



Salt & Fresh Water Marine – Walkways & Light Vehicular Bridges

FOREWORD

The Southern Pine Council (SPC) is a joint promotional body coordinated and supported by members of the Southern Forest Products Association (SFPA) and the Southeastern Lumber Manufacturers Association (SLMA). One of SPC's primary missions is to acquaint those interested in using the industry's products with the technical information available. This publication is a compilation of information gathered from industry sources by SPC to acquaint marine contractors and those who design and use docks, wharves, bulkheads and other structures with the availability and superior characteristics of Southern Pine products in aquatic applications.

The data included in this publication was not developed by SPC. Rather it is a summary of data taken from other industry sources, including the *SPIB Standard Grading Rules for Southern Pine Lumber, 2002 Edition*, published by the Southern Pine Inspection Bureau, the *Book of Standards* of the

American Wood Protection Association (AWPA) and the *2005 National Design Specification® (NDS®) for Wood Construction* published by the American Forest & Paper Association and the U.S. Forest Products Laboratory. The design concepts contained herein are illustrative of the engineering and other factors involved in building bulkheads, piers and docks with treated Southern Pine and are not intended to be used as a substitute for plans and specifications prepared by qualified professionals for each individual marine installation.

Neither SFPA nor SLMA designs, constructs or provides labor and materials for marine installations and do not, and cannot, have any knowledge of the adequacy of the design, engineering, quality of workmanship or the materials incorporated in completed structures. Therefore, neither they nor their members warrant, expressly or impliedly, the performance of completed structures in use and disclaim all responsibility thereof.



The Southern Pine Council is a joint promotional body coordinated and supported by members of the Southern Forest Products Association and Southeastern Lumber Manufacturers Association. For more information, contact either association.

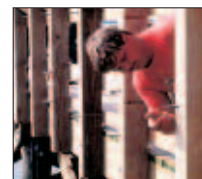
Southern Forest Products Association
2900 Indiana Ave. Kenner, LA 70065
504/443-4464 • FAX 504/443-6612

Southeastern Lumber Manufacturers Association
200 Greencastle Rd. Tyrone, GA 30290
770/631-6701 • FAX 770/631-6720

www.southernpine.com

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Charleston, SC

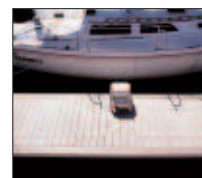
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Kure Beach, NC

Southern Pine Inspection Bureau (SPIB)

Timber Products Inspection, Inc. (TP)

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Southern Pine – a Natural Choice for Sensitive Environments

The use of Southern Pine lumber for aquatic and wetland service includes a wide range of residential and commercial applications such as docks, piers, marinas, bulkheads, boardwalks and light vehicular bridges.

These systems are exposed to especially harsh environmental conditions; therefore, accurate specification of lumber, timbers and fastening hardware is critical to achieve proper performance and serviceability. This guide offers technical information useful to the professional who specifies Southern Pine for these applications.

Industry quality control standards for the manufacture and preservation of Southern Pine ensure long-term performance and minimize environmental impact. Advances in preservative treatments, modern design and construction techniques, and sustainable forestry management make Southern Pine a cost-effective, ecologically sound and renewable construction material.

Earth-Friendly Access

Southern Pine provides a warm, natural look that blends beautifully with the surrounding landscape. To meet today's environmental requirements, designers often span wetland areas with timber bridges and elevated wood boardwalks. Nature trails also lend themselves to timber walkways, providing unrestricted access to rest stops and interpretation stations overlooking impressive vistas. Elevated walkways also provide an environmentally benign alternative to visitor paths paved with asphalt or concrete in zoos and nature centers while blending with the habitat and protecting natural terrain.



Golf courses around the country are experiencing success by incorporating paths and bridges made of preservative treated Southern Pine. Timber cart paths appeal to club developers because their natural look blends with the surroundings and eliminates the need for fill, making environmental permitting an easier process.

Environmental Impact

The potential impact of using treated wood in aquatic environments was the focus of close scientific study in the 1990s. Various government agencies, universities and the wood treating industry launched extensive efforts to understand the potential effects. This continuing work has produced a substantive base of knowledge about the behavior of treated wood and the

level of risk it represents. A worldwide review failed to find a single case where appropriately produced, specified and installed treated wood products resulted in a significant adverse environmental impact. Studies of treated wood in the most sensitive aquatic environments have shown that the associated risks are small and easily manageable.

For details on how to select and manage the use of treated wood to achieve best performance while minimizing the potential for adverse environmental impact, refer to *Treated Wood in Aquatic Environments* and its companion document, *Best Management Practices (for Treated Wood in Aquatic and Other Sensitive Environments)*, at www.southernpine.com.



HISTORY PRESERVED: The Great Atlantic City Boardwalk was built with preservative treated Southern Pine in 1867.

Library of Congress, Prints and Photographs Division, Detroit Publishing Company Collection.

Grade and Quality Marks

To protect the buyer and consumer, the industry has developed a system requiring ink-stamped grade marking of each piece of lumber under adequate quality control measures. This assures delivery of the grade specified for its intended use. Lumber grading and marking is monitored and inspected by agencies accredited by the American Lumber Standard Committee (ALSC). A valid agency grade mark on Southern Pine lumber indicates the product meets structural and appearance requirements established for that grade.

In addition, all treated Southern Pine should be identified with an inspection agency quality mark (either plastic end tag or ink stamp) conforming to accepted standards. For the quality mark to be valid after treatment, the lumber must adhere to the grade requirements and the

moisture content of the grade represented by the mark.

Specify Quality

It is recommended that the buyer specify pressure-treated wood bearing ink-stamped quality marks and/or plastic end tags denoting the material was produced under supervision of an independent inspection agency accredited by the ALSC. Use of such marks by the producer provides assurance that the preservative retention and penetration complies with American Wood Protection Association (AWPA) and/or Building Code specifications and that the preservative used is EPA approved and treated in compliance with federal law. Use of treated wood that does not bear an approved agency quality mark will not meet requirements of the International Code Council (ICC).

TYPICAL SOUTHERN PINE LUMBER GRADE MARKS
(ink stamp)

Example 1: SPIB® No.2 KD19 HT 7

Example 2: TP NO.2 KD-19 000 HT SYP

Example 3: RR® No 1 SYP 028 KD19HT

Quality Southern Pine lumber is graded in accordance with the grading rules of the Southern Pine Inspection Bureau (SPIB), SPIB, Timber Products Inspection, Inc., Renewable Resource Associates, Inc. (RRA) and other organizations are accredited to inspect and grade mark Southern Pine lumber in accordance with SPIB grading rules.*

- 1 Inspection Service: Southern Pine Inspection Bureau (SPIB)
- 2 Inspection Service: Timber Products Inspection, Inc. (TP)
- 3 Inspection Service: Renewable Resource Associates, Inc. (RRA)
- 4 Lumber Grade
- 5 Mill Identification Number
- 6 Lumber Species
- 7 (optional) Logo denoting a member mill of Southern Forest Products Association (SFPA)
- 8 Moisture Content (MC): Kiln-dried (KD) to a maximum of 19%
- 9 Heat Treated

*Note: Other agencies are accredited by ALSC to inspect and grade all or selected Southern Pine products according to SPIB Grading Rules, including: California Lumber Inspection Service (CLIS); Northeastern Lumber Manufacturers Association (NELMA); West Coast Lumber Inspection Bureau (WCLIB); and Western Wood Products Association (WWPA).

TYPICAL QUALITY MARK FOR TREATED LUMBER
(plastic end tag or ink stamp)

2009 - 2010 **GROUND CONTACT** **AWPA UC4**

CC **.40** **KDAT**

ABC TREATING CO. **ANYTOWN, USA**

- 1 ALSC inspection agency mark
- 2 AWPA Use Category
- 3 Year of treatment, if required
- 4 Preservative used for treatment
- 5 Preservative retention
- 6 Dry or KDAT, if applicable
- 7 Exposure category
- 8 Treating company and location

Southern Pine Lumber Grade Descriptions

The following grade descriptions are based on the *Standard Grading Rules for Southern Pine Lumber, 2002 Edition*, published by the Southern Pine Inspection Bureau (SPIB). Southern Pine grade descriptions for products not listed below are detailed in the *Southern Pine Use Guide*, available online at www.southernpine.com.

Dimension Lumber: 2" to 4" thick, 2" and wider

No.1 – Recommended for construction where high strength, stiffness and good appearance are desired.

No.2 – Recommended for most general construction uses where moderately high design values are required. Allows well-spaced knots of any quality.

No.3 – Assigned design values meet a wide range of design requirements. Recommended for general construction purposes where appearance is not a controlling factor. Many pieces included in this grade would qualify as No.2 except for a single limiting characteristic.

No.1 Prime – Recommended where appearance and strength are a consideration. Grade based on No.1 Dimension Lumber except wane and other characteristics that affect appearance are limited.

No.2 Prime – Recommended where appearance and strength are a consideration. Grade based on No.2 Dimension Lumber except wane and other characteristics that affect appearance are limited.

Timbers: 5" x 5" and larger

Select Structural – Recommended where high strength, stiffness and good appearance are desired.

No.1 and No.2 – Similar in appearance to corresponding grades of Dimension Lumber. Recommended for general construction uses.

No.3 – Non-stress rated, but economical for general utility purpose such as bracing, blocking, bulkheading, etc.

Radius Edge Decking: 1 1/4" thick, 4" to 6" wide

Premium – High-quality product, recommended where smallest knots are desired and appearance is of utmost importance.

Standard – Slightly less restrictive than Premium Grade. A very good product to use where a more rustic appearance is desired.

Moisture Content Requirements

Moisture content of Southern Pine lumber is an important consideration in aquatic and wetland applications.

Most of the in-service problems with heavy timbers and planking have been the result of inadequate drying practices prior to preservative treatment.

Dimension lumber and decking used in marine applications should be kiln-dried or air-dried to 19% or less. Timbers (5x5 and larger), if specified to be kiln-dried, must be 20% or less and, if specified to be air-dried, must be 23% or less. These moisture content guidelines for untreated Southern Pine originate from the Southern Pine Inspection Bureau (SPIB). One should be aware of these practices in order to develop a working knowledge of the lumber



drying process. For further information on end-use requirements, refer to the *Southern Pine Use Guide*, at SouthernPine.com.

Treated lumber can be specified to be Kiln-Dried After Treatment (KDAT). Some lumber treaters Air Dry After Treatment, (ADAT). These processes involve drying lumber to its in-service moisture content of 19% after treatment.

NOTE: AWP Standard T-1 states that the maximum permissible kiln temperature for

redrying after treatment is 165 degrees Fahrenheit.

Refer to the SPC publications *Pressure-Treated Southern Pine* and *Southern Pine Use Guide* for further details.

Design Values

Design values published in the *SPIB Standard Grading for Southern Pine Lumber, 2002 Edition*, apply to treated and untreated Southern Pine lumber, and are critical factors in designing and writing specifications for marine applications. Design value adjustment factors in the National Design Specification apply to both treated and untreated lumber; the noted exception being that the Load Duration Factor, C_D , of 2.0 for impact shall not apply to structural members pressure-treated with waterborne preservatives to the heavy retentions required for "marine exposure."

For applications where the end-use will exceed 19% moisture content, there is a Wet Service Factor, C_M .



Where loads are applied to the flat face of members (such as decking), there is a Flat Use Factor, C_{fu} . Members that are either in contact or spaced 24" on center or less and are at least three in number may take advantage of the Repetitive Member Factor, C_r , if they are joined by adequate load distributing elements.

Southern Pine adjustment factors are based on the *National Design Specification (NDS®) for Wood Construction*, published by the American Forest & Paper Association (AFPA). Refer to the *Southern Pine Use Guide* for further information.

NOTE: Timbers (5x5 and larger) have the same design values for wet and dry uses; design values for timbers are based on green (wet) use conditions.

Proper Lumber Storage

Using proper storage techniques is essential to the efficient and economical use of treated lumber. Proper storage also:

- ▶ Prevents defects that may result from alternate wetting and drying
- ▶ Helps maintain appearance and dimensional stability
- ▶ Helps to safeguard against costly callbacks for builders

Job Site Storage

Regardless of where lumber is stored at the job site, a few simple precautions should be observed:

- ▶ Lumber should be unloaded in a dry place – not in water or muddy areas.
- ▶ Lumber should not be in direct contact with the ground. It should be elevated on stringers to allow air circulation.
- ▶ Lumber stored in an open area should be covered with a material that will give protection from the elements, but be porous enough to allow moisture to escape. Polyethylene or similar covers may not allow the passage of moisture.

The builder, building contractor, licensed contractor, erector or erection contractor is responsible for the proper unloading, receiving, storage, handling, installation and bracing of lumber at the job site.



Sizes

Southern Pine sawmills produce lumber in two-foot multiples, commonly supplying lengths of 8' to 20'. Some mills produce longer lengths, typically 22' and 24'. Marine construction designs should consider standard sawmill lengths to utilize full-length lumber and minimize cut-offs and waste installation.

Southern Pine Lumber Sizes (Boards & Dimension)

Nominal Size (inches) thickness x width	Actual Size (inches) thickness x width
5/4 x 6	1 x 5-1/2
1 x 4	3/4 x 3-1/2
1 x 6	3/4 x 5-1/2
2 x 4	1-1/2 x 3-1/2
2 x 6	1-1/2 x 5-1/2
2 x 8	1-1/2 x 7-1/4
2 x 10	1-1/2 x 9-1/4
2 x 12	1-1/2 x 11-1/4

Southern Pine Timber Sizes

Nominal Size (inches) thickness x width	Actual Size (inches) thickness x width
6 x 6	5-1/2 x 5-1/2
6 x 8	5-1/2 x 7-1/2
8 x 8	7-1/2 x 7-1/2

NOTE: Timber sizes shown above are “dressed” or surfaced on four sides (S4S). Rough timbers can also be specified. Minimum rough sizes are 3/8” scant of nominal sizes, in thickness (inches) and in width (inches), and rough timbers may be 1” oversize if over 2” thick, according to SPIB grading rules; refer to paragraph 121.4 (rough), 123.5 (dressed) and 121.5 (oversize).

- 1” and 2” thick “rough” lumber is normally not separated and available for domestic uses because of sawmill production practices geared to commodity lumber markets and uses.
- Traditional bulkhead sheeting products are surfaced 1” and 2” nominal dimension lumber (actual thickness 3/4” & 1 1/2”). These products are readily available from Southern Pine sawmills and treaters.

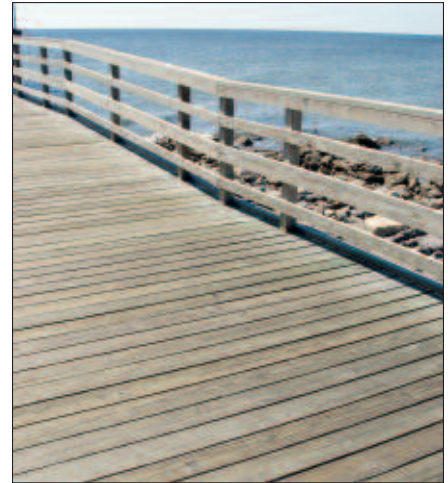
Surfacing

Surfacing the lumber to its final configuration (either dimensional size or a specialty pattern) should also be a part of a marine product specification, depending on the final application. According to SPIB grading rules, surfacing options are:

- S4S – Surfaced Four Sides
(all four faces)
- S2S – Surfaced Two Sides
(two faces on the width)
- S1E – Surfaced One Edge
(one edge on the thickness)
- S2E – Surfaced Two Edges
(two edges on the thickness)

Proper specification of lumber surfacing often contributes to a cost-effective, well-designed project.

Example: Substructural members 3” and thicker need not always be surfaced on all four sides for optimum service. Rough lumber for joist applications, surfaced one edge (S1E) or surfaced two edges (S2E) can be used to provide an even surface for decking material.



Profiles & Patterns

Southern Pine lumber for marine construction can be remanufactured into a variety of profiles, including “sloppy T&G,” a common pattern used in bulkheading (see illustrations). Simple guidelines involving thickness and tongue length are as follows: If 2”-thick lumber is used, the tongue should be 3/4” long; if 3” or 4”-thick lumber is used, the tongue should be 1” long.

Notching, if necessary, should be specified, as well as any special cutting, drilling, ripping or other modifications to the lumber. Given the proper specifications, sawmills and treating plants perform these cuts prior to treatment. Absolutely none of these practices should be done after treatment. In the case of fabrication during installation, field cuts should be treated in accordance with AWP Standard M4.

Refer to the *SPIB Standard Grading Rules for Southern Pine Lumber, 2002 Edition*, for more details on surfacing and profile designations, provisions and net product sizes.



“Sloppy VT & G”



“Square Sloppy T & G”



TABLE 1: SPECIFICATIONS FOR SOUTHERN PINE COMPONENTS IN FRESH & SALT WATER SERVICE

Location	Component	Dimension	Grade	Surface Texture	Moisture Content
ABOVE WATER	Decking ^{1,2}	5/4 x 6 or 2 x 6	Premium, No. 1	RED, S4S	S-Dry 19% or less
	Handrails	2 x 4 or 2 x 6	No. 1, No. 1 Dense or Select Structural	S4S	S-Dry 19% or less
	Wallcaps	2 x 6, 2 x 8 or 2 x 10	No. 1	S4S	S-Dry 19% or less
SPLASH ZONE	Split Pile Caps	2" to 4" thick	No. 1 Dense	S4S, Rough	S-Dry 19% or less
	Stringers	2 x 8, 2 x 10 or 2 x 12	No. 1	S4S/S2E	S-Dry 19% or less
BELOW WATER	Sheet Piles ⁴	2" to 4" thick	Saltwater: Marine Grades No. 1 Freshwater: No. 2	S4S (S2S – optional, but not normally used)	S-Dry 19% or less (Lumber, 2'-4" thick) KD 20% or less or Dry 23% or less (Timbers, 5x5 & larger)
	Walers ³	3 x 6 & greater	Saltwater: Marine Grades No. 1 Freshwater: No. 2	S4S (S2S – optional, but not normally used)	S-Dry 19% or less (Lumber, 2'-4" thick) KD 20% or less or Dry 23% or less (Timbers, 5x5 & larger)
	Cross Bracing	2" to 4" thick	Saltwater: Marine Grades No. 1 Freshwater: No. 2	S4S, Rough	S-Dry 19% or less
	Piling (sawn timber)	6 x 6, 6 x 8 or 8 x 8	Saltwater: Marine Grades No. 1 Freshwater: No. 2	S4S, Rough	Dry 23% or KD 20% or less
	Piling (round timber)	Specify minimum tip circumference and length	ASTM D25	N/A	KD 25% or less
VARIABLES	Glulam Timber	Custom & Standard	Performance based upon grades used in beam layup	Industrial, Architectural, or Premium	12% Average

(1) Where appearance is important, specify decking in No. 1 grade in dimension lumber or premium grade in 5/4 radius edge. (2) Some manufacturers offer treatments that include water repellent additives. Water repellants can increase service life, enhance durability and improve aesthetics. Topical treatments such as brush-on sealers are also recommended on a periodic basis. Contact a supplier in your area for details, or search the product locator at www.southernpine.com. (3) Bolt-laminated "Marine Grade" 2x dimension can be used to fabricate large walers, such as 2x8 nominal to build an 8x10. This bolt lamination technique could apply to any size combination up to 2x12 nominal. (4) Sheet pile T&G profile must be run prior to CCA treatment.

