and/or locations are required for fueling vessels, berthing vessels carrying explosives, or for cleaning ship's bilges.

**REQUIRED FEATURES.** The following list gives appurtenances and facilities generally provided at piers. The facilities to be provided depend on functional requirements which often determine the classification of the pier.

1. Berths having sufficient depths and widths to allow for efficient servicing of the ship and safe vessel approach and departure.

2. Sufficient mooring devices (bollards, bitts, cleats) to safely secure vessel.
3. Access facilities for railroad cars and trucks.
4. Covered and open storage space for cargoes; fenced where required, for control of pilferage,
5. Cargo handling equipment.
6. Office space.
7. Hotel and ship service facilities.
8. Sanitary facilities.
9. Support building at the dock to house general purpose tooling and administrative areas when main shipyard complex is distant from the waterfront.
10. Fender systems.
11. Camels or struts.
12. Medical facilities.
13. Firefighting equipment.
14. Cranes and trackage.

LOCATION AND ALIGNMENT. The location and alignment of piers in a harbor should consider factors such as ease of entering and leaving berth, required quayage, harbor line restrictions, foundation conditions and isolation requirements. For further information and criteria, see Harbors, NAVPAC DM-26.1.

PIER DIMENSIONS AND CLEARANCES. The dimensions of a pier are based primarily on the lengths of the vessels, present or contemplated, that it is to accommodate. The length of the pier is dependent upon the type of ship, and the width is dependent upon the type of service to be provided. Pier measurements and allowances for single-length and multiple-length berths are based upon either accommodating known vessels or known types of vessels, where types but not specific ships are known. The dimensions for both types are determined as follows:

1. Pier Length.

- a. Single-Length Berth shall equal the overall length of the largest vessel to be accommodated, plus an allowance of 50 feet at each end of the vessel. For aircraft carriers, the allowance at each end of the vessel should be increased to 100 feet. See Figure 151-10 for berthing diagram and Table 151-10 for ship's dimensions.

- b. Multiple-Length Berths shall equal the total overall length of the largest vessels simultaneously accommodated, plus allowances of 100 feet between vessels and 50 feet beyond outermost moored vessels. See Figure 151-10 for berthing diagram and Table 151-10 for ship's dimensions.

2. Pier and Wharf Width. The width of a pier or wharf is determined on the basis of functional requirements, space availability and site conditions such as water depths, subsurface conditions and clearances. The widths of piers and wharves, as discussed hereinafter, refer to the dimensions determined for specific function classifications. These dimensions should not be less than the widths determined by geotechnical and structural considerations. Factors to be considered in the determination of pier and wharf widths are as follows:

a. Berths Provided on Outboard Face of Pier. Because pier widths are determined on the basis of the requirements of the main berths, the outboard face of a pier may be used only for vessels whose overall length does not exceed the width of pier and where bow and stern clearances conform to established criteria.

b. Berths Provided Alongside Pier or Wharf. Total structure width depends upon size of shed, if any, type of crane service provided, number of railroad tracks and truck lanes furnished and requirements for work space and open storage areas. At wharf facilities, open storage areas are contiguous to the apron and shed, but at pier facilities open storage areas are generally located off the pier and thus do not affect the determination of total pier width. Table 151-11, indicating minimum pier widths, is furnished as a guide.

c. Berths for Carriers. Camels specifically designed to breast off aircraft carriers should be provided at designated carrier berths. Alternatively, the provision of additional pier width may be considered to provide clearances for overhangs of flight decks and sponsors.

d. Services Requiring Additional Width. Adequate width should be provided to accommodate railroad tracks, truck lanes, craneways and fuel handling equipment when furnished.

### 3. Slip width.

a. General Considerations. The clear distance between piers, or slip width, should be adequate to permit the safe docking and undocking of the maximum size vessels that are to be accommodated in the slip. The size of slip should also permit the safe maneuvering and working of tugboats, barges, lighters and floating cranes. At multiple berth piers, where vessels are docked either one per berth, two abreast per berth or more, sufficient clearance should be available to permit the docking and undocking of vessels at the inboard berth without interfering with vessels at the outboard berth. Because the size of a slip is affected by docking and undocking maneuvers, consideration should be given to the advice of local pilots who are familiar with the ships to be handled and with prevailing environmental conditions such as winds, waves, swells and currents. The width should be reviewed with specific functional requirements of the individual installation before a final determination is made.

b. Minimum Width of Slip for Active Berthing.

(1) Minimum widths should be as shown on Figure 151-10. widths are defined as a factor times the beam of the largest vessel to be accommodated. The minimum width should not be less than 300 feet. The recommended criteria are applicable only if vessels are turned outside the slip area.