Abbreviations: ASTM D25 – American Society for Testing and Materials, Standard for Round Timber Piles; KD – Kiln Dried; RED – Radius Edge Decking; S2E – Surfaced on Two Edges; S4S – Surfaced on Four Sides; S-Dry – Dried Prior to Surfacing

Preservative Treatments for Aquatic Applications

Preservative Process and Selection

Pressure-treated Southern Pine is the product of a carefully monitored and controlled process. Preservatives are forced into the wood's cells within a closed cylinder while under pressure. A "fixation" process bonds the preservative to the wood fiber. Fixation results in a virtually insoluble bond that protects lumber products in service.

Pressurized treatment of lumber, timbers and piling is the most effective method of protecting wood designated for the marine environment. The pressure process allows deeper penetration of chemical components in the wood and closer control of retention levels.

The choice of preservative depends on how and where wood will be used. There are three broad types of wood preservatives used in modern pressure-treating processes.

► **Waterborne Preservatives** are used for residential, commercial, marine, agricultural, recreational, and industrial applications.

► **Creosote** and creosote/coal tar mixtures are used for railroad ties, pilings, timber bridges, utility poles and heavy commercial marine uses.

► **Oilborne Preservatives**, namely Pentachlorophenol, or "Penta," and Copper Naphthenate are used for industrial applications, including utility poles. Penta and copper naphthenate are not recommended for saltwater marine construction, especially in immersion or in the splash zone.

CCA Approved for Saltwater Use

The use of CCA for marine construction, as specified in AWPA Use Category UC5, is approved by the Environmental Protection Agency for certain uses. CCA is allowed for piling and walers in salt water immersion. CCA is also allowed for other framing, stringers and cross bracing exposed to saltwater splash in 2x8 and/or 3x6 and larger nominal dimension and treated to a minimum of 0.60 pcf.

CCA is not allowed for decking, railings, wall caps and related applications

using lumber less than 2x8. Approved alternative preservatives, just as effective as CCA for these applications, will be used for these components above water.

AWPA Standards

The American Wood Protection Association (AWPA) publishes its *Book of Standards* annually, which lists the proper preservatives and retentions for various service conditions.

The pressure treating industry has established different preservative retention levels for treated lumber, based on intended use.

"Retention levels" refer to the amount of chemical preservative remaining in the wood's cell structure after the pressure process has been completed. Preservative retentions are expressed in pounds of preservative per cubic foot of wood; the higher the retention level, the harsher the condition to which the wood can be exposed.

Commodity Specifications & Service Conditions

AWPA Use Category System

The American Wood Protection Association Use Category System (UCS) defines exposure categories that wood products are subjected to in service. The UCS helps users identify the exposure condition for specific products and end-use environments and then specify the acceptable preservatives and retention levels necessary for that application.

The specifier should become familiar with the Commodity Specifications (Table 2) that designate the general classification of treated wood components and the Service Conditions (Table 3) to which components will be exposed. Approved preservatives and retentions for treated Southern Pine by end-use or application and exposure condition are summarized in Tables 4 - 6, pages 7 and 8.

When purchasing treated Southern Pine under the Use Category System, material orders should include the general commodity specification (Table 2), Service Condition (Table 3), specific end-use and preservative and retention level (Tables 4-6), and any special requirements such as pre- or post-treatment preparations (including conditioning and drying).

TABLE 2: COMMODITY SPECIFICATIONS

A	Sawn Products Permanent Wood Foundation (PWF)	E	Round Timber Piling
B	Posts Playground Material Round Building Poles	F	Wood Composites
C	Crossties and Switchties	G	Marine (Salt Water) Applications
D	Poles	H	Fire Retardants
		I	Nonpressure Applications
		J	Nonpressure Composites
		K	Barrier Protection Systems

NOTE: Major classifications of treated wood commodities (A-K) displayed in Table 2 are excerpted from the *AWPA Book of Standards*, Section 6, Commodity Specifications. Section 6 provides detailed information on listed preservative systems and allowable wood species applicable for each service condition. Specifications and guidance for preservative-treated commodities listed under Commodity Specification H, I, J and K are not included in Southern Pine Council publications due to their specialized applications and/or proprietary preservative systems. Southern Pine Council recommends end-users contact manufacturers of the preservative systems and/or commodities approved under the particular specifications (H, I, J, K) to determine performance and applicability to their project requirements.

Use Category System Replaces Commodity Standards

The AWPAs Use Category System was introduced in 1999 as a user-friendly format to eventually replace the Commodity (or “C”) Standard for treatment specification. The Commodity Standard was deleted from the *AWPA Book of Standards* beginning with the *2005 Edition*. Commodity Standards pertaining specifically

to Southern Pine are displayed below for historical context and their continued influence on certain issues. For example, the “C” Standards in the *AWPA Book of Standards, 2001 Edition*, were used as the basis for determining which categories of CCA-treated commodities would be phased out of consumer use as of 2004.

COMMODITY STANDARDS: C1 - All Timber Products – Preservative Treatment by Pressure Processes; C2 - Lumber, Timber, Bridge Ties and Mine Ties; C3 - Piles; C4 - Poles; C5 - Fence Posts; C6 - Crossties and Switch Ties; C9 - Plywood; C11 - Wood Blocks for Floors and Platforms; C14 - Wood for Highway Construction; C15 - Wood for Commercial – Residential Construction; C16 - Wood Used on Farms; C17 - Playground Equipment; C18 - Marine Construction; C20 - Structural Lumber: Fire Retardant Treatment by Pressure Processes; C22 - Permanent Wood Foundations; C23 - Round Poles and Posts used for Building Construction; C24 - Sawn Timber used to Support Residential and Commercial Structures; C25 - Sawn Crossarms; C27 - Plywood Fire Retardant Treatment by Pressure Processes; C28 - Glued Laminated Members; C29 - Lumber and Plywood to be used for the Harvesting, Storage and Transportation of Food Stuffs; C30 - Lumber, Timbers and Plywood for Cooling Towers; C31 - Lumber used Out of Contact with the Ground and Continuously Protected from Liquid Water; C32 - Glue Laminated Poles; C33 - Structural Composite Lumber; C34 - Shakes and Shingles

TABLE 3: SERVICE CONDITIONS FOR USE CATEGORY DESIGNATIONS (FRESH & SALT WATER)

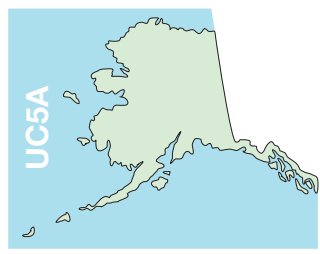
Use Category (UC)	Service Conditions	Use Environment	Common Agents of Deterioration	Typical Applications
Lumber & Timbers				
3B	Exterior Construction, Above Ground, Uncoated	Exposed to all weather cycles, including prolonged wetting	Decay fungi and insects	Decking, handrails, wall caps
4B	Ground Contact or Fresh Water	Members out of water but subject to saltwater splash*	Decay fungi and insects with increased potential for biodeterioration	Split pile caps, stringers
4C	Ground Contact or Fresh Water	Exposed to all weather cycles, severe environments, extreme decay potential	Decay fungi and insects with extreme potential for biodeterioration	Land & freshwater piling, foundation piling, cross bracing
5A, 5B, 5C	Salt or Brackish Water	Continuous marine exposure	Salt water organisms	Piling, bulkheads, bracing
Piling, Round & Sawn				
4C	Ground Contact or Fresh Water	Exposed to all weather cycles, severe environments, extreme decay potential	Decay fungi and insects with extreme potential for biodeterioration	Land & freshwater piling, foundation piling
5A, 5B, 5C	Salt or Brackish Water	Continuous marine exposure	Salt water organisms	Piling, bulkheads, bracing

* Salt Water Splash is the exposure of any member of a marine structure which is positioned above mean high tide, but is subject to frequent wetting from wave action or wind which supports intermittent degradation by marine organisms.

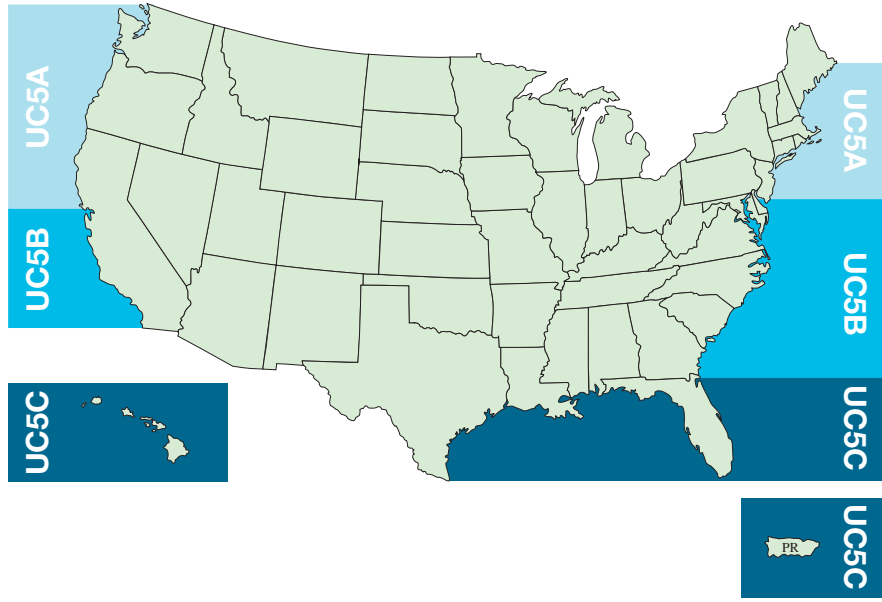
TABLE 4: PRESERVATIVE SPECIFICATIONS FOR SOUTHERN PINE IN SALT WATER SERVICE¹

End-Use Commodity	AWPA Use Category (UC) Designation	Minimum Retention Requirements — Pounds per Cubic Foot (pcf)			
		Creosote (CR, CR-PS, CR-S) ⁴	Copper Azole - (CA)	Copper Quat - (ACQ, MCO) ⁵	
Piles, round					
New Jersey & San Francisco Bay, North	5A	1.5	16.0		
Mid-Atlantic & San Francisco Bay, South	5B	2.5	20.0		
Florida, Gulf Coast, Puerto Rico, Hawaii	5C	2.5	20.0		
Dual Treatment					
First treatment	5B-C	1.0			
Second treatment	5B-C		20.0		
Piles, square sawn & sheet pile					
Dual Treatment	5A-C	2.5	25.0		
First treatment	5A-C	1.5			
Second treatment	5A-C		20.0		
Glulam Timber³					
Dual Treatment	5A-C	2.5	25.0		
First treatment	5A-C	1.5			
Second treatment	5A-C		20.0		
Bulkhead Sheathing, Cross Bracing, Walers					
	5A-C	2.5	20.0		
Split Pile Caps, Stringers					
Salt Water Splash	4B-C	0.60	12.0	0.31	0.60

(1) Preservatives and retentions listed in Table 4 per American Wood Protection Association (AWPA) Book of Standards, 2008 Edition. (2) In salt water marine use, CCA treatment is not allowed in nominal dimensions less than 2x8, but is allowed for walers, pile caps, stringers, cross bracing and other framing when 2x8 and/or 3x6 and larger nominal dimensions are treated to a minimum of 0.60 pcf. (3) Per AITC 109-2007, American Institute of Timber Construction, Standard for Preservative Treatment of Structural Glued Laminated Timber. (4) CR and CR-S only. (5) ACQ-B and D only.



Marine Use Categories U.S. Coastal Waters



Marine (salt water) Use Categories for U.S. Coastal Waters — Coastal zones and corresponding Use Categories for salt water marine exposure are shown here. Use Category requirements for particular zones are based on the presence of specific marine organisms. The degree of hazard posed by these organisms in a specific coastal zone will determine the appropriate preservative loading. This map is only a general guide and should be supplemented with local information where there is doubt concerning the nature of marine borer activity and selection of an appropriate preservative.

TABLE 5: PRESERVATIVE SPECIFICATIONS FOR SOUTHERN PINE IN FRESH WATER SERVICE¹

End-Use Commodity	AWPA Use Category (UC) Designation	Minimum Retention Requirements — Pounds per Cubic Foot (pcf)			
		Creosote (CR, CR-PS, CR-S)	Copper Azole – (CA)	Copper Quat – (ACQ, MCQ)	Chromated Copper Arsenate (CCA) ²
Piles					
Round	4C	0.80	12.0	0.41	0.80
Square Sawn & Sheet Pile	4C	0.60	12.0	0.31	0.60
Glulam Timber³	4A	0.40	10.0		0.40
Bulkhead Sheathing, Cross Bracing Split Pile Caps, Stringers, Walers	4A		10.0	0.21	0.40

(1) Preservatives and retentions listed in Table 5 per American Wood Protection Association (AWPA) Book of Standards, 2008 Edition. (2) CCA preservative is not allowed for solid sawn dimension lumber in fresh water use. (3) Per AITC 109-2007, American Institute of Timber Construction, Standard for Preservative Treatment of Structural Glued Laminated Timber.

Table 6: Preservative Specifications for Southern Pine – Decking, Handrails & Bulkhead Wall Caps

Classification	Preservative System	Minimum Retention – Lbs/Cubic Foot (pcf)			ICC Evaluation Service Report ²
		AWPA ¹ Use Category [©]	International Code Council ² Service Condition		
		UC3B	Decking ³	General Use	
Creosote	Creosote (CR, CR-PS, CR-S) ⁴	8.0			
Oilborne	Copper-8-Quinolinolate (Cu8)	0.02			
	Copper Naphthenate (CuN)	0.04			
	Pentachlorophenol (PCP-A&C)	0.40			
Waterborne, Copper Based, Solution	Alkaline Copper Quat (ACQ-C&D)	0.25	0.15	0.25	628
		0.25	0.15	0.15	643
		0.25	0.15	0.20	1980
	Ammoniacal Copper Quat (ACQ-A&B)	0.25	0.15	0.20	1980
	Copper Azole (CA)	0.10	0.06	0.06	1721
	Copper HDO Type A (CX-A)	0.206	0.11	0.20	1863
	Waterborne Copper Naphthenate (CuN-W)	0.07			
Waterborne, Copper Based, Suspension	Dispersed Copper Azole (μCA-C)		0.05	0.05	1721
	Micronized Copper Azole (MCA)		0.06	0.07	2325
	Micronized Copper Azole		0.06	0.06	2240
	Micronized Copper Quat (MCQ)		0.15	0.15	1980
Waterborne, Carbon Based	DCOI + Imidacloprid (EL2)	0.018	0.0187	0.0187	2067
	Propiconazole-Tebuconazole-Imidacloprid (PTI)	0.013	0.013	0.013	1477
Waterborne, Borates	DOT & Polymer Binder		0.50	0.50	1081

(1) American Wood Protection Association retentions per AWPA Book of Standards, 2008 Edition. The term "Use Category" copyright AWPA. (2) International Code Council retentions per ICC Evaluation Service Reports (ESR). See Southern Pine Council publication, *Pressure-Treated Southern Pine*, for list of report holders. View reports at www.icc-es.org. (3) Above ground decking and other specialties (posts, pickets, rail and wall caps, lattice, trim). (4) Creosote not recommended for this application where a clean appearance and an odor-free environment are important.

Decking Specifications & Installation Guidelines

Southern Pine lumber is often used for decking in marine construction. Boardwalks, piers, and floating docks are just a few examples. As with all marine construction, knowing the correct materials and proper installation techniques are crucial to the long-term performance and longevity of the structure.

Moisture Content and Size Considerations

Because a waterborne preservative system is used, the moisture content and dimensional use of Southern Pine lumber can vary after treatment. Wood swells in thickness and width during treatment. For example, a 2x6 at 19% MC prior to treatment measures 1 1/2" x 5 1/2". This treatment measurement can increase as much as 1/8" to 1/4" directly after treatment, depending on the density of the wood.

Most treated Southern Pine is shipped to the building supply store or job site in a moist condition, usually in excess of 25%. The dimensional measurement of this material will vary depending on drying time after treatment and ambient temperatures. Accordingly, decking may need to be butted together during installation to avoid excessive gapping as the lumber dries (see chart).

Treated Southern Pine lumber can also be purchased that is redried after treat-



ment. This represents only a small percentage of Southern Pine lumber (about 5%). This lumber is designated ADAT or KDAT on the quality mark or end-tag. AWPA Standards specify a 19% moisture content for all ADAT and KDAT material. Generally, this lumber should be spaced during installation to avoid buckling (see chart).

Material Selection and Installation

Decking should be specified, ordered and installed in even 2-foot lengths (4', 6', 8', etc.) For optimum appearance and performance, decking material should be specified No. 1 (for 2" nominal thickness) or Premium (for Radius Edge Decking). Lumber should bear the grade-mark and the treatment quality mark or label of an American Lumber Standards approved inspection agency. An installation "rule of thumb" has always been to

install decking bark side up. Research continues to confirm this, but more importantly, proper fastening practices and a deck maintenance program are required to ensure stability and good deck performance.

To avoid cupping, decking should not exceed 6" in width. Today's wood preservatives can be specified to include water-repellent additives that will minimize weather damage to deck surfaces. Color additives are also available.

Another option is to seal all decking with a topical water-repellent formulation.

Hot-dip galvanized screws provide superior holding power for decking. Alternately, stainless steel or hot-dip galvanized ring or spiral-shank nails can be used. Refer to Decking & Fastening Guidelines, page 21.

Recommended Spacing for Treated Decking	
2x6 or 5/4x6 Nominal	
Width at Installation	Spacing (min - max)
5 1/2" (wet or dry)	1/8" - 1/4"
5 5/8" (wet)	1/16" - 1/8"
5 3/4" (wet)	Butt boards together
Over 5 3/4" (wet)	Allow drying time prior to installation



Fasteners & Connectors for Use with Treated Wood

The potential for corrosion of hardware in contact with treated wood occurs when metals in the preservative (such as copper) are different from the metals in the hardware (the iron in steel, or aluminum). In a wet environment, these dissimilar metals create a small electrical current that triggers a chemical reaction resulting in galvanic corrosion.

To select proper hardware, the specifier should first consider the end-use application and exposure conditions. In damp or wet exposure, hardware in contact with pressure-treated wood must be corrosion resistant. Hardware includes fasteners (e.g. nails, screws and bolts) and all connectors (e.g. joist hangers, straps, hinges, post anchors and truss plates).

Regardless of exposure condition, fasteners and connectors should be specified in compliance with the hardware manufacturer's recommendations and the building codes for their intended use.

Copper-Based Preservatives

Copper-based formulations may be used in interior or exterior applications and include the traditional Chromated Copper Arsenate (CCA) and advanced products such as Copper Azole (CA) or Copper Quat (ACQ or Micronized Copper). CA and ACQ have shown a slight increase in corrosion rates on mild steel compared to CCA and Micronized Copper.

In damp or wet environments, hot-dip galvanized or stainless steel hardware is strongly recommended in contact with copper-based preservative treated wood. Hot-dip galvanized *fasteners* should meet ASTM A153. Hot-dip galvanized *connectors* should meet ASTM A653, Class G185 sheet with 1.85 ounces of zinc coating per square foot minimum.

Type 304 or 316 stainless steel is recommended for maximum corrosion resistance in more severe exterior applications, such as swimming pools or salt-water. Stainless steel fasteners are generally required for below-grade applications such as Permanent Wood Foundations. Stainless steel is also a recommended option when CA or Copper Quat formulations are



specified at retention levels greater than required for Ground Contact.

Standard carbon-steel, aluminum or electro-plated products must not be installed in direct contact with CA or ACQ treated wood. However, aluminum products may be placed in direct contact with Micronized Copper treated wood when used in interior applications or exterior applications above ground.¹ Electroplated galvanized metal products generally have a thinner layer of protection compared to hot-dip galvanized and are typically not accepted by the building codes for use in exterior applications. Fasteners and connectors used together must be of the same metallic composition to avoid galvanic corrosion (e.g. use hot-dip nails with hot-dip joist hangers).

When aluminum or electroplated hardware must be used in proximity to CA or ACQ treated wood, spacers or physical barriers can protect products such as flashing or termite shields. Barriers should be non-conductive and remain durable for the intended service life of the application. Suitable barriers may include heavy plastic sheeting, rubber, vinyl, or a high quality, non-permeable tar bitumen or epoxy.

Hardware coated with proprietary anti-corrosion technologies is also available. Consult individual hardware manufacturers for specifics regarding their performance.

Non-Copper Preservatives

Non-copper based preservatives include traditional borates for use in interior applications and new carbon-based formulations for outdoor use. These preservatives are less corrosive than their

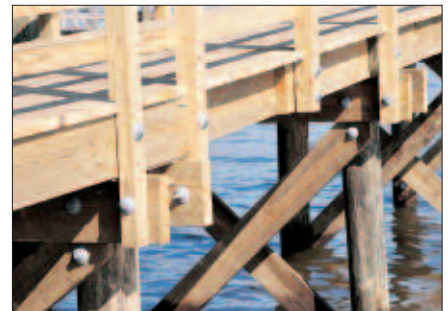
copper-based counterparts, but exposure conditions must always be a primary consideration.

Borate preserved wood (Inorganic Boron – SBX) is limited to Above Ground interior use in dry or damp applications, continuously protected from weather.

New carbon-based preservatives are formulated for Above Ground exterior use. Like borates, they are no more corrosive to hardware than untreated wood, but end-use and

exposure is the key to proper specification. For example, wood decking treated with a carbon-based preservative will still be exposed to all weather cycles including prolonged wetting.

(1) Per independent corrosion testing conducted for Osmose, Inc.



NOTE: This advisory provides a summary of recommendations from a variety of sources. The Southern Pine Council (SPC) does not guarantee the performance of products used in conformance with these recommendations, and does not endorse any type of wood preservative, fastener, or connector. SPC does not attest to the validity of methodologies used to conduct corrosion tests and does not attest to the validity of the test conclusions upon which these recommendations are based.

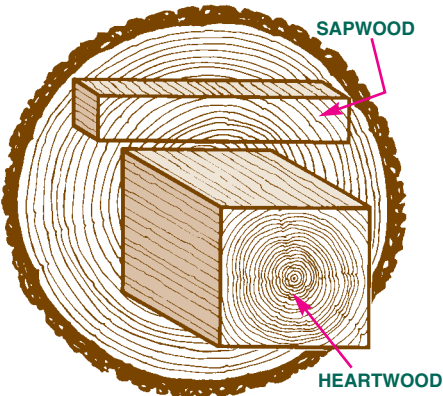
The Marine Environment & Southern Pine Lumber

Lumber Characteristics

An understanding of Southern Pine lumber and its interaction with fresh and saltwater environments is important.

Southern Pine lumber is composed basically of sapwood and heartwood cells. Lumber, timbers and piling cut from a log can be 100% sapwood or 100% heartwood or a combination of either depending on log size, growth conditions and other log characteristics.

Sapwood is the living outer portion of the tree composed of elongated cells or tracheids which take an active part in the growth and water movement within the tree. Heartwood is the dead or inactive center part of the tree and becomes a repository for resins and extractives. These extractives impart a degree of nat-



ural decay resistance. Logs that come from old-growth forests contain higher heartwood concentrations. Logs originating in second-growth stands and pine plantations have faster growth rates and contain more sapwood than heartwood because of their younger age.



Pressure-treating the sapwood portion of lumber, timbers, and piling with preservatives is the most important and effective method of protecting wood and assuring long-term performance.

Wood Decay Factors

The constant or intermittent presence of water in a typical marine setting is the overwhelming factor favoring fungal growth.

Fungi need four criteria to survive: moisture, warm temperature, oxygen and food. The absence of any one of these essentials will interrupt or prevent growth. That's why portions of piers and piles that are constantly under water do not decay – there's no free oxygen. It's also why protected wood framing, high and dry above the water surface, doesn't decay – there's no water or persistent moisture present.

But in areas at or near the waterline, where wood's moisture content remains above 30%, decay is common. The only way it can be prevented is to eliminate the food supply of the fungi. The treatment process accomplishes pressurized impregnation of the wood, making it undesirable as a food source for fungi.

Marine Borers

Properly treated Southern Pine lumber, timber and piling is commonly used for submerged saltwater applications because it can be sawn with treatable sapwood on all four sides. (refer to "Marine Grades," next page) This is an important consideration in areas of marine borer activity, principally salt and brackish water environments.

Marine borers are small invertebrate sea animals that burrow in the wood for food and shelter. They can either be crustaceans, such as gribbles and pill bugs, or mollusks, such as shipworms and pholads. Marine borers are found throughout the world, but most areas have only selected species. The U.S. Southern Atlantic coast and Gulf of Mexico are home to four different types. Talking to local marine contractors, harbor masters, marina operators and waterfront property owners is one of

the best ways to find out what types of borers are prevalent in a particular area. Pill bugs are mainly limited to brackish water estuaries within this region.

Borer damage to wooden marine structures can be prevented, but it requires knowledge of the types of borers present and the use of the proper preservative. In case of saltwater marine borer presence, Chromated Copper Arsenate (CCA) remains approved for use as the primary preservative to resist shipworms and gribbles. Some types of marine borers are tolerant of preservative treatments, while other types are not. Investigate local conditions and specific marine borer activity and refer to American Wood Protection Association (AWPA) standards for detailed preservative treatment information.



The wood products industry, preservative chemical companies and the USDA Forest Products Laboratory (FPL) in Madison, Wisconsin, are continuing research involving marine borers. For example, FPL research has found that marine exposure retention levels – 2.5 lbs./cu.ft. CCA in sapwood – offer long-term performance in saltwater where gribbles and shipworms are present and in brackish water located in temperate regions. These treatments are necessary because marine borer activity changes and may increase as harbors and other industrial coastal areas become less polluted.

Special Grades for Salt Water Service

Marine

In marine construction, the specification of Southern Pine lumber, timbers and piling will vary according to its end use. Higher grades of Southern Pine (No.1 and better) are commonly specified when strength requirements and aesthetics are important.

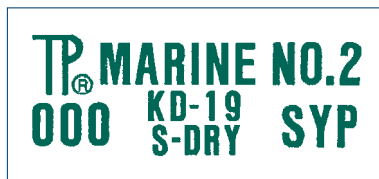
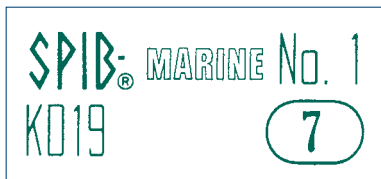
Some producers offer a grade of heart-free face lumber called “Marine Grade,” as described in paragraph 508 of the *SPIB Standard Grading Rules for Southern Pine Lumber, 2002 Edition*. Marine grade conforms to service conditions under AWPA Use Category Standards UC5A, 5B and 5C, Section 6.5, which states:

“Treated Southern Pine, Ponderosa Pine and Red Pine lumber and timber with exposed heartwood that is used in salt or brackish water is subject to early attack by marine borers and greatly reduced service life. Southern Pine must be identified by a grademark or certificate meeting an ALSC approved grade that provides for heart-free faces in marine exposure...Except for bulkhead sheathing, all lumber and timber of Southern, Ponderosa and Red Pines that is treated for use in salt or brackish water shall be free of heartwood on all four faces.”

Dimensions included under the “Marine Grade” are:

1” to 20” nominal thickness and 2” to 20” nominal widths

Typical “Marine Grade” Marks



Seawall

“Seawall Grade” provides for the allowance of heart-free lumber on one wide face and both adjoining edges. The sapwood face must have sapwood at least 1/2 inch thick, as graded from both ends. The Seawall Grade is described in Supplement No. 11 (Paragraph 507) of the *SPIB Standard Grading Rules for Southern Pine Lumber, 2002 Edition*.

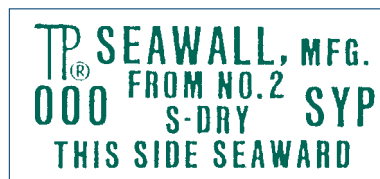
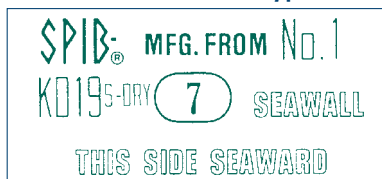
The intent of this grade provision is to provide suitable material for salt water marine **bulkhead sheathing**. Lumber so designated will be clearly marked “This Side Seaward” and can be manufactured in sizes:

2” to 4” nominal thickness and 6” to 14” nominal widths

The Seawall Grade conforms to service conditions under AWPA Use Category Standards UC5A, 5B and 5C, Section 6.5, which states:

“Bulkhead sheathing shall have two sapwood edges and a sapwood face. A sapwood face shall have sapwood at least 13mm (1/2 in.) thick (measured at both ends) and shall be clearly marked **THIS SIDE SEAWARD**.”

Typical “Seawall Grade” Marks



Fresh & Salt Water Marine Construction Details

Basic Design Guidelines

- ▶ Marine construction is a complex process with many variables — it requires extensive knowledge of local conditions and should only be undertaken by qualified professionals. Water level extremes including storm surge, tidal histories, loadings, codes, construction practices, materials and soil analysis all must be considered. Seek out experienced design professionals and look at examples of their work. Use only licensed, experienced contractors with a long history in marine construction. Ask for pictures and references. Visit completed projects and talk to recent customers.
- ▶ The proper evaluation of soils is critical to design and performance of the marine structure. Sandy (granular) soils are usually quite predictable and yet are subject to scour and erosion. Clays (cohesive soils) may not be consistent in a given area and may vary widely within a single project. Even when viewed by an experienced design professional, soil analysis without the benefit of testing by a qualified soil testing laboratory is approximate at best. The relatively low cost of a local certified soils testing lab is easily offset by the advantages of accurate quality and strength data.
- ▶ Marine installations using properly specified Southern Pine materials should give long attractive life under all anticipated conditions. Materials that do not meet or exceed specifications should be rejected. Substitute materials may appear to offer short-term cost benefits, but such short-term savings may deprive the owner of the enjoyment of long-term, low maintenance use.
- ▶ Remember that any field cuts may damage the preservative effectiveness of treatment. Whenever possible, have cuts such as mortises – the cuts at bottom of sheet piles or radius milling of edges – completed prior to treatment or at least dip or brush these surfaces with copper naphthenate prior to installation (AWPA Standard M4).

Wood – The Ideal Marine Material

Wood has been the marine construction material of choice ever since man launched his first boat, and since the advent of modern wood preservation, Southern Pine has been America's preferred aquatic construction material.

When exposed to the often severe buffeting of wind and waves, the flexibility of wood can yield superior resistance as compared to rigid construction materials. In addition, wood cannot rust, will not corrode, and doesn't spall (flake) like steel. In the event structural damage does occur, wood can usually be repaired in a more efficient and less costly way than other construction materials. And repairs can be made in all kinds of weather, in both wet and dry environments, often using nothing more complicated than ordinary carpentry tools.

Design Concepts & Engineering for:

- ▶ Salt/Brackish Water Bulkheads (pp. 14-17)
- ▶ Freshwater Bulkheads with Square Piles (p. 18)
- ▶ Fixed Piers (pp. 19-22)
- ▶ Commercial/Public Fishing Piers (pp. 23-24)
- ▶ Floating Dock Systems (pp. 25-26)

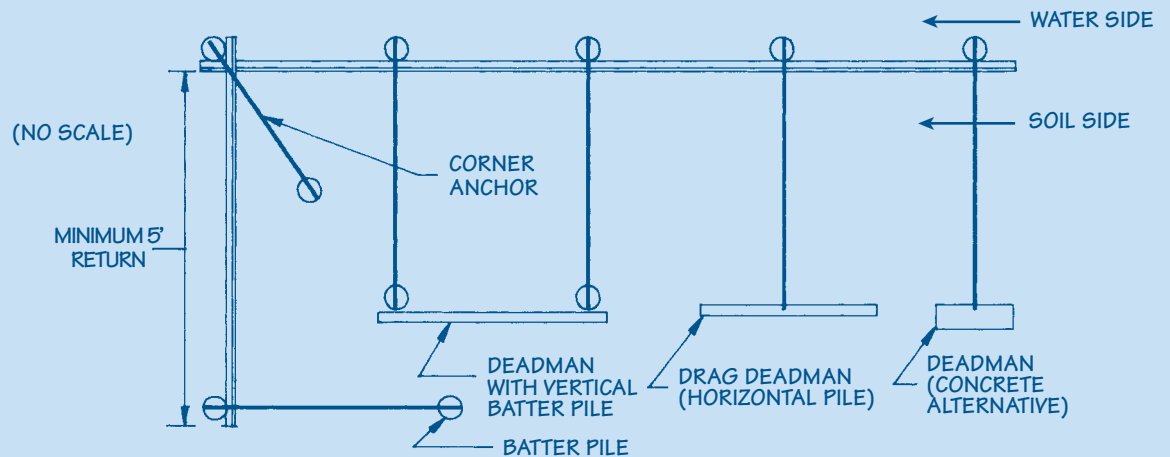
Site Planning/Design Factor Investigation

- ▶ *Water Levels*
 - Mean high/high water
 - Mean low/low water
 - Wave height and runoff
 - Possibility of overtopping
- ▶ *Types of soils*
 - Sands and gravels – good drainage
 - Sand/clay mixes – slow drainage
 - Clays – poor drainage, moldable
- ▶ *Susceptibility to scour or erosion*
- ▶ *Alignment*
 - Relation to existing shoreline
 - Minimize turns or direction changes
- ▶ *Location of permanent structures*
 - Large trees
 - Utilities
 - Buildings or other structures
- ▶ *Slope of bank*
 - Drainage
 - Plant watering and inundation
- ▶ *Slope of berm*
- ▶ *Backfill materials*
 - Drainage
 - Compaction
- ▶ *Elevation of top of wall*
 - Minimum 2' to 3' above high water

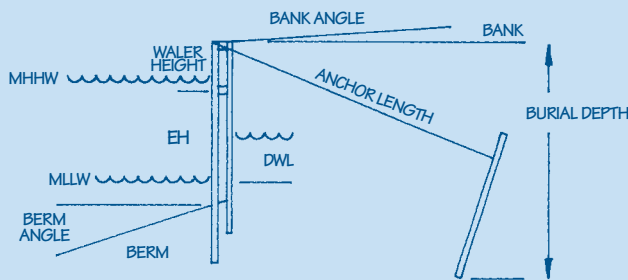


Salt/Brackish Water Bulkheads • Use of Round Piles

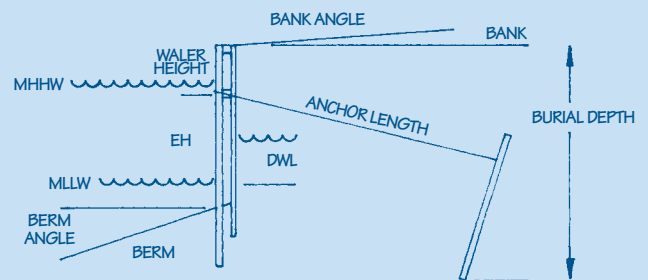
Anchor Systems



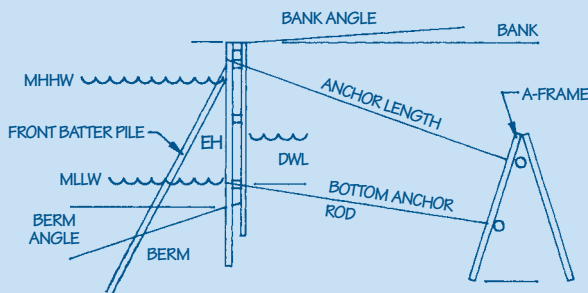
Timber Bulkhead Anchor System Options



SINGLE ANCHOR AT TOP FOR LOW BULKHEADS
Single anchors located at the top of low exposed height (three feet and below) bulkheads should only be used in residential applications where loads are small and no surcharge is present.



MID-HEIGHT SINGLE ANCHOR
Mid-height, single anchor systems are the most common and perhaps most practical anchor systems for exposed heights of four to eight feet. Anchors should always be through-connected to the face pilings.

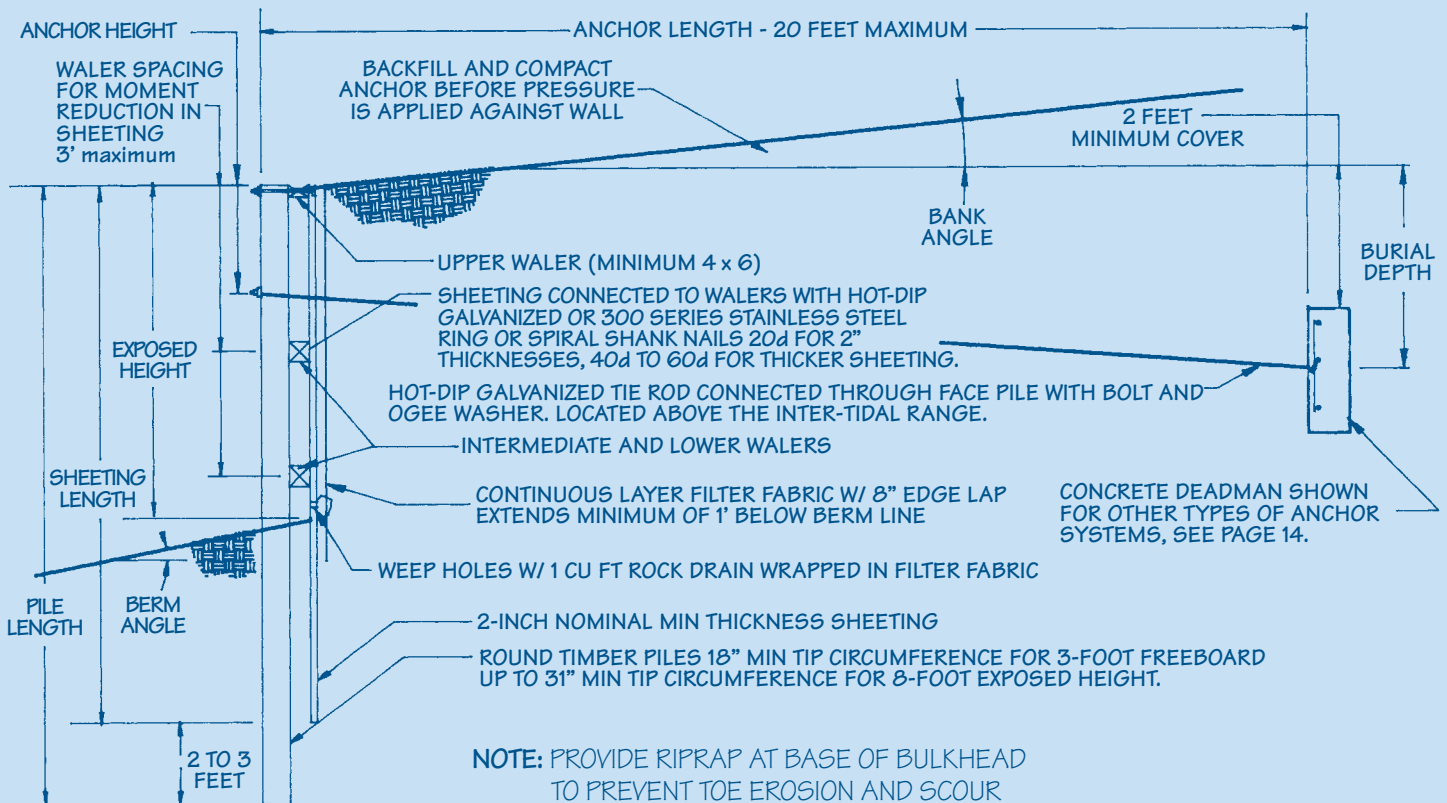


DOUBLE-ANCHOR / A-FRAME / BATTER PILES
Double-anchor systems utilize A-Frame deadmen or front batter piles. This structure should be considered when design loads call for a sheeting thickness in excess of four inches, when proper placement of walers to reduce bending moment in the sheeting is impractical or when site conditions are difficult due to boundaries or poor soils. Actual loadings are difficult to predict through classical analysis and, therefore, proper tensioning, placement and sizing of the tie rods are difficult to calculate.