Refer to Table 151-10 for the beam of typical vessel types. At submarine slips, width requirements should be increased by at least four vessels beam and more, as required, to account for camels and separators, to provide for ships' vulnerability if their safety is involved, to provide for special maneuvering requirements of other ships during berthing or passing and to provide for special environmental conditions such as currents, waves and winds.

(2) The requirements discussed above apply where vessels are berthed on both sides of a slip. Where vessels are berthed on only one side of a slip, the width may be reduced.

(3) Referring to Figure 151-10, when more than 2 abreast berthing is employed, the width of slip should be increased by one ship beam for each additional ship added in order to maintain adequate clearances between moored ships during berthing and unberthing maneuvers. Thus, for 3 abreast berthing on both sides of a slip, the slip width for single berth piers would be equal to 10 times ship beam and the slip width for multiple berth piers would be equal to 11 times ship beam.

#### C. Minimum Width of Slip for Inactive Berthing.

(1) At slips containing inactive berths where vessels are stored for long periods of time on inactive status, in nests of two, three or more, clear distances between moored vessels and slip width may be reduced by one or two vessels beam to reflect the reduction in the frequency of berthing maneuvers and the decrease in activities of small boats and floating equipment.

#### 4. Water Depth in Slips.

a. Minimum Depth of Water. In a sheltered harbor and where the harbor bottom consists of soft material, water depth in a slip, measured from mean low water level (M.L.W.) should be equal to the maximum loaded draft of the vessels to be accommodated plus a minimum clearance of 4 feet which includes an allowance of 1 foot for vessel trim in loading, 2 feet for underkeel clearance and an allowance of 1 foot for tidal variations. For the loaded draft of typical vessel types, refer to Table 151-10 and DM-26.6. Specified water depths should be maintained as close to the fender line of the structure as is practicable considering the accessibility of dredging equipment used during maintenance dredging operations.

b. Other Considerations. Minimum keel clearance of 4 feet should be increased if any of the following conditions prevail:

- (1) Harbor bottom consists of a hard material such as rock.
- (2) Excessive silting (one foot per year or more) occurs.
- (3) Slip area is exposed to waves, swells and winds.
- (4) Extreme low water (one foot or more) occurs.
- (5) Investigation indicates probable fouling of condensers.

(6) Aircraft carriers have had situations where they suck up bottom sediments and marine organisms through their intakes, clog up condenser

coils and cause undue wear on machinery. In model tests it has been determined that one part of the solution to these situations is to increase the depth below the keel. Therefore, the water depth at carrier berths and anchorages shall be 50 ft. from MLW or MLLW datum for new construction. Water depth at existing facilities shall be increased to 50 ft. where feasible. Depths for BB's and AOE's may be increased for similar reasons. However, special studies at specific locations are required.

c. Vessel Characteristics. Table 151-10 is a comprehensive listing of pertinent data for vessels in the Naval fleet at the time of publication. The following is a list of footnotes which applies to this table:

(1) Vessels in class were established from the hull prototype number. Two or more hull prototype numbers possessing the same or nearly the same dimensions and other characteristics were combined in the same class.

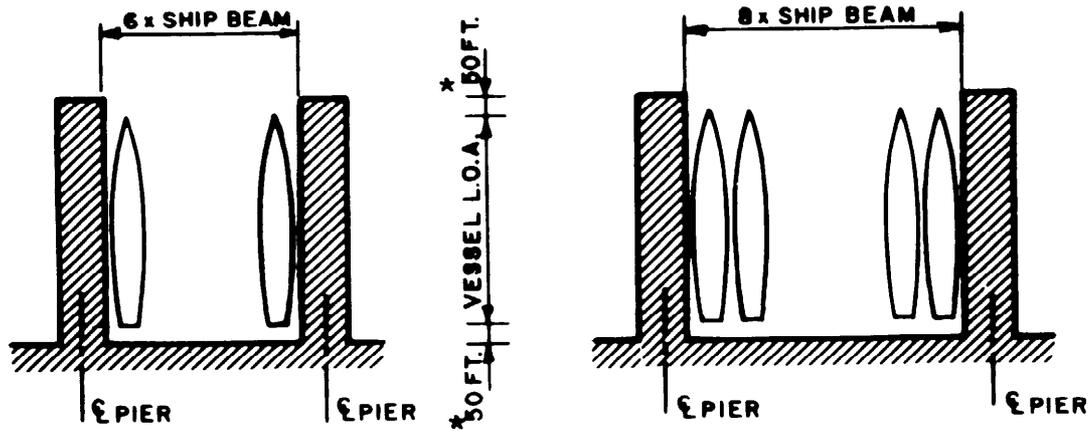
(2) Ordinarily, extreme breadth is the maximum width of vessel. For submarines, the value given is the maximum diameter or width of the hull structure and is not necessarily the maximum width which may occur at the horizontal stabilizer plans and is so noted. Canted aircraft carrier flight decks may not be dimensionally symmetrical about the longitudinal centerline of the vessel, marking the extreme breadth value for aircraft carriers unsuitable for determining berthing beam width at piers and wharves with gantry crane service.