<i>Engineers Bulkhead Design Questionnaire</i>			RECOMMENDED DESIGN	
DESIGN CRITERIA			Pile Tip Circumference	In
Exposed Height (EH)	Ft		Pile Length	Ft
Bank Angle	Degrees		Sheet Thickness	In
Berm Angle	Degrees		Sheet Length	Ft
Mean Lower Low Water (MLLW)	Ft		Top Waler Size	
Mean Higher High Water (MHHW)	Ft		Intermediate and Lower Waler Size	
Differential Water Level (DWL)	Ft		Height Intermediate Waler	Ft
Wave Height (historical)	Ft		Height Lower Waler	Ft
Surcharge Lbs/Sq Ft			Anchor Type	
SOIL Dry Density	Lbs/Cu Ft		Anchor Spacing	Ft C. to C.
Saturated Density	Lbs/Cu Ft		Anchor Length	Ft
Buoyant Density	Lbs/Cu Ft		Anchor Rod Diameter	In
			Burial Depth	Ft

Typical Section thru Timber Bulkhead

Salt or Brackish Water Application (no scale)



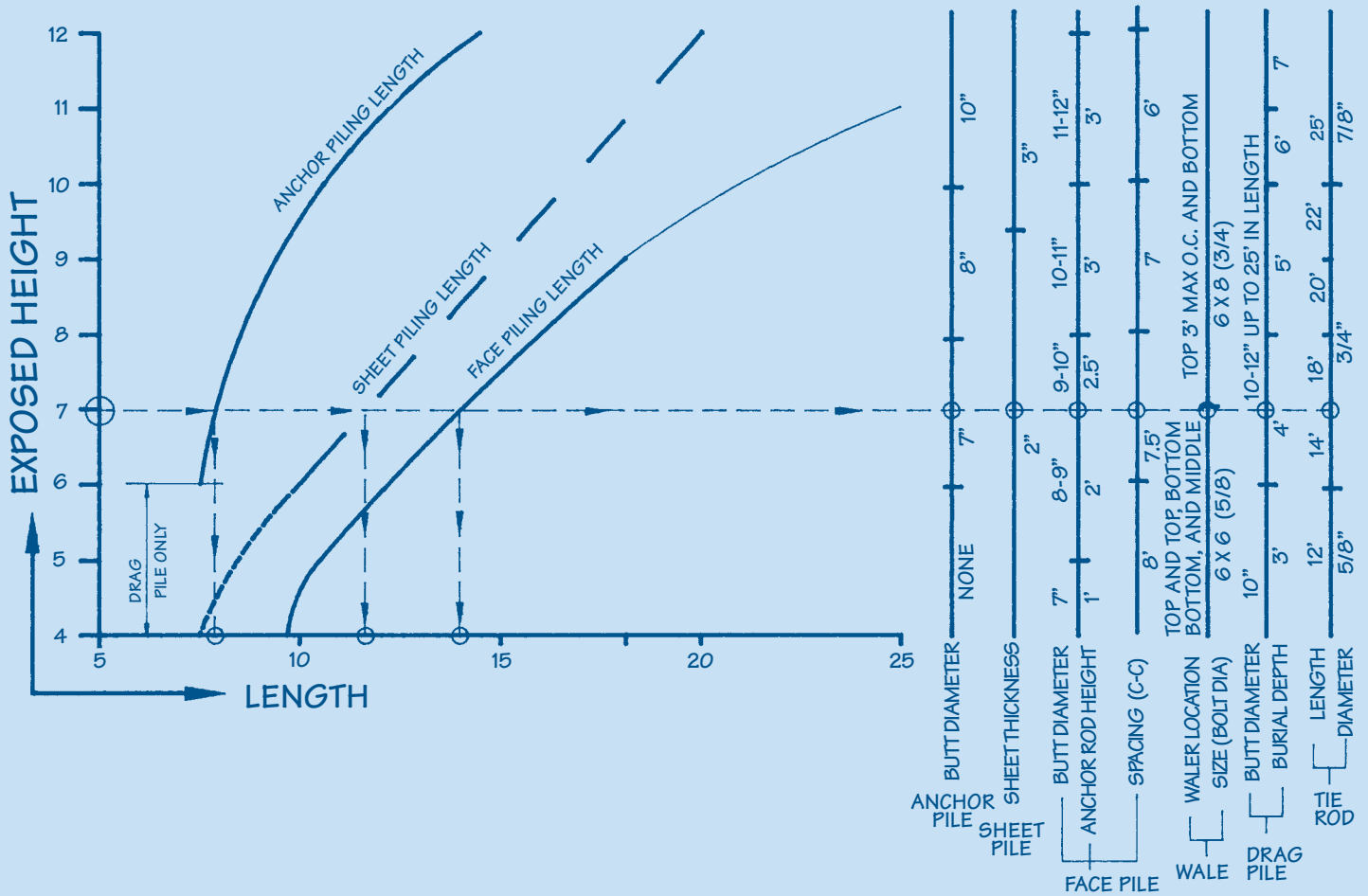
Timber Bulkhead Notes: Salt/Brackish Water

1. ALL TIMBER SHOULD BE MARINE GRADE SOUTHERN PINE PRESERVATIVE TREATED TO AMERICAN WOOD PROTECTION ASSOCIATION (AWPA) STANDARD USE CATEGORY UC5. (BULKHEAD SHEETING CAN BE SEAWALL GRADES.)
2. ALL FACE AND ANCHOR PILES USED IN CONSTRUCTION SHOULD BE SPECIFIED USING TIP CIRCUMFERENCE IN ACCORDANCE WITH ASTM D-25. PRESERVATIVE TREATMENT SHALL BE TO AWPA STANDARD USE CATEGORY UC5.
3. TIMBER SHEETING SHOULD BE SEAWALL OR MARINE GRADES AND OF TONGUE-AND-GROOVE, WAKEFIELD OR OVERLAP DESIGN. SEE PAGE 18.
4. ALL FASTENERS AND TIE RODS SHOULD BE HOT DIPPED GALVANIZED PER ASTM A-153 WITH 2 OUNCES OF ZINC PER SQUARE FOOT OR BE CORROSION RESISTANT (BITUMASTIC COATED OR 300 SERIES STAINLESS STEEL).
5. BACKFILL SHOULD BE A FREE DRAINING, CLEAN, GRANULAR (SAND) MATERIAL.
6. MINIMUM 1 1/2" DIAMETER WEEPHOLES WITH FILTER FABRIC AND GRAVEL FILTER MATERIAL (1 cubic foot) SHOULD BE INSTALLED EVERY 6' ON CENTER AT 6' ABOVE BERM LINE OR AT MLLW. WEEP HOLES IN AREAS OF WAVE ACTION WILL ALSO REQUIRE PROTECTION AT THE OUTLET.
7. RETURNS MUST BE PROVIDED AT THE ENDS OF ALL BULKHEADS TO PREVENT THE POSSIBILITY OF FLANKING.
8. ALL CUTS, HOLES + INJURIES TO THE SURFACE OF TREATED WOOD SHOULD BE PROTECTED BY FIELD TREATMENT WITH COPPER NAPHTHENATE MEETING AWPA STANDARD P-8.
9. ALL TREATED WOOD PRODUCTS SHOULD BE HANDLED + FIELD FABRICATED IN ACCORDANCE WITH AWPA STANDARD M4.

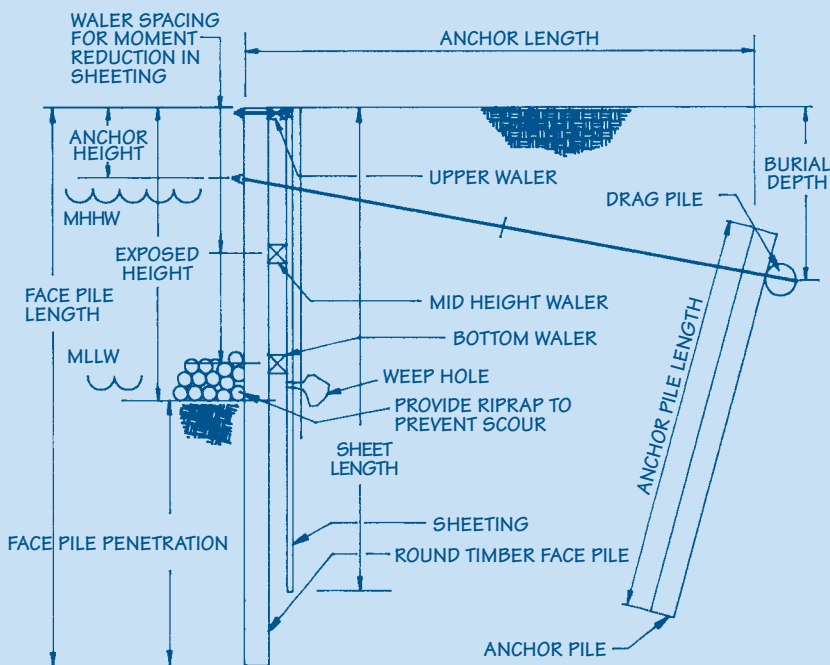
Bulkhead Design Nomograph *(Flat Berm, Flat Bank, Sandy Soil)*

Procedure for Use of Nomograph

DRAW HORIZONTAL LINE FROM EXPOSED HEIGHT OF BULKHEAD ACROSS ENTIRE WIDTH OF NOMOGRAPH AS SHOWN IN EXAMPLE BELOW. DRAW VERTICAL LINES FROM POINTS OF INTERSECTION ON GRAPHS (ANCHOR, SHEET AND FACE PILES DOWN TO LENGTH LINE.)



Typical Bulkhead Design Terminology



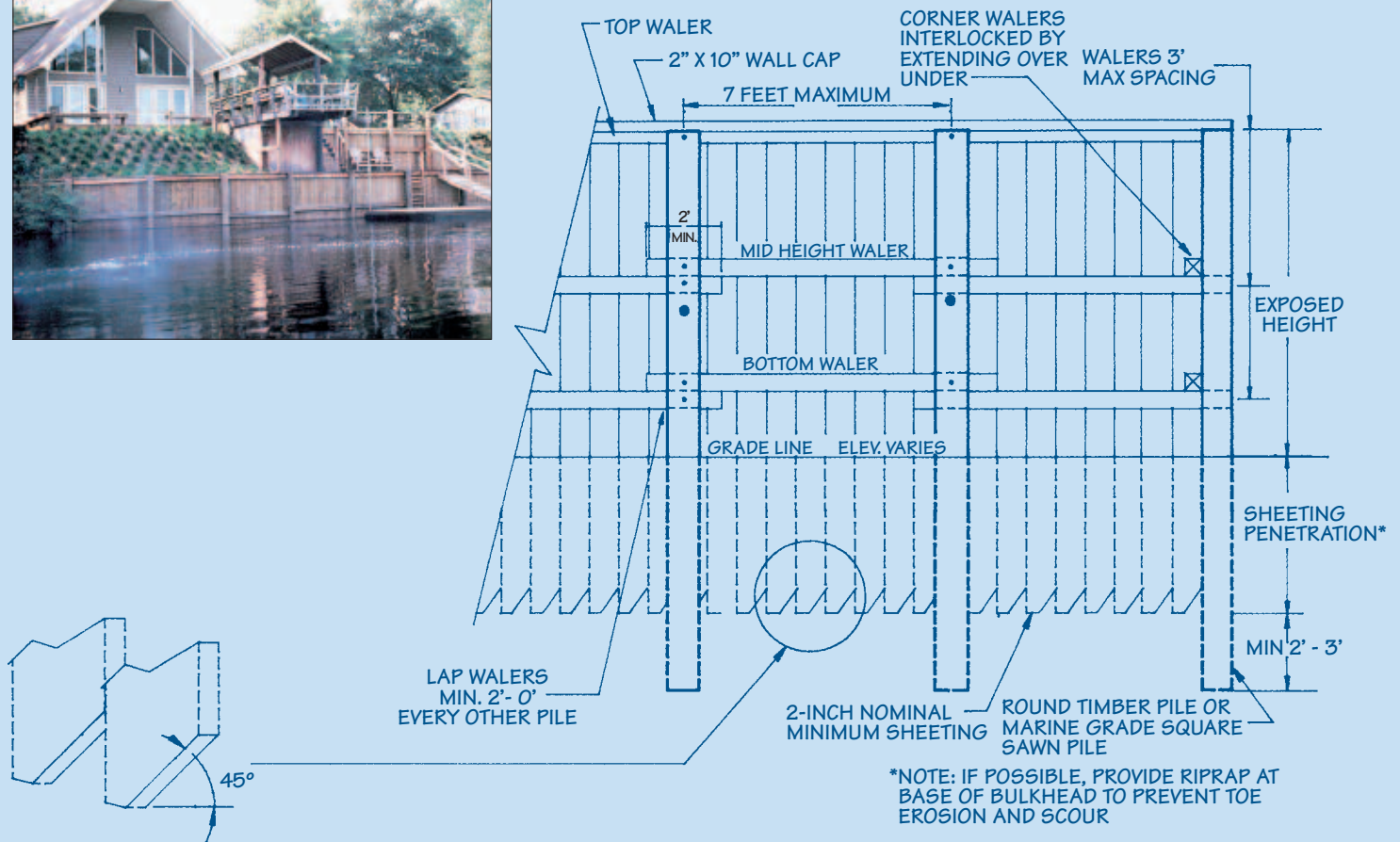
NOMOGRAPH EXAMPLE: FOR A 7' EXPOSED HEIGHT BULKHEAD IN GOOD GRANULAR SOIL WITH A FLAT BERM ANGLE (0°) AND A FLAT BANK ANGLE (0°), A TRIAL DESIGN WOULD YIELD:

- ANCHOR PILE LENGTH = 8'
- SHEETING THICKNESS = 2"
- SHEET PILE LENGTH = 12'
- FACE PILE LENGTH = 14'
- ANCHOR PILE BUTT DIA = 7"
- FACE PILE BUTT DIA = 9-10"
- ANCHOR LOCATION = 2.5'
- ANCHOR SPACING = 7.5'

WALER DESIGN

- TOP WALER 6 X 8 (3/4 BOLTS)
- MID WALER 6 X 8 (3/4 BOLTS)
- BOTTOM WALER 6 X 8 (3/4 BOLTS)
- DRAG PILE BUTT DIA = 10"
- DRAG PILE BURIAL DEPTH = 4'
- TIE ROD = 3/4" DIA 18' LONG

Typical Elevation • Timber Bulkhead (no scale)



Typical Sheeting Penetration for 2" Dimension Lumber Ratio of Total Sheet Length to Exposed Height

BANK ◁	BERM MATERIAL								
	CLAY/SAND BERM ◁			SAND BERM ◁			FIRM SAND BERM ◁		
	0	10	15	0	10	15	0	10	15
0	1.8	2.1	2.4	1.7	1.9	2.5	1.5	1.7	2.0
10	1.9	2.2	2.5	1.7	2.0	2.8	1.6	1.7	2.1
20				1.8	2.2	3.2	1.6	1.8	2.3

NOTE: ASSUMES NO SURCHARGE AND ADEQUATE ANCHORAGE.

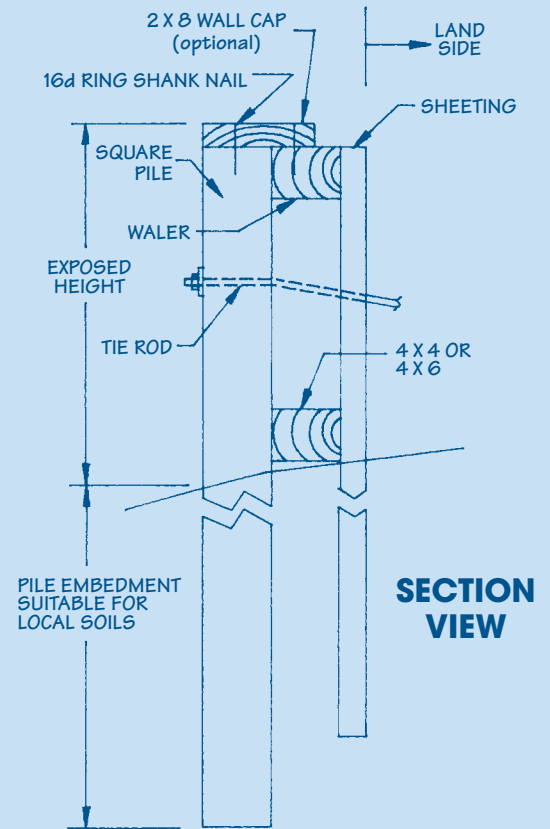
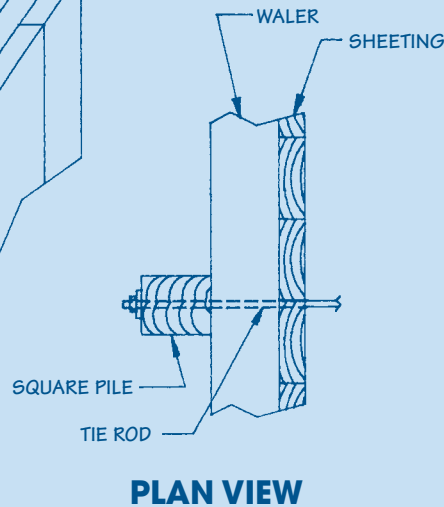
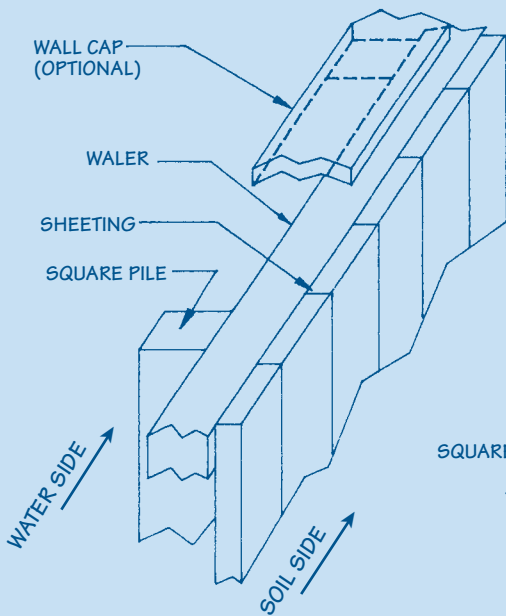


EXAMPLE: WITH A BANK ANGLE OF 10°, BERM ANGLE OF 10° AND AN EXPOSED HEIGHT OF 5 FEET IN A SAND MATERIAL, THE SHEET LENGTH WOULD BE 5.0 X 2.0 (RATIO) = 10 FEET.

Freshwater Bulkheads • Use of Square Piles

Square piles of 6 X 6, 6 X 8 and 8 X 8 nominal sizes have been used successfully for many years in freshwater bulkhead applications. Square piles longer than 20 feet in length are available by special order, but exposed heights are normally limited to 8 feet and below. The design and placement of walers, face piles and sheet piles are similar to that for salt/brackish water

bulkheads; however, anchors should be spaced closer. Modifications to design should be left to a design professional familiar with local codes and conditions. As in salt/brackish water use, sheeting should be of 2" nominal thickness and tongue-and-groove or "wakefield" design. Spacing between walers should not exceed 3'.