(3) Maximum navigational draft is the minimum depth of water required to prevent grounding of a vessel due to appendages projecting below the vessel's base line or keel. Such appendages may be sonar domes, propellers, rudders, hydrofoils, vertical submarine control planes, etc. Many vessels also possess a decided trim to the bow or stern in fully loaded condition or in the case of submarines, a trim to the stern in surfaced condition,

(4) Water depth at carrier berths and anchorages is 50 ft. from MLW or MLLW datum for new construction. Water depth at existing facilities will be increased to 50 ft. where feasible. Depths for BB's and AOE's may also be increased if justified.

### **151 10 AMMUNITION PIER (FB)**

Ammunition piers are designed for use in the receipt of ammunition for storage and for the outloading of ammunition onto barges and ships. In many cases outgoing ammunition is first loaded from the ammunition pier onto barges for transfer to ships moored offshore or in a roadstead. The services and facilities provided for ammunition piers include lighting, telephone and fire alarm systems, and salt water for firefighting. Railroad tracks are normally provided unless the established method of handling ammunition is by truck. Freshwater is provided if a supply is readily available. For dimensional and other pertinent information, see Code 151. For quantity-distant standards for pier and wharf facilities handling explosives and ammunition, see NAVORD OP-5, Volume 1, Chapter 15. This pier is for break bulk load/off-load of ammunition. For containerized load/off-load of ammunition, use Category Code 151 70, Ordnance Container Handling Pier.

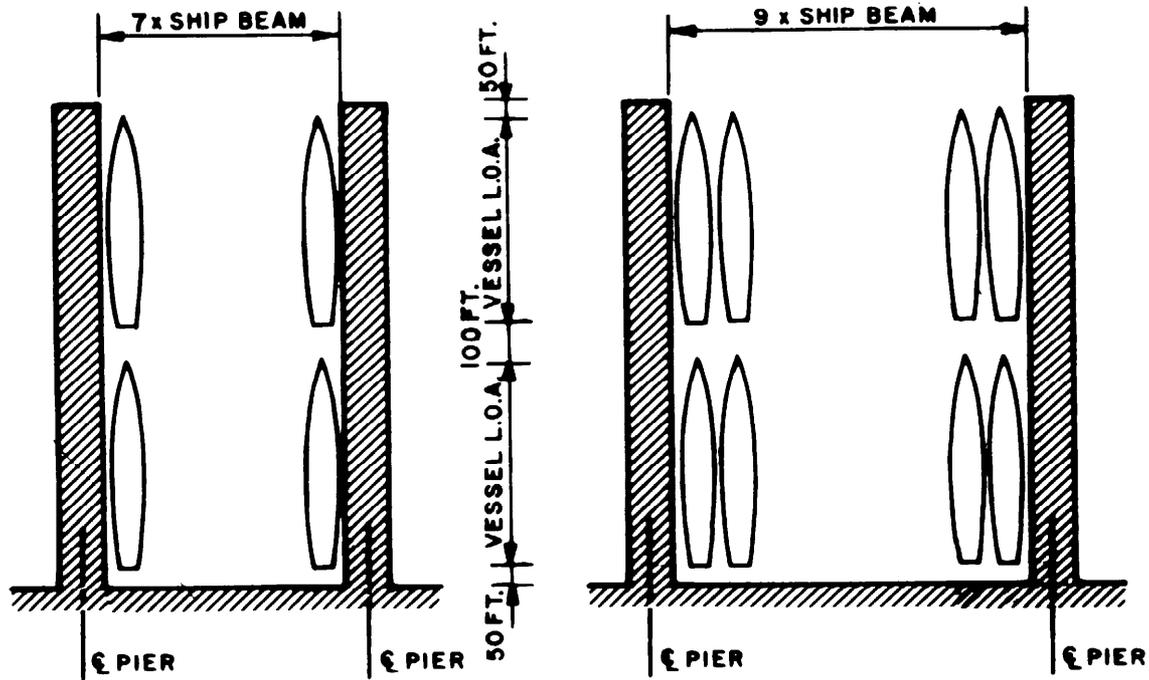


SINGLE BERTHING

TWO-ABREAST BERTHING

\* 100 FT. FOR AIRCRAFT CARRIERS

SINGLE BERTH PIERS



SINGLE BERTHING

TWO-ABREAST BERTHING

MULTIPLE BERTH PIERS

FIGURE 151-10  
Slip Widths

## **151 20 GENERAL PURPOSE/BERTHING PIER (FB)**

Berthing piers are used primarily for mooring ships that do not require piers equipped with shipyard facilities. Berthing piers are classified as active or inactive. The active berthing piers are used when ships are berthed for a relatively short time; the inactive classes are used when ships are to be tied up for long periods in a decommissioned status.