SQUARE PILES IN SALT/BRACKISH WATER

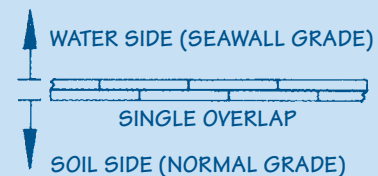
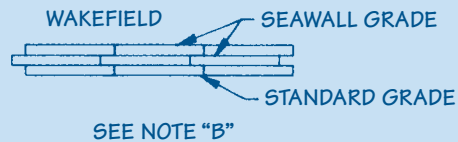
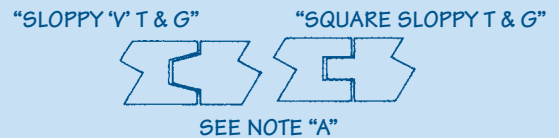
SOME SECTIONS OF THE COUNTRY CONTINUE TO USE SQUARE PILES IN SALT/BRACKISH WATER APPLICATIONS. WHEN USED IN SALTWATER APPLICATIONS, SQUARE PILES SHALL BE MARINE GRADE LUMBER TREATED TO SALT/BRACKISH WATER SPECIFICATIONS.

Types of Timber Sheet Piles

BULKHEADS SHOULD BE AS TIGHT AND FREE OF CRACKS AS POSSIBLE. IT IS RECOMMENDED THAT ONE OF THE TWO TYPES OF LAP JOINTS SHOWN BE USED, WAKEFIELD OR SINGLE OVERLAP.

NOTE "A"— TONGUE PROFILE SHOULD FIT LOOSELY IN GROOVE AND NEEDS TO BE 3/4" LONG FOR 2" DIMENSION TIMBER AND 1" FOR 3" AND 4" TIMBERS. BOTH SEAWALL AND MARINE GRADES MAY BE USED.

NOTE "B"— "WAKEFIELD" PATTERN IS FAIRLY NORMAL FOR 1" RESIDENTIAL APPLICATIONS IN FRESH WATER. BOTH SEAWALL GRADE AND HAND-SELECTED NORMAL GRADES MAY BE USED.

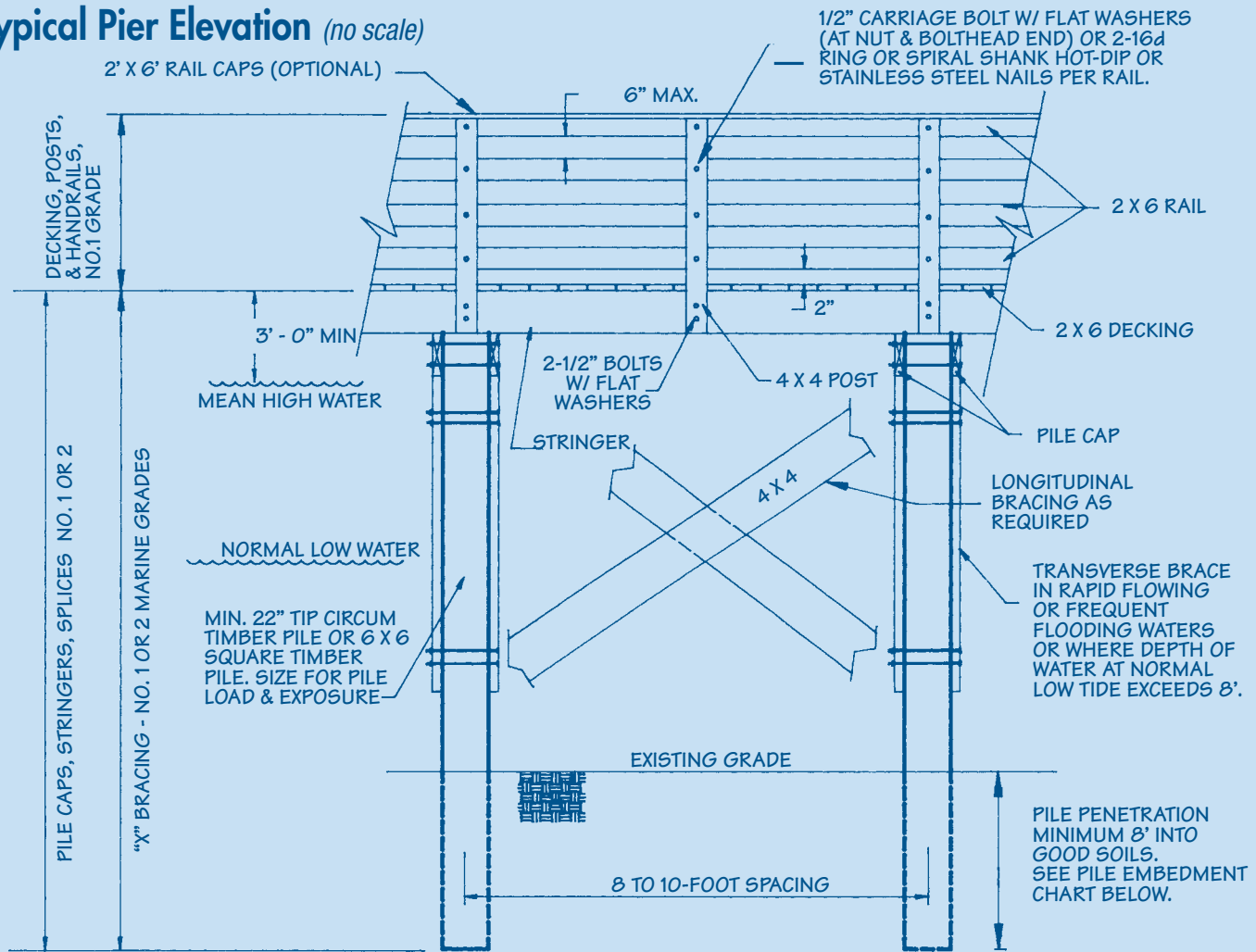


Treated Southern Pine • Fixed Piers

Fixed piers have a long and successful history of providing access to the water for coastal and waterfront property owners. Fixed piers are used for boating access where the active boating period (usually summer) water level fluctuations are minimal (0 to 3 feet). Where the active boating periods exceed three feet, the choice of boating access systems usually goes to floating dock systems. However, even in floating dock systems, fixed piers are often used to traverse shallow or marsh areas to reach the floating dock system located in deeper waters. See pages 25-26 for typical floating dock design details.

For residential fixed-pier systems, a pile span of 8 to 10 feet is common (a maximum span of 12 feet can be designed provided stringer sizes are increased appropriately). The normal width of residential piers is four to six feet. Therefore, typical bay sizes (the area between piles in adjacent bays) are 4x8, 4x10, 6x8 and 6x10. An adequate vertical live-load capacity for residential fixed piers is 50 pounds per square foot of dock area. Based on this assumption, the chart below will usually give conservative pile embedment values for the common soil types shown.

Typical Pier Elevation (no scale)



PILE EMBEDMENT CHART (FEET)

PILE SIZE CIRCUMFERENCE (TIP DIAMETER)	25"	31"	6X6	8X8
	(8" TIP)	(10" TIP)	SQUARE SAWN	SQUARE SAWN
SOIL TYPE				
MEDIUM DENSE SAND	8	8	8	8
LOOSE SAND	12	9	14	10
MEDIUM STIFF CLAY	8	8	8	8
SOFT CLAY	8	8	8	8

Pile Notes

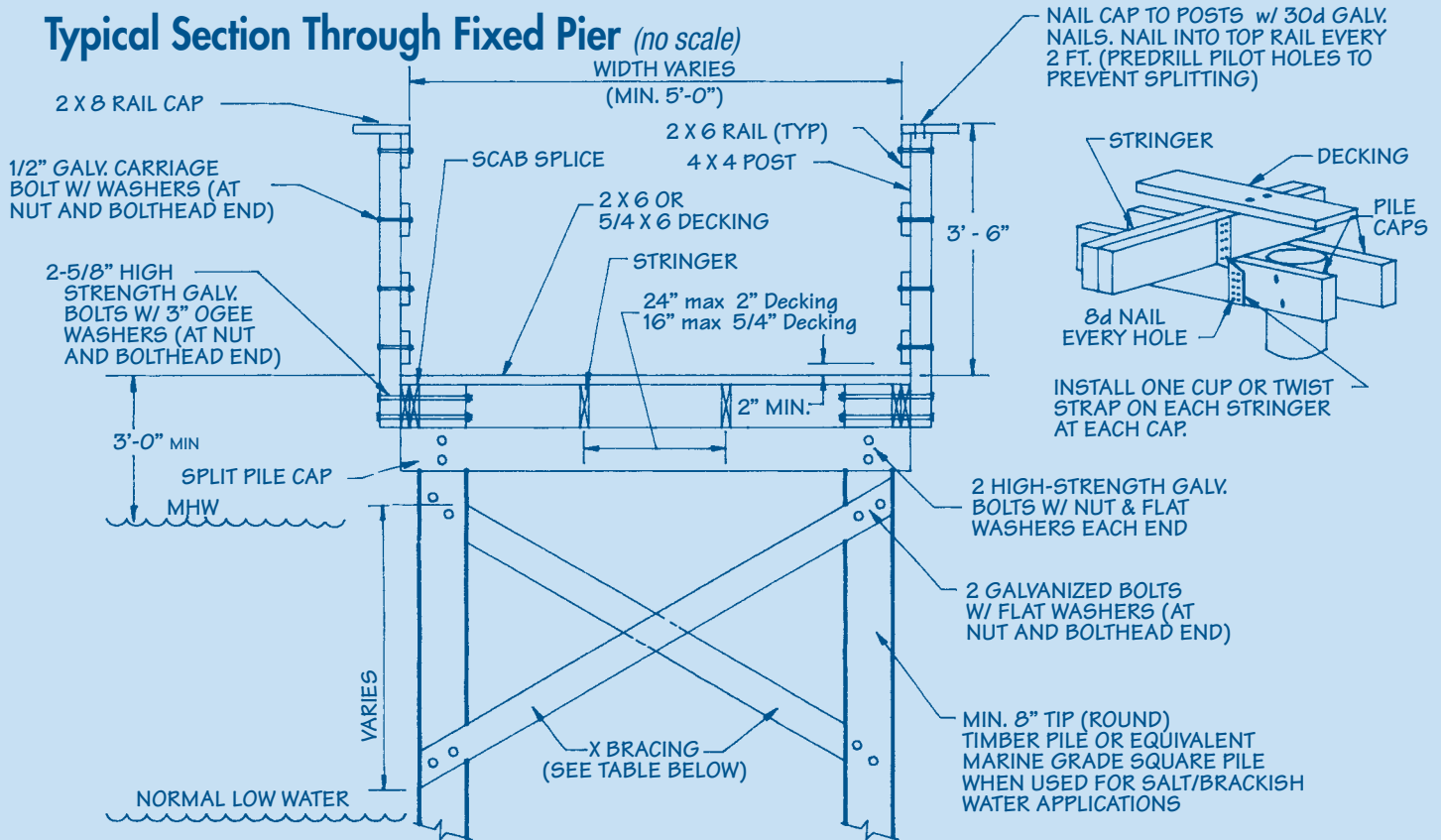
- Specify, order and install piles for true length. Do not cut long piles or use pile cut offs for shorter piles.
- Piles should be driven to grade. Jetting of first two feet of embedment may be allowed to obtain alignment.
- Piles should be driven vertical (plumb).
- Owners can request that CCA preservative is fixed in piles at the time of delivery. Suppliers can verify fixation by testing piles in accordance with AWPA Standard A3 Method 11. For creosote treatment information, refer also to the AWPA Book of Standards.

Bracing and Pile Caps

Transverse bracing (X-bracing) of piles is required in rapidly moving or frequently flooding waters or where water depth exceeds eight feet. Transverse bracing – when required – is usually 2x6 or 2x8. Transverse bracing should always be considered for 6x6 square piles (fresh water or marine)

because of the lack of lateral strength in this dimension. The combination of pile caps and the stringer system form the part of the structure that carries the decking load (assumed 50 psf) to the piles and into the soil.

Typical Section Through Fixed Pier (no scale)

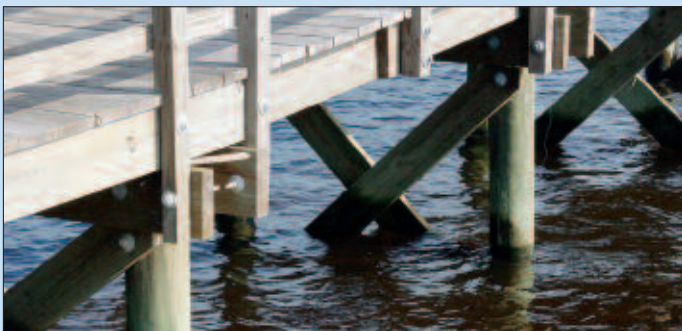


Selection of pile caps, transverse bracing, stringers, and sizing of connectors:

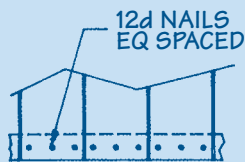
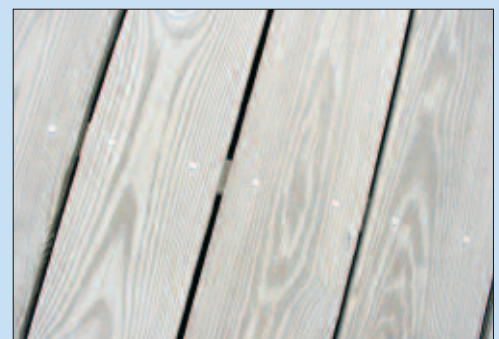
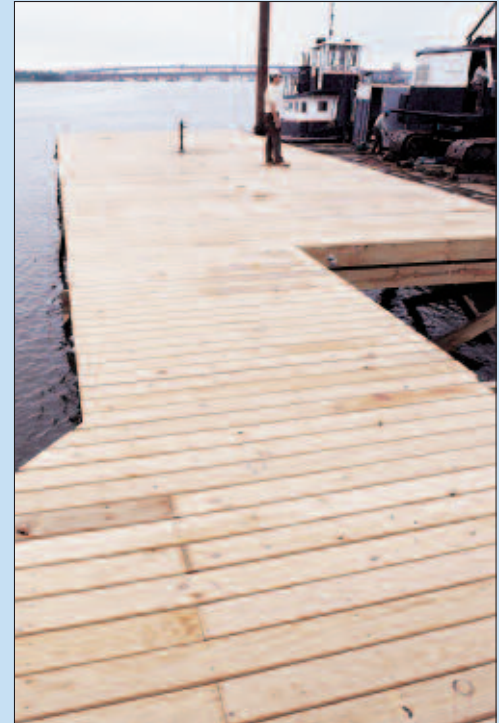
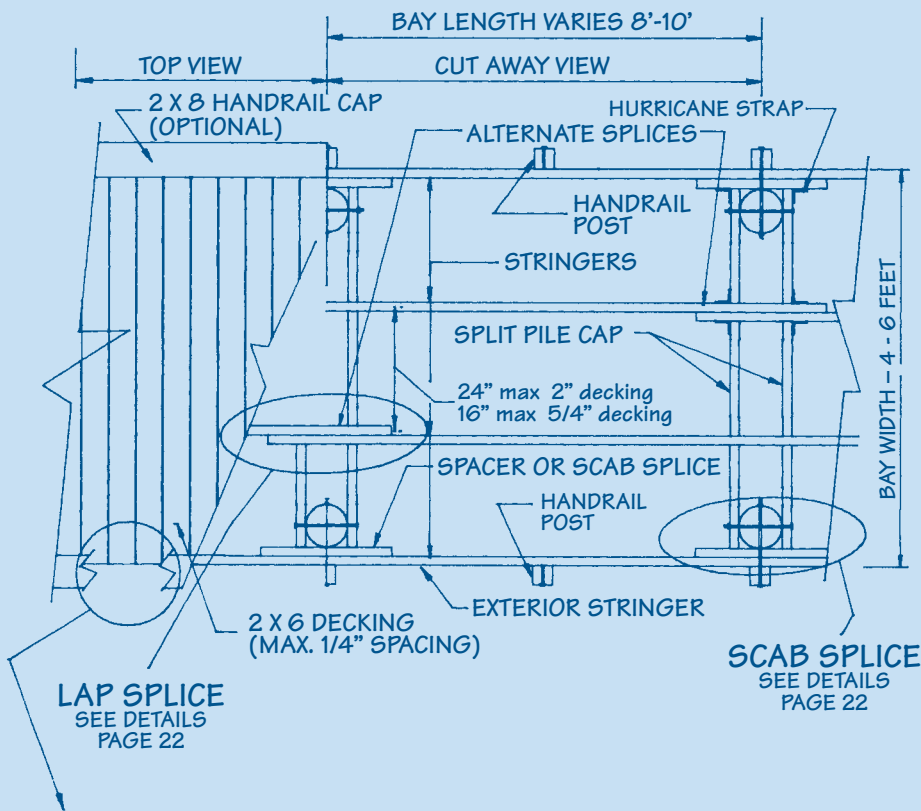
BAY SIZE (W X L)	X-BRACING SIZE* (CONNECTORS)	PILE CAP SIZE (CONNECTORS)	STRINGER SIZE** (CONNECTORS)
4 x 8	2 x 6 (2-5/8" x 8" Bolts)	2 x 8 (2-5/8" Bolts)	2 x 8 (Toe-Nail/HS)
4 x 10	2 x 6 (2-5/8" x 8" Bolts)	2 x 8 (2-5/8" Bolts)	2 x 8 (Toe-Nail/HS)
6 x 8	2 x 8 (2-3/4" x 8" Bolts)	2 x 8 (2-5/8" Bolts)	2 x 8 (Toe-Nail/HS)
6 x 10	2 x 8 (2-7/8" x 8" Bolts)	2 x 8 (2-5/8" Bolts)	2 x 8 (Toe-Nail/HS)

* Could use a single bolt with spike grid single connector. Use ogee washers on bolt head side with 4x4-1/8" cut washer or ogee washer on nut side.

** Toe-nail with 2-30D ring-shank nails – use hurricane straps in addition to toe-nail in hurricane or heavy tornado areas.



Typical Fixed Pier Framing Plan (no scale)



INSTALL DECKING USING THE FOLLOWING SCHEDULE:

- 2 X 4 2 - 12d (3 1/4")
- 2 X 6 3 - 12d (3 1/4")
- 2 X 8 4 - 12d (3 1/4")

Deck Selection, Fastening Guidelines

The most obvious visual feature of a completed fixed pier is the deck. The higher grades – No. 1 (2" nominal) and Premium (5/4 nominal) – give excellent structural performance with minimal visual imperfections. Nails or decking screws that are carefully aligned and properly installed create a uniform, eye-pleasing pattern. Predrilling pilot holes for nails or screws helps prevent splitting.

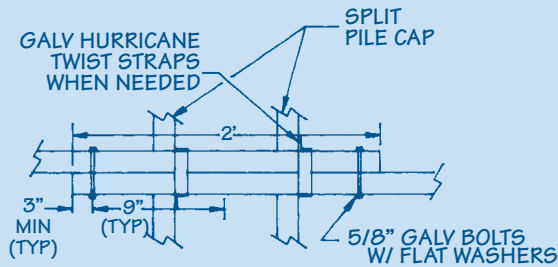
Based upon limited test data and investigated deck performance, deckboards of 1-1/4" to 1-1/2" thickness should be fastened to the stringers with at least a 3-1/4" ring-shanked or spirally wound nail or a multipurpose (dry wall type) screw. All fasteners should be hot-dip galvanized or stainless steel.

Predrill pilot holes for nails (1/16" less than nail diameter). The deckboards are put under very severe stresses caused by the cyclical wetting and redrying of the material. Restraining the natural tendency to crook, bow or twist with good nail penetration into the stringer is very important in assuring the lumber remains flat.

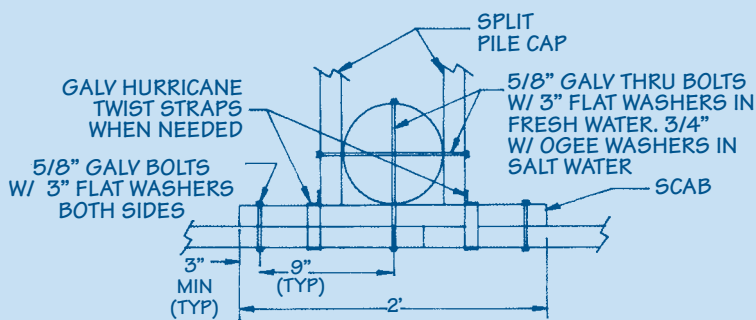
Pier Stringer Splices

Timber sizes are market sensitive and often the pile spacing is dictated by the available lumber sizes for stringers. It is usually more economical to use a 10-foot pile spacing if the longer stringer material is available. This also reduces the number of piles and the number of splices that join adjacent stringers and carry the load over the pile caps to adjacent bays. Splices must occur over pile caps. For practical purposes, splices should be alternated so that two adjacent splices do not occur over the same pile cap.

Lap Splice Detail (Plan View)



Scab Splice Detail (Plan View)



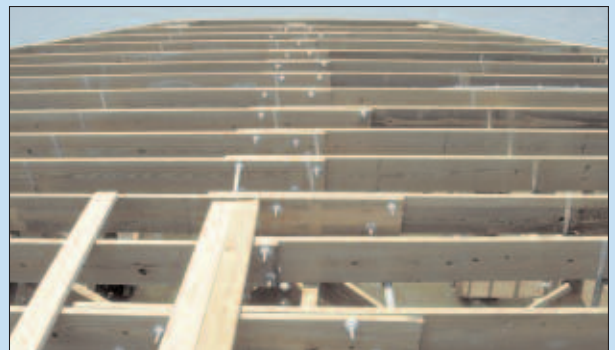
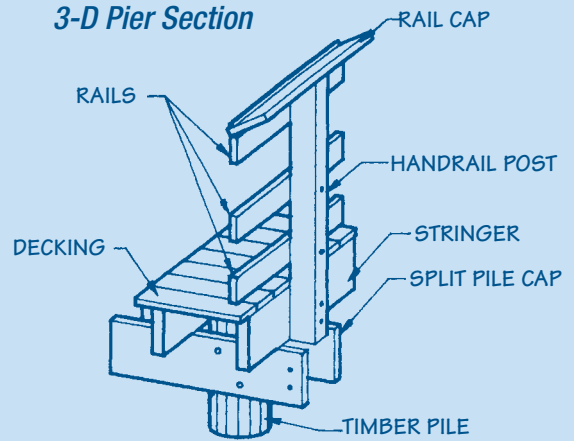
NOTE: THE SPACING BETWEEN DECKING MEMBERS SHOULD BE CHOSEN TO PREVENT A GAP WHICH WOULD HINDER DISABLED ACCESS IN CASE OF SHRINKAGE. (SEE SPACING CHART, PAGE 9).

HARDWARE SHOULD BE OVERSIZED DUE TO THE HARSHNESS OF THE ENVIRONMENT IN WHICH A TYPICAL PIER IS LOCATED. HURRICANE STRAPS ARE RECOMMENDED.

RING OR SPIRAL SHANK NAILS MAY BE CONSIDERED INSTEAD OF BOLTS, BUT DESIGNERS SHOULD EVALUATE LEVEL OF USE OF THE STRUCTURE AND EASE OF REPLACEMENT OR REPAIR.

AS IN ALL MARINE CONSTRUCTION, FASTENERS SHOULD BE HOT-DIP GALVANIZED (COATED WITH EPOXY AFTER INSTALLATION) OR STAINLESS STEEL. SEE PAGE 10.

3-D Pier Section

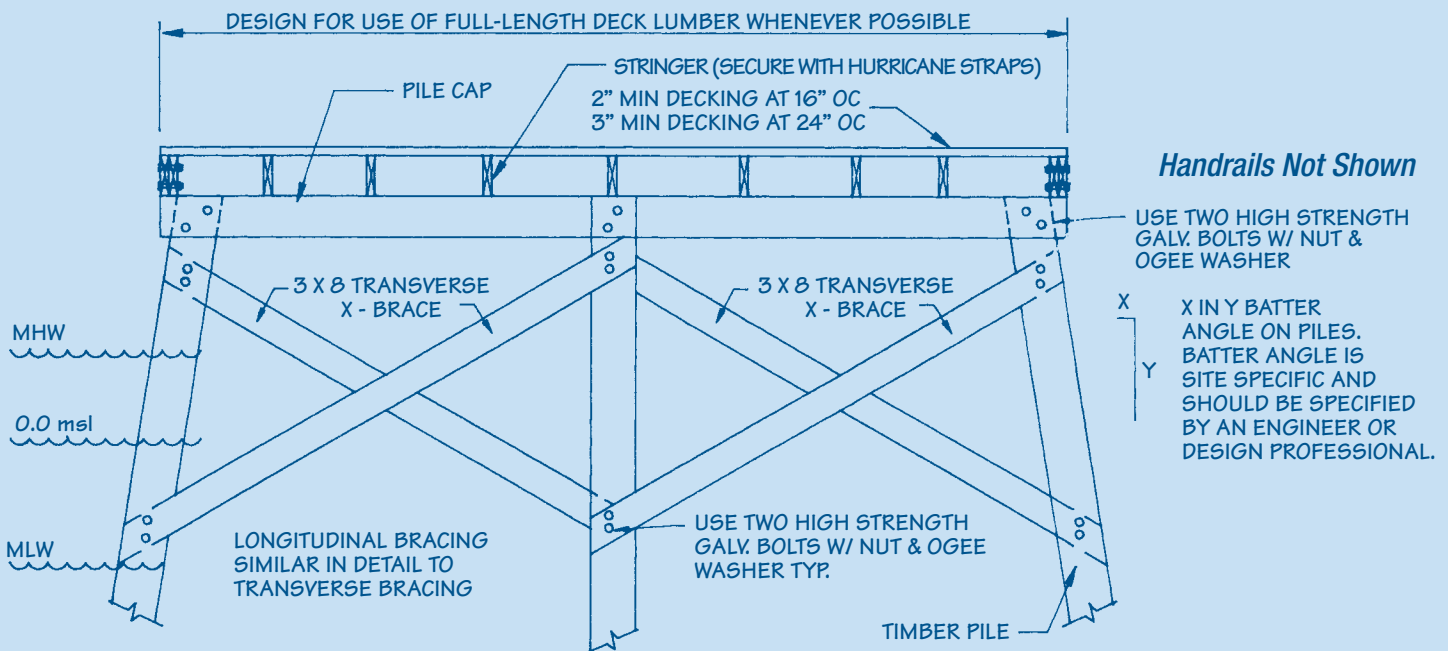


Commercial/Public Fishing Piers

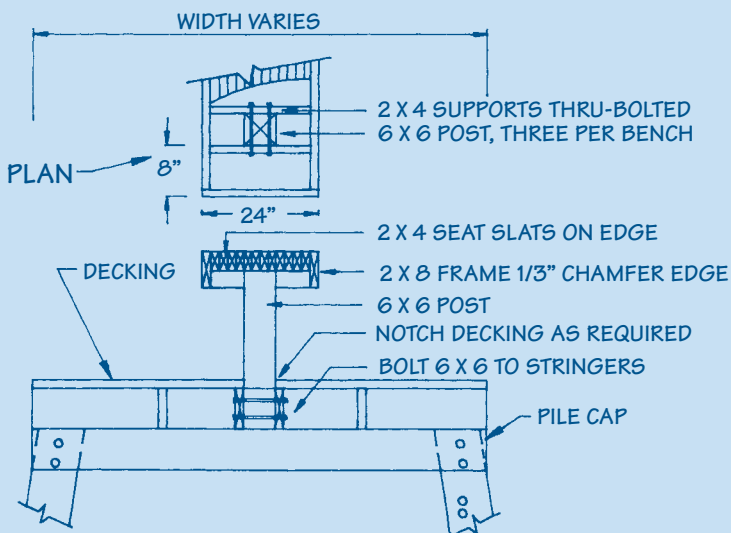
Fishing piers, whether commercial or public, are characterized by heavier construction and more involved design than the residential fixed pier. Decks are wider and bays sometimes longer than a residential pier with heavier timbers used for these larger spans. This type of pier usually provides for handicap access by providing handrails and other features designed for disabled use. Because of their location, often in rougher, deeper waters, outer piles on this type of pier are often battered. Both longitudinal and transverse braces are used because of stronger wave and current forces. Embedment of the piles and design of this bracing are site-specific and should be left to a design professional. Features such as benches, tables, and sinks as well as shelters are often built in as part of the structure.



Typical Section Through Fishing Pier (no scale)



Built-in Bench – Fishing Pier (no scale)

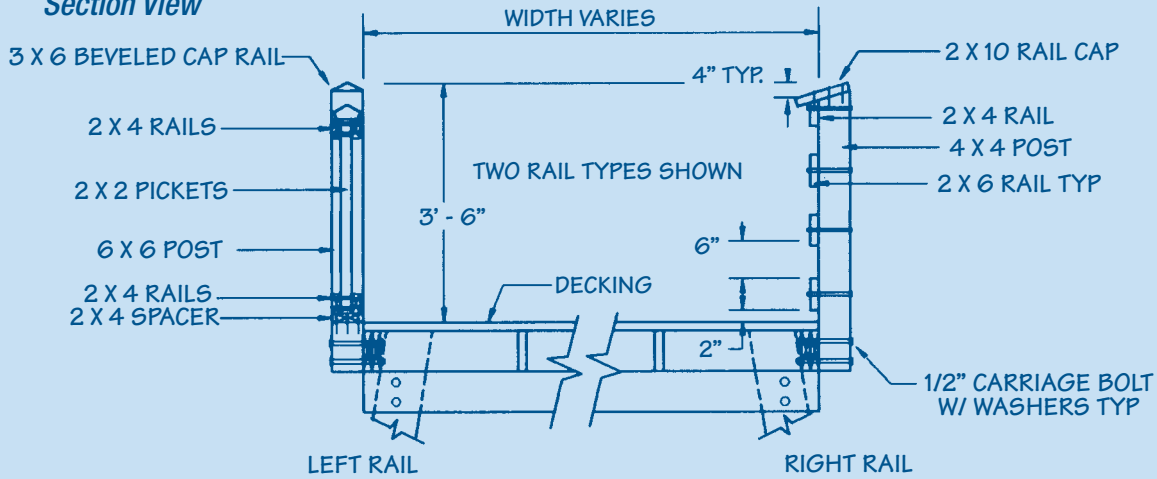


Fishing Pier Handrail Details

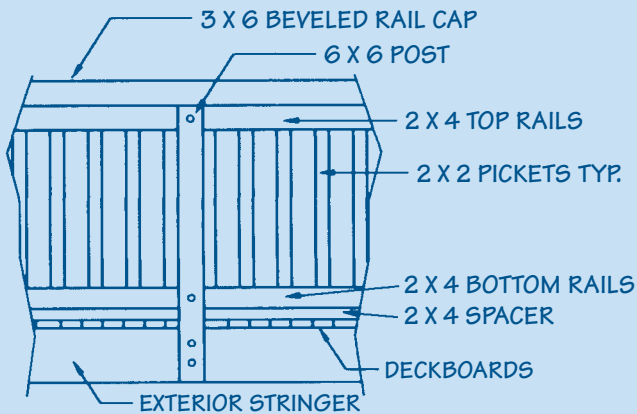
Handrails provide safety for users and make the fixed pier more secure for children, senior citizens and the disabled. Horizontal rails are added at the top and as required at middle and bottom to secure activities (walking, fishing, etc.) along the deck space. Maximum

spacing on a 4x4 post is five feet. Top and intermediate rails are 2x4s or 2x6s, nailed with 2-16d ring or spiral shank hot-dip galvanized or stainless steel nails, or secured with 1/2" carriage bolts w/ flat washers (at nut and bolthead end).

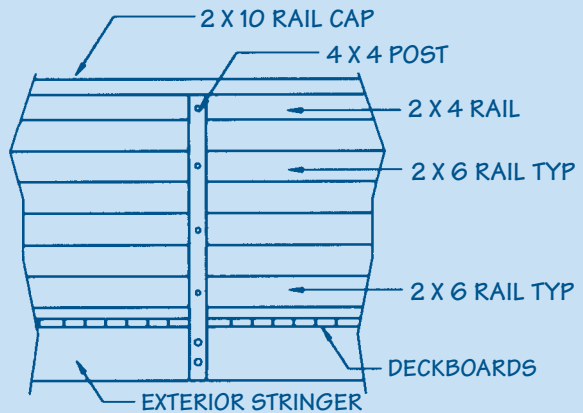
Section View



Elevation View – Left Rail



Elevation View – Right Rail

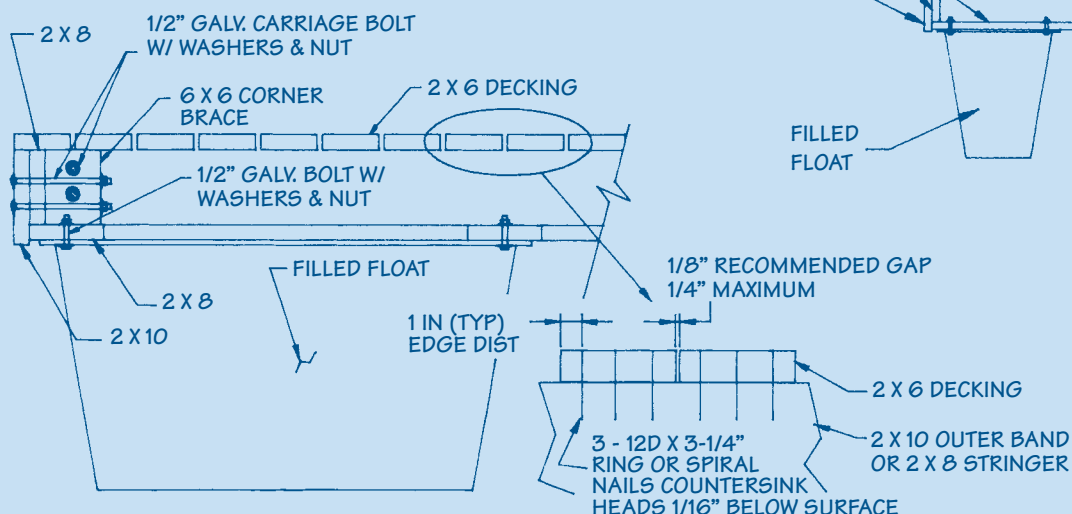
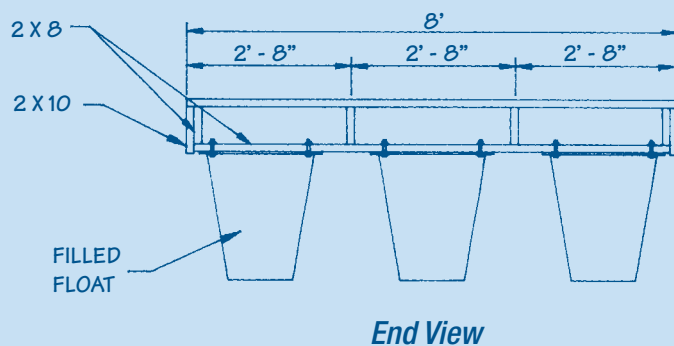
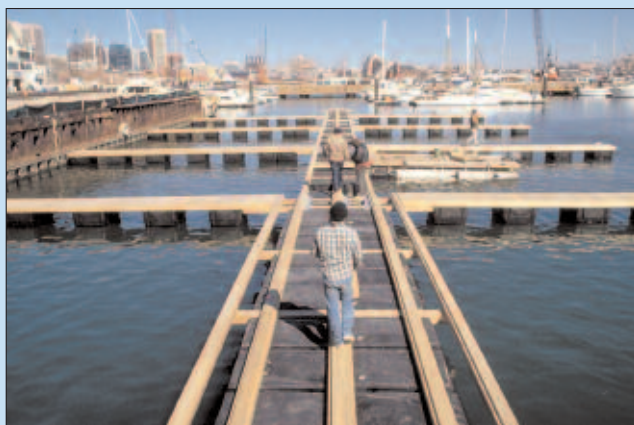
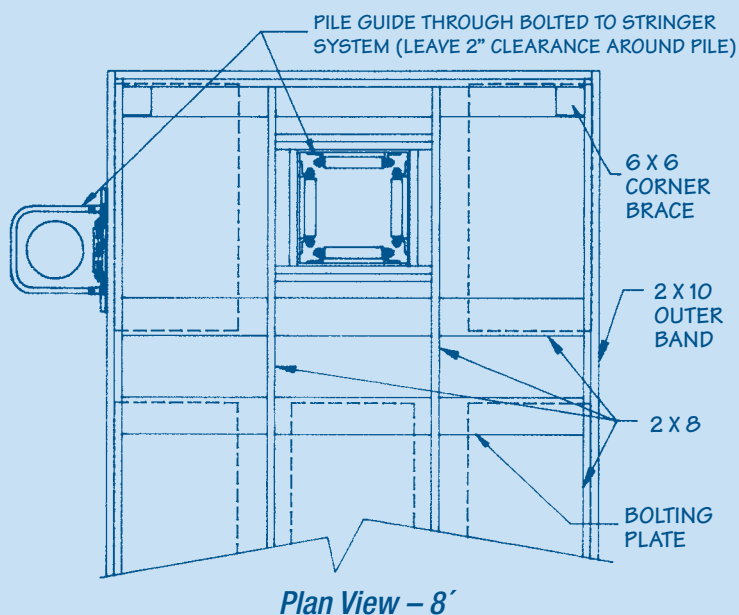


Floating Docks Using Treated Southern Pine

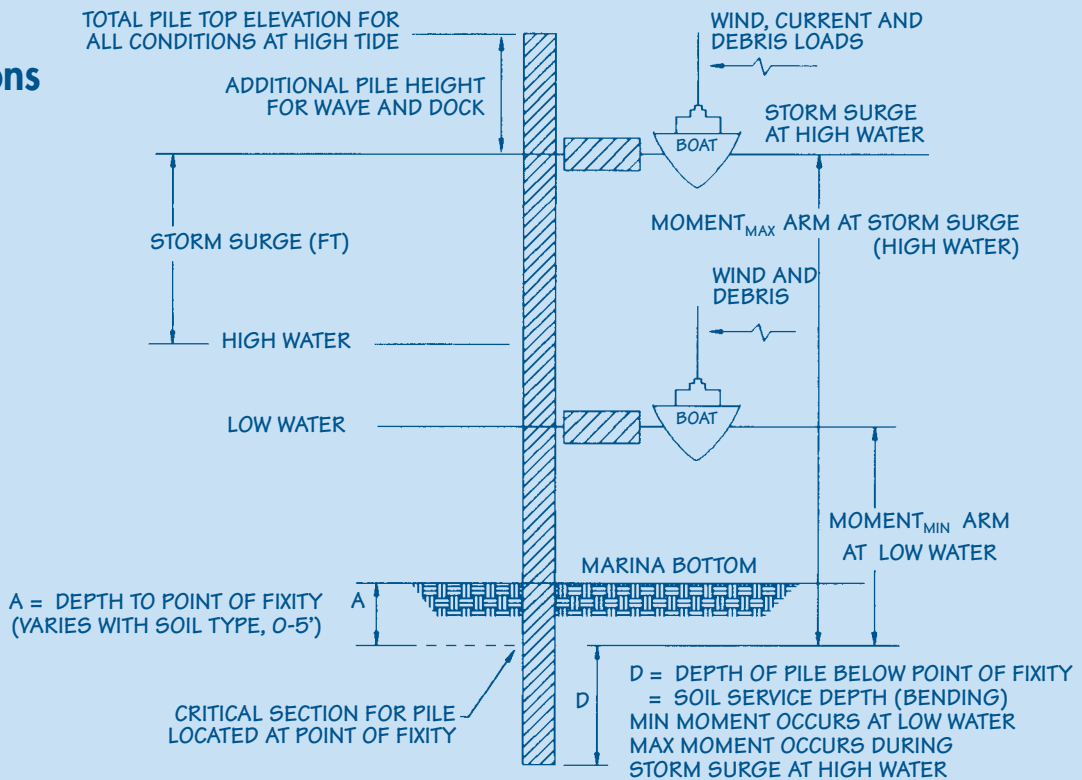
The use of treated Southern Pine in floating docks has proven itself in both public and private applications. The pleasing appearance of the treated timber, long service life with ease of repair and resistance to impact damage make Southern Pine an attractive choice for commercial and residential builders. Floating docks are anchored using the 4-roller inside pile guides or single roller hoop guides as shown at right. Floats, commonly 2' X 4', are attached to the stringer system with bolts through the 2 X 8 bolting plates. The designer must be familiar with water levels and tidal actions in the area of the floating dock system, including abnormal water levels associated with storm surge.