When berthing for carriers is to be provided on one side only or on both sides of a berthing pier the width of the structure shall be adequate to provide clearance for the overhang of the flight decks and sponsors. Alternatively, camels or other separators may be provided to fend off carriers.

All piers regardless of their function, will include such appurtenances as protective dolphins, fender systems, and dredging in connection with the facility. Supporting utilities, crane/railroad trackage, fixed cranes, and transit sheds on piers will carry their appropriate category codes. For a typical berthing pier, see Definitive Designs, NAVFAC P-272. For other pertinent information, see Code 151 (general notes).

For design criteria see Waterfront Operational Facilities, NAVFAC DM-25.

## **151 30 FITTING-OUT PIER (FB)**

Piers for fitting-out are very similar to those used for repair purposes, providing approximately the same facilities. However, fitting-out piers will have, in addition to light and heavy gantry cranes, a large fixed-tower crane for handling guns, turrets, engines, and heavy armor. The area around this facility must be of sufficient size to permit other equipment to maneuver and operate. This may vary depending on station mission. For dimensional and other pertinent information, see Code 151.

For design criteria see Waterfront Operational Facilities, NAVFAC DM-25.

## **151 40 FUELING PIER (FB)**

Facilities for berthing ships while discharging fuel to storage or receiving fuel from storage are provided at fueling piers. Such piers will provide salt water for firefighting, freshwater, steam in cold climates, electric power, and telephone and fire alarm facilities. In addition, a fuel main and special protective hose racks and small derricks for handling fuel hoses are necessary. They shall also be equipped with pipelines for each type of fuel to be stored at the site, including bilge and ballast lines. Stripper pumps for emptying lines are also necessary. A fueling pier may be justified for those stations where bulk quantities of liquid fuel can be economically handled by water transportation. These piers vary according to the service required, the local exposure to wind and water, and the geologic formation of the site. For dimensional and other pertinent information, see Code 151.

For design criteria see Waterfront Operational Facilities, NAVFAC DM-25.

## **151 50 REPAIR PIER (FB)**

Repair piers are constructed and equipped to permit overhaul of those portions of a vessel above the waterline. These structures will normally be equipped with a gantry crane and standard-gage railroad tracks and have facilities to provide salt and freshwater, steam, compressed air, telephone and fire alarm service, and electric power for ship service, lighting, and welding. In some cases industrial gases may be provided.

For typical repair pier see Definitive Designs, NAVFAC P-272. For dimensional and other pertinent information see Code 151.

For design criteria see Waterfront Operational Facilities, NAVFAC DM-25.

## **151 60 SUPPLY PIER (FB)**

Supply piers accommodate berthing for the transfer of materials between ship and shore. A large building or transit shed normally occupies the central portion of a supply pier. The pier width will be in direct ratio to the width of the shed or sheds, placed longitudinally down the center of the pier. For example, the shed for a ship needing 600 feet of berthing space is 150 feet wide. Transit sheds are normally placed side by side parallel with the long axis of the pier when both sides of a pier are used for shipments. The pier width should then be from 380 to 420 feet because the pier deck or apron should be from 40 to 60 feet wide to accommodate railroad track, dock truck trains and allow proper cargo handling. Space restrictions at some seacoast installations will undoubtedly dictate the construction of piers of lesser width. In such cases, transit sheds must be designed with these restrictions. Planning for supply piers at installations will usually be restricted to industrial seaport locations having a primary stock point mission. For dimensional and other pertinent information relative to supply piers other than that in the preceding paragraph, see Code 151.

For design criteria see Waterfront Operational Facilities, NAVFAC DM-25; Supply Facilities, NAVFAC DM-32.

## **151 70 ORDNANCE CONTAINER HANDLING PIER (FB)**

An ordnance container handling pier is used primarily for the outloading and receiving of explosive ordnance in containers from non-self-sustaining container ships. This does not preclude use of the pier by conventional break-bulk or self-sustaining container ships. The pier should be sited in accordance with NAVSEA OP-5, Volume I. The services and facilities provided on the pier are lighting, telephones, fire alarms, and salt water for fire fighting. Railroad tracks are provided where the normal method of drilling containers to the pier is by Trailer on Flat Car or Container on Flat Car (TOFC/COFC). Rails are flush with pier deck surface for ease of operations when moving containers by trucks on the pier. For dimensional and other pertinent data, see Code 151 (general notes) and NAVFAC DM-25.

**151 71 DEGAUSSING PIER (FB)**

No criteria are currently available for this code.

**151 80 DEPERMING PIER (FB)**

No criteria are currently available for this code.