Typical Floating Dock Details



Design Considerations For Floating Dock Piles



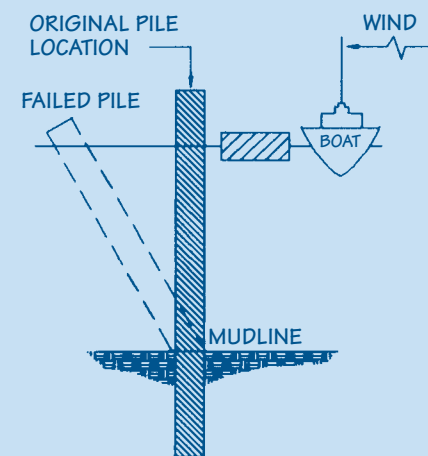
Design Reference Standards

AGENCY	NUMBER	DESCRIPTION
ASTM	D-25	PILE CLASSIFICATIONS AND SIZES
ASTM	D-2555	STRENGTH VALUES
ASTM	D-2899	STRENGTH VALUES AND FACTORS, WET ROUND TIMBER PILES
ASTM	D-245	BENDING STRESSES FOR DENSE WOOD GRAIN
ASTM	D-4022	SEALING OF PILE CUT-OFFS
AWPA	UC4, UC5	TREATMENT STANDARDS FOR PILES
AWPA	M-4	CARE OF PRESERVATIVE TREATED WOOD PRODUCTS
FEMA	55	COASTAL CONSTRUCTION MANUAL
FHWA	1P-84-11	HANDBOOK ON DESIGN OF PILES
AF&PA	NDS (LATEST)	NATIONAL DESIGN SPECIFICATION – ADJUSTMENT FACTORS FOR SOUTHERN PINE PILES

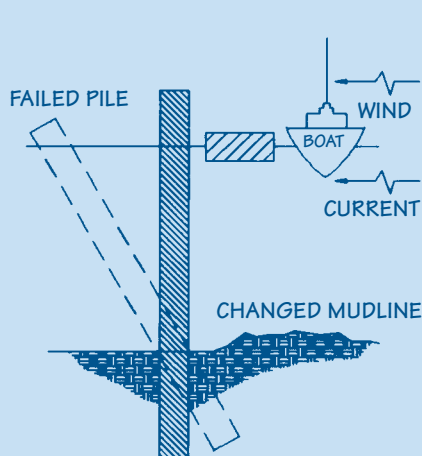
AWPA – AMERICAN WOOD PROTECTION ASSOCIATION
 FEMA – FEDERAL EMERGENCY MANAGEMENT AGENCY

FHWA – FEDERAL HIGHWAY ADMINISTRATION
 AF&PA – AMERICAN FOREST & PAPER ASSOCIATION

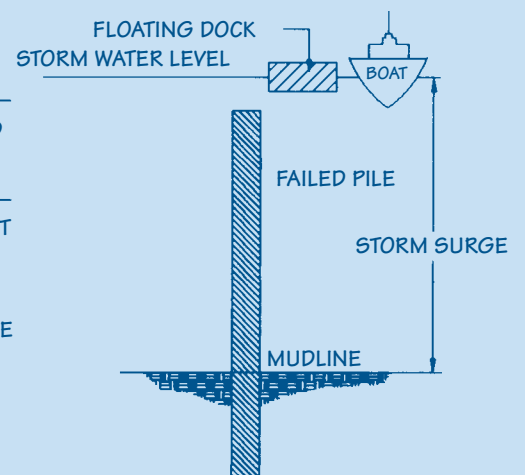
Pile Failure Modes



PILE FAILS IN BENDING
 NOT ENOUGH CROSS SECTION



PILE FAILS WITH SOIL
 NOT ENOUGH PENETRATION



STORM SURGE RAISES WATER LEVEL
 PILE TOO SHORT

Practical Marine Use Considerations for Southern Pine Lumber

MATERIALS (LUMBER, FASTENERS)

- ▶ Use properly treated Southern Pine lumber bearing the quality mark of an approved inspection agency. **A**
- ▶ For saltwater environments, use round pilings to limit heartwood exposure.
- ▶ Square-sawn piling can be used in freshwater environments.
- ▶ Use tiebacks of sufficient size. Undersized tiebacks often fail or bite into the pile face.
- ▶ Use hot-dip galvanized or stainless steel fasteners to resist corrosion and extend service life of the structure. **B**
- ▶ Use clean, granular fill which is free-draining and has good bearing strength.



DESIGN

- ▶ Provide tiebacks, even on bulkheads with low exposed height (3' to 4'). Size the tiebacks to handle loads and harshness of the marine environment. **C**
- ▶ Provide weepholes at 6", on-center, with rock drains. If sprinkler system is used on landward side, provide proper drainage to take excess water away from the structure.
- ▶ A sufficient number of piles, adequately penetrated, as well as proper water orientation, contribute to a long service life. **D**
- ▶ Inadequate piles, undersized walers and undersized tieback rods may result in bulkhead alignment problems.
- ▶ Proper overlap of walers at piles and proper orientation of walers to provide greatest bending resistance are essential.
- ▶ Adequate piling, anchor sizes, walers and the use of ogee washers combine to resist forces and provide structures with a long service life.
- ▶ Ogee washers, spike grids and adequately sized lumber and piling are examples of good engineering and design.
- ▶ Disabled access piers must comply with federal ADA regulations. Alternating the height of the fishing pier handrails and installing a nearby roofed structure for shade are helpful for children, the handicapped and senior citizens. Slant the fishing pier handrails to provide convenient armrests. **E**



CONSTRUCTION METHODS

- ▶ Overlap walers two feet at each joint and interlock ends at returns. **F**
- ▶ Provide bulkhead toe protection to prevent erosion and loss of embedment.
- ▶ Spacers are often used to maintain the proper alignment of stringers with handrails.
- ▶ Overlap splices and hurricane straps to keep fixed pier structures in place during high winds and storm wave forces. **G**
- ▶ Preferably, sheet piles should be driven to grade, and jetting of sheet piles should only be done in sandy soils, under professional supervision.
- ▶ Weep holes, geotextile fabric and graded rock filter bags help the bulkhead adjust to varying soil and groundwater conditions.



Walkway & Light Vehicular Bridge Construction Details

- ▶ Walkway construction in wetlands and other environmentally sensitive areas is a complex process with many variables requiring extensive knowledge of local conditions. This should only be undertaken by qualified professionals.
- ▶ Considerations should be given to natural surroundings and aesthetics, loadings, codes and construction practices, materials and soil analysis. Do not hesitate to seek out experienced design professionals and look at examples of their work. Use only licensed, experienced contractors. Ask for pictures and references. Visit past projects and talk to recent customers.
- ▶ The proper evaluation of soils is critical to design and performance of the walkway structure. Sandy (granular) soils are usually quite predictable and yet are subject to scour and erosion. Clays (cohesive soils) may not be consistent in a given area and may vary widely within a single project. Even when viewed by an experienced design professional, soil analysis without benefit of testing by a qualified soil testing laboratory is approximate at best. The relatively low cost of a local certified testing lab is easily offset by the advantages of accurate quality and strength data.
- ▶ Properly specified Southern Pine lumber should give long performance under all anticipated conditions. Materials that do not meet or exceed specifications should be rejected. Substitute materials may appear to offer short-term benefits, but such savings may translate into higher maintenance and repair costs for the owner.
- ▶ Lumber is supplied in increments of two feet. To avoid unnecessary cutoff and waste, designs should be developed to utilize the full length. Remember that any field cuts damage the preservative effectiveness of treatment. Whenever possible, have cuts such as mortises or radius milling of edges completed prior to treatment or at least dip or brush these surfaces with copper naphthenate prior to installation (AWPA Standard M4).

Design Concepts and Engineering For:

- ▶ Pedestrian Walkways (pp. 29-32)
- ▶ Light Vehicular Bridges (p. 33)

For use in:

- ▶ Wildlife and nature preserves
- ▶ Wetland areas
- ▶ Recreational parks and playgrounds
- ▶ Residential developments
- ▶ Golf courses

Site Planning and Design Factors:

- ▶ Natural Surroundings and Site Conditions

Desirable trees and flora
Natural streams, ponds
Wildlife sensitivity
Flow with natural terrain

- ▶ Structural Aspects

Expected loading and use
Elevation above ground
High winds or flood zone
Soil conditions

- ▶ Americans with Disabilities Act (ADA)

Proper width of deck
Minimal slope
Required rest areas
Smooth transitions

In Harmony with the Ecosystem

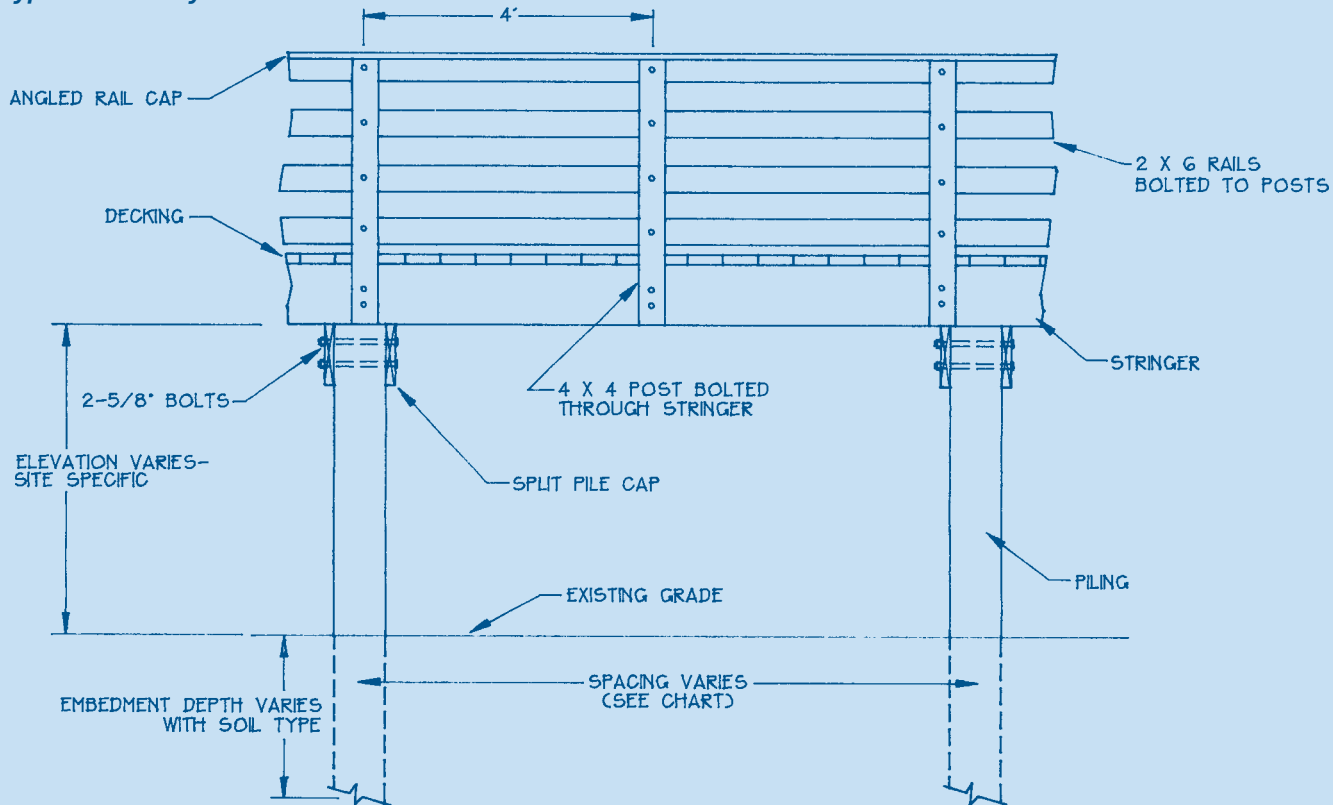
Elevated walkways are an excellent alternative to wetland filling and the associated negative environmental impacts. Meandering elevated walkways through forests, wildlife sanctuaries and nature preserves offer pedestrians and cyclists opportunities to view environmentally sensitive areas from a new perspective, while minimizing impact on the ecosystem. Timber walkways adapt and blend into sensitive surroundings because of their versatility, flexibility and relative ease of construction.

Pedestrian bridges and walkways also lend themselves to an aesthetically pleasing park or recreation area when used over retention ponds, drainage ditches or naturally occurring wetlands. In downtown development projects, timber provides excellent pathways for sightseeing and walking through historical areas, especially when situated near the waterfront.



Walkway Design Details

Typical Walkway Elevation



NOTES:

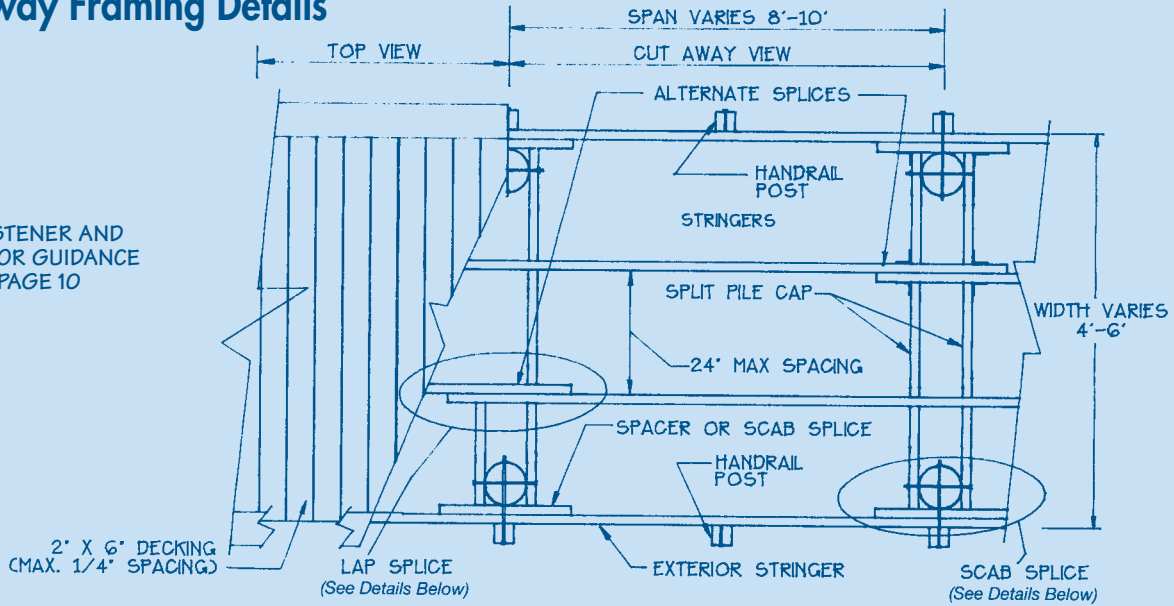
1. See chart for general guidance on spacing and sizing information.
2. For optimum appearance all lumber shall be No.1 or better grade Southern Pine. See *SPC Southern Pine Use Guide* for further grade and size descriptions.
3. See following pages for typical section and plan views.
4. Use ogee washers on bolt head with 4x4-1/8" cut or ogee washer on nut end.
5. Toe-nail interior stringers to pile caps with 2-30D ring shank nails – use hurricane straps in hurricane or heavy tornado areas.
6. Refer to the *SPIB Standard Grading Rules for Southern Pine Lumber, 2002 Edition*, for more details on surfacing designations, provisions and net product sizes.

		STRINGER SIZE PILE CAP SIZE			
		50 PSF		100 PSF	
FILE SPAN (CFT)	WIDTH (CFT)	8	10	8	10
	4		2 X 6	2 X 8	2 X 8
		2 X 6	2 X 8	2 X 8	2 X 10
5		2 X 6	2 X 8	2 X 8	2 X 10
		2 X 8	2 X 8	2 X 8	2 X 10
6		2 X 6	2 X 8	2 X 8	2 X 10
		2 X 10	2 X 10	2 X 10	2 X 12



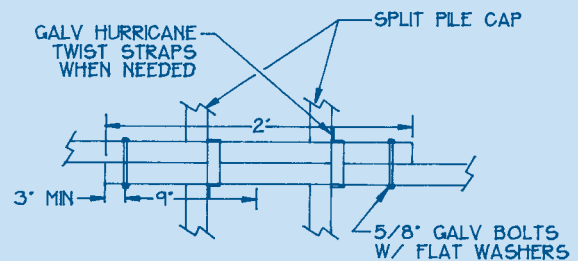
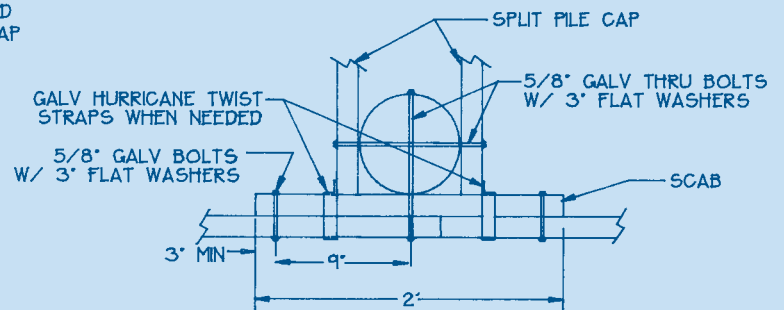
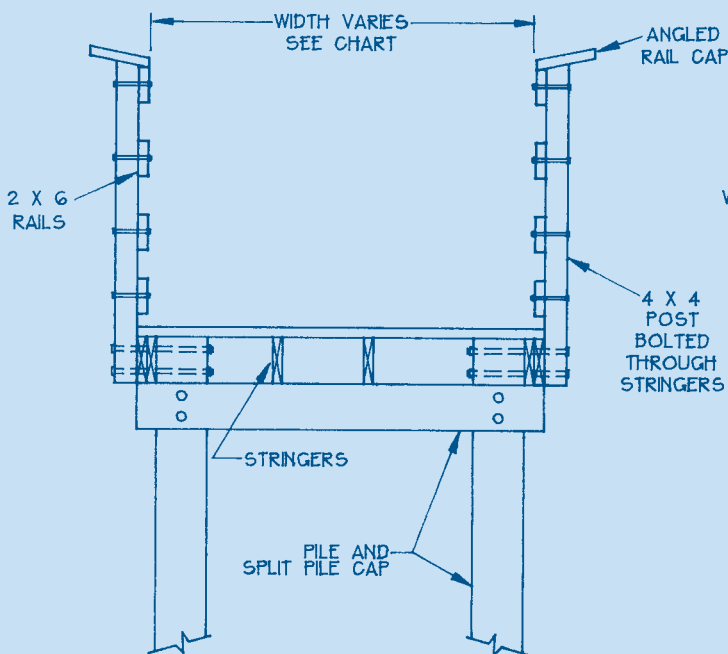
Walkway Framing Details

SEE FASTENER AND CONNECTOR GUIDANCE ON PAGE 10

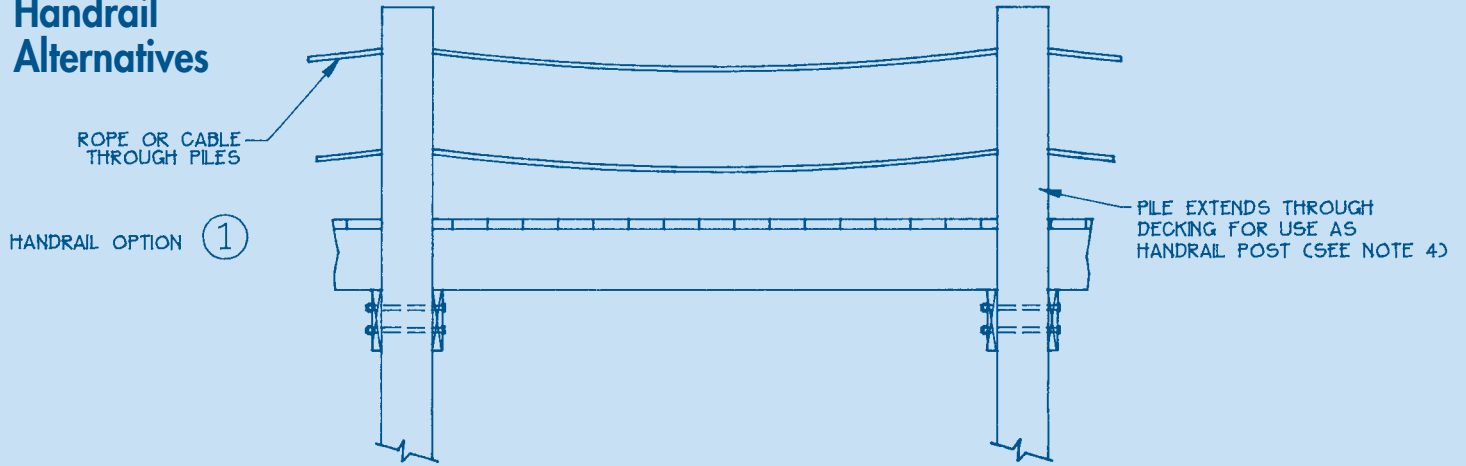


NOTES:

1. One of the most aesthetically important aspects of a walkway is the handrail system. The handrails provide necessary safety and offer an eye-pleasing look when designed properly.
2. An installation practice is to use stainless steel screws (see page 10) to fasten deckboards. This allows for the removal of screws and turning over of deckboards after a fixed period of time, resulting in a fresh deck surface at low cost.
3. See chart on previous page for dimensions of walkways and sizing of structural members.
4. Note angled rail cap, allowing for comfortable leaning or sightseeing.
5. Lumber sizes and often pile spacing is dictated by availability. It is usually more economical to use a 10' pile span if the longer stringer material is available.
6. Scab splices must occur over pile caps. As far as practical, lap splices should be alternated so that two adjacent splices do not occur over the same pile cap.

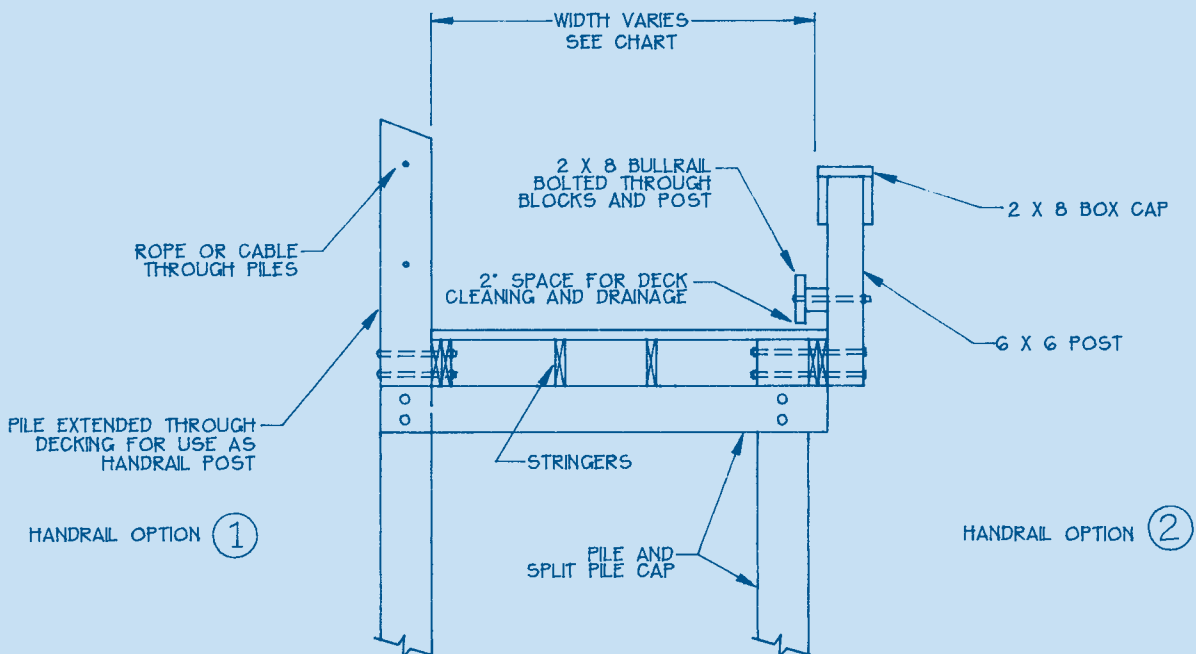
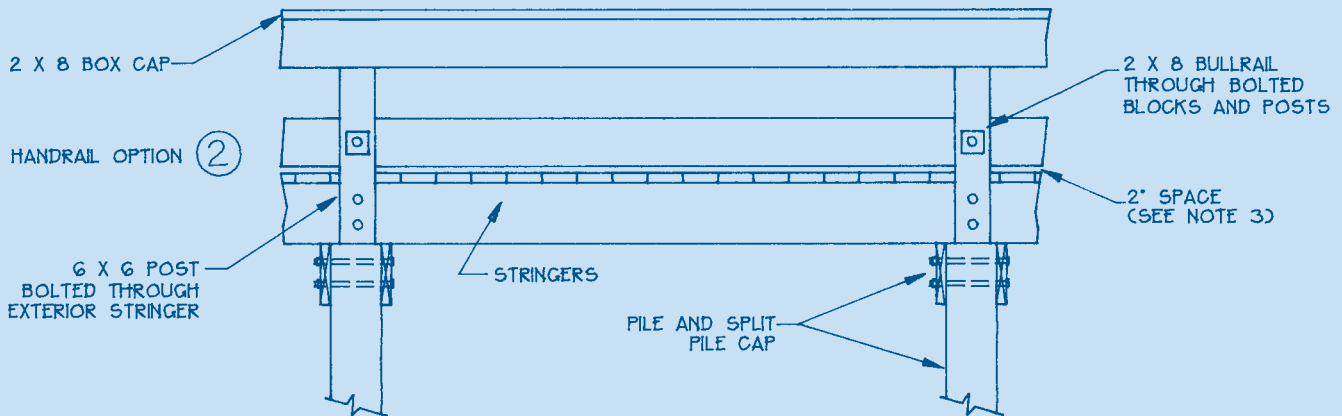


Handrail Alternatives



NOTES:

1. Other handrail options can include various forms of those shown here. In cases with low liability issues, rail posts may be desirable, or possibly no handrail at all – although the latter is usually not recommended. Non-wood materials such as vertical aluminum rods, steel, cable rope, etc., are popular when used in conjunction with timber posts, as shown in OPTION 1.
2. Rail OPTION 2 is also practical for golf cart bridges.
3. Note common practice of leaving 1-2" space between decking and bottom rail to aid in draining and cleaning of deck.
4. As shown in rail OPTION 1, the piling may be used for a railing post. However, this is not recommended in many cases, as the straight and exact driving of the piles becomes very crucial.
5. Another obvious visual feature of a pedestrian walkway is the decking. Higher grades of Southern Pine lumber – No. 1 and Premium – give excellent structural performance with minimal visual imperfections. Nails or deck screws that are carefully aligned and properly installed create a complementary pleasing pattern.



Glued Laminated Pedestrian Walkway Applications

Structural glued laminated timber (glulam) is a popular construction material that is frequently used for pedestrian bridges and walkways. North American architects, engineers, designers and contractors have been specifying glulam for more than half a century. The demand for Southern Pine glued laminated timber continues to increase because of its high strength, natural beauty, competitive cost, dimensional stability, and its wide availability in a large range of sizes and shapes.

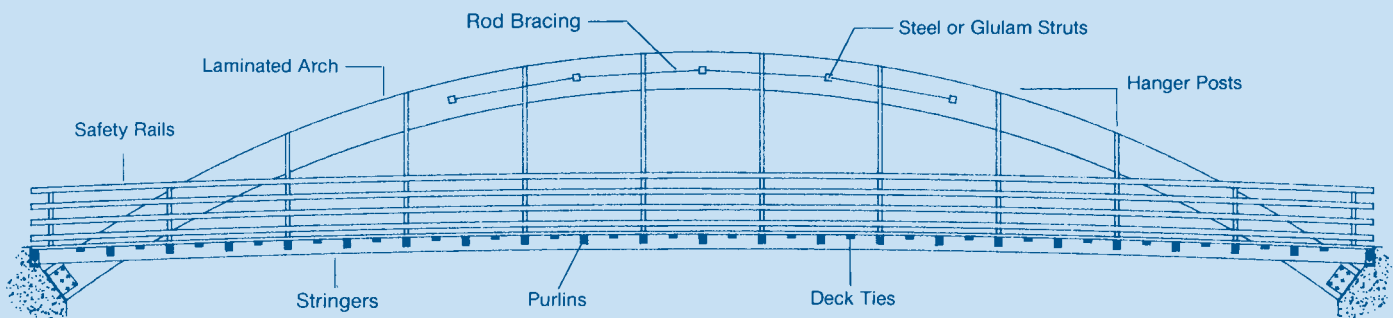
Glued laminated timber can be easily preservative-treated for wet service conditions and can satisfy virtually any design while provid-

ing fast erection and competitive in-place costs, hence its growing acceptance and use in pedestrian bridges and walkways. Complete information regarding preservative treatments is available in the American Institute of Timber Construction (AITC) 109-2007 Standard for Preservative Treatment of Structural Glued Laminated Timber and the SPC booklet *Pressure Treated Southern Pine*. For site-specific designs and specifications, contact the manufacturers of glued laminated timbers listed in the online Product Locator at www.southernpine.com.



Old Salem Covered Bridge; Winston-Salem, North Carolina
(courtesy of Blue Ridge Timberwrights)

Arch Suspension Bridge



Courtesy of Enwood Structures, Inc. Morrisville, NC

Longitudinal Section

For further information on Structural Glued Laminated Timber, contact:

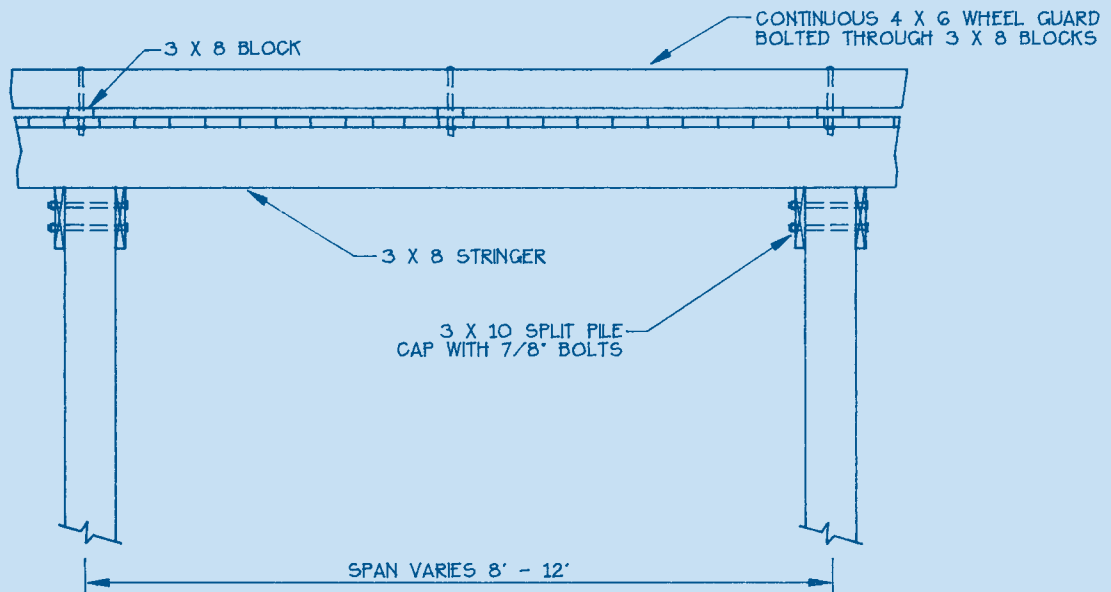
American Institute of Timber Construction (AITC)

7012 S. Revere Pkwy., Suite 140
Englewood, CO 80112
303/792-9559 Fax 303/792-0669
email: info@aitc-glulam.org
www.aitc-glulam.org

**APA - The Engineered Wood Association
Engineered Wood Systems (EWS)**

7011 So. 19th
Tacoma, WA 98466
APA/SPC Help Desk 253/620-7400
253/565-6600 Fax 253/565-7265
e-mail: help@apawood.org
www.apawood.org

Light Vehicular Bridge Applications

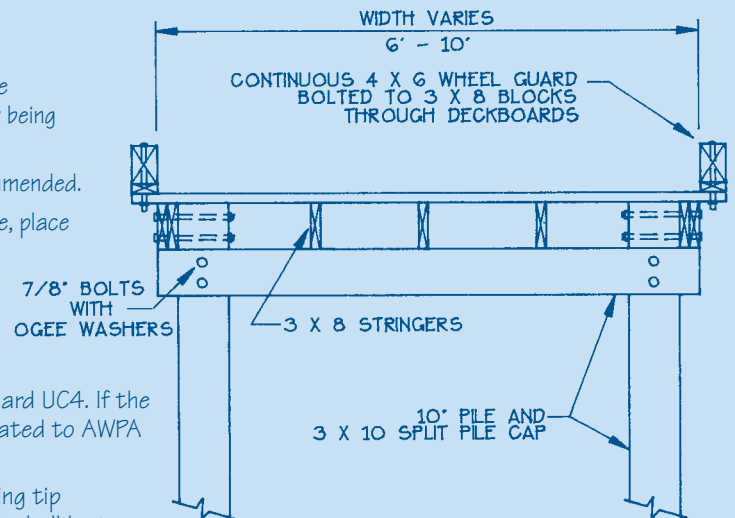


DESIGN NOTES:

1. The design shown in this section is for a 5-ton capacity timber bridge. However, the predicted loading for each bridge should be calculated and used as the basis for engineering design of each individual structure.
2. The rail shown is standard for golf cart bridges, offering the safety of the wheel guard and uninterrupted views of the surroundings and water body being crossed. Also see page 31, handrail option 2.
3. When heavy-use conditions are anticipated, 3" decking material is recommended.
4. If it is desirable to prevent vehicles of a certain size from using the bridge, place a 4x4 post in the center of the bridge entrance. This will restrict the maximum width allowed on the bridge.

SPECIFICATION NOTES:

1. All timber should be Southern Pine preservatively treated to American Wood Protection Association (AWPA) Use Category Standard UC4. If the bridge is built to vehicular standards, Southern Pine preservative treated to AWPA Use Category Standard UC4 or UC5 may be applicable.
2. All face and anchor piles used in construction should be specified using tip circumference in accordance with ASTM D25. Preservative treatment shall be to AWPA Use Category Standards (UC4C, 5A, 5B or 5C).
3. All fasteners and tie rods should be hot-dip galvanized per ASTM A-153 or corrosion resistant (bitumastic coated or 300 series stainless steel).
4. All cuts, holes and injuries to the surface of treated wood should be protected by field treatment meeting AWPA Standard M4.
5. All treated wood products should be handled and field fabricated in accordance with AWPA Standard M4 for the care of preservative treated wood products.
6. For further information on fresh and saltwater specifications, consult the AWPA Book of Standards and sources listed on the back of this publication.



ADDITIONAL RESOURCES

Complimentary single copies of selected SPC publications are available free upon request or online as a free PDF download, at www.southernpine.com.

Southern Pine Use Guide (#200)
design values, grade descriptions, sample specifications

Southern Pine Maximum Spans for Joists and Rafters (#202)
span tables for specific lumber grades

Pressure-Treated Southern Pine (#300)
product standards, treating process, preservative types, specification guidelines

Additional Industry References:

Southern Pine Inspection Bureau	www.spib.org
American Wood Protection Association	www.awpa.com
Timber Piling Council	www.timberpilingcouncil.com
National Wood in Transportation Program	www.fs.fed.us/na/wit

Online Continuing Education

Professionals earn CEUs online at southernpine.com/eClassroom

Two seminars available:

"Design, Specify, Build"
"Pressure-Treated Southern Pine"

Participants earn a one-hour continuing education credit for each unit.

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WOOD: AN ENVIRONMENTAL ASSET

Wood products offer so many cost and construction advantages over other building materials that it is easy to forget what an environmental asset it is to use wood.

We sometimes forget that wood is naturally reusable, recyclable, and biodegradable. It is also the best insulator of all structural building materials. Less energy is required to heat and cool a home built with wood, conserving finite fossil fuels. Furthermore, it takes far less energy to transform trees into wood products than it does to manufacture steel, aluminum, masonry or plastic products. This means less pollution of the air and water, too.

Wood is also renewable. Ores and petroleum used for non-wood products, once used, are not renewable. They are gone forever.

Trees, however, *are* forever. Contrary to popular belief, America is *not* running out of trees. More trees are grown each year in the U.S. than are harvested or lost to disease, insects and fire. A third of America is covered with trees today, more



than we had 100 years ago. Trees are being planted at the rate of five million a day — six trees a year for every American.

Finally, remember that a growing forest removes the greenhouse gas carbon dioxide, while giving off life-sustaining oxygen. Can you think of a better environmental exchange than that?

Pressure treatment provides the protection needed to significantly prolong the life of wood products, assuring structural soundness and a long service life. This process greatly reduces the amount of wood that would otherwise be required to replace untreated wood structures damaged by decay or termites, thereby extending our important forest resource.



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504/443-4464 • Fax 504/443-6612

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200 Greencastle Rd. Tyrone, GA 30290
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